Yakima River Floodplain Mining Study:

Fish Assemblage Report

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5. FISH ASSSEMBLAGE

5.1 Overview

Fish populations were sampled between May and November 2002 at 10 floodplain mining study sites in the Yakima River floodplain between Cle Elum and Richland. Ponds were formed at these locations after gravel was mined for highway and other construction projects. In addition, I-82 Pond 3 was sampled and fish entering and leaving the pond were trapped. In several cases we sampled multiple ponds at a study site. Ponds were sampled with a boat-mounted electroshocker, gill nets, and fyke nets following a standard Washington State Department of Fish and Wildlife protocol. River reaches adjacent to each pond were sampled by backpack electrofishing, drift boat electrofishing and snorkeling. We were unable to sample river reaches below and above each pond with identical sample techniques because of variable water depths, flow (water velocity) and turbidity.

We estimated species composition at each study site and compared species composition between sites and between the ponds and river. We sampled 18,617 fish representing 24 species or genera. Fifty-three percent (9,862) were sampled in ponds and 47 percent in the Yakima River (8,755), including side channels and sloughs. Two exotic species, pumpkinseed sunfish (21%) and yellow perch (15%), followed by native sucker (10%), chinook salmon (8%), and mountain whitefish (8 %) were sampled most frequently based on all pond and river samples.

The results of our fish assemblage work and studies conducted by the Floodplain Mining Study participants will help managers determine which ponds should be connected to the river or protected from natural avulsion to protect/enhance native salmonid populations.Study results also provide insight into how to best design and implement breaching projects to increase the probability of successfully creating high quality river habitat.

5.2 Methods

In general, we used backpack and boat electroshocking gear, snorkeling gear, fyke nets, and gill nets to sample fish populations. The data tables referenced in the next section of this report include details, such as length of river sample sections, and detailed percent species composition data for each sample method and site that are briefly summarized and discussed in the text. When percent (%) is recorded in the text, this refers to the number of fish of a given species divided by the total sample of all species of fish (species composition). Rather than inserting the data tables in the report text, detailed data and charts is presented in Excel workbooks in Appendices A - D. The standard sampling methods described below were altered at some of the sites because of adverse site-specific conditions. Deviations from standard methods will be described for each site in the “Site Analysis and Recommendations” section of this report.

5.2.1 Pond Sampling

Pond sampling was conducted consistent with WDFW fish sampling guidelines for ponds and lakes (Bonar, et. al. 2000). Our sampling methodology, briefly described here, is referred to as "standard protocol" throughout this report. Pond fish populations were sampled using a boat electroshocker, two fyke nets, and two gill nets. All three methods were used in each pond. Boat electrofishing was done at night after dark. The electrofishing unit consisted of a boat-mounted Smith-Root 5.0 GPP electroshocking unit which uses 120 Hz, pulsed DC current ranging from 4 to 6 amps. Fyke nets were constructed of a series of: 1) several circular hoops 1.2 meters (m) in diameter with a trap body 4.7 m long made of ¼" mesh net material, 2) a center lead net (30.5 m long x 1.2 m deep) that diverts the fish towards the trap from shore, and 3) two wing nets (7.6 m long x 1.2 m deep) that form a "funnel" with the center lead net to guide fish into the trap body. Variable mesh monofilament gill nets were 150 feet in length x 8 feet deep with the following mesh sizes: ½" - 25 feet, ¾" - 25 feet, 1" - 50 feet, and 2" - 50 feet.

Three people, two people in the bow who netted fish, and a person who maneuvered the boat, operated the electroshocking boat. Lake shoreline sections were shocked for a period of 600 seconds (10 minutes) of actual "pedal-down" time. The boat was maneuvered along the shore and fish were captured with dip nets. Normally, the entire perimeter of the pond was fished, or at least three randomly selected shoreline sections were shocked on larger ponds. At the end of each section fish were identified, total length (mm) was measured, a sub-sample were weighed (grams), and the fish were released in the middle of the pond to minimize the chance of recapturing them a second time.

Two fyke nets and two gill nets were randomly set in each pond, usually on opposing ends of the pond. Both types of nets were deployed before the night electrofishing occurred and then pulled and fish collected the following morning. Fyke nets were set with the center lead net tied to and deployed perpendicular to the shoreline with the wing nets set at a 45° angle from the lead net. Gill nets were set with the small mesh net panel tied to and deployed perpendicular to the shoreline extending out into deep water. A weight was attached to the outer end of the lead line and a buoy tied to the float line. As with boat electrofishing, fish live-trapped in the fyke nets were identified, measured for total length, a sub-sample was weighed, and fish were released. Most fish sampled in the gill nets were injured or dead , however, any uninjured specimens were enumerated, measured and released.

5.2.2 River Sampling

River fish assemblage sampling was also done with three types of gear: drift boat electroshocker, backpack electroshocker and dry suit/snorkeling gear. However, all three gear types were not used in each sample reach. Backpack electroshocking was the most frequently used method used to sample riverine fish populations. We used various methods to compensate for "gear bias" and assure a representative sample of the fish community at each site. The effectiveness of each method varies for different fish species, size classes and types of riverine habitat. Drift boat electrofishing can catch fish at greater depths, but may miss some of the smaller species or individuals that backpack electrofishing gear might capture. Snorkeling was limited to the upper sections of the Yakima River because poor visibility made snorkeling problematic downstream of the Naches River confluence. Because water velocities and depths varied significantly, we were not able to sample with identical gear types at each study site as originally planned.

Drift boat electrofishing was conducted with a Smith-Root 5.0 GPP electrofishing unit producing pulsed DC current at approximately 4 amps. One person rowed the boat and a second person netted fish from the bow of the boat. Sample reaches were 2000 m in length. Drift boat electrofishing occurred during daylight hours because night shocking was judged to be too dangerous in most reaches because of high water velocity and woody debris. Sampling was performed along the shoreline adjacent to the study pond (left or right bank). Fish were captured with a soft mesh dip net and placed in a live well until shocking was finished. At the end of each electrofishing reach fish were processed and released in the same way as they were at the pond sites.

Backpack electrofishing was conducted during daylight hours using a battery-powered Smith-Root Type VII backpack electrofisher with a 28-centimeter aluminum ring anode and a 305 cm long cable cathode. Power settings varied between 300-500 volts and 30 Hz pulsed DC dependent on the conductivity of each site. Two sample reaches, each 200 m long (above the pond and below the pond) were sampled when possible, but river depth, high velocity, and muddy substrate resulted in some sample reaches being less than 200 m. In addition, some sample reaches were longer because we had a target collection of 200 fish per sample.

Snorkel surveys were conducted only on the upper Yakima River reaches (sites 1-4) and at the I-82 Pond 5 site because of poor visibility in the middle and lower reaches of the river. Snorkeling these four sites was performed by a team of three surveyors in the water, and one shoreline data recorder, if available. If not, data was recorded by snorkling personnel on PVC pipe arm cuffs and transferred to data forms later. Each surveyor used a divers mask, snorkel, and dry suit with wading boots to conduct surveys. Although we intended to sample two - 200 m sections immediately above and below each pond with the same methods and collect a minimum of 200 fish, adverse water depth, velocity, clarity and safety considerations often altered this plan. In most cases, identical and directly comparable samples were not collected above and below each pond. For example, water depth prevented backpack electrofishing at some sample sites, and turbidity prevented snorkel surveys in other areas. Only one lower river site (I-82 Pond 5) was surveyed with snorkel gear. An attempt was made to sample enough area so that representative habitat at each site was sampled. However, there were often different habitat characteristics between the paired (above pond/ below pond) sites that likely affected the species composition. We are confident that in most cases we found all fish species inhabiting each pond and river reach.

Particular care was taken while handling *Oncorhynchus mykiss* (juvenile anadromous steelhead and resident rainbow trout) to stay in compliance with the Endangered Species Act Section 10 "incidental take" permit for boat electroshocking and the Section 4(d) "scientific research limit" [on take prohibition] for other sampling techniques. During backpack electrofishing, fish were placed in 5 gallon buckets after being netted and bio-data was collected after every 25 meters of sampling. Fish were monitored closely during backpack and boat electrofish sampling for burn marks, vertebral damage, and mortality and power settings were adjusted accordingly to prevent injury/mortality.

5.2.3 Migration Trap Sampling

Two fish traps (ingress and egress) were placed in the outlet channel of I-82 Pond 3 about six miles southeast of Union Gap on the WDFW Sunnyside Wildlife Area. Each wood frame, wire mesh-covered (¼ inch hardware cloth) trap was 4 feet long x 3 feet wide x 3 feet high with a cone-shaped entrance tapering from 16 inches to 7 inches diameter. Partitions of ¼ inch hardware cloth and 2 inch chicken wire were built inside the traps to reduce predation on small fish, in the event that large predatory and small fish entered the trap at the same time. The traps were placed in the channel, attached with steel fence posts and wire. Wood frame hardware cloth panels were placed in a "V" configuration on each side of the traps to divert fish into each trap. These panels blocked fish from moving in and out of the pond without entering the traps. One trap was placed with the entrance facing the pond, which captured fish migrating out of the pond and the other was placed facing downstream to capture the fish migrating into the pond from the Yakima River.

All fish collected in the traps were identified, fin clipped (right or left ventral), measured for length, and a sub-sample was weighed. The first time a fish was sampled, it was returned to the water on the same side of the trap that it entered. When a fish was captured a second time, it was recorded again, received a second ventral fin clip and was again released on the same side of the trap that it entered. The third time the fish was trapped (both ventral fins clipped) it was returned to the body of water it was trying to reach. In other words, a fish entering the trap a third time from the lake that was attempting to move out of the pond to the river was released on the river side side of the trap, and vice versa.

