A Study Plan to Evaluate Northern Pikeminnow (*Ptychocheilus oregonensis*) Sustained Removal Efforts and Continued Removal Measures at the Priest Rapids Project for Year 2008

Prepared By:

Public Utility District No. 2 of Grant County
P.O. Box 878
Ephrata, WA 98823

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Executive Summary

On May 3, 2004, the National Marine Fisheries Service (NMFS - then referred to as NOAA Fisheries) issued its Biological Opinion of the effects (Biological Opinion) of the proposed action on listed species, in accordance with Section 7 of the Endangered Species Act of 1973 as amended (16 USC 1531 et seq.), regarding the Federal Energy Regulatory Commission's (FERC's) proposed action amending Public Utility District No. 2 of Grant County's (Grant PUD's) existing license for the Priest Rapids Hydroelectric Project (Project) to authorize implementation of an Interim Protection Plan for listed anadromous salmonids. On December 16, 2004, FERC adopted the Biological Opinion, which includes NOAA Fisheries' Reasonable and Prudent Alternatives (RPAs) and Incidental Take Statement for Upper Columbia River (UCR) spring-run Chinook salmon (*Oncorhynchus tschawytscha*) and UCR steelhead (*Oncorhynchus mykiss*).

Under the Biological Opinion, Grant PUD is required to achieve 95% juvenile dam passage survival and 93% juvenile project (one dam and reservoir) survival as described in RPA 1 (Performance Standards). In order to achieve these Performance Standards, Grant PUD has begun implementation of the measures outlined in the Biological Opinion. These measures include the construction and operation of juvenile fish bypasses at Priest Rapids and Wanapum dams, installation and testing of advanced turbines, exploring spill measures (top-spill), assessing turbine operations, and conducting northern pikeminnow and avian predator control programs. The northern pikeminnow control program measures were outlined in RPAs 11 and 20 and require Grant PUD "*to continue to develop and annually fund an overall programmatic approach to reduce juvenile salmon mortality associated with predation by northern pikeminnow (Ptychocheilus oregonensis) within the Priest Rapids Project area"*. The Biological Opinion also requires Grant PUD, *"in consultation with the Priest Rapids Coordinating Committee* (PRCC)*, to develop and implement a monitoring and evaluation program and to evaluate its effectiveness"* (NOAA Fisheries 2004).

The objective of the northern pikeminnow control program is to reduce predation on salmonid smolts. The 2007 northern pikeminnow program resulted in the removal of 20,146 pikeminnow (17,357 >9 inches in total length; 2,789 <9 inches in total length).

A 20% sub-sample of all northern pikeminnow removed was evaluated to describe pikeminnow population trends within the Project area. Of the sub-sampled northern pikeminnow, 45% were identified as males, while 26% were female. The remaining 29% could not be identified by sex. The most abundant sex and year classes of northern pikeminnow were males in the three to five-year age classes. The dominant age classes for females were the five to seven year age classes. Results from the gonad analysis showed that northern pikeminnow spawning was initiated in early June, peaked in early July, and neared completion around the end of August.

Dietary data from the sub-sampled northern pikeminnow indicated that 64% percent had empty stomachs. Plant material and crayfish were the dominant prey items consumed, while consumption of migrating salmonid smolts was minimal. Of the 1,474 northern pikeminnow found to contain material in their stomachs, only 35 smolts were observed, accounting for 0.87% of all prey items found.

During 2008 northern pikeminnow removal efforts, Grant PUD will remove as many northern pikeminnow as possible from the Priest Rapids Project area. This will be accomplished by

fishing known high catch-per-unit-effort (CPUE) areas, as well as exploring other methods of collection to increase the total number of northern pikeminnow removed.

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1.0 Introduction

Northern pikeminnow (*Ptychocheilus oregonensis*), a member of the Cyprinidae (minnow) family, is a native species of the Columbia River. Northern pikeminnow are large, opportunistic predators that feed on a variety of prey and are considered a predominant predator of anadromous juvenile salmonids (*Oncorhynchus* sp.) (Rieman and Beamesderfer 1990; Ward et al. 1995). It is further believed that northern pikeminnow alter their spatial distribution and feeding habits in response to increased prey abundances, thereby targeting juvenile salmonids during their migration to the Pacific Ocean (Poe et al. 1994; Collis et al. 1995).

