From: Bao Le

Sent: Friday, February 09, 2007 8:55 AM

To: Art Viola; Bill Towey; Bob Clubb; Bob Dach; Bob Heinith; Bob Jateff; Bob Rose; Brad Hawkins; Brad James; Bryan Nordlund; Carl Merkle; Carmen Andonaegui; David Turner (david.turner@ferc.gov); Dennis Beich; Joe Miller; Joe Peone; John Devine; Jonathan Merz; Keith Kirkendall; Mark Miller; Mary Mayo; Molly Hallock; Pat Irle; Robert Easton; Sally Sovey; Shane Bickford; Steve Lewis; Steve Parker; Tony Eldred (eldredte@dfw.wa.gov)

Subject: Aquatic Study Plans

Attachments: Aquatic Study Plans from Pre-Application Document - Appendix H.pdf

Aquatic RWG members, per Action Item #2 from Wednesday's meeting, I am distributing the 7 Aquatic Study Plans that we have collaboratively developed and that are now part of FERC's Scoping Document 1. Please review these plans and if you have any additional comments, specifically related to methods, please submit them to me by April 2nd (also the date when comments are due to FERC). Please feel free to give me a call if you have any questions.

Cheers,

Bao Le
Sr. Aquatic Resource Biologist
Douglas PUD
1151 Valley Mall Pkwy.
East Wenatchee, WA 98802
509-881-2323 (Direct)
509-884-0553 (FAX)

SURVIVAL AND RATES OF PREDATION FOR JUVENILE PACIFIC LAMPREY MIGRATING THROUGH COLUMBIA RIVER HYDROELECTRIC PROJECTS (AQUATIC ISSUE 6.2.1.1)

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

December, 2006

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington

For copies of this study plan, contact:

Public Utility District No. 1 of Douglas County
Attention: Relicensing
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4497
Phone: (509)884-7191
E-Mail: relicensing@dcpud.org

ABSTRACT:

The current Wells Hydroelectric Project (Wells Project) license will expire on May 31, 2012. The Public Utility District No. 1 of Douglas County (Douglas PUD) owns and operates the Wells Project and is using the Integrated Licensing Process (ILP) for relicensing as promulgated by Federal Energy Regulatory Commission (FERC) regulations issued July 23, 2003 (18 CFR Part 5).

The Aquatic Resource Work Group (RWG), which is composed of stakeholders (resource agencies and tribes) and Douglas PUD staff, was formed for the purpose of identifying issues and information gaps that may require study during the relicensing of the Wells Project. The Aquatic RWG, through a series of technical meetings, is proposing a study intended to fill gaps in the local knowledge of juvenile Pacific lamprey (*Lampetra tridentata*) survival migrating through the Wells Project.

Although there is a growing body of information on adult Pacific lamprey and their interactions at hydroelectric projects, relatively little information exists related to the survival of outmigrating juvenile lamprey (macrophthalmia) at hydroelectric projects. A review of the recent body of literature related to juvenile lamprey survival passing through hydroelectric projects concludes that there is currently a lack of methodologies and technologies to effectively quantify the level of survival of juvenile lamprey migrating through a hydroelectric facility. In other words, no studies currently exist that document the level of survival attributed to a project's operations, nor does an accepted technology currently exist that would achieve this level of assessment for juvenile lamprey.

In lieu of being able to directly measure survival for juvenile lamprey passing through the Wells Project, the Aquatic RWG proposes to conduct an updated literature review which will compile all of the available information regarding juvenile lamprey survival at hydroelectric projects in the Columbia River Basin. Additionally, a field study will be implemented during the 2-year ILP study period to assess the significance of juvenile lamprey in the diets of predatory fishes and birds present in the Wells Forebay and Tailrace. Stomach samples of both predatory fishes and birds will need to be obtained and an effort will be made to coordinate with pre-existing activities that may already be collecting such specimens (An evaluation of the effects and alternatives to the existing piscivorous bird and mammal control program (Terrestrial Issue 6.2.3.1)).

A technical report summarizing the results of this study will be produced to provide a current state-of-the-science assessment of juvenile lamprey survival to address the issues raised by the Aquatic RWG. Furthermore, the results of the study will inform future Wells Project relicensing decisions by assessing the effectiveness of existing predator control programs (which have traditionally targeted salmonid predators) for juvenile lamprey.

1.0 INTRODUCTION

1.1 General Description of the Wells Hydroelectric Project

The Wells Hydroelectric Project (Wells Project) is located at river mile (RM) 515.8 on the Columbia River in the State of Washington. Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (COE), and 42 miles upstream from the Rocky Reach Hydroelectric Project, owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam.

The Wells Project is the chief generating resource for the Public Utility District No. 1 of Douglas County (Douglas PUD). It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides the hydrocombine, which is 1,130 feet long, 168 feet wide, with a crest elevation of 795 feet in height.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The normal maximum surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at elevation of 781. The normal maximum water surface elevation of the reservoir is 781 feet (Figure 1.1-1).

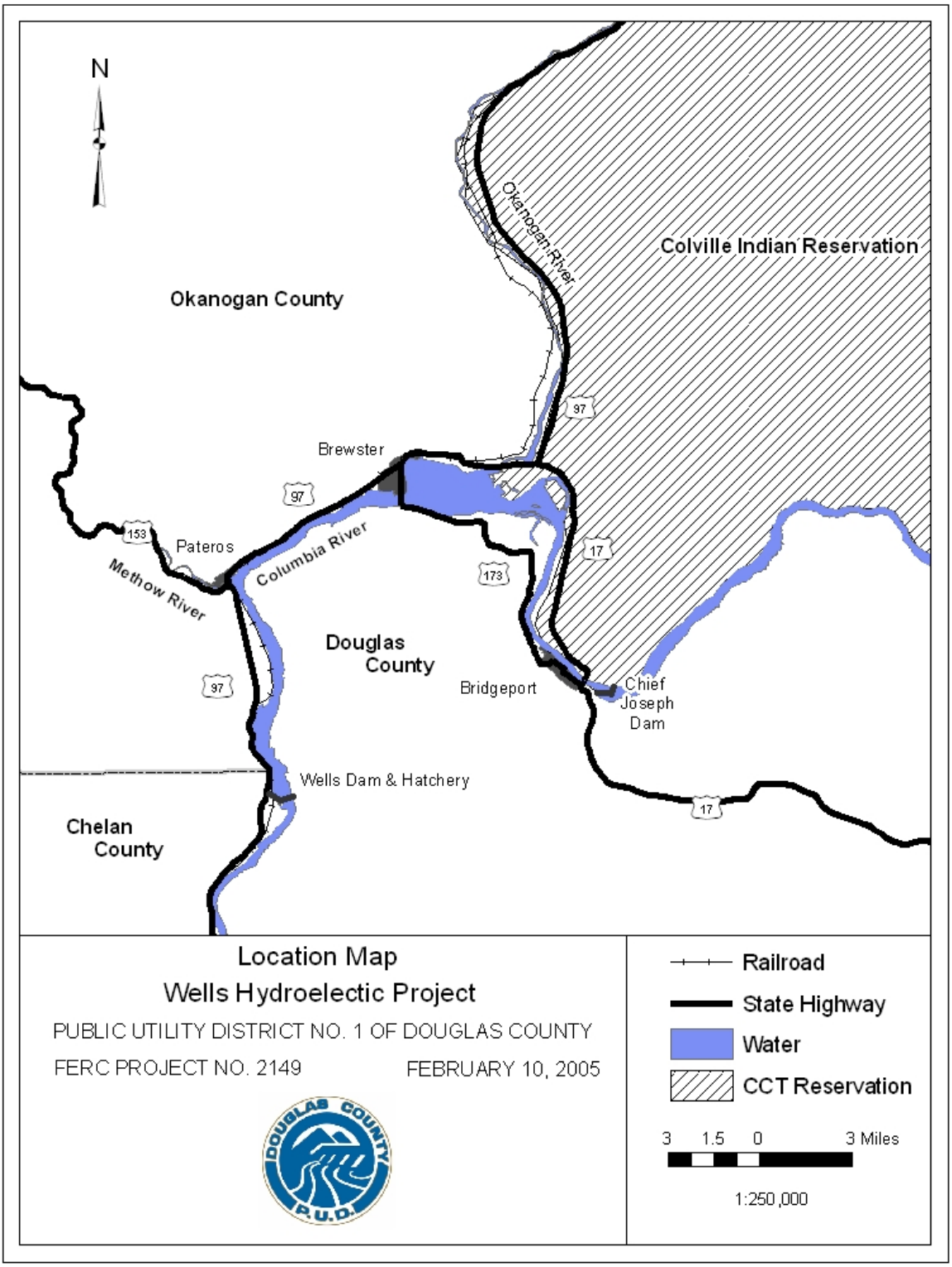

Figure 1.1-1. Location Map of the Wells Project

1.2 Relicensing Process

The current Wells Project license will expire on May 31, 2012. Douglas PUD is using the Integrated Licensing Process (ILP) as promulgated by FERC regulations issued July 23, 2003 (18 CFR Part 5). Various state and federal agencies, tribes, local governments, non-governmental organizations and the general public will participate in the Wells Project ILP. During the ILP, information needs related to the relicensing of the Wells Project will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b).

18 CFR § 5.9(b) Content of study request. Any information or study request must:

(1) Describe the goals and objectives of each study and the information to be obtained;
(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
(4) Describe existing information concerning the subject of the study proposal, and the need for additional information;
(5) Explain any nexus between project operation and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;
(6) Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate, considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

All study plans submitted to FERC will be reviewed by Douglas PUD and the applicable Resource Work Group(s) to determine if studies proposed will fill the information needs related to the Wells Project Relicensing. Any dispute over alternative study methods, that cannot be reconciled with stakeholders, will be decided by FERC.

2.0 GOALS AND OBJECTIVES

The goal of this study is to collect up-to-date information on the survival and the rates of predation of juvenile Pacific lamprey macropthalmia migrating through Columbia River hydroelectric Projects and to collect site specific information on rates of predation on juvenile lamprey in the waters immediately upstream and downstream of Wells Dam. This information will be used to inform existing predator control programs in the reduction of predation on juvenile lamprey macropthalmia.

The specific work needed to accomplish this goal is:

- Conduct a literature review on juvenile lamprey macrophthalmia survival and predation studies conducted at Columbia River hydroelectric projects.
- Conduct an analysis on the stomach contents of predatory fish and birds (if feasible) to assess the location (only applicable to fish) and level of predation that may be occurring on juvenile Pacific lamprey macropthalmia in the Wells Forebay and Tailrace.

3.0 STUDY AREA

The study area for field activities will consist of the Wells Forebay and Tailrace. The Wells Tailrace is defined, for this study, as the waters immediately below Wells Dam downstream to a distance of 3000 feet. The definition of the Wells Forebay, for this study, extends 1,000 feet upstream from the face of the dam (Figure 1.1-1).

4.0 BACKGROUND AND EXISTING INFORMATION

Pacific lamprey (*Lampetra tridentata*) are present in most tributaries of the Columbia River and in the mainstem Columbia River during their migration stages. They have cultural, utilitarian and ecological significance including the ceremonial, subsistence and medicinal use of adult lamprey by Native Americans (Close et al. 2002). As an anadromous species, they also contribute marine-derived nutrients to the aquatic and terrestrial ecosystem found in the interior Columbia Basin. Little specific information is available on the life history or status of lamprey in the mid-Columbia River watersheds. They are known to occur in the Methow, Wenatchee and Entiat rivers (NMFS, 2002) and recently have been captured during juvenile trapping operations in the Okanogan River.

In general, adults are parasitic on fish in the Pacific Ocean while ammocoetes (larvae) are filter feeders that inhabit the fine silt deposits in backwaters and quiet eddies of streams (Wydoski and Whitney, 2003). Adults generally spawn in low-gradient stream reaches in the tail areas of pools and in riffles, over gravel substrates (Jackson et al. 1997). Adults die after spawning. After hatching, the ammocoetes burrow into soft substrate for an extended larval period filtering particulate matter from the water column (Meeuwig et al. 2002). The ammocoetes undergo a metamorphosis to macrophthalmia between 3 and 7 years after hatching, and migrate from their parent streams to the ocean from October to April (Close et al., 2002). Adults typically spend 1-4 years in the ocean before returning to freshwater tributaries to spawn.