5.2.4 Data Analysis

Fish assemblage data were entered into Excel worksheets. Data collected at each of the 10 study sites was compiled for each of three data sets: pond, Yakima River above the pond, and Yakima River below the pond. The Terrace Heights site is completely avulsed (no ponds present); consequently no pond data was collected, but data was collected in the river at the approximate historic location of the pond. We tabulated the number of fish by species sampled at each site with each sampling gear type, then calculated percent composition by dividing the number of fish sampled for each species by the total number of fish sampled. We then calculated an overall average species composition for all gear types for each pond and for all gear types in the river. Graphs and charts were prepared in Excel to illustrate the results visually.

The differences in percent composition between sampling methods in both the ponds and river are significant, and demonstrate the challenge in determining true fish community species composition even when using several gear types. Unfortunately, because we were unable to use identical sampling techniques, or multiple gear types in a number of areas above and below each pond, we determined that making statistical species composition comparisons between river reaches upstream and downstream of each pond site was not a viable option.

Table 2 is a list of fish species codes that we used to record data in the field and in the Excel data summaries. Rainbow/steelhead (*Oncorhynchus mykiss*) is referred to as *O. mykiss* in the text, and as "RB" in the tables. Most of the *O. mykiss* that we sampled were presumably juvenile resident rainbow trout, but these two life forms are indistinguishable in the field and some individuals, particularly in the Yakima R. downstream of Roza Dam, may have been juvenile steelhead, the anadromous form.

Table 2. Fish species sampled during this project and species codes used in the report.

Code	Common Name	Scientific Name	Code	Common Name	Scientific Name
BBH	Brown Bullhead	*Ameiurus nebulosus*	MNS	Mountain Sucker	*Catastomus platyrhynchus*
BC	Black Crappie	*Pomoxis nigromaculatus*	NPM	Northern Pikeminnow	*Ptychocheilus oregonensis*
BG	Bluegill	*Lepomis macrochirus*	PS	Pumpkinseed	*Lepomis gibbosus*
CC	Channel Catfish	*Ictalurus punctatus*	*RB	Rainbow Trout (hatchery)	*Oncorhynchus mykiss*
CK	Chinook Salmon	*Oncorhynchus tshawytscha*	RB	Rainbow Trout (wild)	*Oncorhynchus mykiss*
CMO	Chiselmouth	*Acrocheilus alutaceus*	RS	Redside Shiner	*Richardsonius balteatus*
CO	Coho Salmon	*Oncorhynchus kisutch*	SK	Sucker (generic)	*Catostomus sp.*
COT	Sculpins (generic)	*Cottus sp*.	SMB	Smallmouth Bass	*Micropterous dolomieui*
CP	Common Carp	*Cyprinus carpio*	STB	Stickleback	*Gasterosteus aculeatus*
CT	Cutthroat Trout	*Oncorhynchus clarki lewisi*	WBL	Western Brook Lamprey	*Lampetra richardsoni*
DAC	Dace (generic)	*Rhinichthys sp.*	WF	Mountain Whitefish	*Prosopium williamsoni*
LMB	Largemouth Bass	*Micropterus salmoides*	YP	Yellow Perch	*Perca flavescens*
LND	Longnose Dace	*Rhinichthys cataractae*			

Because of large sample sizes and the time required, we infrequently identified and recorded sucker, sculpin, and dace to species. When mountain suckers were sampled, they were recorded as MNS (mountain sucker), the other two species of sucker were recorded as SK (sucker - generic). Occasionally, we identified and recorded a sub-sample of dace to species.

I-82 Pond 3 migration trap data was compiled in a table recording the date of initial capture, first recapture (one ventral fin clip) and/or second recapture (two ventral clips) by species. Graphs of daily in-migration and out-migration for yellow perch, pumpkinseed sunfish, and totals for all species were developed from the data.

5.3 Results

5.3.1 Site 1: Hansen Ponds

Hansen Ponds, located south of the town of Cle Elum, are two gravel pits separated from each other and the river by a levee. When these pits were abandoned, groundwater infiltration formed the two ponds, which are approximately 13 and 25 surface acres. Gravel was mined to a depth of about ten feet below the average water surface elevation. WDFW has stocked catchable-size rainbow trout in these ponds for many years to provide a "put-and-take" recreational fishery. We sampled the lower (downstream) pond, which is the larger of the two. The Yakama Nation has developed plans to connect both ponds to the Yakima River to provide salmonid habitat (Nicolai, 2001). Water clarity was excellent--- the bottom of the pond was visible during all phases of fish assemblage data collection. There is no surface connection with the river during normal flows, but there is an elevation gradient between the ponds and water flows from the upper pond into the lower. A small outlet drains into a shallow beaver pond and eventually into the Yakima River, but there is no ingress/egress channel for fish migration at this time.

Lower Hansen Pond was sampled with the electroshocking boat, fyke nets, and gill nets following standard protocol. Theft of one fyke net required a second fyke net set after the initial survey. The river was sampled with backpack electroshocking gear and snorkel gear both above and below the pond. A 300 m reach above and 225 m reach below the pond were backpack electrofished. Snorkel survey reaches were 400 m above and 500 m below the lower pond. The minimum target sample of 200 fish was achieved for all sample sets except the backpack electrofishing survey upstream of the pond.

Data collected in Lower Hansen Pond and the Yakima River above and below Hansen Ponds is presented in Appendix A, Tables 1-5 and Appendix B. Species composition for this site is summarized in Table 3 with the dominant specie(s) highlighted in yellow. In the text, sample size is denoted by (n = value).

A total of 355 fish and seven species were sampled in the pond. A predator, northern pikeminnow (48% of the total, all sampling methods combined) was the most frequently sampled fish, followed by sucker and redside shiner. Another predator, largemouth bass was present, but comprised a small component (4%) of the species assemblage.

Backpack electroshocking yielded 265 fish in river sample reaches representing eight species. The most frequently sampled species with this gear in the river were *O. mykiss* (resident rainbow trout and/or juvenile steelhead) and juvenile spring chinook salmon. Mountain whitefish (44%) and juvenile chinook (44%) were the most frequently observed fish during snorkel surveys (816 fish sample). Based on all river sampling methods combined (9 species; n = 1,081), mountain whitefish were the most abundant species (40%) followed by chinook salmon (37%) and *O. mykiss* (12%). Only one exotic species, pumpkinseed sunfish (<1%) was sampled in the river below the pond. Even though northern pikeminnow were present in the pond, no northern pikeminnow were observed or captured (sampled) in the river.

Based on the low abundance of native or exotic predatory/competitive species in the river, these ponds do not appear to be influencing species composition in this river reach. The spring chinook salmon, *O. mykiss*, and mountain whitefish dominance in the river adjacent to these ponds is consistent with the habitat and our expectations for this upper reach of the Yakima River. No northern pikeminnow were sampled in the Yakima River adjacent to Hansen Ponds, which is somewhat surprising. Our results suggest that this pond serves as a reservoir for northern pikeminnow production, but these fish cannot normally escape and enter the river. The February, 1996 flood may have overtopped the dike and allowed access to northern pikeminnow and other species that are residing in this pond. Breaching and connecting the Hansen Ponds will release significant numbers of predatory sub-adult and adult northern pikminnow into the river. The co-managers

(WDFW and the Yakama Nation) may want to reduce the northern pikminnow population before these ponds are connected to the river. Few practical, efficient tools are available, other than rotenone.

Table 3. Percent composition by species of fish community sampled at Lower Hansen Pond and the Yakima River adjacent to Hansen Ponds.

Species	Hansen Pond	River Above	River Below	River Drift Boat	River Combined
BG	2.3			No Data	
CK		42.0	32.7	No Data	36.7
CO			0.8	No Data	0.5
COT		1.7	11.3	No Data	7.2
DAC			5.0	No Data	2.9
LMB	3.9			No Data	
NPM	47.6			No Data	
PS	9.0		0.3	No Data	0.2
*RB	2.0			No Data	
RB		8.4	14.0	No Data	11.6
RS	17.2		0.6	No Data	0.4
SK	18.0		0.3	No Data	0.2
WF		47.8	34.8	No Data	40.4
Total (%)	100.0	100.0	100.0	No Data	100.0
Sample Size	355	462	620	No Data	1082

Lower Hansen Pond sampled 7/24/02; river backpack electrofishing 9/5-6/02; river snorkeling 10/23/02.

5.3.2 Site 2: Gladmar

The Gladmar site (23 acres) is located one mile east of Thorp, WA. Groundwater filled this gravel pit when it was abandoned in the late 1960's. Norman et. al. (1998) reported that the Yakima River captured (avulsed) this pond during the February, 1996 flood. The main channel of the Yakima River now flows directly through the pond and is gradually converting the pond into riverine habitat.

Gladmar was sampled with the electroshocking boat, fyke nets, and gill nets following the standard protocol on July 18-19. The river was sampled with backpack electroshocking gear on September 25 only above the pond (250 m reach) and was surveyed with snorkeling gear both above (300 m) on Sept. 25 and below (300 m) the pond on Oct. 16. Water depth prevented backpack shocking below the pond. The water was very clear and visibility during sampling was excellent.

Appendix A, Tables 6-9 and Appendix B display data collected at Gladmar and in the Yakima River above and below the naturally avulsed pond. A summary of species composition is presented in Table 4.