Northern pikeminnow have a relatively long life-span (up to 16 years) with low rates of natural mortality. A small increase in the rate of annual mortality for older age classes of northern pikeminnow may result in a substantial reduction in the number of larger, older northern pikeminnow (Rieman and Beamesderfer 1990). Because these larger and older fish have the greatest predation impact (i.e., consume the greatest numbers of juvenile salmonids), a substantial reduction in their numbers may have a significant impact on juvenile salmonid predation rate even though the overall northern pikeminnow population is not dramatically reduced (Parker et al. 1995).

Intensive predation by northern pikeminnow on juvenile *Oncorhynchus* sp. is well documented throughout the Columbia River basin (Rieman and Beamesderfer 1990; Rieman et al. 1991; Ward et al. 1995). Predation concerns led to the development of large-scale northern pikeminnow removal programs (Beamesderfer et al. 1996; Friesen and Ward 1997a). The success of test fisheries by the Northern Pikeminnow Management Program (NPMP) in 1990 led to full-scale implementation of the Sport Reward Program which pays private anglers for each northern pikeminnow collected. Fisheries personnel were also employed to angle for northern pikeminnow from dams and from boats in close proximity to the dams.

Beamesderfer et al. (1996) estimated that approximately 16.4 million out-migrating juvenile anadromous salmonids were consumed by northern pikeminnow annually in the Columbia and Snake rivers prior to the NPMP for the lower Columbia and Snake rivers and northern pikeminnow removal programs implemented collectively by Public Utility District No. 2 of Grant County (Grant PUD), Public Utility District No. 1 of Chelan County (Chelan PUD), and Public Utility District No. 1 of Douglas County (Douglas PUD). Of the estimated 200 million juvenile anadromous salmonids produced in these two river systems, northern pikeminnow are believed to consume approximately 8% of all downstream migrants, with 6.5% consumed downstream of The Dalles Dam (Beamesderfer et al. 1996).Various reports have estimated juvenile salmonid smolts represent as much as 50–70% of northern pikeminnow diets (Gray and Rondorf 1986; Peterson et al. 1991; Petersen and Gadomski 1992; Bennett and Naughton 1998).

On May 3, 2004, the Biological Opinion issued for the Priest Rapids Project by National Oceanic & Atmospheric Administration Fisheries (NOAA Fisheries 2004) and adopted by Federal Energy Regulatory Commission (FERC) on December 16, 2004, required Grant PUD to continue to develop and fund a northern pikeminnow removal program. Specifically, Reasonable and Prudent Alternatives (RPAs) 11 and 20 require that Grant PUD continue to develop and annually fund an overall programmatic approach to reduce juvenile salmon mortality associated with predation by the northern pikeminnow in the area of the Priest Rapids Project (Project). The Biological Opinion also requires that Grant PUD, in consultation with the Priest Rapids

Coordination Committee (PRCC), develop and implement a monitoring and evaluation program to evaluate the northern pikeminnow removal program's effectiveness (NOAA Fisheries 2004).

Grant PUD has managed a northern pikeminnow removal program since 1995. This program was initially operated by Grant PUD staff and temporary crews. Beginning in 1998, the program was conducted with an annual contract format paid on a per-fish basis. In 2000, Grant PUD awarded a three-year contract to Columbia Research for northern pikeminnow control services. In 2006, Grant PUD reverted to operating the program using Grant PUD staff. Since 1995, a total of 299,877 northern pikeminnow have been removed from the Project (Figure 1).