Pacific lamprey populations of the Columbia River have declined in abundance over the last 40 years according to counts at dams on the lower Columbia and Snake rivers (Close et al. 2002). Starke and Dalen (1995) reported that adult lamprey counts at Bonneville Dam that regularly exceeded 100,000 fish in the 1960s. More recently lamprey counts have ranged between 20,000 and 120,000 for the period 2000-2004 (DART - www.cqs.washington.edu/dart/adult.html).

Close et al. (2002) identified several factors that may account for the decline in lamprey counts in the Columbia River Basin. This includes reduction in suitable spawning and rearing habitat from flow regulation and channelization, pollution and chemical eradication, reductions of prey in the ocean, and juvenile and adult passage problems at dams (Nass et al., 2005).

Although there is a growing body of information on adult Pacific lamprey and their interactions at hydroelectric projects, relatively little information exists describing the effects of hydroelectric plant operations on outmigrating juvenile lamprey (macrophthalmia). Recent juvenile lamprey studies at hydroelectric projects have addressed testing for lamprey macrophthalmia survival through juvenile bypass facilities (Bleich and Moursund, 2006), impingement by intake diversion screens (Moursund et al., 2000 and 2003), validation of existing screening criteria (Ostrand, 2005), and responses of juvenile Pacific lamprey to simulated turbine passage environments (Moursund et al., 2001; INL, 2006). Results of other studies targeting predaceous birds and fish suggest that juvenile lamprey may compose a significant proportion of the diets of these predators (Poe et al., 1991; Merrell, 1959).

A review of the recent body of work addressing juvenile lamprey at hydroelectric facilities concludes that there is a current lack of a methods and tools to effectively quantify the level of survival for juvenile lamprey migrating through hydroelectric facilities. Furthermore, no studies exist that assign a level of survival attributed to a project's operations. This is due to the lack of miniaturized active tag technologies to overcome two study limitations. Macrophthalmia (juvenile outmigrating lamprey) are relatively small in size and unique in body shape and they tend to migrate low in the water column resulting in the rapid attenuation of active tag signal strength. In an effort to develop a tagging protocol, the Bonneville Power Administration (BPA) annually funds Oregon State University (OSU) to identify and develop tag technologies for lamprey macrophthalmia. Recent reports on this developmental effort have concluded that the smallest currently available radio-tag was still too large for implantation in the body cavity of a juvenile lamprey (Schreck et al., 2000). Additionally, external application was not effective as animals removed tags within the first week and fish performance was affected. This report also concluded that internal implantation of Passive Integrated Transponder (PIT) tags was the most viable option for tagging juvenile lamprey although this method included severe limitations such as the limited range of detection systems and the ability to tag only the largest outmigrating juvenile lamprey (Schreck et al., 2000).

4.1 Aquatic Resource Work Group

As part of the preparation for the relicensing of the Wells Project, Douglas PUD established an Aquatic Resource Work Group (RWG) which began meeting informally in November, 2005. This voluntary effort was initiated to provide stakeholders with information about the Wells Project, to collaboratively identify potential resource issues related to Project operations and relevant to relicensing, and to develop preliminary study plans to be included in the Wells Pre-Application Document (PAD).

Through a series of meetings, the Aquatic RWG cooperatively developed a list of Issue Statements, Issue Determination Statements and Agreed Upon Study Plans. An Issue Statement is an agreed upon definition of a resource issue raised by a stakeholder. An Issue Determination Statement reflects the RWG's efforts to review the existing project information and to determine whether an issue matches with FERC's seven criteria and would be useful in making future relicensing decisions. Agreed Upon Study Plans are the finished products of the informal RWG process.

Based upon these meetings and discussions, the Aquatic RWG is proposing to include a study plan into the Wells PAD to collect and summarize the existing literature related to juvenile lamprey survival at hydroelectric projects and to assess the level of juvenile lamprey predation taking place within the Wells Tailrace. The need for this study was agreed to by all of the members of the Aquatic RWG, including Douglas PUD. This study will help to inform future relicensing decisions and will fill data gaps that have been identified by the Aquatic RWG.

4.2 Issue Statement

Finalized Issue Statement (6.2.1.1)

Operations of the Project may affect juvenile Pacific lamprey dam passage and reservoir survival (survival, route of passage and timing) during their downstream migration.

Final Issue Determination Statement (6.2.1.1)

It is unknown as to whether there is a Project effect on juvenile lamprey. At this time, there are no studies documenting Project effects on juvenile lamprey. However, dam passage survival can be broken down into 4 specific areas of concern; survival, route of passage, timing and predation. Currently, there are two limitations to the implementation of a field study for dam passage survival; 1) tag technology for juvenile macropthalmia is currently being developed; and 2) obtaining macropthalmia in sufficient numbers within the Project to meet sample size requirements for a statistically rigorous study is not practicable. Reservoir predation on juvenile lamprey is unknown. A review of existing data and literature on predation, including bird predation in the tailrace, would be beneficial.

The resource work group agrees that a study is needed during the two-year ILP study period. This study will include an updated literature review on juvenile lamprey survival and predation on juvenile lamprey and will examine the stomach contents of fish. If permits can be obtained, the study will also examine the stomach contents of birds.

5.0 PROJECT NEXUS

Anadromous lamprey actively migrate from estuarine and marine waters to freshwater spawning areas as adults. Upon metamorphosis, juveniles participate in both active and passive emigration from freshwater rearing areas. In the Columbia River Basin, lamprey may migrate hundreds of kilometers through both mainstem and tributary habitats. Consequently, they encounter a variety of obstacles to passage that could affect their populations. Recent research has indicated that large hydropower dams delay and obstruct adult passage (LTWG, 2005). These facilities may also affect the downstream passage of juvenile lamprey during their outmigration. Specifically, areas of turbulence in the Wells Tailrace could increase the susceptibility of juvenile lamprey macropthalmia to predation.

Currently, little information exists as to the types and levels of impact that may occur to outmigrating juvenile lamprey through hydroelectric facilities. Given the current limitations in

technology and methods capable of accurately quantifying impacts to juvenile lamprey migrating through hydroelectric facilities, the proposed study will review and condense the most accurate and scientifically available information related to juvenile lamprey passage through Columbia River dams.

In addition to the literature review, stomach content analysis will be conducted from predatory birds and fish found within the Wells Tailrace and predatory fish found in the Wells Forebay. Stomach contents will be used to determine whether juvenile Pacific lamprey are being consumed by predators and the location where they are being consumed while migrating through the Wells Reservoir and following passage through Wells Dam. Given the difficulty in assessing the location of predation activity by birds, location information will only be applicable to predatory fish. This study plan is not proposing to develop new technologies. The information collected from this study will help to inform the development of license requirements (18 CFR § 5.9(b)(5)) by assessing the effectiveness of existing predator control programs (traditionally aimed at targeting salmonid predators) with regards to predation on juvenile Pacific lamprey. Based upon the results of the study, predator control programs may be modified to maximize protection for outmigrating juvenile lamprey while continuing to ensure high levels of protection for juvenile salmonids.

6.0 METHODOLOGY

The literature review will consist of a search of all existing information currently available on juvenile lamprey survival and predation at hydroelectric projects in the Columbia River Basin. This search will examine the availability of information from peer-reviewed journals, federal and state publications, academia, private industry, and grey literature. References cited from the initial literature search that are of relevance to the subject matter will also be collected and added to the literature database. An annotated bibliography will be produced from the results of the literature search.

The field collection and analysis of stomach contents will consist of the collection of various predators known to be present in the Wells Forebay and Tailrace. Fish species that will be collected are northern pikeminnow (*Ptychochelius oregonensis*), smallmouth bass (*Micropterus dolomieu*), and walleye (*Stizostedion vitreum*). Fish will be collected via angling and through coordination with other programs that are already capturing such species; i.e., northern pikeminnow removal program in the Wells Project and Chelan PUD predation study in the Wells Tailrace. An effort will be made to collect 20 samples of both smallmouth bass and walleye from the Wells Tailrace. Stomach contents from 500 northern pikeminnow in both the Wells Tailrace and above Wells Dam in the reservoir will be collected from the existing predator control program. These data will assist in a comparative analysis of rates of predation upon juvenile lamprey before and after passage through Wells Dam.

In addition to fish species collection, the stomach contents of avian species that are present in the Wells Tailrace will also be analyzed pending the ability to secure the appropriate permits. There may be opportunities to coordinate with existing or proposed programs that collect avian predators in the Wells Tailrace or Wells Hatchery. Currently, the United States Department of Agriculture (USDA) oversees a piscivorous bird damage management program for the protection

of juvenile salmonids on the Mid-Columbia River (USDA, 2003). This program is a potential source of avian predator samples for the study. Furthermore, the Terrestrial RWG has submitted a proposed study to evaluate the effects and alternatives to the existing piscivorous bird and mammal control program. Provided that FERC approves the study plan for the piscivorous bird control study, then there may be an opportunity to secure samples through the implementation of this study. The number of samples and the species of birds to be sampled will be dependent upon the availability of samples from these other studies. At a minimum, an effort will be made to obtain samples from at least 2 of each bird species that are removed from the Wells Project.

Both predatory fish and bird collection will occur from May through July, 2008 to coincide with the juvenile Pacific lamprey outmigration in the mid-Columbia River. Sampling effort during the study will also be segregated in an effort to collect samples throughout the entire outmigration period. General information such as location, date, and time of capture will be recorded in addition to biological information (length, weight, species, sex) of samples collected independently or through coordinated efforts. All samples collected by Douglas PUD will be sent to an accredited laboratory for analysis. Samples will be preserved according to Quality Assurance/Quality Control specifications of the accredited laboratory. Data acquired from the stomach content analysis will consist of prey species diversity, prey species percent composition, and a comparative analysis of the levels of predation observed by location (applicable only to predatory fish) and by predator species.

7.0 STAFFING AND EQUIPMENT REQUIREMENTS

Based upon discussions with the Aquatic RWG regarding specific study design and study needs, Douglas PUD will secure the assistance of a qualified consultant(s) to conduct the literature review and if necessary, coordinate the field sampling and laboratory analysis of stomach samples.

No special equipment will be necessary to complete this study with the notable exception of a boat capable of safely accessing the Wells Tailrace and permits for the collection of stomach samples from birds and fish found within the Wells Tailrace. Should the applicable permits be secured prior to the study, the existing USDA contractor will use shotguns to collect stomach samples from birds collected from the Wells Tailrace. Stomach samples from predatory fish will be collected through the existing long-line predator control program and may be augmented through other angling efforts.

The technical skills necessary to complete the study literature portion of the study are knowledge of data acquisition and management.

8.0 BUDGET

The total estimated hours for study implementation is approximately 1,400 person hours. The allocation of these hours is approximately 64 hours for project management and coordination; 568 hours for the literature review; 392 hours for the predator stomach analysis; and 376 hours for data analysis and reporting. Labor costs are estimated to be $116,000. Equipment costs and

expenses related to implementation (travel, miscellaneous supplies, boat use) are estimated to be $12,000. Total planning level cost for this effort is approximately $128,000.

9.0 SCHEDULE

The literature review will begin shortly after FERC's issuance of the Study Plan Determination in October 2007. The results of the literature review will be detailed in a brief report and annotated bibliography.

If sampling associated with the field portion of the study is necessary, it will occur from May to July of 2008. Laboratory analysis of stomachs collected will occur in late summer 2008. An Initial Study Report will be provided in October 2008. The Initial Study Report will detail the results of the field study and literature review. A final report will be available by October 2009 for use by FERC, the Aquatic RWG and stakeholders in discussions related to the Wells Project relicensing.

10.0 REFERENCES

Bleich, M.D., and R.A. Moursund. 2006. PIT Tag Evaluation of Juvenile Bypass System at the McNary Dam for Passage of Juvenile Pacific Lamprey (*Lampetra tridentata*), 2005. Prepared for the U.S. Army Corps of Engineers. Prepared by Battelle-Pacific Northwest Division, Richland, WA.

INL (Idaho National Laboratory). 2006. Responses of Juvenile Pacific Lamprey to Turbine Passage. Idaho National Laboratory. Advanced Turbine Systems. http://hydropower.inl.gov/turbines/index.shtml

LTWG (Columbia River Basin Lamprey Technical Workgroup). 2005. Critical Uncertainties for Lamprey in the Columbia River Basin: Results from a strategic planning retreat of the Columbia River Lamprey Technical Workgroup. April 19, 2005

Merrell, T.R. 1959. Gull food habits on the Columbia River. Fish Commission of Oregon Research Briefs 7(1):82.