Eleven species (n = 414) were sampled in the pond. Based on a composite sample of all three sample gear types, suckers (28%) were slightly more plentiful than northern pikeminnow (25%) followed by juvenile chinook (23%). Other salmonids (rainbow and cutthroat trout; whitefish) were present but less abundant in the pond than in the adjacent river reaches. The significant presence of northern pikeminnow, even though this pond is avulsed, is clear evidence that the remaining low velocity areas on each side of the river flow that now bisects the pond, currently provides preferred pikeminnow rearing habitat. Most northern pikeminnow were observed at the velocity interface between moving and still water.

Chinook salmon and whitefish presence in the river above and below the Gladmar site is consistent with our expectations for this reach and similar to the species complex near Hansen Ponds. We sampled seven species (n = 113) with backpack electrofishing gear and observed the same seven species (n = 1,077) with snorkeling gear. We sampled a total of 1,190 fish representing nine species in the river. Based on all river sampling methods combined, chinook (39%), whitefish (22%), and *O. mykiss* (14%) were most the most abundant. Northern pikeminnow (8.5%) were the only interspecific salmonid predators sampled in the river.

Based on our data, there is no evidence to suggest that Gladmar Pond is currently influencing species composition in the river. The only exotic species observed in the pond was common carp at very low relative densities (0.2%) and none were sampled in the river. Besides carp, two other native species, chiselmouth and coho salmon, were observed in the pond. These species were not observed during river sampling although they are undoubtedly there. Cutthroat trout was the only species observed in the river (0.2%) that was not observed in the pond.

As the avulsion process continues, the Gladmar site is expected to become more "riverine" (lotic) and less "pond-like" (lentic). This should result in a shift towards improved salmonid habitat and a reduction in preferred habitat (deeper, slower velocity) for northern pikeminnow, suckers and carp. The results from sampling this pond illustrate the short-term response of fish species after avulsion of a gravel pit pond in the upper reaches of the Yakima Basin. Except for the relatively high northern pikeminnow population in what remains of this avulsed pit site, the pond and river have similar salmonid populations.

Prior to avulsion, Gladmar Pond was stocked annually with rainbow trout, and supported several exotic species, including largemouth bass and pumpkinseed sunfish. Post-avulsion, the spiny-ray species are absent and the habitat is gradually becoming more conducive to supporting Yakima River salmonids. None of the exotic species that would have entered the river when Gladmar was captured by the river in 1996 were found in the river above or below the pond, indicating that river habitat in this reach is not conducive to exotic warmwater species.

Table 4. Percent composition of fish sampled at Gladmar and the Yakima River adjacent to Gladmar.

Species	Gladmar Pond	River Above	River Below	River Drift Boat	River Combined

CK	22.7	25.1	48.5	No Data	39.2
CMO	0.2			No Data	
CO	5.6			No Data	
COT	1.4	7.2		No Data	2.9
CP	0.2			No Data	
CT		0.2	0.1	No Data	0.2
DAC	0.2	1.5		No Data	0.6
NPM	24.9	20.3	0.7	No Data	8.5
RB	2.7	17.9	10.8	No Data	13.6
RS	6.3	0.6	8.7	No Data	5.5
SK	28.0	12.4	4.5	No Data	7.6
WF	7.7	14.8	26.8	No Data	22.0
Total %	100.0	100.0	100.0	No Data	100.0
Sample Size	414	474	716	No Data	1190

Gladmar Pond sampled 7/18-19/02; river backpack electrofishing 9/25/02; river snorkeling 9/25/02 and 10/16/02.

5.3.3 Site 3: I-90 Ponds

There are several ponds at this site adjacent to Interstate 90 (I-90) approximately seven miles west of Ellensburg, WA. They are all shallow, cover a total of 43.6 acres and lie between the river and highway. For this study, we sampled the largest pond, which we called "I-90 Pond 4". The pond has no surface inlet or outlet, but may be overtopped by the river during major floods like Hansen Ponds.

I-90 Pond 4 was sampled with the electroshocking boat, fyke nets, and gill nets following the standard protocol. The sample river reach above the pond was upriver of the series of small ponds that drain into the largest I-90 Pond. The sample site below the pond was closest to the eastern most point of the pond. The reach above the pond was sampled with both backpack electroshocking (225 m) and snorkeling gear (200 m). The section below the pond was too deep to backpack electrofish so a 400 m reach was snorkel surveyed. We exceeded the minimum sample size of 200 fish in all reaches. Water in the pond was turbid and may have affected sampling efficiency during boat electroshocking, but the river was clear with good visibility during sampling.

Appendix A, Tables 10-13 and Appendix B display data collected in I-90 Pond 4 and in the Yakima River above and below the pond. A summary of species composition for this site is presented in Table 5.

Eight species (n = 874) were collected from I-90 Pond 4. Pumpkinseed sunfish (43%) were most abundant followed by yellow perch (31%), but neither species was observed in the adjacent river samples. Northern pikeminnow and carp were collected, but comprised only 6% and 1% of the pond sample, respectively. Two juvenile coho salmon were sampled, but no chinook or *O. mykiss*, which suggests that the pond is connected to the river infrequently and for short duration during flood events.

Nine species were sampled in the river (n = 340) with backpack electroshocking gear and six species (n = 895) during snorkel surveys. Salmonids, including chinook, *O. mykiss*, and mountain whitefish, in that order, dominated the river sample above the pond based on backpack electroshocking. However, suckers and whitefish were the most abundant species upstream based on snorkeling observations, which was a more effective sampling method in deeper water where adult suckers and whitefish were primarily located. During snorkel surveys downstream of the pond, chinook (40%), whitefish (29%) and suckers (14%), in that order, were the most abundant species observed. Based on all river samples combined, whitefish (32%), sucker (27%), chinook (22%) and *O. mykiss* (8%) were the most abundant species (Table 5). Northern pikeminnow (3%) was the only non-salmonid predator sampled in the Yakima River at this site.

Although the species assemblage in the pond was markedly different than found in Hansen and Gladmar, the species composition in the river adjacent to these ponds was similar to the two upriver sites. If this pond is allowed to naturally avulse, or is breached, a number of exotic species will enter the river, but the species present are not important predators and the river habitat is not conducive to establishing a community of exotic spiny-ray species in this upper part of the Yakima Basin. These ponds could provide valuable salmonid habitat if connected to the river in a manner that minimizes slack water areas preferred by northern pikeminnow. These salmonid predators are currently at low abundance in the pond and river, but breaching has the potential to increase their abundance similar to Gladmar.

Table 5. Percent composition of fish sampled I-90 Pond 4 and the Yakima River adjacent to I-90 Pond 4.

Species	I-90 Pond	River Above	River Below	River Drift Boat	River Combined
CK		12.1	40.2	No Data	21.9
CMO	0.8			No Data	
CO	0.2	0.4		No Data	0.2
COT		10.2		No Data	6.6
CP	1.3			No Data	
DAC		2.6		No Data	1.7
NPM	6.4	0.9	5.8	No Data	2.6
PS	42.9			No Data	
RB		6.6	11.0	No Data	8.1
RS	15.0	0.5		No Data	0.3
SK	2.6	34.0	14.0	No Data	27.0
WF		32.8	29.0	No Data	31.5
YP	30.8			No Data	
Total	100.0	100.0	100.0	No Data	100.0
Sample Size	874	807	428	No Data	1235

I-90 Pond 4 sampled 6/17-18/02 and 6/24/02; river backpack electroshocking 10/15/02; snorkel surveys 10/8/02 and 11/6/02.

5.3.4 Site 4: Selah Ponds

The Selah Gravel Pit Ponds are located just east of Selah and four miles north of Yakima. This pit site, the largest floodplain gravel mining operation in the state, was avulsed during the February, 1996 flood. The mined area covered about 250 acres and gravel had been removed to a maximum depth of about 25 feet prior to the flood. There are four or five ponds in this pit that continue to change as gravel is mined. The dike that was breached during the flood was rebuilt by September, 1996 to force the Yakima R. back into it's pre-flood channel (Norman et.al.1998). This pit site is leased by Central Pre-Mix, Inc. and portions were being actively mined during the study. The study pond is the largest pond in this pit and is located on the southwest portion of the property immediately adjacent to the Yakima River. This pond was mined previously and is no longer active.

East Selah Pond 1 was sampled with the electroshocking boat, fyke nets, and gill nets following the standard protocol. The pond has no surface inlet or outlet, but subsurface water from the pond seeps into a slough that enters the river near the south end of the property. The downstream river sample site extended downriver from this slough. Approximately2000 m of river was sampled above and below the pond with a drift boat-mounted electroshocker. Two reaches (275 m) above the pond were sampled with backpack shocker and the area below the downstream "seep slough" was sampled with snorkel gear (300 m). We sampled less than the desired 200 minimum fish with the backpack shocker. Detailed data is presented in Appendix A, Tables 14-17 and Appendix B for East Selah Pond 1 and the river reaches adjacent to the pond. A summary of species composition at this site is presented in Table 6.

Yellow perch (51%) and pumpkinseed sunfish (23%) dominated the East Selah Pond 1 fish assemblage (n = 803). Twelve species were sampled, some in very low numbers, including several hatchery rainbow trout that were stocked by the pond owner. Carp comprised nearly 10% of the sample and two species of warm water gamefish stocked by the pond owner, largemouth bass (6%) and bluegill (4.5%), were present in significant numbers.

In the river, we collected eight species (n = 136) with backpack shocking gear, nine species (n = 313) with the drift boat electroshocker, and observed 10 species (n = 200) during snorkel surveys below the pond. Suckers and *O. mykiss* were most frequently sampled above the ponds and redside shiner was most frequently sampled below the ponds. Sloughs below the ponds had so many redside shiners that we were unable to count them during snorkel surveys. Backpack electroshocking above the ponds revealed that *O. mykiss* (21%) were surprisingly abundant and juvenile spring chinook (11%) were present. Few chinook or *O. mykiss* were observed below the pond, indicating a preference for upriver habitat. Northern pikeminnow were present in both the pond and river, but were a relatively small percentage of the species composition. Several largemouth bass, pumpkinseed sunfish, and common carp were found in the river. This site was the furthest upriver location where largemouth bass, a salmonid predator, were found in the river.