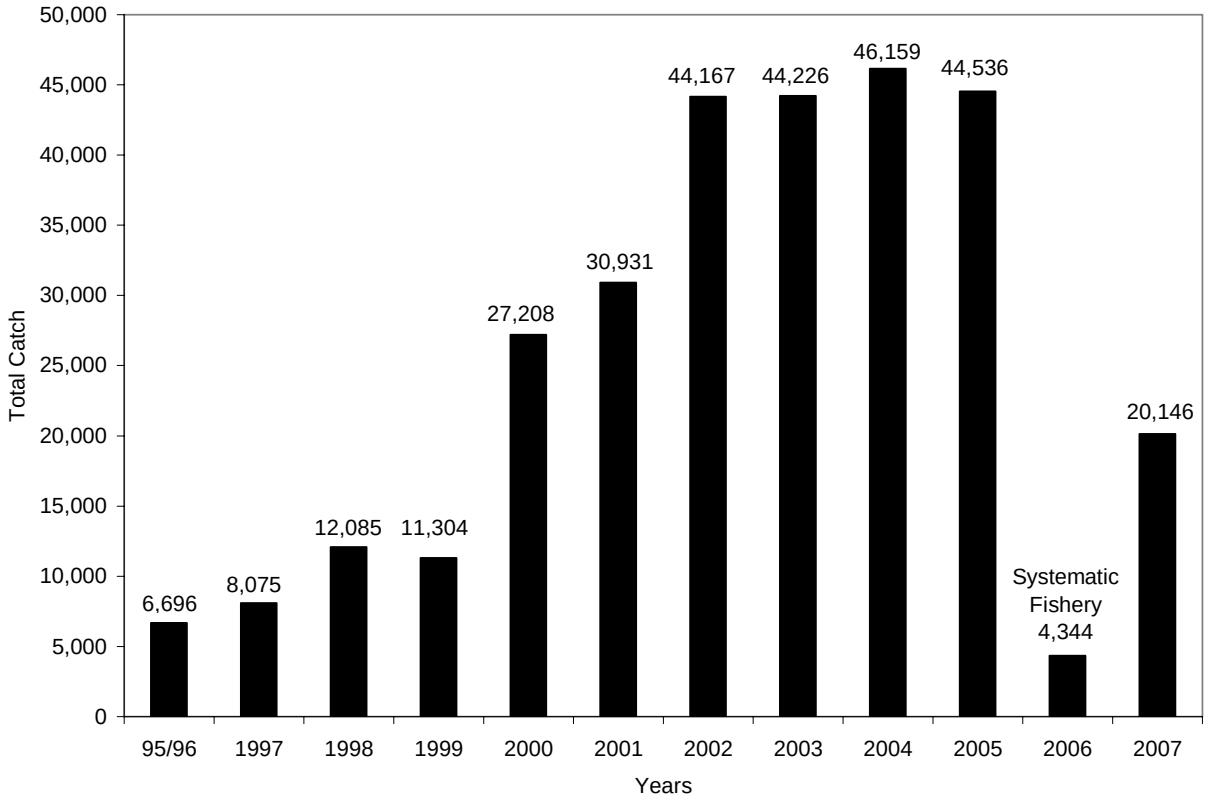

Figure 1 Total catch by year for the northern pikeminnow removal program. Note: the 2006 total catch was low due to the systematic fishery required to establish the 2006 northern pikeminnow population estimate for the Project.

In 2007, Grant PUD caught 20,146 northern pikeminnow. In 2008, Grant PUD will expend all efforts to remove as many northern pikeminnow from the Priest Rapids Project area as possible.

This study plan has been designed to scientifically and feasibly address the requirements of RPAs 11 and 20 of the May 2004 Biological Opinion. The study plan is also designed to allow for an adaptively managed and more focused approach in future programs.