Moursund, R.A., D. D. Dauble, and D. Belch. 2000. Effects of John Day Dam Bypass Screens and Project Operations on the Behavior and Survival of Juvenile Pacific Lamprey (*Lampreta tridentata*). Prepared by Pacific Northwest National Laboratory for the U.S. Army Corps of Engineers, Portland District, Portland, Oregon.

Moursund, R.A., R. P. Mueller, T. M. Degerman, and D. D. Dauble. 2001. Effects of Dam Passage on Juvenile Pacific Lamprey (*Lampetra tridentata*). Prepared by Pacific Northwest National Laboratory for the U.S. Army Corps of Engineers, Portland District, Portland, Oregon. Contract DE-AC06-76RL01830.

Moursund, R. A., D. D. Dauble, and M. J. Langeslay. 2003. Turbine Intake Diversion Screens: Investigating Effects on Pacific Lamprey. Hydro Review.

Ostrand, K.G. 2005. Validation of Existing Screening Criteria for Lamprey Macropthalmia. United States Fish and Wildlife Service: Abernathy Fish Technology Center, Longview, WA.

Poe, T.P., H.C. Hansel, S.Vigg, D.E. Palmer, and L.A. Prendergast. 1991. Feeding of predaceous fishes on out-migrating juvenile salmonids in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:405-420.

Schreck, C., S. Heppell, and D. Lerner. 2000. Determination of Passage of Juvenile Lamprey: Development of a Tagging Protocol. Oregon Cooperative Fish and Wildlife Research Unit, Biological Resources Division-U.S. Geological Survey, Oregon State University.

USDA (United States Department of Agriculture). 2003. Environmental Assessment: Piscivorous Bird Damage Management for the Protection of Juvenile Salmonids on the Mid-Columbia River. Prepared by the United States Department of Agriculture, Wildlife Services.

AN ASSESSMENT OF ADULT PACIFIC LAMPREY SPAWNING WITHIN THE WELLS PROJECT (AQUATIC ISSUE 6.2.1.2)

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

December, 2006

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington

For copies of this study plan, contact:

Public Utility District No. 1 of Douglas County
Attention: Relicensing
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4497
Phone: (509)884-7191
E-Mail: relicensing@dcpud.org

ABSTRACT:

The current Wells Hydroelectric Project (Wells Project) license will expire on May 31, 2012. The Public Utility District No. 1 of Douglas County (Douglas PUD) owns and operates the Wells Project and is using the Integrated Licensing Process (ILP) for relicensing as promulgated by Federal Energy Regulatory Commission (FERC) regulations issued July 23, 2003 (18 CFR Part 5).

The Aquatic Resource Work Group (RWG), which is composed of stakeholders (resource agencies and tribes) and Douglas PUD staff, was formed for the purpose of identifying issues and information gaps that may require study during the relicensing of the Wells Project. The Aquatic RWG, through a series of technical meetings, is proposing a study intended to examine the effects of Wells Project operations on adult Pacific lamprey (*Lampetra tridentata*) habitat, specifically spawning habitat.

Currently, the information available in the mid-Columbia River on adult Pacific lamprey addresses only their migration through hydroelectric projects. No studies have been conducted to examine the presence of spawning within a Project area and further whether Project operations impact lamprey spawning.

The study proposes to identify sites within the Wells Project where suitable spawning habitat may be available through an analysis using Geographic Information Systems (GIS). These sites will be field verified for suitability prior to the implementation of a field study. The field study will consist of spawning surveys throughout the lamprey spawning period (typically May to July) in 2008. If spawning activity is observed, an analysis will be conducted to examine whether Wells Dam operations have an effect on lamprey spawning habitat.

A technical report summarizing the results of this study will be produced to help fill the information gap identified by the Aquatic RWG. The results of the study will assist the Aquatic RWG in future Wells Project relicensing decisions.

1.0 INTRODUCTION

1.1 General Description of the Wells Hydroelectric Project

The Wells Hydroelectric Project (Wells Project) is located at river mile (RM) 515.8 on the Columbia River in the State of Washington. Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (COE), and 42 miles upstream from the Rocky Reach Hydroelectric Project, owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam.

The Wells Project is the chief generating resource for Public Utility District No. 1 of Douglas County (Douglas PUD). It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides the hydrocombine, which is 1,130 feet long, 168 feet wide, with a crest elevation of 795 feet in height.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The normal maximum surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at elevation of 781. The normal maximum water surface elevation of the reservoir is 781 feet (Figure 1.1-1).

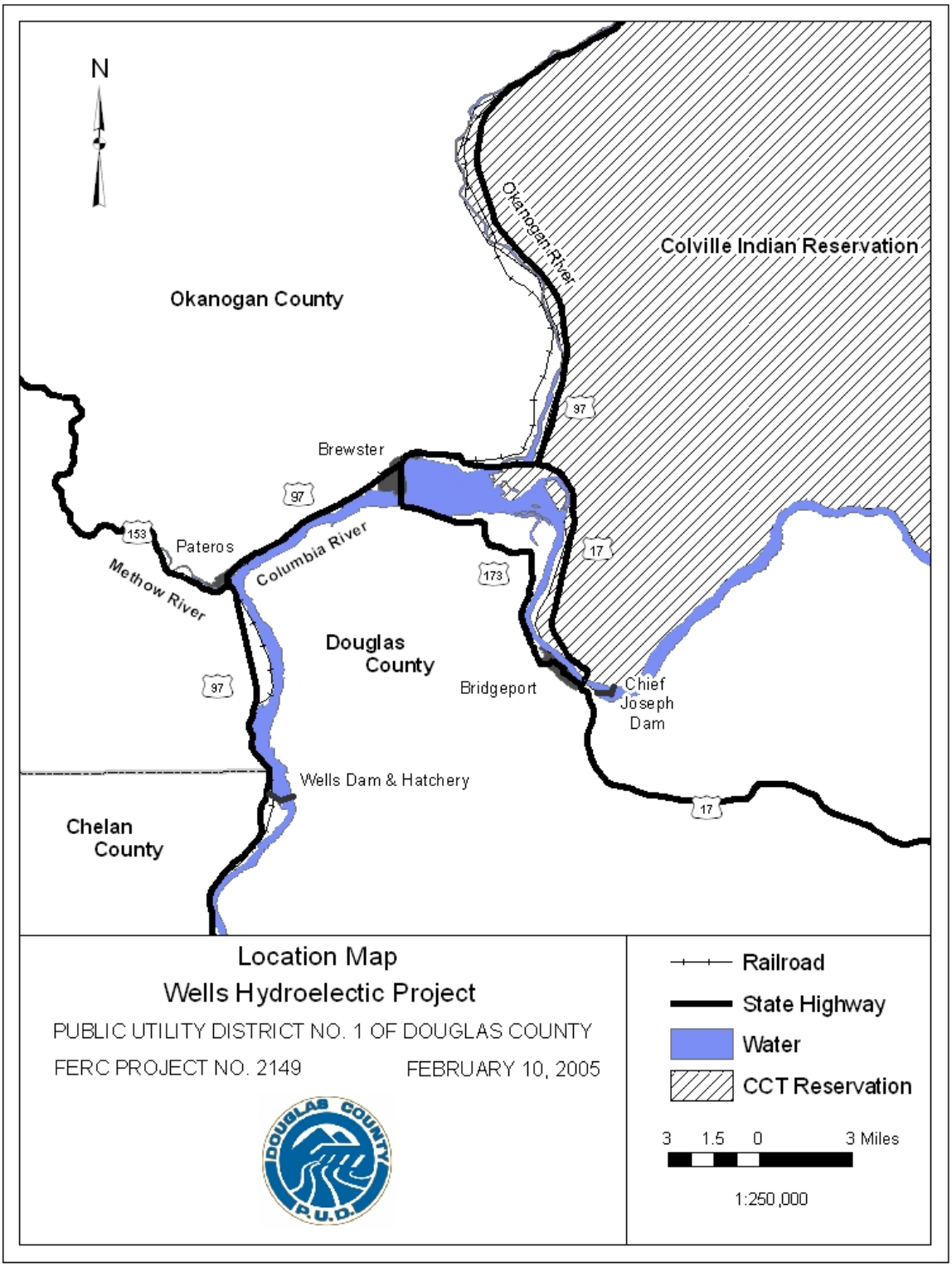

Figure 1.1-1 Location Map of the Wells Project

1.2 Relicensing Process

The current Wells Project license will expire on May 31, 2012. Douglas PUD is using the Integrated Licensing Process (ILP) as promulgated by FERC regulations issued July 23, 2003 (18 CFR Part 5). Various state and federal agencies, tribes, local governments, non-governmental organizations and the general public will participate in the Wells Project ILP. During the ILP, information needs related to the relicensing of the Wells Project will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b).

<u>18 CFR § 5.9(b) Content of study request</u>. Any information or study request must:

(1) Describe the goals and objectives of each study and the information to be obtained;
(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
(4) Describe existing information concerning the subject of the study proposal, and the need for additional information;
(5) Explain any nexus between project operation and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;
(6) Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate, considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

All study plans submitted to FERC will be reviewed by Douglas PUD and the applicable Resource Work Group(s) to determine if studies proposed will fill the information needs related to the Wells Project Relicensing. Any dispute over alternative study methods, that cannot be reconciled with stakeholders, will be decided by FERC.

2.0 GOALS AND OBJECTIVES

The primary objective of this study is to assess the level of spawning activity by adult Pacific lamprey in the Wells Project and whether Wells Dam operations are affecting this activity.

Specific objectives of the study include:

- Identify areas within the Wells Project where suitable spawning habitat may exist for adult Pacific lamprey,
- Survey these areas of spawning habitat for use by lamprey to confirm suitability, and
- Assess whether the operations of Wells Dam are having adverse effects on these spawning areas (i.e., dewatering, flow alterations, scour, etc.).

3.0 STUDY AREA

The study area is defined as the waters within the Wells Reservoir and Wells Tailrace. The Wells Reservoir consists of the mainstem Columbia River upstream of Wells Dam to the tailrace of Chief Joseph Dam, and the Okanogan (to RM 15.5) and Methow (to RM 1.5) rivers within Project boundary. The Wells Tailrace consists of the Columbia River downstream of Wells Dam within Project boundary (approximately 1.2 miles) (Figure 1.1-1).

4.0 BACKGROUND AND EXISTING INFORMATION

Pacific lamprey are present in most tributaries of the Columbia River and in the mainstem Columbia River during their migration stages. They have cultural, utilitarian and ecological significance in the basin since Native Americans have historically harvested them for subsistence, ceremonial and medicinal purposes (Close et al., 2002).

Pacific lamprey are cartilaginous, jawless, anadromous fish that develop morphologically and physiologically in three primary stages. First, lamprey begin as larvae that hatch after approximately 19 days at 15°C (Close et al., 2002). After hatching, they remain a larvae (also known as ammocoete) for 4 to 6 years (10-200 mm body length). Ammocoetes reside burrowed in fine sediment (Close et al. 2002) during this time filter feeding on diatoms, algae, and detritus by pumping water through their branchial chamber (Beamish and Levings, 1991). Lamprey then enter a transformation phase (ocean-migrating macrophthalmia) and migrate from their parent streams to the ocean. Pacific lamprey transform from ammocoetes to macrophthalmia from July to November (Hammond, 1979 and Close et al., 2002). During transformation, the shape and angle of the head and mouth changes, and the gut develops to allow consumption of flesh and fluids (Hart, 1973). The macrophthalmia migrate to the ocean between late fall and spring and are physiologically capable of handling life in salt water. They spend 1 to 4 years as adults feeding as external parasites on marine fish and mammals before returning to freshwater to spawn (Beamish, 1980 and Close et al., 2002).

Upstream migrating Pacific lamprey are likely heading to tributaries or mainstem holding and/or spawning areas to over-winter. Though their exact timing likely varies among locations, upstream migration has been documented to cease in mid-September (Beamish, 1980), and resume in mid-March of the following spring if the final spawning destination has not been reached (Bayer et al., 2001). Somewhat like salmon, adult lamprey dig depressions in the gravel of freshwater streams. Spawning occurs in the spring and early summer (May to July) following the upstream migration year (Lê et al., 2004). Lamprey prefer low-gradient reaches, with gravel-pebble-sand substrate for spawning (Mattson, 1949 and Close, 1995). Adults generally spawn in low-gradient stream reaches in the tail areas of pools and in riffles, over gravel substrates (Jackson et al., 1997). Lamprey die after spawning (Hart, 1973).