Combining all river sampling methods, the most frequently sampled fish were suckers (41%), chiselmouth (16%), and redside shiners (12%) followed by *O. mykiss* (6%), northern pikeminnow (6%), and chinook salmon (6%).

Native river species were not present, or were at very low abundance, in the East Selah Pond 1. No chinook, sculpins, dace or wild *O. mykiss* were captured following the standard protocol. Instead, exotic warmwater species and a few hatchery rainbow trout stocked by the private owner accounted for virtually the entire fish community. The few chiselmouth (0.1%) and northern pikeminnow (1.4%) probably were entrained and trapped during the 1996 flood, but it appears that chinook salmon and wild rainbow trout were not "stocked" by the flood in sufficient numbers to show up during sampling six years later. Conversely, all non-native species (largemouth bass, pumpkinseed, common carp) combined only comprised 1.2% of the river fish assemblage. The absence of a surface outlet and high, maintained dikes have generally kept the pond and river isolated, with the exception of the temporary avulsion in 1996.

Table 6. Percent composition of fish sampled at East Selah Pond 1 and the Yakima River adjacent to East Selah Pond 1.

Species	Selah Pond	River Above	River Below	River Drift Boat	River Summary
BBH	0.9				
BC	1.0				
BG	4.5				
CC	0.1				
CK		11.0	4.0	5.1	6.0
CMO	0.1		1.5	32.3	16.0
COT		18.4	0.5		4.0
CP	9.6		1.5		0.5
DAC		16.9		0.6	3.9
LMB	6.0		1.0	0.3	0.5
NPM	1.4	6.6	10.0	2.9	5.9
PS	22.9			0.3	0.2
*RB	0.5				
RB		20.6	4.0		5.5
RS		2.9	11.0	15.7	11.6
SK	2.7	21.3	58.0	38.0	40.7
STB		2.2			0.5
WF			8.5	4.8	4.9
YP	50.3				
Total	100.0	100.0	100.0	100.0	100.0
Sample Size	803	136	200	313	649

East Selah Pond 1 sampled 6/13-14/02; drift boat electroshocking 8/20/02; backpack river electroshocking 10/17/02; and snorkel surveyed on 10/11/02.

5.3.5 Site 5: Terrace Heights

The Terrace Heights site, a short distance upstream of the Yakima Ave.-Terrace Heights bridge on the north side of the river, was avulsed in the early 1970's. After 30 years of sculpting by the river during channel-forming flood events, the pit site looks like natural Yakima River habitat with little or no evidence that a 30 acre pit ever existed. The pond sampling protocol was not followed because there is no "still water" pond to sample. The location of sampling reaches was based on historical data regarding the boundaries of the former pond. The main channel of the Yakima River flows around the west side of the site; many side channels and sloughs characterize the riverine habitat within the old pit site. The main river channel and a number of side channels were sampled. Nine sites (1156 m) were sampled with a backpack electroshocker and approximately 2000 meters was sampled with the drift boat electroshocker. Only the reach above the old pit site was surveyed with backpack electrofishing gear, and the only sampling method used below the former pond site was the drift boat electroshocker. We did not meet our minimum desired sample size of 200 fish with the drift boat survey, but far exceeded that number with the backpack electrofisher.

Appendix A, Tables 18-20 and Appendix B display detailed fish assemblage data for Terrace Heights, Yakima River and side channels. A summary of species composition at this site is presented in Table 7.

We captured 1,115 fish with backpack electroshocking gear and 108 fish with the drift boat electroshocker. Twelve species of fish were sampled. Native minnows, predominately dace and to a lesser extent suckers, dominated the species assemblage. Salmonids (chinook, coho, *O. mykiss*, and mountain whitefish) collectively ranged from 0-24 percent of the species composition with backpack electrofishing gear, depending on specific sample reach. At four of the eight sites sampled with the backpack electroshocker, salmonids contributed more than 20 percent of the fish community. A higher percentage of salmonids (41%), predominately whitefish (28%), were present in the relatively small sample collected with the drift boat electrofisher. Although a large number of species were present, because dace, suckers and salmonids generally comprised more than 90 percent of the total population, other species were present in low numbers. Northern pikeminnow was the most abundant non-salmonid predator (4%). Only one largemouth bass, the only other predatory fish, was found at this site. Several western brook lamprey were sampled at this pit site. Based on all river sampling methods combined (Table 7), the most frequently sampled species were dace (42%), redside shiner (15%), and sucker (15%), while less frequently sampled species included chinook (8%) and *O. mykiss* (5%).

The results of our sampling reflect the expected species assemblage in the middle reach of the Yakima R. when ponds avulse and complex braided channel habitat is created. This reach of the Yakima River serves as salmonid rearing habitat, and may be more important as winter rearing habitat than our summer/fall data reflect. Large populations of competitive native fish and a small number of northern pikeminnow may have some impact on salmonid growth and survival, but this former pit site provides very good salmonid habitat.

Table 7. Percent composition of fish sampled in riverine habitat at the Terrace Heights site.

Species	Avulsed Terrace Hghts	River Above	River Below	River Drift Boat	River Summary
CK	5.7	10.0	No Date	11.1	7.8
CMO	1.7	3.1	No Date	11.1	3.0
CO		0.7	No Date		0.2
COT	2.4	3.3	No Date	0.9	2.6
CP			No Date	0.9	0.1
DAC	42.0	52.9	No Date		42.3
LMB	0.5		No Date		0.2
LND		2.9	No Date		1.1
MNS		0.4	No Date	1.9	0.3
NPM	4.7	3.1	No Date	4.6	4.1
PS	0.6		No Date		0.3
RB	3.0	8.4	No Date	1.9	4.9
RS	22.1	5.1	No Date	8.3	14.6
SK	16.2	8.9	No Date	31.5	14.9
WBL	1.2	0.2	No Date		0.7
WF		0.9	No Date	27.8	2.8
Total	100.0	100.0	No Date	100.0	100.0
Sample Size	665	450	No Date	108	1223

Backpack electroshocking 9/13, 18, 24/02 and 10/22/02; drift boat electroshocking 8 /20/02

5.3.6 Site 6: Newland Pond 1

Newland Pit Ponds, owned by Central Pre-mix, Inc. are east of the City of Yakima on the left bank of the Yakima River, downriver from State Route 24. This pit has been mined for a number of years, has three main ponds and two or three very small ponds, and was being mined in 2002. We sampled the northern most (upper,or Pond 1), which was serving as a gravel washing settling pond, and the pond immediately south from the settling pond (lower, or Pond 2).

Both ponds were sampled with the electroshocking boat, fyke nets, and gill nets following the standard protocol. Because the water clarity was poor in the settling pond, electrofish sampling efficiency was very low. A 100 m reach of the river was sampled with backpack electroshocker above the pond, and approximately 2000 m were surveyed with the drift boat electrofisher above and below these ponds. Fish sample sizes were lower than the 200 fish target in the river.

Appendix A, Tables 21-23 and Appendix B present detailed fish species assemblage data collected in the two Newland Ponds and the Yakima River adjacent to these ponds. A summary of species composition at this site is presented in Table 8.
We sampled 766 fish (4 species) in Newland Pond 2 and 131 fish (6 species) in Newland Pond 1. The low sample size in the gravel wash settling pond was the the result of poor boat electroshocking efficiency due to extreme turbidity and/or low fish abundance resulting from the high level of total suspended solids. Pumpkinseed sunfish (53% Pond

2; 40% Pond 1) dominated the fish community in both ponds. Yellow perch (41%) were the second most frequently sampled species in Pond 2; largemouth bass (31%) were the second most frequently sampled species in Pond 1. No northern pikeminnow or other native minnows were found in these ponds, unlike many of the other ponds surveyed. Likely, this is an indication that fish have never had access to these ponds from the river during flood events.

Seventy-five fish were sampled in the river with backpack electroshocking gear. Only five species were collected: dace (65%), cottids (28%), chinook (3%), western brook lamprey (3%) and *O. mykiss* (1%). Based on all river sampling methods combined, redside shiner (39%), sucker (17%), dace (14%), and chiselmouth (13%) were the most frequently sampled species adjacent to the Newland Ponds site.

Table 8. Percent composition of fish sampled at two Newland Ponds and the Yakima River adjacent to the Newland Ponds site.

Species	**Newland Pond 1**	**Newland Pond 2**	**River Above**	**River Below**	**River Drift Boat**	**River Summary**
				No Data		
BBH	1.5			No Data		
BC	22.1			No Data		
CK			2.7	No Data	3.6	3.4
CMO				No Data	16.2	12.7
COT			28.0	No Data	0.7	6.5
CP	0.8			No Data		
DAC			65.3	No Data		13.9
LMB	31.3	5.7		No Data		
MNS				No Data	2.5	2.0
NPM				No Data	4.0	3.1
PS	40.5	40.7		No Data		
RB			1.3	No Data	1.1	1.1
RS				No Data	49.3	38.8
SK				No Data	21.6	17.0
WBL			2.7	No Data		0.6
WF				No Data	1.1	0.8
YP	3.8	53.5		No Data		
Total %	100.0	100.0	100.0	No Data	100.0	100.0
Sample Size	131	766	75	No Data	278	353

Newland Pond 1 sampled 10/29-30/02; Newland Pond 2 sampled 5/30-31/02; river backpack electrofishing on 8/15/02; drift boat electrofishing on 8/20/02.