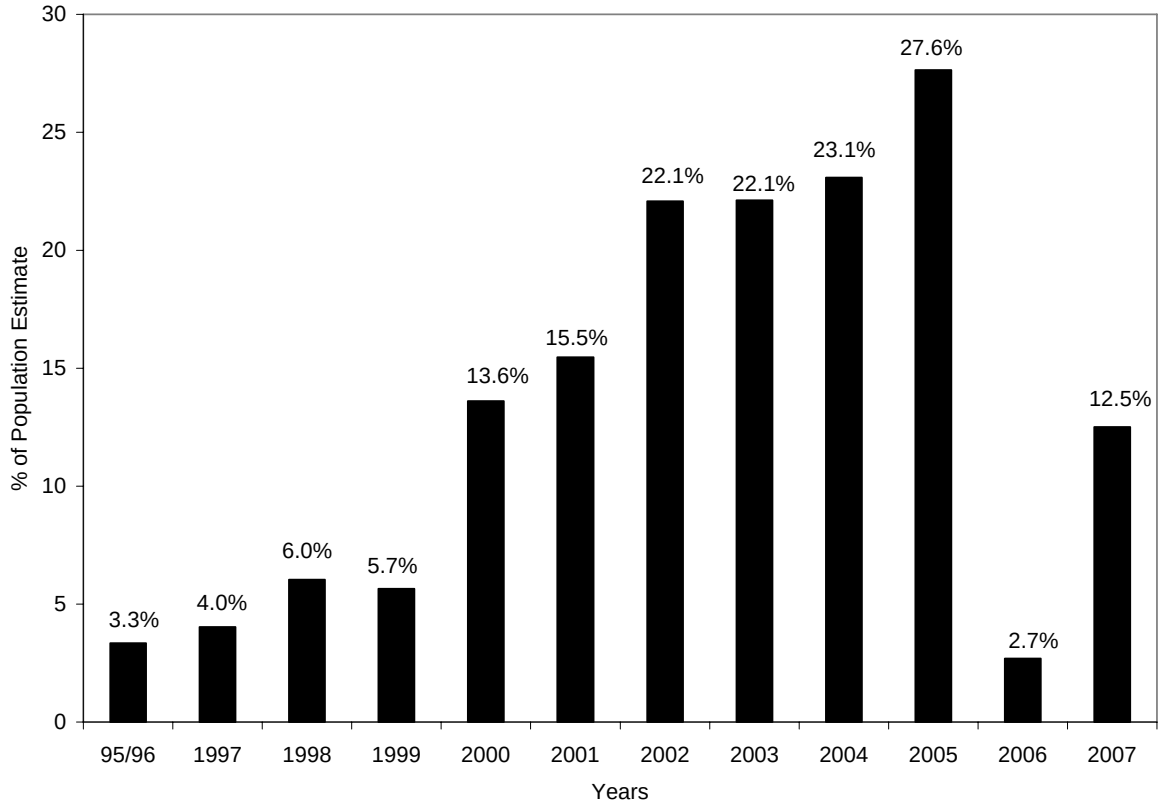

Figure 2 Exploitation rates for the northern pikeminnow removal program from 1995–2007. Removal years 1995–2004 are based on the Burley and Poe (1994) population estimate of 200,000; whereas, 2005–2007 years are based on the Turner et al. (2006) Jolley-Seber population estimate of 161,134.

2.0 Study Area

The study area for this Priest Rapids Project northern pikeminnow removal program will consist of approximately 56 river miles of the mainstem Columbia River from Rock Island Dam downstream to Wanapum Dam, then downstream to the Priest Rapids Dam forebay. For study purposes, both the Wanapum and Priest Rapids reservoirs will be divided into three sections defined by near-surface velocity, habitat type, and physical characteristics (Hjort et al. 1981; Horne and Goldman 1994; Normandeau Associates et al. 2000). The Wanapum and Priest Rapids reservoir complex follows a typical longitudinal impoundment gradient composed of three macro-habitats or reaches (Figure 3). These sections were defined as follows:

Wanapum Reservoir

- Wanapum upper-reservoir is defined as that portion of the reservoir from the tailwater of Rock Island Dam (river mile 453.5) downstream to river mile 443.0. Tailwater areas are the most riverine habitats within the Project area.
- Wanapum mid-reservoir is defined as that portion of the reservoir from river mile 442.0 downstream to river mile 427.0. The mid reservoir section is indicative of a

transitional area from the lotic (riverine) character of the tailwater, extending downstream to the lacustrine-like forebay.

- Wanapum lower-reservoir is defined as that portion of the reservoir from river mile 426.0 downstream to Wanapum Dam forebay (river mile 415.8). Lower reservoir and forebay areas are representative of lacustrine macro-habitat types.