Pacific lamprey populations of the Columbia River have declined in abundance over the last 40 years according to counts at dams on the lower Columbia and Snake rivers (Close et al., 2002). Starke and Dalen (1995) reported that adult lamprey counts at Bonneville Dam that regularly exceeded 100,000 fish in the 1960s and more recently have ranged between 20,000 and 120,000 for the period 2000-2004 (DART - www.cqs.washington.edu/dart/adult.html).

Close et al. (1995, 2002) identified several factors that may account for the decline in lamprey counts in the Columbia River Basin. This includes reduction in suitable spawning and rearing habitat from flow regulation and channelization, pollution and chemical eradication, reductions of prey in the ocean, and juvenile and adult passage problems at dams.

Little specific information is available on the life history or status of lamprey in the mid-Columbia River watersheds. They are known to occur in the Methow, Wenatchee and Entiat rivers (NMFS, 2002) and recently have been captured during juvenile trapping operations in the Okanogan River above Project boundary. In the mid-Columbia River basin, available information exclusively addresses adult lamprey passage and behavior through hydroelectric projects via radio-telemetry studies and dam counts (Nass et al., 2003 and 2005; Stevenson et al., 2005). Similarly in the Wells Project, adult passage information is available through a preliminary radio-telemetry study (Nass et al., 2003) and counts at Wells Dam (since 1998). Currently, no studies have been conducted on adult Pacific lamprey related to spawning within the Wells Project.

4.1 Aquatic Resource Work Group

As part of the preparation for the relicensing of the Wells Project, Douglas PUD established an Aquatic Resource Work Group (RWG) which began meeting informally in November, 2005. This voluntary effort was initiated to provide stakeholders with information about the Wells Project, to collaboratively identify potential resource issues related to Project operations and relevant to relicensing, and to develop preliminary study plans to be included in the Wells Pre-Application Document (PAD).

Through a series of meetings, the Aquatic RWG cooperatively developed a list of Issue Statements, Issue Determination Statements and Agreed Upon Study Plans. An Issue Statement is an agreed upon definition of a resource issue raised by a stakeholder. An Issue Determination Statement reflects the RWG's efforts to review the existing project information and to determine whether an issue matches with FERC's seven criteria and would be useful in making future relicensing decisions. Agreed Upon Study Plans are the finished products of the informal RWG process.

Based upon these discussions, the Aquatic RWG is proposing to include a study plan into the Wells PAD to determine whether adult Pacific lamprey are spawning within the Wells Project and if so, whether the operation of Wells Dam is affecting this habitat. The need for this study was agreed to by all of the members of the Aquatic RWG, including Douglas PUD. This study will help to inform future relicensing decisions and will fill data gaps that have been identified by the Aquatic RWG.

4.2 Issue Statement

Issue Statement (6.2.1.2)

The Wells Project may affect adult Pacific lamprey habitat use.

Issue Determination Statement (6.2.1.2)

There were two types of habitat identified by the group (spawning and overwintering habitat). It is unlikely that there is a Project effect on adult lamprey overwintering habitat. Literature suggests that overwintering habitat for adult Pacific lamprey consists of deep pools. In the Wells Reservoir deepwater habitat is plentiful and undisturbed by Project operations.

There is no information currently available related to adult lamprey spawning habitat within the Wells Project. Existing literature (Beamish, 1980) suggests that adult lamprey prefer smaller tributaries that are characterized by suitable spawning substrate and velocities (pool-tailouts, large gravel to small cobble substrate, depth of 1 meter). This type of habitat is generally not available within the Wells Project.

Adult Pacific lamprey spawning has not been documented within the Wells Project; however, there may be areas within the Wells Project that may have marginal spawning habitat for adult Pacific lamprey.

The resource work group agrees that a study is needed to determine whether adult lamprey are spawning within the Wells Project and if so, whether the operation of Wells Dam is affecting this habitat. This study should be conducted during the two-year ILP study period.

5.0 PROJECT NEXUS

Two recent reviews of Pacific lamprey (Hillman and Miller, 2000 and Golder Associates Ltd., 2003) in the mid-Columbia River have indicated that little specific information is known on their status. Within the Wells Project waters, no studies have been conducted to address the level of spawning that may be occurring and whether Project operations affect lamprey spawning habitat. Pacific lamprey spawning has been observed in the Lower Columbia River from May to July (Lê et al., 2004)) and habitat preferences consist of the tail-outs of pools and riffles over gravel substrate (Jackson et al., 1997). This type of habitat is characteristic of the upper reaches of tributary streams in the mid-Columbia River system, however within the Wells Project boundary, there may be patches of habitat meeting these criteria. If adult lamprey are utilizing these areas of suitable habitat, it is important to assess whether Wells Project operations have any adverse effects on these areas during periods of lamprey spawning. Potential adverse effects attributed to Project operations may include flow fluctuations or dewatering of lamprey nests. The proposed lamprey spawning study will assist in filling the information gap identified by the Aquatic RWG and in the development of licensing requirements for the Wells relicensing process.

6.0 METHODOLOGY

Implementation of the study will consist of three separate components:

- The use of detailed bathymetry, high resolution orthophotographic information, and knowledge of Douglas PUD staff to identify areas within the Wells Project that are consistent with spawning habitat requirements of Pacific lamprey (Beamish, 1980),

- Conduct spawning surveys of these identified potential spawning areas when the probability of adult lamprey spawning is highest (May to July), and
- If spawning is observed, assess whether Wells Dam operations affect habitat in such a way to adversely impact spawning or spawning success.

In order to develop a map of sites that may be suitable for lamprey spawning, an analysis utilizing a Geographic Information System (GIS) will be conducted. A GIS will be used to integrate bathymetric data and high resolution orthophotography to better refine potentially suitable spawning areas within the Wells Project. This information will be coupled with the knowledge of Douglas PUD staff to identify suitable spawning habitat. A map will be produced identifying the areas within the Wells Project that consist of depths (approximately 1 meter), habitat type (low gradient riffles and pool-tailouts), and substrate (large gravel) typical of lamprey spawning habitat. Sites on this map will be field verified prior to field surveys to ensure that the identified habitat is consistent with the spawning requirements of adult lamprey.

Foot and boat surveys of the potential spawning areas will occur, beginning in May, 2008 or when flows allow. All field sites will be visited once a week by two field biologists with training in Pacific lamprey nest identification. Physical characteristics of nests will be measured, including: habitat type (riffle, pool-tail out, run, pool), nest dimensions, substrate (dominant, sub-dominant and % fines), and flow. If applicable, presence of adults on the nest will be noted as well as number and sex of fish. When possible, locations of each nest will be recorded with global positioning system (GPS) technology. Nests will be marked with weighted flagging to determine nest longevity and to avoid counting nests twice upon subsequent surveys. Weighted flags will be removed on subsequent surveys if the nest no longer appears viable. Lamprey in the lower Columbia River basin typically spawn from May to July and as such, spawning ground surveys will be conducted in the Wells Project during this time period. If activity continues to be observed past this period of time, spawning surveys will continue at the identified reaches until no activity is observed.

If spawning is observed in any of the identified reaches, an assessment of the Wells Project operations and its potential effects on these areas will need to be conducted. This portion of the study will be integrated into the spawning surveys and will likely be conducted between May and July 2008 with analysis and report preparation taking place prior to October 2008. A combination of GPS locations of observed lamprey nests, detailed bathymetry of the spawning reach, historical river flow information and typical Wells Project operations during this time period can be used to develop a backwater curve to assess the likelihood of nest dewatering or scour events induced by Project operations and the magnitude of this effect to spawning lamprey.

Facilities and equipment necessary to complete the habitat assessment portion of the study will consist of a computer with GIS software and the associated data sets. Field equipment consisting of flow meters, staff gauges, waders, GPS unit, camera, flagging, and weights will be required to conduct the spawning surveys. Use of vehicles and possibly motorboats will also be necessary to access possible survey sites. If an assessment of Project effects is required, access to current and historical databases of river flow, Project operations, and data collected during the field surveys will be necessary to assess whether Wells Project operations affect spawning lamprey.

7.0 STAFFING AND EQUIPMENT REQUIREMENTS

Douglas PUD will provide the necessary equipment and staff to conduct all phases of the study based upon discussions with the Aquatic RWG regarding specific study design and study needs.

The technical skills necessary to complete the study are knowledge of Pacific lamprey life history and general biology, biological sampling methods including nest identification, data acquisition and management, GPS and GIS technology, hydrologic modeling (if necessary), and motor boat operation and safety.

No permits are required to complete the study.

8.0 BUDGET

The total estimated hours for the implementation of a Wells Project Pacific lamprey spawning assessment is approximately 1,024 person hours. The allocation of these hours is approximately 144 hours for GIS and habitat suitability analysis; 256 hours for on-the-ground field verification of GIS analysis output; 384 hours for field spawning surveys; and 240 hours for data analysis and reporting. Labor costs are estimated to be $84,000. Equipment costs and expenses related to implementation (travel, miscellaneous supplies, software, boat use, etc.) are estimated to be $22,000. Total planning level cost for this effort is approximately $106,000.

9.0 SCHEDULE

Planning for this study will begin shortly after the issuance of FERC's Study Plan Determination in October 2007, with an initial analysis of potential spawning areas in the Wells Project. Results of this analysis will be used to develop the field survey portion of the study which is scheduled to take place between May and July 2008. Results of the 2008 spawning survey will be provided to the Aquatic RWG and filed with FERC in the form of an Initial Study Report due in October 2008. A final report will be provided to FERC and stakeholders by October 2009.

10.0 REFERENCES

Bayer, J., T.C. Robinson, and J. Seelye. 2001. Upstream migration of Pacific Lampreys in the John Day River: behavior, timing and habitat use. Annual report 2000. Project No. 200005200, Contract No. 2000AI26080. Report to the US Dept of Energy, Bonneville Power Administration, Portland, OR.

Beamish, R.J. 1980. Adult biology of the river lamprey (*Lampetra ayersi*) and the Pacific lamprey (*Lampetra tridentata*) from the Pacific coast of Canada. Canadian Journal of Fisheries and Aquatic Sciences 37: 1906-1923.

Beamish, R.J. and C.D. Levings. 1991. Abundance and freshwater migrations of the anadromous parasitic lamprey, *Lampetra tridenta*, in a tributary of the Fraser River, British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 48:1250:1263.

Close, D., M. Fitzpatrick, H. Li, B. Parker, D. Hatch, and G. James. 1995. Status report of the Pacific Lamprey (*Lampetra tridentata*) in the Columbia River basin. Project No. 94-026, Contract No. 95BI39067. Report to the U.S. Department of Energy, Bonneville Power Administration, Portland Oregon. USA.

Close, D., M. Fitzpatrick, and H. Li. 2002. The ecological and cultural importance of a species at risk of extinction, Pacific Lamprey. North American Journal of Fisheries Management, July.

Golder Associates Ltd. 2003. Review of Pacific lamprey in the Rocky Reach Project Area. Internal Draft. Report to Chelan County Public Utility District, Wenatchee, WA.

Hart, J. 1973. Pacific Fishes of Canada. Fish. Res. Board Canada. Bulletin 180.

Hammond, R.J. 1979. Larval biology of the Pacific lamprey, *Entosphenus tridentatus (*Gairdner), of the Potlatch River, Idaho. M.S. thesis. University of Idaho, Moscow.

Hillman, T. and M. Miller. 2000. Status of Pacific lamprey in the mid-Columbia region. BioAnalysts, Inc. Report to Chelan County Public Utility District, Wenatchee, WA.

Jackson, A., P. Kissner, D. Hatch, B. Parker, M. Fitzpatrick, D. Close, and H. Li. 1997. Pacific Lamprey research and restoration. Annual Report 1996. Project No. 94-026, Contract No. 95BI39067. Report to the US Dept of Energy, Bonneville Power Administration, Portland, OR.

Lê, B., C. Luzier, and T. Collier. 2004. Evaluate Habitat Use and Population Dynamics of Lamprey in Cedar Creek. Annual Report for 2003 Sampling Season. BPA Project No. 2000-014-00

Mattson, C.R. 1949. The lamprey fishery at Willamette Falls, Oregon. Fish Commission of Oregon Research Briefs. 2(2):23-27.