5.3.7 Site 7: Edler Ponds

Edler Ponds, located east from the city of Union Gap off Valley Mall Boulevard, are a complex of three, small pit ponds along the right bank of the Yakima River. These are relatively new ponds formed when pits filled with ground water after mining in late 1990 and early 2000. We sampled all three of the ponds totaling about 17 acres. The upper or northernmost is called Pond 1, with the middle pond, being Pond 2. The most recently formed lower pond, Pond 3, avulsed during a June 2002 high flow event after the initial fish assemblage sampling was completed. This gave us a unique opportunity to sample the pond a second time to determine if the fish species assemblage changed immediately after the initial stages of avulsion. We anticipated that "before and after" sampling could help us better understand interactions between pond and riverine species.

We followed standard protocol on Pond 1. However, because of their small size, we sampled with one fyke net and one gill net in each of the lower two ponds (Ponds 2 and 3), but boat electroshocking followed standard protocol. A river reach (400 m), which is best described as a slough, was shocked above the pond with the backpack electroshocker. Because of high velocity and depth, the only river sampling below the pond was accomplished with a drift boat-mounted electroshocker. Approximately 2000 m was surveyed above and below the site.

Detailed fish assemblage data are presented in Appendix A, Tables 24-27 for the three ponds and the river adjacent to the ponds. A summary of species composition is presented in Table 9. The drift boat electrofishing sample did not attain the target sample size of 200 fish.

The species complex was markedly different in each pond prior to the breach of Pond 3. We found 10 species (n = 3,769) in the combined three pond complex, but not all species inhabited each pond. Pumpkinseed sunfish comprised 73% and 68% of the sample in Pond 3 and Pond 2, respectively. Brown bullhead (45%) and pumpkinseed (42%) were the dominant species in Pond 1 where more than 2,200 fish were captured. Although present in these pit ponds, northern pikeminnow (0.5%) and largemouth bass (0.3%) were not abundant. No salmonids were found in these ponds prior to breaching.

We collected 207 fish representing 10 species in Pond 3 after a flood event partially captured the pond in June. The abundance of two river species increased dramatically. Chiselmouth increased from 5% to 29% of the sample, and suckers increased from 7.5% to 25%. However, pumpkinseed sunfish abundance declined precipitously, relative to the other species, from 73% before to 21% after breaching, suggesting they migrated out of the pond into the river. Conversely, migration of juvenile spring chinook into the pond increased abundance from 0% (before breach) to 7% (after) of the sample in the span of one month.

In the river, we sampled 51 fish (6 species) with the drift boat electrofisher. That sample included 51% suckers and 39% whitefish; chinook (2%) and *O. mykiss* (4%) were also present. We collected 568 fish with backpack electrofishing gear. That sample in a slough and the river above the ponds included 13 species, none of which dominated the fish community. Chiselmouth, carp, dace, sucker, *O. mykiss*, and chinook salmon were among the diverse community sampled in the slough and river. Based on a composite sample of all gear types, the most frequently sampled species above and below the Edler Ponds were sucker (17%), chiselmouth (16%), dace (15%), pumpkinseed sunfish (13%), and common carp (13%). Largemouth bass, primarily inhabitating the river slough, comprised a higher percentage (9%) of the river assemblage than at any of the upriver study sites.

Due to difficulty in sampling this section of river, we cannot conclusively determine that the Edler Ponds site has impacted the fish species complex in the river. However, pumpkinseed (PS) constituted 13% of the combined river sample after the lower pond breach, while at the same time PS abundance in the pond declined precipitously. The avulsion of Edler Pond 3 may provide salmonid rearing habitat. However, the pond may also serve as a reservoir for predatory northern pikeminnow and largemouth bass unless substantial river flow is maintained through these ponds and the conversion from lentic to lotic habitat continues.

Table 9. Percent composition of fish sampled at the three Edler Ponds and the Yakima River adjacent to this site.

Species	Edler Ponds Pre-breech	Pond 3 Post-breech	River Above	River Below	River Drift Boat	River Summary
				No Data		
BBH	29.7			No Data		
BG			0.2	No Data		0.2
CK		7.2	5.6	No Data	2.0	5.3
CMO	1.3	29.0	16.9	No Data		15.5
COT			1.1	No Data		1.0
CP	0.3	3.9	14.4	No Data		13.2
DAC		0.5	16.7	No Data		15.3
LMB	0.3	4.3	9.7	No Data		8.9
LND				No Data	2.0	0.2
NPM	0.5	4.3	1.1	No Data		1.0
PS	53.6	20.8	14.6	No Data		13.4
RB			3.0	No Data	3.9	3.1
RS	0.1	1.9	1.4	No Data	2.0	1.5
SK	1.9	25.1	14.3	No Data	51.0	17.3
STB		2.9		No Data		
WBL			1.1	No Data		1.0
WF				No Data	39.2	3.2
YP	12.4			No Data		
Total	100.0	100.0	100.0	No Data	100.0	100.0
Sample Size	3769	207	586	No Data	51	619

Edler Ponds (pre-breech) sampled 6/3-7/02; Pond 3 (post-breech) 7/2/02; drift boat electrofishing 8/14/02; backpack electrofishing 8/27/02.

5.3.8 Site 8: Parker

The Parker Pit Ponds are located approximately 2 miles south of Union Gap adjacent to the right bank of the Yakima River. This large pond complex, totaling 35 acres and averaging 10 feet deep, was partially avulsed during the February, 1996 flood. Prior to sampling, the avulsed pond (Pond 7) was selected for evaluation by the study partners. However, we were unable to access this pond with the electrofishing boat. Instead, we sampled the three ponds located furthest downriver. The western-most pond sampled (Pond 5) is isolated from the other two ponds surrounding it and the river. Pond 1 and Pond 2 are connected by a channel and Pond 1 has an outlet to the river. The river sample site above the pond complex was a side channel of the Yakima River that turned and flowed through avulsed Pond 7. The downriver sample reach was located downstream of the Pond 1 outlet channel.

Pond 5, a small pond was sampled using standard lake protocol, with only one fyke and one gill net sample used. Ponds 1 and 2 were also small and were sampled with one gill net and one fyke net total, to stay within standard lake protocol of three sections shocked, two fyke, and two gill net samples. A 250 m river reach was sampled with backpack electrofishing gear above the pond complex, but the sample size did not meet our goal of 200 fish. Approximately 2000 m above and below the ponds was sampled with the drift boat electroshocker. This sampling included fishing along the right bank of avulsed Pond 7.

Detailed data collected in the ponds and river are presented in Appendix A, Tables 28-30 and Appendix B. A summary of species composition at this site is presented in Table 10. We collected 984 fish representing 14 species from the three ponds. Sucker (35%), whitefish (15.5%), pumpkinseed sunfish (12%) and redside shiner (11%) were the most frequently sampled species. Northern pikeminnow (7%) and largemouth bass (2.5%) were present in these ponds. Few chinook (3%) and coho salmon (0.5%) were sampled, and no *O. mykiss*. Salmonids were found only in Pond 1 and Pond 2 which are connected to the river---none were in isolated Pond 5.

Backpack electroshocking in the river produced seven species (39 fish) including dace (44%), sculpins (15%), sucker (13%), and pumpkinseed sunfish (13%) which comprised most of this small sample. Chinook and *O. mykiss* were sampled in small numbers. Drift boat shocking resulted in a larger sample of 210 fish (11 species). Sucker (36%), whitefish (27%), redside shiner (12%), and chiselmouth (12%) were most frequently sampled with drift boat gear. Juvenile chinook (4%) and *O. mykiss* (1%) were also collected even though drift boat electrofishing was conducted on August 19 during a period of high air temperature. Based on a composite of all sampling methods used in the river (12 species; n = 249), suckers were the most abundant (32%) followed by whitefish (23%), chiselmouth (10%), and redside shiner (10%). Chinook salmon and *O. mykiss* are present in small numbers, 4% and 2%, respectively. Northern pikeminnow (4%) and largemouth bass (1%) were present, but at relatively low abundance.

Although largemouth bass and northern pikeminnow did not appear to be present in numbers that would impact chinook salmon and *O. mykiss* survival, few salmon and trout were present. Mountain whitefish were the only abundant salmonid. Native competitors, such as redside shiner, dace and sucker may have a competitive advantage in this reach of the river. High water temperatures, extreme flow fluctuations downstream of Wapato Diversion Dam (about one mile upstream) and other factors may be limiting salmon and trout production in this reach of the Yakima R., which is generally considered the downstream limit for salmonid rearing during the summer.

Table 10. Percent composition of fish sampled at three Parker Ponds and the Yakima River adjacent to this site.

Species	Parker Ponds	River Above	River Below	River Drift Boat	River Summary
BBH	6.0	No Data			
CK	2.8	No Data	2.6	3.8	3.6
CMO	6.1	No Data		12.4	10.4
CO	0.5	No Data			
COT	0.1	No Data	15.4	0.5	2.8
CP	0.9	No Data			
DAC	0.2	No Data	43.6	1.0	7.6
LMB	2.5	No Data	5.1	0.5	1.2
MNS		No Data		0.5	0.4
NPM	6.6	No Data		4.8	4.0
PS	12.3	No Data	12.8		2.0
RB		No Data	7.7	1.4	2.4
RS	11.3	No Data		12.4	10.4
SK	34.9	No Data	12.8	35.7	32.1
WF	15.5	No Data		27.1	22.9
YP	0.2	No Data			
Total	100.0	No Data	100.0	100.0	100.0
Sample Size	984	No Data	39	210	249

Ponds sampled 7/10-11/02; river backpack electroshocker 8/13/02; river drift boat electroshocker 8/19/02.