Priest Rapids Reservoir

- Priest Rapids upper-reservoir is defined as that portion of the reservoir from the base of Wanapum Dam (river mile 415.8) downstream to river mile 408.0. Tailwater areas are the most riverine habitats within the Project area.
- Priest Rapids mid-reservoir is defined as that portion of the reservoir from river mile 407.0 downstream to river mile 404.0. The mid-reservoir section is indicative of a transitional area from the lotic (riverine) character of the tailwater, extending downstream to the lacustrine-like forebay.
- Priest Rapids lower-reservoir is defined as that portion of the reservoir from river mile 403.0 downstream to Priest Rapids Dam forebay (river mile 397.1). Lower reservoir and forebay areas are representative of lacustrine macro-habitat types.

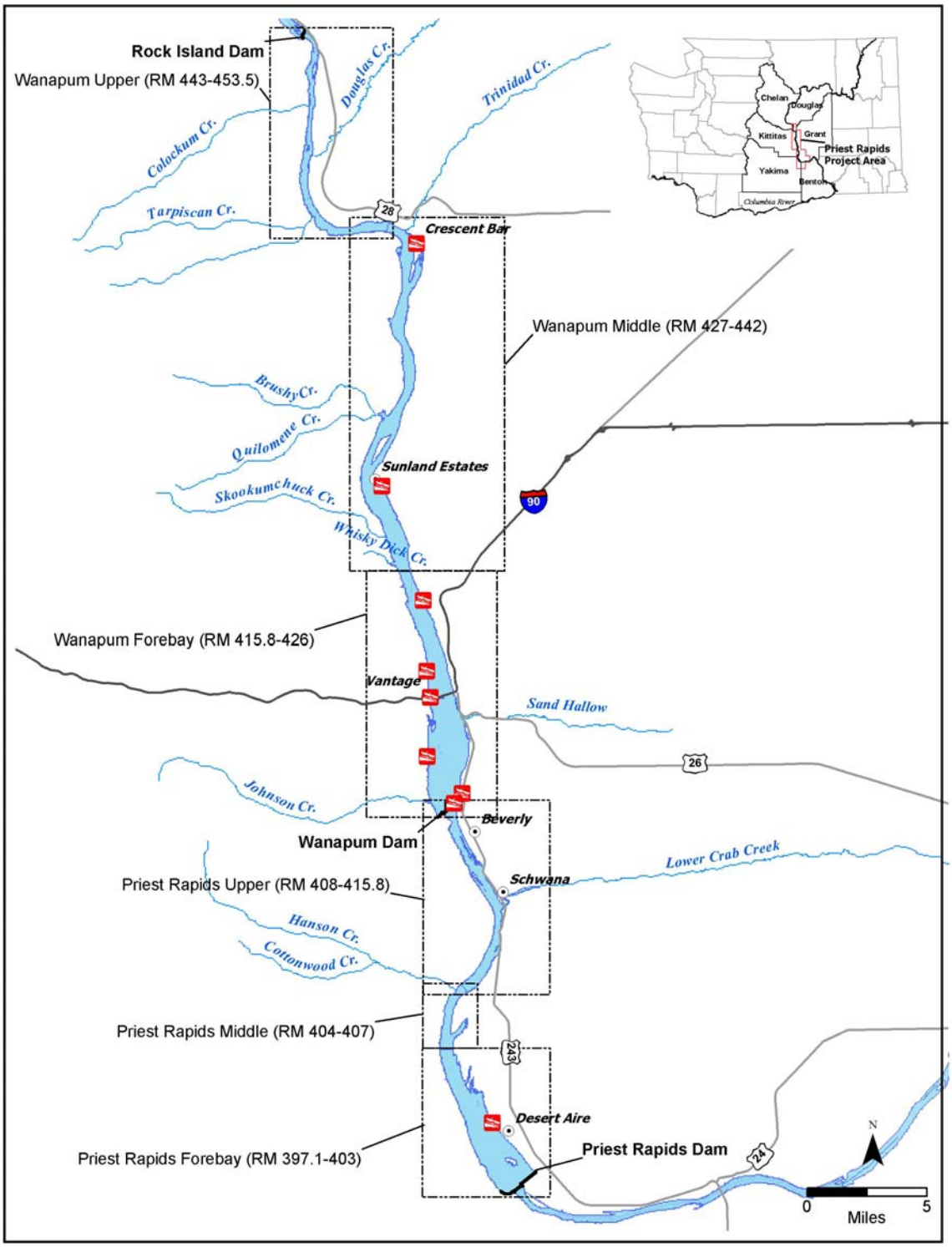

Figure 3 Established river reaches presented by river mile for the Priest Rapids Project, mid-Columbia River, USA.