Nass, B.L., C. Sliwinski, K.K. English, L. Porto, and L. Hildebrand. 2003. Assessment of adult lamprey migratory behavior at Wanapum and Priest Rapids Dams using radio-telemetry techniques, 2001-2002. Report prepared by LGL Limited, Sidney, BC, Canada, for Public Utility District No. 2 of Grant County, Ephrata, WA

Nass, B.L., C. Sliwinski, D. Robichaud. 2005. Assessment of Adult Pacific Lamprey Migratory Behavior at Wells Dam Using Radio-telemetry Technicques, 2004. Report prepared by LGL Limited, Sidney, B.C. Canada, for Public Utility District No. 1 of Douglas County, WA.

NMFS (National Marine Fisheries Service). 2002. Anadromous Fish Agreements and Habitat Conservation Plans: Final Environmental Impact Statement for the Wells, Rocky Reach, and Rock Island Hydroelectric Projects. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service.

Starke, G. and J. Dalen. 1995. Pacific Lamprey (*Lampetra tridentata*) passage patterns past Bonneville Dam and incidental observations of lamprey at the Portland District Columbia River dams in 1993. U.S. Army Corps of Engineers, Cascade Locks, Oregon. USA.

Stevenson, J.R., P. Westhagen, D. Snyder, J. Skalski, and A. Giorgi. 2005. Evaluation of Adult Pacific Lamprey Passage at Rocky Reach Dam Using Radio-telemetry Techniques, 2004. Prepared for Public Utility District No. 1 of Chelan County, Wenatchee, WA.

ADULT PACIFIC LAMPREY PASSAGE AND BEHAVIOR STUDY (AQUATIC ISSUE 6.2.1.3)

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

December, 2006

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington

For copies of this study plan, contact:

Public Utility District No. 1 of Douglas County
Attention: Relicensing
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4497
Phone: (509)884-7191
E-Mail: relicensing@dcpud.org

ABSTRACT:

The current Wells Hydroelectric Project (Wells Project) license will expire on May 31, 2012. The Public Utility District No. 1 of Douglas County (Douglas PUD) owns and operates the Wells Project and is using the Integrated Licensing Process (ILP) for relicensing as promulgated by Federal Energy Regulatory Commission (FERC) regulations issued July 23, 2003 (18 CFR Part 5).

The Aquatic Resource Work Group (RWG), which is composed of stakeholders (resource agencies and tribes) and Douglas PUD staff, was formed for the purpose of identifying issues and information gaps that may require study during the relicensing of the Wells Project. The Aquatic RWG, through a series of technical meetings, is proposing a study to examine the effects of the Wells Project and its operations on the migration of adult Pacific lamprey (*Lampetra tridentata*).

To perform this study, Douglas PUD will undertake a radio-telemetry study to assess migration and passage characteristics of adult lamprey migrating through Wells Dam. Adult lamprey will be captured in the fishways at Wells Dam during August and September 2008. All captured lamprey meeting specific size criteria will be tagged and released at or below Wells Dam. A combination of fixed-station monitoring at Wells Dam will be used to determine migration and passage characteristics of these tagged fish.

A technical report summarizing the results of this study will provide the resource information needed to inform relicensing decisions related to adult lamprey passage through Wells Dam.

1.0 INTRODUCTION

1.1 General Description of the Wells Hydroelectric Project

The Wells Hydroelectric Project (Wells Project) is located at river mile (RM) 515.8 on the Columbia River in the State of Washington. Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (COE), and 42 miles upstream from the Rocky Reach Hydroelectric Project owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam.

The Wells Project is the chief generating resource for Public Utility District No. 1 of Douglas County (Douglas PUD). It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides the hydrocombine, which is 1,130 feet long, 168 feet wide, with a crest elevation of 795 feet in height.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The normal maximum surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at elevation of 781. The normal maximum water surface elevation of the reservoir is 781 feet (Figure 1.1-1).

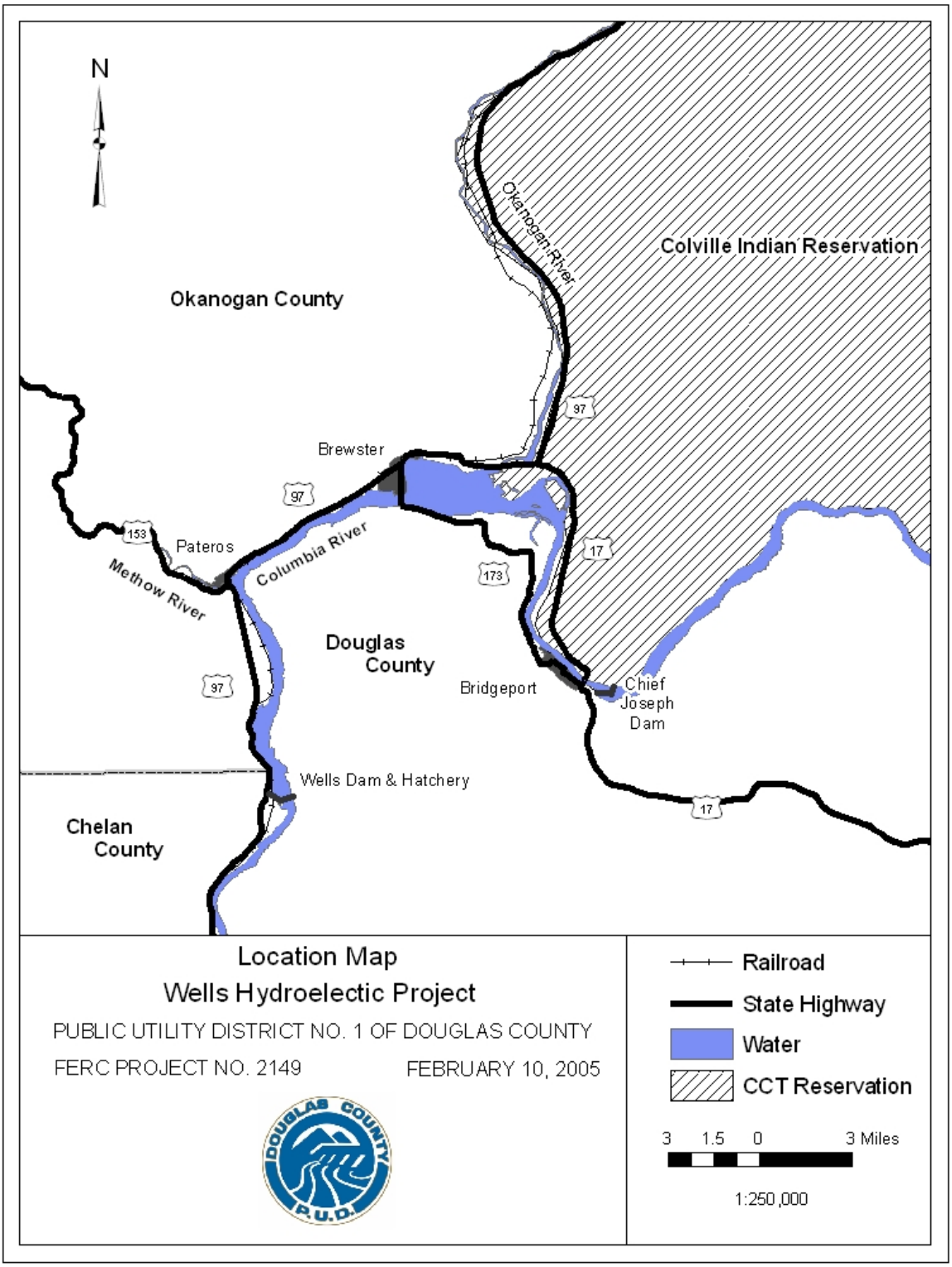

Figure 1.1-1 Location Map of the Wells Project

1.2 Relicensing Process

The current Wells Project license will expire on May 31, 2012. Douglas PUD is using the Integrated Licensing Process (ILP) as promulgated by FERC regulations issued July 23, 2003 (18 CFR Part 5). Various state and federal agencies, tribes, local governments, non-governmental organizations and the general public will participate in the Wells Project ILP. During the ILP, information needs related to the relicensing of the Wells Project will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b).

<u>18 CFR § 5.9(b) Content of study request</u>. Any information or study request must:

(1) Describe the goals and objectives of each study and the information to be obtained;
(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
(4) Describe existing information concerning the subject of the study proposal, and the need for additional information;
(5) Explain any nexus between project operation and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;
(6) Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate, considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

All study plans submitted to FERC will be reviewed by Douglas PUD and the applicable Resource Work Group(s) to determine if studies proposed will fill the information needs related to the Wells Project Relicensing. Any dispute over alternative study methods, that cannot be reconciled with stakeholders, will be decided by FERC.

2.0 GOALS AND OBJECTIVES

The goal of this study is to evaluate the effect of the Wells Project and its operations on adult Pacific lamprey behavior related to ladder passage, timing, downstream passage events (drop back) through the dam and upstream migration. This information will be used to help identify potential areas of passage impediment within the Wells ladders.

Specific objectives of the study include:

- Conduct a literature review of existing adult Pacific lamprey passage studies at Columbia and Snake river dams;
- Identify methods for capturing adult Pacific lamprey at Wells Dam;

- Document the timing and abundance of radio-tagged lamprey passage through Wells Dam;
- Determine whether adult lamprey are bypassing the adult counting windows at Wells Dam;
- Where sample size is adequate, estimate passage metrics including fishway passage times and efficiencies, residence time between detection zones and downstream passage events (drop back); and
- If necessary, identify potential areas of improvement to existing upstream fish passage facilities for the protection and enhancement of adult lamprey at the Wells Project.

3.0 STUDY AREA

The study area includes Wells Dam, the Wells Dam tailrace, and the Wells Dam forebay (Figure 1.1-1).

4.0 BACKGROUND AND EXISTING INFORMATION

Pacific lamprey are present in most tributaries of the Columbia River and in the mainstem Columbia River during their migration stages. They have cultural, utilitarian and ecological significance in the basin since Native Americans have historically harvested them for subsistence, ceremonial and medicinal purposes (Close et al. 2002). As an anadromous species, they also contribute marine-derived nutrients to the basin. Little specific information is available on the life history or status of lamprey in the mid-Columbia River watersheds. They are known to occur in the Methow, Wenatchee and Entiat rivers (NMFS, 2002) and recently have been captured during juvenile trapping operations in the Okanogan River.

In general, adults are parasitic on fish in the Pacific Ocean while ammocoetes (larvae) are filter feeders that inhabit the fine silt deposits in backwaters and quiet eddies of streams (Wydoski and Whitney, 2003). Adults generally spawn in low-gradient stream reaches in the tail areas of pools and in riffles, over gravel substrates (Jackson et al. 1997). Adults die after spawning. After hatching, the ammocoetes burrow into soft substrate for an extended larval period filtering particulate matter from the water column (Meeuwig et al. 2002). The ammocoetes undergo a metamorphosis, between 3 and 7 years after hatching, and migrate from their parent streams to the ocean from October to April (Close et al., 2002). Adults typically spend 1-4 years in the ocean before returning to freshwater tributaries to spawn.

Pacific lamprey populations of the Columbia River have declined in abundance over the last 40 years according to counts at dams on the lower Columbia and Snake rivers (Close et al. 2002). Starke and Dalen (1995) reported that adult lamprey counts at Bonneville Dam that regularly exceeded 100,000 fish in the 1960s and more recently have ranged between 20,000 and 120,000 for the period 2000-2004 (DART - www.cqs.washington.edu/dart/adult.html).

Close et al. (2002) identified several factors that may account for the decline in lamprey counts in the Columbia River Basin. This includes reduction in suitable spawning and rearing habitat

from flow regulation and channelization, pollution and chemical eradication, reductions of prey in the ocean, and juvenile and adult passage problems at dams (Nass et al., 2005).

Returning adult Pacific lamprey have been counted at Wells Dam since 1998. Between the years of 1998 and 2005, the numbers of lamprey passing Wells Dam annually has averaged 401 fish and ranged from 73 fish in 1999 to 1,417 fish in 2003 (Table 4.0-1). The relatively small number of adult lamprey observed at Wells Dam can be attributed to fact that the Wells Project is the last passable dam on the mainstem Columbia River and the fact that the Wells Project is over 500 miles upstream from the Pacific Ocean.