5.3.9 Site 9: I-82 Ponds 4&5

I-82 Pond 5 is a 27 acre gravel pit pond located approximately 7 miles south of Union Gap. The Washington Dept. of Fish & Wildlife owns this site and has managed Pond 5 and adjacent Pond 4 for public fishing since 1981. Pond 4 drains into Pond 5 through a culvert pipe. Catchable hatchery rainbow trout are stocked in Pond 4 and a few may move into Pond 5 through the culvert. Channel catfish have been stocked both ponds.

The pond was sampled with the electroshocking boat, fyke nets, and gill nets following the standard protocol. River reaches were sampled with the backpack electroshocker above (225 m) and below (650 m) the pond. A snorkel survey was conducted below the pond (400 m reach). Approximately 2000 m was sampled with the drift boat-mounted electroshocker. Water velocity was high and visibility was poor during the snorkel survey. Appendix A, Tables 31-35 and Appendix B present detailed fish assemblage data for I-82 Pond 5 and the Yakima River above and below this pond. Table 11 summarizes species composition at this site.

We collected 359 fish representing 14 species in this pond. Yellow perch (30%), pumpkinseed sunfish (21%), bluegill (19%) and largemouth bass (16%) were most frequently sampled species. Except for a small number of hatchery rainbow, no salmonids were sampled in this pond. Although not sampled effectively with the methods used, channel catfish (1%) were part of the species assemblage. This pond has a higher percentage of exotic species popular with anglers (largemouth bass, black crappie, bluegill and channel catfish) than the other sampled ponds. This reflects WDFW's management objective to produce a quality warmwater fishery in Pond 5.

The backpack electrofishing sample in the river produced 393 fish representing nine species. Native resident fish, including chiselmouth, sucker, dace, whitefish, redside shiner, and northern pikeminnow were present, but percent composition was highly variable between the sample sites, and no species dominated. Although whitefish were important in the species assemblage, few chinook and *O. mykiss* were sampled. An exotic predator, largemouth bass, and competitor, pumpkinseed sunfish were sampled in the river in relatively small numbers. Drift boat sampling produced 105 fish and seven species, including almost equal proportion of whitefish (24%), redside shiner (25%), chiselmouth (19%) and dace (18%). Whitefish were the dominant species sampled with the drift boat electroshocker (24%), but sample size was small. Redside shiners accounted for 78% of the 381 fish observed during the snorkel survey followed by dace (20%).

Based on all river sampling techniques (Table 11) redside shiner (37%), dace (25%), and chiselmouth (15%) were most frequently sampled in this reach of the river. Salmonid predators northern pikeminnow (8%) and largemouth bass (1%) were present, as well as the exotic species, pumpkinseed sunfish (<1%) and yellow perch (<1%). Yellow perch were infrequently sampled in the river. Yellow perch prefer still water (pond) habitat, and would be expected to move downriver and seek preferred habitat if they move into the river from a pond. Only a very small number of chinook (1.5%) and *O. mykiss* (0.1%) were sampled. The sample reach adjacent to I-82 Pond 5 was the lowest site in the Yakima R. where salmon and *O. mykiss* were found.

High summer water temperatures, low flow and rapid fluctuations downstream of Sunnyside Diversion Dam, and other factors are limiting salmon and trout production in this reach of the Yakima River. Except for whitefish, salmonids were present in much smaller numbers than upriver sample sites above Parker, which was expected.

Table 11. Percent composition of fish sampled at I-82 Pond 5 and the Yakima River adjacent to this site.

Species	I-82 Pond 5	River Above	*River Below	River Drift Boat	River Summary
BBH	0.3				
BC	3.3				
BG	19.2				
CC	0.8				
CK		10.2	0.1		1.5
CMO	2.8	41.6	10.2	19.0	15.4
COT		0.7		1.0	0.2
CP	3.1				
DAC		6.6	29.7	18.1	25.4
LMB	15.9		1.4		1.1
MNS			0.1		0.1
NPM	0.6	22.6	5.2	6.7	7.7
PS	21.2	0.7	0.3		0.3
*RB	0.3				
RB		0.7			0.1
RS	0.3	13.9	43.2	24.8	37.3
SK	1.9	2.2	9.3	6.7	8.1
WF				23.8	2.5
STB			0.5		0.4
YP	30.4	0.7			0.1
Total	100.0	100.0	100.0	100.0	100.0
Sample Size	359	137	774	105	1016

*River below includes backpack electroshocking (5/20/02; 9/12/02) and snorkel survey on 10/18/02; river above (backpack only) conducted on 11/6/02; drift boat electrofishing on 8/21/02; pond survey on 5/24-25/02.

5.3.10 Site 10: DeAtley Pit

The DeAtley Pit Ponds are a group of gravel pit ponds owned by Acme Materials/Inland Asphalt, Inc. just upstream of the State Route 240 bridge in Richland, WA. The pond selected for study is 17 surface acres and the standard pond protocol was imployed. The only sampling method utilized in the river was the drift boat electrofisher. The river depth and soft silt bottom made sampling with a backpack electroshocker ineffective and the turbidly made snorkeling impossible.

Carp were the only fish sampled in DeAtley Pit (Appendix A, Table 36). The pond was dewatered in 2002, which explains why no other species were found (but not why carp were still present). Nineteen fish (7 species) including smallmouth bass (48%), bluegill (16%), and channel catfish (16%) were sampled in the river (Appendix A, Table 37). Although sample size was small, other WDFW sampling has shown that smallmouth bass and channel catfish, both predators on salmonids, are abundant throughout the lower Yakima R. and prey heavily on juvenile fall chinook salmon (Fritts et. al. 2001a and 2001b). No juvenile salmonids were captured in the river at Richland during the drift boat electroshocking in late August, as expected. Chinook, coho and *O. mykiss* would have been present in late winter and spring during downstream migration to the Columbia River.

Table 12. Percent composition of fish sampled at DeAtley Pit and the Yakima River adjacent to this site.

Species	DeAtley Pond	River Above	River Below	River Drift Boat	River Summary
BBH		No Data	No Data	5.3	5.3
BG		No Data	No Data	15.8	15.8
CC		No Data	No Data	15.8	15.8
CP	100.0	No Data	No Data	5.3	5.3
NPM		No Data	No Data	5.3	5.3
PS		No Data	No Data	5.3	5.3
SMB		No Data	No Data	47.4	47.4
Total	100.0	No Data	No Data	100	100
Sample Size	308	No Data	No Data	19	19

Pond sampled on 6/27/02; river drift boat electroshocking on 8/23/02.

5.3.11 Out-migration Trap

We placed traps in the outlet of I-82 Pond 3 to assess the possible interaction of pond and riverine species when there is a flowing surface connection between a gravel pit pond and the river. We were unable to locate a suitable outlet trap site at the 10 primary study sites. This pond was chosen because of easy access and the ease at which it could be monitored. We trapped fish from May 30 to November 21, 2002.

The out-migration trap, which captured fish leaving the pond (moving into the river), caught mostly yellow perch (Appendix C, Figure 1 and 2). Most yellow perch migrated out of the pond early in the season soon after the trap was placed in the outlet channel in May until mid-June. Very few yellow perch were found moving out of the pond in the later months of the study. Pumpkinseed sunfish began moving out in late summer/early fall with peak movement in mid-October. We captured 187 yellow perch and 268 pumpkinseed sunfish in the out-migration trap (Appendix C, Table1). Only 2 fin clipped yellow perch were recaptured (1 ventral fin clip) compared to 32 recaptured pumpkinseed sunfish. We also captured 21 largemouth bass (none recaptured), a minimal number of bluegill, chiselmouth, common carp, dace, northern pikeminnow, and one brown bullhead (Appendix C, Table 1 and Figure 3).

5.3.12 In-Migration Trap

Yellow perch, by a large margin, were the most numerous species that entered the in-migration trap. We trapped 494 perch, 34 pumpkinseed sunfish, 32 carp, and 42 northern pikeminnow (Appendix C, Table 2 and Figure 4). Common carp and northern pikeminnow showed up sporadically throughout the study period. Appendix C, Figure 2 shows movement over time into the trap. Yellow perch in-migration numbers were very high from early July to mid-August. Many fin clipped perch (116) were recaptured. Many yellow perch left the pond (were trapped in the out-migration trap), and returned in a short time period (approximately 1 ½ months). Brown bullhead, bluegill, chiselmouth, dace, largemouth bass, redside shiners, and one sucker were also captured in the in-migration trap.

We have some concern due to the location of this trap, that fish entering and leaving I-82 Pond 3 may have been trying to move back and forth between a slough like area and the pond, as opposed to migrating into and out of the river. The fact that perch moved out and then returned suggests that this concern is valid.

We used standard protocol to sample I-82 Pond 3 to determine species composition for comparison with trap data. We collected 892 fish representing 10 species (Table 13). Yellow perch (60%) and pumpkinseed sunfish (28%) made up most of the population, and their abundance explain why they were most frequently found in the outlet traps. The only salmonid in the sample were brown trout (2%). Northern pikeminnow (1%) and largemouth bass (3%) were also present. Trap data indicates the both species are migrating in both directions. The species composition in the pond is very similar to the trap data, which would be expected if most species are equally likely to migrate.

Table 13. Number and percent composition of fish sampled in I-82 Pond 3.