3.0 General Objectives

The goal of the 2008 removal efforts will be to remove as many northern pikeminnow from the Project area as possible. High catch-per-unit effort (CPUE) areas will be identified by depth, spill season, and reservoir location to aid in future removal years. Information gathered in past removal years will be used to maximize CPUE and the total number of northern pikeminnow removed. The objectives for 2008 are as follows:

- Remove as many northern pikeminnow from the Project area as possible;
- Collect biological information from 20% of the northern pikeminnow captured to compare with previous years data;
- Identify and evaluate potential options to increase efficiency of future removal programs.

This plan describes, at an overview level, the approach and methods that will be used to achieve the stated objectives. The goal of the 2008 removal year will be to remove as many northern pikeminnow within the Project area as possible.

4.0 Study Methods

Northern pikeminnow removal efforts will occur through the use of modified set line methodology, beach seining and angling. Set line data (i.e., date, depth, GPS location) will be collected for each set line deployed and a 20% biological sub-sample will be collected to examine the current northern pikeminnow population characteristics and diet (Turner et al. 2005, Turner et al. 2006).

4.1 Set Line Fishery

The northern pikeminnow set line program will consist of a three-person field crew. Set line methodology will be used to capture and remove northern pikeminnow because it provides the greatest northern pikeminnow catch, is less size-selective than other sample gear, and rarely captures non-target species (Magnotti and Jerald 2001; Jerald 2002; 2003; 2004; 2005; Turner et al. 2005; 2006; Garner et al. 2007). The set lines will be similar to standard trot lines approximately 500-feet in length with hooks attached at equidistant intervals. The set line is composed of tarred Power Braided Twine No. 84. Both ends of the set line are equipped with an 8-lb anchor, and 150-foot buoy lines which will be attached upon deployment to mark the location and allow retrieval of the set line. Set line buoys are labeled with contact information and the current scientific collection permit number. The hook clips used on the set line consist of a single-loop ground clip, a swivel, one foot of 8-lb monofilament line, a size-10 winner day-glow float, and a No. 10 treble hook baited with a cricket. Light-weight monofilament is used to permit larger non-target fish, such as white sturgeon (*Acipenser transmontanus*) and large walleye (*Sander vitreus*) to break away.

Set lines will be deployed and recovered by boat. Set lines are typically deployed perpendicular to the shore; however, areas with higher water velocities require lines to be set either angled downstream or parallel to the shoreline. During line deployment, the lead buoy line will be let out and the hook clips snapped onto the set line at equidistant intervals. When the end of the set line is reached and all the hook clips are attached, a 150-foot buoy line will be attached to the

end of the set line. The set line will then be lowered to the river bottom and the remainder of the buoy line that was not used on the set line's descent will be released until the buoy is reached.

Set lines are fished over a 24-hour period (typically) and recovered daily (depending on river/weather conditions). All non-target species collected will be released and every effort will be made to keep other incidental by-catch below the surface of the water. As the line is retrieved, every fifth (20%) northern pikeminnow will be placed in a cooler and dissected after the entire line has been recovered.

4.1.1 Field Data Collection

Set line data will be collected for each deployed set line and a 20% biological sub-sample of all northern pikeminnow captured during 2008 removal efforts. The northern pikeminnow removal fishery will be initiated in March 2008 and concluded in August–September 2008.

4.1.2 Set Line Data

Data will be collected for every set line fished in the 2008 northern pikeminnow removal efforts. Recorded for each set line will be the following:

- Date and time set line was deployed and recovered.
- The amount of time the set line was fished (decimal hour).
- Number of hooks used.
- Number of northern pikeminnow caught (including the number greater than and less than 9 inches).
- Incidental catch (common name and number caught).
- GPS position (Datum: WGS 84; Coordinate System: Latitude, Longitude in Decimal Degrees) using a handheld Garmin® etrex to identify the GPS position and river mile.
- Depth classified by strata (0-20ft, 20-50ft, >50ft).