Lamprey pass Wells Dam from early July until late November with peak passage times between mid-August and late October (Figures 4.0-1 and 4.0-2). In all years since counting was initiated, Pacific lamprey counts at the east fish ladder are greater than at the west fish ladder. It is important to note that historically, counting protocols were designed to assess adult salmonids and did not necessarily conform to lamprey migration behavior (Moser and Close 2003). Traditional counting times for salmon did not coincide with lamprey passage activity which occurs primarily at night; the erratic swimming behavior of adult lamprey also makes them inherently difficult to count (Moser and Close, 2003). Furthermore, Beamish (1980) noted that lamprey overwinter in freshwater for one year prior to spawning. Consequently, lamprey counted in one year may actually have entered the system in the previous year (Moser and Close, 2003) which confounds annual returns back into the Columbia River Basin. It is unknown to what degree these concerns are reflected in Columbia River lamprey passage data. However, it is important to consider such caveats when examining historic lamprey count data at Columbia River dams including Wells Dam.

Table 4.0-1 Adult Pacific lamprey counts at Wells Dam for east and west fish ladders, 1998-2005

	1998	1999	2000	2001	2002	2003	2004	2005
East Fish Ladder	173	47	96	153	226	723	263	148
West Fish Ladder	170	26	59	106	117	694	140	64
Total	343	73	155	259	343	1417	403	212

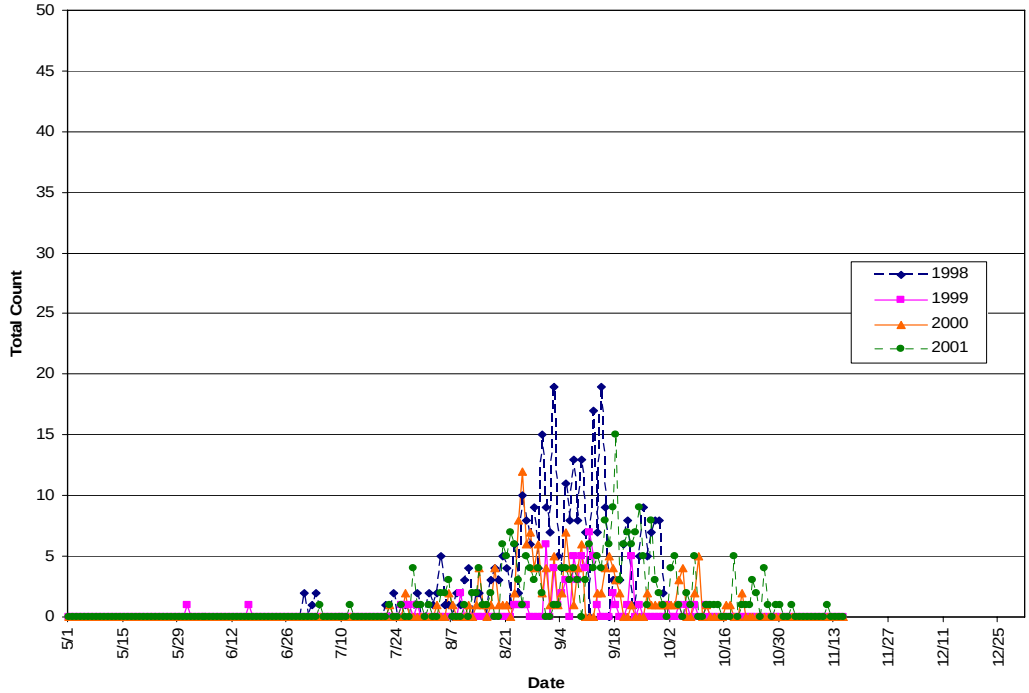

Figure 4.0-1 **Daily counts of Pacific lamprey at Wells Dam during the fish counting season, 1998-2001.**

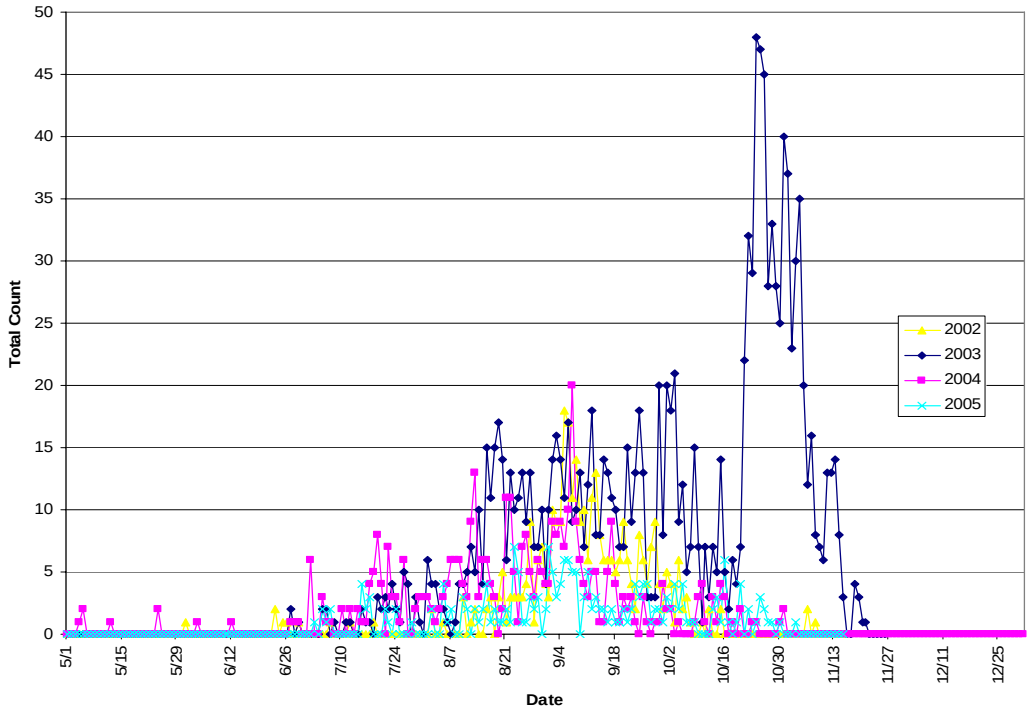

Figure 4.0-2 **Daily counts of Pacific lamprey at Wells Dam during the fish counting season, 2002-2005.**

Until recently, relatively little information was available on Pacific lamprey in the mid-Columbia River Basin. However, with increased interest in the species coupled with a petition for listing under the ESA, the mid-Columbia PUDs have started to initiate studies to address Pacific lamprey passage and migratory behavior in their respective project areas.

The study of adult Pacific lamprey migration patterns past dams and through reservoirs in the lower Columbia River has provided the first data sets on lamprey passage timing, travel times, and passage success at hydroelectric projects (Vella et al. 2001, Ocker et al. 2001, Moser et al. 2002a, Moser et al. 2002b). These studies have shown that approximately 90% of the radio-tagged lamprey released downstream of Bonneville Dam, migrated back to the tailrace below Bonneville Dam; however, less than 50% of the lamprey which encountered a fishway entrance actually passed through the ladder exit at the dam (Nass et al., 2005).

Similar collection and passage efficiency results were observed at Rocky Reach, Wanapum and Priest Rapids dams during tagging studies conducted at those projects (Nass et al., 2003; Stevenson et al., 2005).

Of the 125 radio-tagged lampreys released approximately 7 kilometers downstream of Rocky Reach Dam, 93.6% were detected at the project, and of those fish, 94.0% entered the fishway. Of the fish that entered the Rocky Reach fishway, 55.5% exited the ladder.

During studies at Wanapum and Priest Rapids dams in 2001 and 2002, a total of 51 and 74 lamprey were radio-tagged and released downstream of Priest Rapid Dam, respectively. Over the two years of study, the proportion of fish that approached the fishway that exited the ladders was 30% and 70% at Priest Rapids and 100% and 51% at Wanapum Dam in 2001 and 2002, respectively.

Two recent reviews of Pacific lamprey (Hillman and Miller 2000; Golder Associates Ltd. 2003) in the mid-Columbia River have indicated that little specific information is known on their status (Stevenson et. al., 2005).

In 2004, Douglas PUD contracted with LGL Limited to conduct a lamprey radio-telemetry study at Wells Dam in coordination with the Public Utility District No. 1 of Chelan County (Chelan PUD) who was conducting a similar study at Rocky Reach Dam. A total of 150 lamprey were radio-tagged and released at or below Rocky Reach Dam. The radio-tags used in this study had an expected operational life of 45 days (Nass et al., 2005). It is important to note that because of the release site of the fish was over 50 miles downstream of Wells Dam the value of the study was limited by the relatively small numbers of tagged fish observed at Wells (n=18) and the fact that many of the radio-tags detected at Wells Dam were within days of exceeding their expected battery life.

With that stated, the 2004 study at Wells was implemented through a combination of fixed-station monitoring at Wells Dam and fixed-stations at tributary mouths. Collectively, these monitoring sites were used to determine migration and passage characteristics of lamprey entering the Wells Project area. Of the 150 adult lamprey released at or below Rocky Reach in 2004, 18 (12% of 150) were detected in the Wells Dam tailrace, and ten (56% of 18) of these were observed at an entrance to the fishways at Wells Dam. Two of the 10 lamprey approached

both fishways to produce 12 total entry events. A total of 3 radio-tagged lamprey passed Wells Dam prior to expiration of the tags, resulting in a Fishway Efficiency estimate of 30% (3 of 10) for the study period. A single lamprey was detected upstream of Wells Dam at the mouth of the Methow River (Nass et al., 2005).

For lamprey that passed the dam, the majority (92%) of Project Passage time was spent in the tailrace. Median time required to pass through the fishway was 0.3 d and accounted for 8% of the Project Passage time (Nass et al., 2005).

Although the 2004 study at Wells provided preliminary passage and behavioral information for migrating adult lamprey, the limited observations due to the small sample size (n=18) is insufficient in addressing the objectives set forth in Section 2.0 with statistical confidence.

4.1 Aquatic Resource Work Group

As part of the preparation for the relicensing of the Wells Project, Douglas PUD established an Aquatic Resource Work Group (RWG) which began meeting informally in November, 2005. This voluntary effort was initiated to provide stakeholders with information about the Wells Project, to collaboratively identify potential resource issues related to Project operations and relevant to relicensing, and to develop preliminary study plans to be included in the Wells Pre-Application Document (PAD).

Through a series of meetings, the Aquatic RWG cooperatively developed a list of Issue Statements, Issue Determination Statements and Agreed Upon Study Plans. An Issue Statement is an agreed upon definition of a resource issue raised by a stakeholder. An Issue Determination Statement reflects the RWGs' efforts to review the existing project information and to determine whether an issue matches with FERC's seven criteria and would be useful in making future relicensing decisions. Agreed Upon Study Plans are the finished products of the informal RWG process.

Based upon these meeting and discussions, the Aquatic RWG is proposing to include a study into the Wells PAD that would include a radio-telemetry study to assess lamprey behavior as it relates to passage, timing, drop back and upstream migration. The need for this study was agreed to by all of the members of the Aquatic RWG, including Douglas PUD. This study will help to inform future relicensing decisions and will fill data gaps that have been identified by the Aquatic RWG.

4.2 Issue Statement

Issue Statement (6.2.1.3)

The Wells Project may affect adult Pacific lamprey behavior related to ladder passage, timing, drop back and upstream migration.

Issue Determination Statement (6.2.1.3)

Work group members have determined that this issue has a tie to the Project as it relates to lamprey migration through Wells Dam. Preliminary passage information has been collected at Wells Dam; however, the sample size of the study was limited and additional information is needed. A radio-telemetry study would be feasible to address passage, timing, drop back and upstream migration. The results of an adult lamprey passage study would be useful during the development of PME measures.

The resource work group agrees that a radio-telemetry study to assess lamprey behavior as it relates to passage, timing, drop back and upstream migration should be conducted at Wells Dam during the two-year ILP study period.

5.0 PROJECT NEXUS

The Wells Project may affect adult Pacific lamprey behavior related to ladder passage, timing, drop back and upstream migration. This issue has a tie to the Project as it relates to lamprey migration through Wells Dam. Potential problems facing successful passage of adult Pacific lamprey at dams may be related to their unique method of movement and specific areas within fishways. Specifically, adult Pacific lamprey at other projects have experienced difficulty passing over diffusion gratings and through areas of high velocity, bright light and through orifices with squared, un-rounded edges. Typically, lamprey move through an adult fishway in a repeated series of motions consisting of attaching to the ladder floor with their mouths, surging forward, and re-attaching. The physiological response of adult Pacific lamprey to exhaustive exercise may be immediate, sometimes severe, but short-lived (Mesa el al. 2003). This may suggest that lamprey have difficulty negotiating fishways with high current velocities.