Species	Electroshock	Fyke Nets	Gill Nets	TOTAL	% Comp
BG	9			9	1.0
BT	14	3		17	1.9
CC	0	6		6	0.7
CMO	13	9		22	2.5
CP	4			4	
LMB	24	1		25	2.8
NPM	6	4		10	1.1
PS	241	6		247	27.7
SK	4	17		21	2.4
YP	434	89	8	531	59.5
Total	749	135	8	892	100.0

5.4 Discussion

Yakima River aquatic/riparian habitat and water quality differ significantly between three major reaches: “upper river” (Cle Elum to Yakima River Canyon), “middle river” (Selah to Union Gap), and “lower river” (Union Gap to Yakima River mouth). The real or potential impacts of floodplain gravel pit mining will be discussed within this longitudinally-based habitat context. River fish assemblage at study sites within each major reach were generally found to be similar. Therefore, data from individual ponds were combined for the purpose of drawing broad inferences about gravel mining impacts within each major river reach.

Fish species have also been grouped into two broad categories to facilitate discussion of gravel mining impacts on fish assemblage:

5.4.1 Managed Salmonids - Introduction

Chinook salmon, coho salmon, and steelhead trout (*O. mykiss*) were the only anadromous salmonids that were sampled. The only anadromous “species” (actually, “race”) that was not sampled was fall chinook which inhabit the lower Yakima R. Juvenile fall chinook were not present at Site 10. DeAtley Pit in late August when river sampling was conducted. Resident rainbow trout and anadromous steelhead are indistinguishable from each other. We sampled numerous *O. mykiss* in the upper river, most of which were presumed to be resident rainbow trout because few Yakima Basin steelhead migrate upstream of Roza Dam. Mountain whitefish, sampled frequently during this study, are a resident native salmonid that in some river reaches are more abundant than chinook and *O. mykiss*, but are not actively managed by WDFW other than to limit daily harvest.

5.4.2 Salmonid Predators/Competitors - Introduction

We sampled many non-native, cool or warm-water fish species that have been stocked into ponds and lakes in the Yakima Basin and, in some cases, introduced intentionally or accidentally into the Yakima River. Species such as smallmouth bass, largemouth bass, pumpkinseed sunfish and yellow perch are referred to as “exotics”. Most of these exotic species have high reproductive potential. Even when not intentionally stocked (legally or illegally) to produce recreational fishing opportunity, these species often find a way to populate lakes, ponds and streams. The only study pond intentionally stocked by WDFW with exotic species was I-82 Pond 5. Exotic species in the other study ponds either were illegally introduced, entered ponds from the river or perhaps entered ponds as eggs or juveniles through sub-surface hyporheic flow. Some exotic species are native salmonid predators, others are competitors, and some are neither predators or competitors.

The sampling methods used during this study allowed us to capture or observe 24 fish species or genera (generic dace, sculpins, suckers)---9 exotic and 15 native species. We grouped all non-salmonid species into three ecological trophic (food chain or web) groups based on potential interactions with native salmonids. Table 14 lists all species as either “exotic” or “native” and then, further classifies them as salmonid predators, competitors, or opportunistic feeders. Salmonid predators include species that selectively feed on salmonids if given the opportunity. Although salmonids may sometimes prey on each other, in this analysis we did not classify salmonids as predators. Salmonids and their competitors compete for food and living space when co-existing in the same habitat. Opportunistic species feed on a variety of food sources and do not selectively prey on salmonids. Opportunistic species may prey on salmonids or be competitive in the food chain, but are not strong predators or competitors. Some fish may fit in multiple categories if they exhibit both characteristics, or if their feeding/rearing behavior changes with life stage. For example, yellow perch may be mainly competitors during early life stages, but this species can prey on salmonids if the appropriate conditions exist (e.g. adult yellow perch in a pond connected to the river preying on chinook salmon fry). Generally, the magnitude of negative interactions on juvenile salmonids follows a continuum with the greatest impacts from predatory species to the least impacts from opportunistic feeders.

Table 14. Exotic and native non-salmonid fish species encountered during the Yakima River Floodplain Mining Study and presumed interspecific trophic relationship to juvenile salmonids.

Exotic Species	**Salmonid Predator**	**Salmonid Competitor**	**Opportunistic Feeder**
Black Crappie	**X**	**X**	
Bluegill		**X**	
Brown Bullhead		**X**	**X**
Channel Catfish	**X**		
Common Carp		**X**	**X**
Largemouth Bass	**X**		
Pumpkinseed Sunfish		**X**	
Smallmouth Bass	**X**		
Yellow Perch		**X**	**X**
Native Species	Salmonid Predator	Salmonid Competitor	Opportunistic Feeder
Chiselmouth			**X**
Dace		**X**	
Mountain Whitefish		**X**	
Northern Pikeminnow	**X**	**X**	
Rainbow Tr. (Hatchery)		**X**	**X**
Redside Shiner		**X**	
Sculpin			**X**
Stickleback			**X**
Suckers			**X**
Western Brook Lamprey			**X**

5.4.3 Managed Salmonids - Overview

The co-managers (WDFW and Yakama Nation) manage the Yakima River to protect and enhance salmon (chinook, coho), steelhead, and resident trout (cutthroat, rainbow, bull) populations for tribal subsistence and recreational fisheries. The co-managers are most concerned about impacts that floodplain gravel mining may have on these native, actively managed salmonid species. Appendix D, Tables 1-3 show percent composition for managed salmonids at each site sampled (pond and river). We plotted percent composition data for trout and salmon to compare study sites and to visually illustrate the contribution of trout and salmon to the total fish species assemblage at each sample site (Appendix D, Figures 1-3). These figures illustrate the differences and similarities in managed salmonid populations between sites sampled during this project. As expected, % composition of managed salmonids decreases proceeding downstream (notice the change in y-axis scale) from the upper river to middle to lower river reaches---both in the river and in connected ponds (avulsed or surface outlet). Avulsed ponds in the upper and middle Yakima R. reaches had % salmonid composition similar to the adjacent river (Gladmar, Terrace Heights, Lower Edler Pond after avulsion). Lower Parker Pit Pond (Pond D) is not avulsed like Gladmar or Lower Edler Pond, but the surface outlet did allow ingress of salmonids (3.3%), about half the level of the river at Parker (6.0%). Figure 3 also dramatically illustrates the decline in managed salmonid abundance in the lower river from Union Gap to the mouth, concurrent with the decline in summer water quality suitable for salmonids.

A potential management option for a gravel pit pond that has low numbers of salmonids is to decide whether to connect it to the river. If the river has potential to produce salmonids near that site, then it may depend on the number of predators/competitors present in the pond or the potential for reducing those predators/competitors prior to connection to the river. Ponds located in the upriver and middle reaches have the best potential for year-round salmon and trout production, but ponds in the lower river have potential as winter rearing habitat.

5.4.4 Managed Salmonids – Cle Elum to Yakima River Canyon (Upper River)

Data points for Hansen, Gladmar, and I-90 Pond 4 study sites are plotted (Appendix D, Figure 1) based on data presented in Appendix D, Table 1. As expected, Hansen, Gladmar and I-90 Pond4 river data shows consistently high levels of trout/salmon composition ranging from about 30-50%. Gladmar, an avulsed pond, is supporting salmonids at a level approximately equivalent to the river downstream at I-90 Pond 4.

As expected, Hansen Pond and I-90 Pond 4 currently have no value as native salmonid habitat because they have no surface outlet and are not avulsed. Whereas, Gladmar Pit, naturally breached in 1996, is gradually becoming high quality river habitat better suited to salmonid rearing. Hansen and I-90 Pond 4, and other gravel pit ponds within the upper river reach have the highest potential to benefit managed salmonids if connected to the river. Predatory northern pikeminow are a concern, but breaching can be designed to minimize the slower, deep “velocity interface” habitat preferred by adult pikeminnow for ambush feeding on salmonids.

5.4.5 Managed Salmonids – Selah to Union Gap (Middle River)

Data for East Selah Pond 1, Terrace Heights, Newland Pit Ponds, and Edler Ponds sites are tabulated in Appendix D, Table 2 and plotted in Appendix D, Figure 2. These middle Yakima River fish assemblage samples showed a lower percentage of managed salmonids than the upper reach. Three of the four pond sites did not contain managed salmonids during our initial sampling. Edler Pond 3, surveyed after a spring, 2002 flood event and partial avulsion, contained managed salmonids at levels comparable to the adjacent river. The Terrace Heights site, which avulsed in the early 1970’s, is riverine habitat and supports salmonids at a level equal or higher than the river sample reaches adjacent to the upstream East Selah Pond 1 site. The other three pond sites have no inlets or outlets and very little surface water interaction with the Yakima River, except when the river is at or near flood stage. Breaching or allowing ponds in the middle Yakima River to naturally avulse is justified, as witnessed by salmonid abundance at the Terrace Heights site. Pit ponds in this reach have moderate potential for creating salmonid habitat, particularly winter rearing habitat.

5.4.6 Managed Salmonids - Union Gap to Mouth (Lower River)

Data for Parker, I-82 Pond 5, and DeAtley Pit study sites are summarized in Appendix D, Table 3 and plotted in Appendix D, Figure 3. We found the lowest proportion of salmonids in this lower reach of the Yakima River. Continuing the trend noted for upriver sites, Parker site, the furthest upriver in the lower Yakima habitat zone, held the highest proportion of salmonids in this reach. The root cause of low managed salmonid abundance in the lower Yakima River is poor quality rearing habitat characterized by high summer water temperature and low flow and/or extreme flow fluctuations (frequency, magnitude) resulting from irrigation management---not interspecific ecological impacts from non-salmonids rearing in gravel pit ponds. Although the lower river, particularly below Sunnyside Diversion Dam, has significant populations of exotic species, there is potential for gravel pit ponds to seed the river during floods and if the ponds are breeched. Parker may hold the most promise for salmonid production in this reach, but the river at downriver sites is poor summer habitat for salmonids. Selected ponds may, however, have potential as off-channel winter rearing habitat if managed to prevent “leakage” of predators/competitors during the late spring, summer and early fall.