4.1.3 Northern Pikeminnow Biological Sub-sample

Every fifth northern pikeminnow collected will be sub-sampled for biological data. Fork length (mm), sex, gonad development and diet information will be collected from each selected fish. All northern pikeminnow will be eviscerated to obtain sex, gonad development, and dietary data. Sex will be recorded as male, female, or unknown. Gonad development will be recorded as unknown, immature, ripe, or spent (modified from Beamesderfer et al. 1987). Fishes with unknown sex will have their gonad development recorded as unknown.

The immature gonad development category is used to describe all northern pikeminnow with discernible gametes that are not in a spawning condition. Ripe will be used to describe fish that have milt or eggs easily extruded with external pressure. Spent describes fish with eggs or milt present but with gonad sacs empty or reduced in size. Dietary data will be recorded by dietary item(s) presence/absence as described by Murphy and Willis (1996). Eight general dietary categories will be used for dietary data collection. The dietary categories used are salmonid

smolt (*Oncorhynchus sp.*), unidentified fish, sculpin (*Cottus sp.*), juvenile pacific lamprey (*Lampetra tridentata*), crayfish (*Pacifasticus leniusculus*), Asiatic clams (*Corbicula fluminea*), macroinvertebrates, plant material, and other.

4.1.4 Data Analysis

Data analysis will include CPUE, GPS coordinates for GIS spatial analysis, and northern pikeminnow demographic and dietary analyses. CPUE results will be described for each reach of the river separately and will be presented in graphs on the maps of the different river reaches.

4.1.5 Catch Per Unit Effort

Catch-per-unit-effort values will be calculated as the number of northern pikeminnow caught per 100 hook hours. Catch-per-unit-effort data will be comparatively evaluated and compared considering Columbia River seasonal fish spill operations, depth, and reservoir reach. Catch-per-unit-effort values are categorized as low, average and high according to 2004 CPUE data. Set lines with CPUE values less than 0.2 NPM/100 hook hours will be classified as low, 0.2–0.3 NPM/100 hook hours will be classified as average, and greater than 0.3 NPM/100 hook hours will be classified as high CPUE. Seasonal spill operations are categorized as pre-spill, spring-spill, summer-spill and post-spill, and will follow accordingly with smolt out-migration spill seasons for the Priest Rapids Project. Set line depths are categorized into the depth intervals of 0–20 feet, 20–50 feet, and > 50 feet. ESRI®'s ArcView 8.3 will be used to spatially display CPUE data, set line GPS data, and Project bathymetry.

4.1.6 Northern Pikeminnow Sub-sample Data

Length and sex relationships will be determined for sub-sampled northern pikeminnow. A northern pikeminnow age frequency histogram will be created according to Hankin and Richards (2000) in which the ages of sub-sampled northern pikeminnow will be assigned ages by sex and fork length. Gonad development (Table 1) will be used to determine when northern pikeminnow spawning begins in the Project area to compare the timing of the spawning season with past years. Dietary frequency of occurrence will be examined and compared to past years to see if any trends in northern pikeminnow diet have changed.

Table 1 Criteria used to determine maturity of gonads examined from captured northern pikeminnow.

Code	Definition
0	Unidentified: gonads could not be distinguished between male and female
1	Immature: gonads thin and streamlined, making sex difficult to determine
2	Developing: eggs and milt do not flow easily from external pressure, but sex is determined visually. Eggs are small and gray in color
3	Ripe: eggs and milt flow easily from external pressure. Eggs develop orange tint
4	Spent: eggs or milt may be present but sacs are empty or very reduced in size

4.2 Beach Seine Fishery

In addition to the set line fishery, Grant PUD is proposing a temporary, experimental beach seine fishery in the early spring (March-April), and again in the fall (September) of 2008. Biologists have observed schools of age 0 to age 1 northern pikeminnow in shallow water areas within river miles 437–444 (K.Garner, personal observation). The shallow water areas identified to hold schools of age 0 and 1 northern pikeminnow are ideal locations to beach seine due to the depths of the area and lack of obstructions (Murphy and Willis 1996). Beach seining could possibly result in large catches of age 0 and 1 northern pikeminnow. Removal of age 0 and 1 northern pikeminnow would most likely decrease future predation on salmonids and is unlikely to result in compensatory responses by other predator species (Beamesderfer et al. 1996; Ward and Zimmerman 1999; Knutsen and Ward 1999).