Two recent reviews of Pacific lamprey (Hillman and Miller, 2000; Golder Associates Ltd. 2003) in the Mid-Columbia River have indicated that little specific information is known on their status. The 2004 study at Wells Dam provided preliminary information into the migration characteristics of adult Pacific lamprey through Wells Dam. However, it is important to note that the study was compromised by the relatively small numbers of tagged fish observed at the Project (n=18) and the fact that many of the radio-tags detected at Wells Dam were within days of exceeding their expected battery life. Combined, these factors suggest that additional lamprey passage information is needed at Wells Dam.

The proposed lamprey radio-telemetry study will assist in providing the information needed as identified by the Aquatic RWG and will inform the development of future license requirements.

6.0 METHODOLOGY

6.1 Literature Review

The literature review will consist of a search of all existing information currently available on adult Pacific lamprey passage studies at Columbia and Snake river dams. This search will examine the availability of information from peer-reviewed journals, federal and state

publications, academia, private industry, and grey literature. References cited from the initial literature search that are of relevance to the subject matter will also be collected and added to literature database. An annotated bibliography will be produced from the results of the literature search.

6.2 Telemetry Study Period

Adult Pacific lamprey will be collected, sampled and tagged at Wells Dam during the 2008 peak migration period of August and September. To address lamprey passage characteristics, fixed station telemetry monitoring in the Wells Project will occur from August through November 2008.

6.3 Capture, Tagging, and Release of Lamprey

Radio transmitters that will be used during the study are Lotek NTC-4-2L and are similar to those used by NOAA Fisheries, the Public Utility District No. 2 of Grant County (Grant PUD) and Chelan PUD in recent years. The tags are designed for a 45-day operational life.

From August to September 2008, trapping at Wells Dam will target a total of 40 lamprey which will be released post-surgery directly into the Columbia River at two locations. Distribution of tagged lamprey will generally adhere to the following:

- 10 will be released in the Wells Dam fishway; and
- 30 will be released approximately 1 mile below Wells Dam in an area of reduced flow.

6.4 Telemetry Array

6.4.1 Fixed Stations

The movement and passage of radio-tagged lamprey will be determined by combining detection data collected using underwater and aerial antenna arrays (dipoles and yagi antennas) at Wells Dam. The arrays are designed to monitor movements of radio-tagged lamprey from the Columbia River into the fishway entrances and through the exits at Wells Dam, and are also designed to detect downstream passage movements. Aerial antennas will be used in the tailrace, at remote stations on tributary mouths, and during mobile tracking. Underwater antennas will be used in the fishways. A total of 8 Lotek telemetry receivers, monitoring multiple arrays (6 at Wells Dam, 1 at Methow River, and 1 at Okanogan River) will be used during the study.

6.4.2 Mobile Tracking

Mobile tracking will be conducted by boat in a 2 km reach of the river below Wells Dam. Tracking will be recorded using Global Positioning System (GPS) with a built-in data logger. Twin three-element aerial antennas will be mounted to a post and secured in the boat. Surveys will be conducted by transects running upstream and downstream in the river with the aerials pointed in opposite directions, and usually at each bank.

6.4.3 Data Analysis

The data will be analyzed using *Telemetry Manager*, *Ascent* and other computer programs developed in Visual Foxpro by LGL Limited. In order to differentiate detection locations and streamline analyses, individual antennas will be grouped into "zones" that define pivotal areas of interest, such as individual fishway entrances and exits (Nass et al., 2005).

Telemetry Manager imports raw ASCII data files downloaded from the Lotek SRX receivers. After importing the raw files, *Telemetry Manager* constructs an initial database containing records for each logged data transmission from the tagged fish. *Telemetry Manager* then edits the database to remove records that do not meet the criteria identified for valid data records. Examples of invalid data include background noise at the Project, records with a signal strength that are below a given threshold, single records for a given fish-location combination, and records that were recorded before the official release time and date. After filtering the invalid records, *Telemetry Manager* constructs an operational database that summarizes the time of arrival and departure from each zone of interest ("benchmark times").

6.4.4 Definition of Passage and Residence Times

Strategic deployment of receivers and antennas will make it possible to determine the amount of time that lamprey will be present in the tailrace, fishway entrances, and fishways. Passage times will be calculated from benchmark dates and times corresponding to the first and last detection of a given radio-tagged lamprey at specific locations. At Wells Dam, the benchmark times for lamprey that pass the Project will be:

- first detection in the tailrace,
- first detection at the fishway entrance of passage,
- last detection at the fishway entrance of passage, and
- last detection at the fishway exit.

From these benchmark times, passage times will be calculated for the following passage segments:

Segment	Time	Name
A)	1 to 2	Tailrace Passage time
B)	2 to 3	Entrance Passage time
C)	3 to 4	Fishway Passage time
D)	1 to 4	Project Passage time

From the benchmark times at each of the monitored locations, the passage times and passage efficiencies (proportions) will be calculated for each radio-tagged lamprey where,

Passage Efficiency for a section of the fishway =
No. tags at a fishway detection zone (above)/ No. tags at the fishway zone (below), or
No. tags at a fishway detection zone / No. tags at an entrance.

It then follows that:

Fishway Efficiency = No. of tags at an exit / No. of tags at an entrance.

The metrics described above provide a method to evaluate the extent of upstream movement in the fishways. Note that the telemetry array at Wells Dam does not include underwater antennas outside of the fishway entrances to determine when lamprey approach the fishway; antennas will be only located inside the fishway and therefore constitute an entrance to the fishway rather than an approach. This is an important distinction from other studies (e.g., Moser et al. 2002b and Nass et al. 2003) where detections on antennas external to the fishway (approaches) are used as a basis to calculate overall passage efficiency at the dam. Therefore, this particular metric can not be calculated for Wells Dam. However, the other metrics presented above are consistent with those of other studies and can be used for comparative purposes.

In addition to the above standard passage segments, a detailed analysis of the time lamprey spent in and between detection zones (i.e., residence time) in the Wells Dam fishways will be conducted.

The primary residence time analysis includes:

- Entrance – at the entrance (first to last detection),
- Between the Entrance and Upper Collection Gallery (last detection to first detection),
- Upper Collection Gallery – the first vertical wall in the fishway (first to last detection),
- Between Upper Collection Gallery and Fishway Transition (last detection to first detection),
- Fishway Transition – first section of orifice weirs which are usually inundated with water depending on the water elevation in the tailrace (first to last detection),
- Between Fishway Transition and Below Trap (last detection to first detection),
- Below Trap – just downstream of the adult trapping facility (first to last detection),
- Between Below Trap and Above Trap (last detection to first detection),
- Above Trap – mid-point in series of orifice weirs between the trap and the video station (first to last detection),
- Between Above Trap and Below Video (last detection to first detection),
- Below Video – just downstream of the video station (first to last detection),
- Between Below Video and Above Video (last detection to first detection),
- Above Video – just upstream of the video station (first to last detection),
- Between Above Video and Exit (last detection to first detection), and
- Exit- fishway exit to forebay (first to last detection).

The residence and passage times for each radio-tagged lamprey will be determined by working backwards through a sequence of detections. The fishway of ultimate passage and the respective passage time is determined by identifying a sequence of detections in the ascent of a fishway, starting with detections in a fishway exit zone.

6.4.5 Definition of Downstream Passage Events and Drop Back

For the purpose of analysis, a downstream passage event is defined as a tag that is detected at a fishway exit and subsequently detected in the tailrace or a fishway entrance without any detections at antennas monitoring the inside fishway zones. Drop back fish will be defined as those tags in a fishway detection zone that are subsequently detected in zones directly downstream in the fishway.

7.0 STAFFING AND EQUIPMENT REQUIREMENTS

LGL Limited, a consulting firm located in Ellensburg, WA has been identified as the most likely contractor to conduct the proposed study. LGL Limited has expertise in all phases of radio-telemetry studies (design, implementation, data collection and analysis, equipment maintenance and reporting) for various fish species at mid-Columbia River hydroelectric projects. From implementation of past studies at Wells Dam, LGL is familiar with the Wells Project including the Wells Dam fishway structures, operations, and staff. LGL is currently conducting a radio-telemetry study at Wells Dam as part of the 2005-2008 Wells Bull Trout Monitoring and Management Plan and was the firm responsible for conducting the 2004 Wells Dam Lamprey Study and the 2002-2004 Wells Bull Trout Radio-telemetry Study.

Due to ongoing radio-telemetry studies at Wells Dam, the monitoring equipment necessary to complete the study will already be in place and operational for the 2008 study. Tags will be purchased by the contractor prior to the study. The level of effort and necessary staff time to conduct all phases of the study will be identified by LGL in consultation with the Aquatic RWG.

Incidental take consultation for ESA-listed steelhead and bull trout will need to take place prior to the study. This can be expedited through consultation with the HCP Coordinating Committee and associated agency representatives for the USFWS and NMFS. HCP Coordinating Committee members will be provided an opportunity to comment on draft trap designs and on the operation of the lamprey traps which will need to be installed prior to the study.

A Washington State Collector's Permit will be required to collect adult lamprey for the proposed study. LGL Limited will be responsible for securing this permit prior to study implementation.

8.0 BUDGET

Total estimated hours for the implementation of an adult Pacific lamprey passage and behavior study is approximately 1,034 person hours. The allocation of these hours is approximately 16 hours for project management; 664 hours for field work (includes lamprey trapping and tagging, radio-telemetry system set-up and maintenance, receiver downloading, and mobile tracking); 58 hours for data processing and management; and 296 hours for data analysis and reporting. Labor costs are estimated to be $84,000. Equipment costs and expenses related to field implementation (travel, tagging and miscellaneous telemetry supplies, boat use, computer use, etc.) are estimated to be $41,000. Total planning level cost for this effort is approximately $125,000.

9.0 SCHEDULE

Activities related to the fabrication of trapping equipment and attainment of a scientific collector's permit will begin shortly after the issuance of FERC's Study Plan Determination in October 2007. The field portion of the study will be conducted from August to November 2008. During this time period, an Initial Study Report detailing the progress of the ongoing study will be provided to FERC, stakeholders, and members of the Aquatic RWG in October 2008.

All data collected during the field portion of the study will be analyzed and detailed in a technical report provided by the contractor to Douglas PUD. A draft report will be available for review by the Aquatic RWG by March 31, 2009. A final report will be provided to stakeholders and FERC by October 2009.

10.0 REFERENCES

Beamish, R.J. 1980. Adult biology of the river lamprey (*Lampetra ayersi*) and the Pacific lamprey (*Lampetra tridentata*) from the Pacific coast of Canada. Canadian Journal of Fisheries and Aquatic Sciences 37: 1906-1923.

Close, D., M. Fitzpatrick, H. Li, B. Parker, D. Hatch, and G. James. 1995. Status report of the Pacific Lamprey (*Lampetra tridentata*) in the Columbia River basin. Project No. 94-026, Contract No. 95BI39067. Report to the US Department of Energy, Bonneville Power Administration, Portland Oregon. USA.

Close, D., M. Fitzpatrick, and H. Li. 2002. The ecological and cultural importance of a species at risk of extinction, Pacific Lamprey. North American Journal of Fisheries Management, July.

Golder Associates Ltd. 2003. Review of Pacific lamprey in the Rocky Reach Project Area. Internal Draft. Report to Chelan County Public Utility District, Wenatchee, WA.

Hillman, T. and M. Miller. 2000. Status of Pacific lamprey in the mid-Columbia region. BioAnalysts, Inc. Report to Chelan County Public Utility District, Wenatchee, WA.

Jackson, A.D., D.R. Hatch, B.L. Parker, M.S. Fizpatrick, D.A. Close, and H. Li. 1997. Pacific lamprey research and restoration annual report 1997. Prepared for the Bonneville Power

Meeuwig, M.H., J.M. Bayer, J.G. Seelye, and R.A. Reiche. 2002. Identification of larval Pacific lampreys (*Lampetra tridentata*), river lampreys (*L. ayresi*), and western brook lamprey (*L. richardsoni*) and thermal requirements of early life history stages of lampreys. Report by U.S. Geologic Survey, Western Fisheries Resources Division, Columbia River Research Laboratory for the Bonneville Power Administration, Portland Oregon. Project No. 2000-029.