5.4.7 Salmonid Predators/Competitors - Overview

We graphed percent composition of all exotic fish predators and competitors and native northern pikeminnow to illustrate the potential impact of these predators/competitors on salmonids at our sample sites (Appendix D, Tables 4-6 and Figures 4-6). As discussed earlier exotic species known to prey on native salmonids, and present in our samples are channel catfish, black crappie, smallmouth bass and largemouth bass (Table 14). Habitat where the species assemblage includes a high percentage of predators/competitors is less productive salmon habitat than where predator composition is low. Figures 4-6 also illustrate the potential for seeding the mainstem Yakima River with exotic fish species when ponds are naturally avulsed, inundated by flood water, or breached. Based on data collected at I-82 Pond 3, pumpkinseed sunfish and to a lesser extent, northern pikeminnow and largemouth bass, may be moving into the river from ponds where there is passage through a surface outlet. Obviously, when Gladmar , East Selah Pond4 or any ponds supporting exotic species are naturally avulsed, the fish in those ponds enter the river. Pumpkinseed sunfish were found in the vicinity of several ponds, indicating that gravel pit ponds may be seeding the river with this species.

A potential management strategy for ponds with high abundance of northern pikeminnow and/or exotic predator/competitors would be to “defend” the pond to maintain isolation from the river. This strategy would apply particularly in the lower Yakima River where river habitat conditions could allow these species to prosper to the detriment of rearing or migrant salmon, steelhead and resident trout. In the upper river and middle river reaches, natural avulsion may not have long-term negative impacts because the river habitat favors salmonids rather than warm or cool water predators. If intentional breaching (human activity) is proposed for upper or middle reach ponds, removal of northern pikeminnow, if abundant (e.g. Hansen Ponds), is appropriate since native pikeminnow can survive in the river. Exotic warm-water predator/competitors (e.g. pumpkinseed, yellow perch, largemouth bass, black crappie and brown bullhead) most likely will not survive to successfully reproduce in the cold middle and upper river reaches, thus ponds with these species can be breached without first removing exotics.

5.4.8 Salmonid Predators/Competitors - Cle Elum to Yakima Canyon (Upper River)

Percent composition data for Hansen, Gladmar, and I-90 Pond 4study sites are plotted in Appendix D, Figure 4 based on data presented in Appendix D, Table 4. Native northern pikeminnow is the primary salmonid predator in Hansen Pond and the avulsed Gladmar site. Exotic yellow perch and pumpkinseed comprised 74% of the sample at I-90 Pond 4. Exotic fish predators/competitors were an important part of the pond species assemblages, but generally were not frequently sampled in this reach of the river (Figure 4).

Although Hansen and I-90 Pond 4 have populations of native or exotic predators and competitors, managed salmonid populations would benefit from breaching or natural avulsion because the Yakima River provides an "underlying foundation of excellent cold-water habitat for trout and salmon" in this reach. Breaching should be accomplished in a manner that minimizes areas of slow moving, deep water habitat preferred by northern pikeminnow. The Yakama Nation's proposal to implement a designed breach of Upper and Lower Hansen Ponds should proceed after removal (mechanical or chemical) of the abundant pikeminnow population. The likelihood of successfully providing high quality salmonid habitat at Hansen Ponds is excellent due to the location of the ponds high in the basin.

5.4.9 Salmonid Predators/Competitors – Selah to Union Gap (Middle River)

Data for East Selah Pond 1, Terrace Heights, Newland Pond1, and Edler Ponds sites are tabulated in Appendix D, Table 5 and plotted in Appendix D, Figure 5. River sites have few exotic predators/competitors, and the Terrace Heights site is a good example of the species complex that would be expected in this middle reach of the Yakima River when a pond is fully avulsed and the river has completely "reclaimed" the pond site. Although there is likely some predation on salmonids by fish predators, this site provides good salmon and trout habitat (Appendix D, Figure 2). The river sampling reach above the Edler Ponds was a slough that lies between the main river channel and Edler Pond 1. This slough supported the only significant number of exotic predators/competitors in the middle reach sample sites (Figure 5).

5.4.10 Salmonid Predators/Competitors – Union Gap to Mouth (Lower River)

Data for Parker, I-82 Pond 5, and DeAtley Pit study sites are summarized in Appendix D, Table 6 and plotted in Appendix D, Figure 6. The Parker Ponds, which are partially avulsed and the adjacent river sampling reaches have the lowest proportion of native and exotic predators/competitors (28.5%) in the lower Yakima River Basin. This is not unexpected since it is located at the upstream boundary of the lower river reach in the "transition zone" with the middle river area. Native competitors and/or opportunistic feeders dominated in Parker, Ponds 1, 2 and 5 (not avulsed), which reduced the relative abundance of salmonid predators. While the site furthest downriver, DeAtley, has more than 100% exotic competitors (common carp) and the river, at least in August, is populated exclusively with native and exotic predator/competitors (Table 6; Figure 6).

With the possible exception of the Parker site, gravel pit ponds in the lower Yakima River have low potential for salmon and trout production if avulsed or breached because this river reach currently does not provide the "underlying foundation of high quality cold-water habitat" necessary for managed salmonids to survive and prosper. Instead, breached ponds in this area of the basin are more likely to become continuous reservoirs supplying a source of exotic predators/competitors to prey on overwintering or migrating juvenile anadromous salmonids. New gravel pits proposed for loctions downstream of Sunnyside Diversion Dam should be sited to prevent natural avulsion and existing pits should be "defended" to prevent avulsion and measures taken to assure continued isolation from the river.

5.5 Conclusions

We enumerated and identified 18,617 fish representing 24 species/genera (Appendix B, Table 2). Fifty-three percent of the fish (9,862) were sampled in ponds and 47 percent in the Yakima River (8,755), including side channels and sloughs. Two exotic species, pumpkinseed sunfish (21%) and yellow perch (15%), followed by sucker (10%), chinook salmon (8%), and whitefish (8 %) were sampled most frequently.

Pond and river species assemblage differed significantly from upriver to downriver sample sites. Salmonids (whitefish, *O. mykiss*, and juvenile chinook salmon) contributed most to the species composition in the colder upper reaches of the Yakima River. Fewer species were present in the upriver pit ponds and adjacent river sampling reaches. Species diversity increased in the middle Yakima R. reach from Selah to the Parker Ponds, but with lower numbers of resident and anadromous salmonids present compared to the upper river above the Yakima River Canyon. Species diversity in ponds was high in the middle and lower river sample sites, except for DeAtley. As expected, higher percentages of exotic species were sampled in the ponds in the lower Yakima basin downstream of Union Gap. Summer water temperature, total suspended solids and turbidity increase in the river below Union Gap providing increasingly productive habitat for exotic and native predator/competitor species, and increasingly unproductive habitat for salmonids. However, exotic predator/competitor species and native northern pikeminnow never represented more than 10 percent of the river fish assemblage, with the exception of the Edler Ponds (37%) and DeAtley (100%) sites. Smallmouth bass were present in large numbers in the DeAtley river reach and not seen at any other site. Winter/spring sampling in the river at the DeAtley site would probably result in significantly different species composition estimates. Salmon (coho, spring and fall chinook) and steelhead move downriver in winter for rearing before migrating out of the Yakima River as smolts in the spring.

Based on our sampling, similar species compositions were present above and below each pond site, but there were large differences in fish assemblages between upper, middle and lower river sites. As expected, we found higher abundance of river fish species in ponds that have avulsed and ponds that flood during high water periods, compared to ponds that are isolated and are not inundated by flood events. Ponds that have little or no surface water connection to the river supported higher relative abundance of exotic fish than those that are connected to the river. Ponds in the upper and middle river reaches (upstream from Union Gap) that are not directly connected to the river are considerably warmer than the river and provide ideal habitat for warm-water exotic species.

5.6 Recommendations

Ponds in the upper and middle reaches of the Yakima River are best suited for breaching and connecting to the Yakima River. Ponds in these reaches generally have fewer exotic predators/competitors. However, their presence should not be an obstacle to breaching because the middle and upper Yakima River provides high quality, cold-water habitat that favors salmonid production and prevents warm-water species from becoming established. Lower reaches of the river, under current water management scenarios, provide marginal-to-poor habitat for salmon and trout during the summer months. Gravel pit ponds downstream of Sunnyside Dam should not be considered for breaching and should be defended from natural avulsion to prevent creating a chronic source of salmonid predator/competitor “leakage” into the river. This is of particular concern because juvenile anadromous salmonids utilize the lower river for overwinter rearing habitat (potentially entering breached ponds where abundant predators could cause high mortality) and during the spring downstream migration to the Columbia River.

A concern in the upper and middle reach are native northern pikeminnow that can survive and reproduce in cold water habitats used by salmonids---particularly in lower velocity, deeper habitat that may result from breaching or natural avulsion. Reducing northern pikeminnow populations, if abundant, before ponds are breached using mechanical or chemical piscicide is probably warranted. Furthermore, breaching ponds should be designed and implemented in a way that rapidly converts the pit pond into viable river habitat for salmonids. Large areas of still or slow moving water, or small physical inlet/outlet channels that significantly restrict river flow through the pond---both of which may result in increased water temperature and favor northern pikeminnow and exotic predators---may constitute a chronic “mortality sink” (death trap) for salmonids.

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