Experimental beach seining efforts will take place in the spring during the last two weeks of March and the first week of April prior to increasing smolt count indexes at Rock Island Dam. Historically, yearling Chinook salmon counts begin to rise at the end of the second week of April (FPC 2007). Spring beach seining is anticipated to last from mid-March through the first week of April unless anadromous salmonid smolts are observed, at which time beach seining will be discontinued until the fall. Fall beach seining will take place for two to three weeks in September in the same areas previously mentioned for the spring beach seining. Schools of age 0 and 1 northern pikeminnow have been observed in macrophyte beds in Wanapum reservoir during the month of September (K.Garner, personal observation).

The beach seine crew will consist of a biologist and two additional staff, a boat and an 80- to 100-foot nylon mesh seine. The seine will be deployed by one man standing on the shore holding one end of the seine while the boat driver backs away from the beach at an upstream angle until the entire net is out. The boat driver will then make an arc or half circle and maneuver into the beach downstream of the man holding the other end of the net. After both ends of the net are on shore, the net will be pulled in and the fish will be collected. All northern pikeminnow will be counted. All non-target species collected will be quickly released.

4.3 Angling Fishery

Angling is an effective method used to remove northern pikeminnow from the tailrace of hydroelectric dams, especially in the boater restriction zones (Porter 2007). Angling will be conducted on an opportunistic basis. If schools of northern pikeminnow are observed in the tailrace of Wanapum Dam, angling will be used as a means of collection where set lines cannot be placed due to logistical or safety constraints. Angling efforts below Priest Rapids Dam are the responsibility of the BPA Sport Reward Program, and will not be conducted by Grant PUD staff.

Angling crews will consist of a biologist and two additional staff. Artificial fishing lures that resemble salmon smolt will be used to catch the northern pikeminnow. All northern pikeminnow caught by angling will be counted and 20% will be eviscerated, with biological data recorded as done for the set line fishery. All non-target species will be quickly released.

5.0 Study Schedule

The anticipated 2008 northern pikeminnow control program schedule is presented in Table 2. The set line fishery will begin in the end of March and is tentatively scheduled to end in August or September. Beach seining will be conducted for two to three weeks in the spring (March–

April) and again for two to three weeks in the fall (September). Angling will take place below Wanapum Dam on an opportunistic basis whenever northern pikeminnow are observed or suspected of being present in fishable numbers.

Table 2 Proposed sampling schedule for the Grant PUD northern pikeminnow removal program 2008.

Field Sample Period	Study Activity
March 1 through April 15 (pre-spill)	Conduct Set Line Removal Program Conduct Beach Seining
April 16 through June 15 (spring-spill)	Continue Set Line Removal Program Conduct Angling
June 16 through August 15 (summer-spill)	Continue Set Line Removal Program Conduct Angling
August 17 through September (post-spill)	Continue Set Line Removal Program Conduct Beach Seining

Grant PUD will also monitor for fishable populations of northern pikeminnow below Priest Rapids Dam within the Project boundary. The Sport Reward fishery funded by the Bonneville Power Administration is responsible for northern pikeminnow removal in the Hanford Reach up to the boater restriction zones below Priest Rapids Dam. In 2006, the Sport Reward program removed 12,530 northern pikeminnow over nine inches from the Hanford Reach with 9,180 of those fish being turned in to the Vernita check station. Grant will monitor for fishable populations of northern pikeminnow within the Project boundary below Priest Rapids Dam. If fishable numbers of northern pikeminnow are observed within the Project boundary below Priest Rapids Dam, Grant PUD will exploit those populations.

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