Mesa, M.G., J.M. Bayer and J.G. Seelye. 2003. Swimming performance and physiological responses to exhaustive exercise in radio-tagged and untagged Pacific lampreys. Transactions of the American Fisheries Society 132: 483 - 492.

Moser, M., A. Matter, L. Stuehrenberg, and T. Bjornn. 2002a. Use of an extensive radio receiver network to document Pacific Lamprey (Lampetra tridentata) entrance efficiency at fishways in the Lower Columbia River, USA. Hydrobiologia 483: 45-53.

Moser, M., P. Ocker, L. Stuehrenberg, and T. Bjornn. 2002b. Passage efficiency of adult Pacific Lampreys at hydropower dams on the Lower Columbia River, USA. Trans. Am. Fish. Soc. 131:956-965.

Moser, M. and D. Close. 2003. Assessing Pacific lamprey status in the Columbia River Basin. Northwest Science. Vol. 77, No.2.

Nass, B.L., C. Sliwinski, K.K. English, L. Porto, and L. Hildebrand. 2003. Assessment of adult lamprey migratory behavior at Wanapum and Priest Rapids Dams using radio-telemetry techniques, 2001-2002. Report prepared by LGL Limited, Sidney, BC, Canada, for Public Utility District No. 2 of Grant County, Ephrata, WA

Nass, B.L., C. Sliwinski, D. Robichaud. 2005. Assessment of Adult Pacific Lamprey Migratory Behavior at Wells Dam Using Radio-telemetry Technicques, 2004. Report prepared by LGL Limited, Sidney, B.C. Canada, for Public Utility District No. 1 of Douglas County, WA.

NMFS (National Marine Fisheries Service). 2002. Anadromous Fish Agreements and Habitat Conservation Plans: Final Environmental Impact Statement for the Wells, Rocky Reach, and Rock Island Hydroelectric Projects. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service, Northwest Region, Portland, Oregon. December 2002.

Ocker, A., L. Stuehrenberg, M. Moser, A. Matter, J. Vella, B. Sandford, T. Bjornn, and K. Tolotti. 2001. Monitoring adult Pacific Lamprey (*Lampetra tridentata*) migration behavior in the lower Columbia River using radio-telemetry, 1998-1999. NMFS report of research to USACE, Portland District, Portland, OR.

Starke, G. and J. Dalen. 1995. Pacific Lamprey (*Lampetra tridentata)* passage patterns past Bonneville Dam and incidental observations of lamprey at the Portland District Columbia River dams in 1993. U.S. Army Corps of Engineers, Cascade Locks, Oregon. USA.

Stevenson, J.R., P. Westhagen, D. Snyder, J. Skalski, and A. Giorgi. 2005. Evaluation of Adult Pacific Lamprey Passage at Rocky Reach Dam Using Radio-telemetry Techniques, 2004. Prepared for Public Utility District No. 1 of Chelan County, Wenatchee, WA.

Vella, J., L. Stuehrenberg, M. Moser, and T. Bjornn. 2001. Migration patterns of Pacific Lamprey (Lampetra tridentata) in the lower Columbia River, 1997. NMFS report of research to USACE, Portland District, Portland, OR.

Wydoski, R. and R. Whitney. 2003. Inland fishes of Washington, 2nd edition. American Fisheries Society, Bethesda, Maryland in association with the University of Washington Press.

ASSESSMENT OF DDT AND PCB IN FISH TISSUE AND SEDIMENT IN THE LOWER OKANOGAN RIVER (AQUATIC ISSUE 6.2.1.4)

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

December 2006

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington

For copies of this study plan, contact:

Public Utility District No. 1 of Douglas County
Attention: Relicensing
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4497
Phone: (509)884-7191
E-Mail: relicensing@dcpud.org

ABSTRACT:

The current Wells Hydroelectric Project (Wells Project) license will expire on May 31, 2012. The Public Utility District No. 1 of Douglas County (Douglas PUD) owns and operates the Wells Project and is using the Integrated Licensing Process (ILP) for relicensing as promulgated by Federal Energy Regulatory Commission (FERC) regulations issued July 23, 2003 (18 CFR Part 5). As part of the Wells Project relicensing process, Douglas PUD is required to obtain a water quality certificate pertinent to section 401 of the Clean Water Act. The Washington State Department of Ecology (WDOE) is responsible for the issuance of a 401 certificate as well as administering the state's Water Quality Standards. As part of the 401 certification process, Ecology must assess the effect of a hydroelectric project's operations on the transport and accumulation of toxins within the sediment as they apply to the numeric and narrative criteria of the state standard.

The Aquatic Resource Work Group (RWG), which is composed of stakeholders (including WDOE) and Douglas PUD staff, was formed for the purposes of identifying issues that may require study during the Wells Project relicensing, identified the need to collect more information with regards to DDT and PCB in the lower Okanogan River within the Wells Project boundary and its potential human health effects related to recreational activities. In order to satisfy this request, the Aquatic RWG proposes a study to collect and analyze for the presence of toxins in fish tissue and at specific recreation sites located on the lower Okanogan River. These samples will be collected in an effort to address the human health concerns brought forth by the RWG.

In 2001-2002, WDOE conducted a technical assessment in support of the development of a Total Maximum Daily Load (TMDL) for 1,1,1-trichloro-2,2-*bis*[*p*-chlorophenyl]ethane (DDT) and polychlorinated biphenyls (PCBs) in the Lower Okanogan River. For the purposes of the 2001-2002 assessment, the Lower Okanogan River was defined as the portion of the river from the U.S./Canadian border at Lake Osooyos (RM 80.2) downstream to the town of Monse (RM 5.0). During this assessment, various mediums (water, sediment, and fish tissue) at various locations in the Okanogan River were assessed for concentrations of DDT and PCB. This study will augment the previous information collected during the development of the TMDL and will be consistent with the recommendations of the Water Quality Implementation Plan (WDOE, 2006) submitted by WDOE which provides recommendations to assure that DDT and PCB concentrations in the waters and fish tissues from the Okanogan River and its tributaries continue to improve with the goal of meeting the regulatory standards for these persistent bioaccumulative toxins.

Sampling locations for fish during the study will include all accessible reaches of the lower Okanogan River within Project boundary (RM 15.5 to RM 0.0). Sampling sites for sediment will include recreational sites of concern (e.g. swimming areas and boat launches) from the Okanogan River mouth up to RM 15.5. Study implementation is planned for the 2-year ILP study period (2008-2009) with sampling occurring in May 2008. Sampling frequency, timing, and methodology as well as sample analysis will be consistent with the 2001-2002 WDOE TMDL Technical Assessment as outlined in Serdar (2003) and WDOE's "Water Quality Certification for Existing Hydropower Dams: Preliminary Guidance Manual (September 2004)."

A technical report of the study will be produced to assist the Aquatic RWG in determining the concentration of DDT and PCBs in recreational fish species and in swimming areas of the lower Okanogan River within Project boundary. The information may inform the development of an appropriate information and education program to address the human health risks towards recreational use by the public in the lower Okanogan River.

1.0 INTRODUCTION

1.1 General Description of the Wells Hydroelectric Project

The Wells Hydroelectric Project (Wells Project) is located at river mile (RM) 515.8 on the Columbia River in the State of Washington. Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (COE), and 42 miles upstream from the Rocky Reach Hydroelectric Project, owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam.

The Wells Project is the chief generating resource for Public Utility District No. 1 of Douglas County (Douglas PUD). It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides of the hydrocombine, which is 1,130 feet long, 168 feet wide, with a crest elevation of 795 feet in height.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The normal maximum surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at elevation of 781. The normal maximum water surface elevation of the reservoir is 781 feet (Figure 1.1-1).

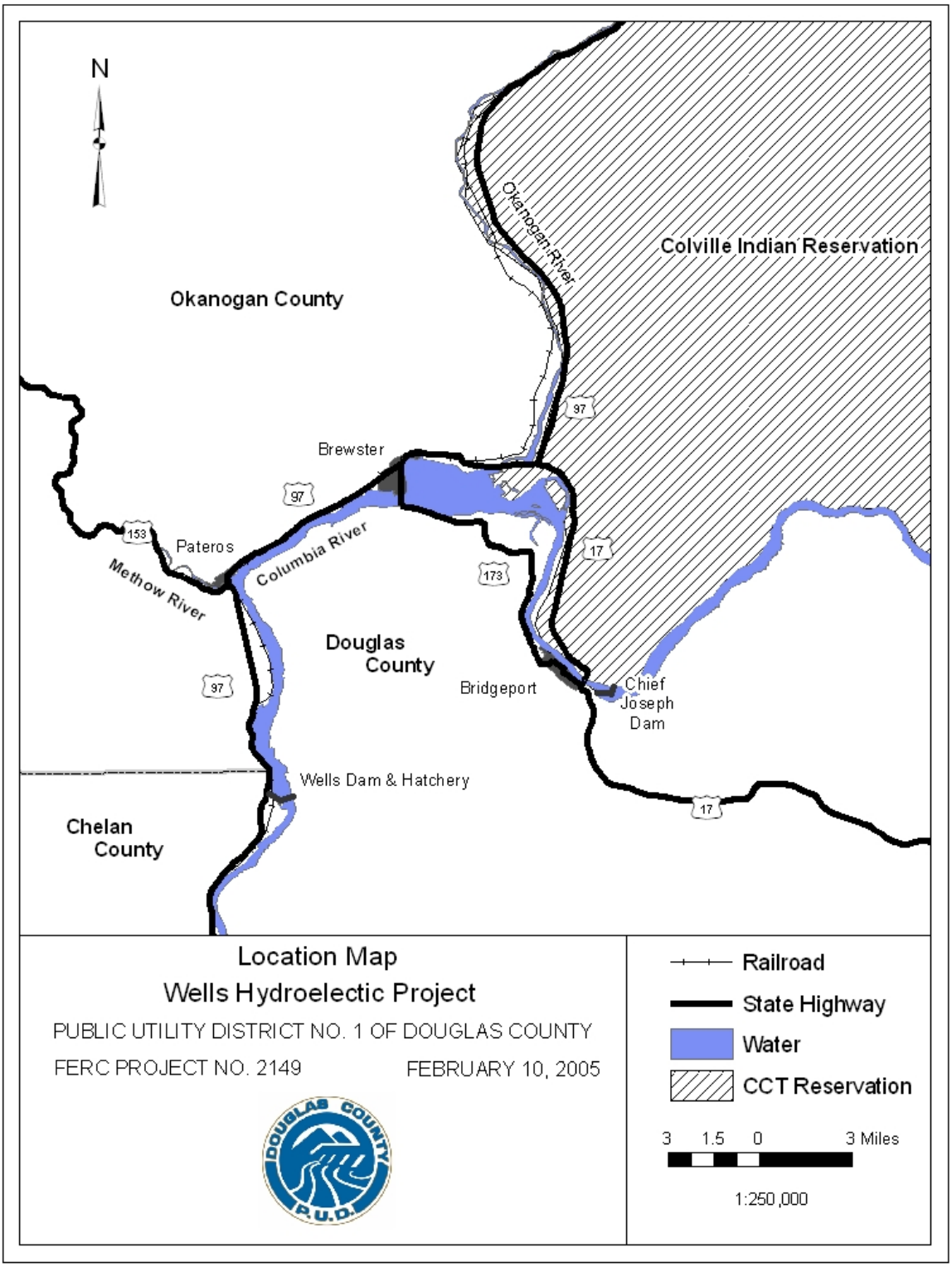

Figure 1.1-1 Location Map of the Wells Project

1.2 Relicensing Process

The current Wells Project license will expire on May 31, 2012. Douglas PUD is using the Integrated Licensing Process (ILP) as promulgated by FERC regulations issued July 23, 2003 (18 CFR Part 5). Various state and federal agencies, tribes, local governments, non-governmental organizations and the general public will participate in the Wells Project ILP. During the ILP, information needs related to the relicensing of the Wells Project will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b).

<u>18 CFR § 5.9(b) Content of study request</u>. Any information or study request must:

(1) Describe the goals and objectives of each study and the information to be obtained;
(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
(4) Describe existing information concerning the subject of the study proposal, and the need for additional information;
(5) Explain any nexus between project operation and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;
(6) Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate, considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

All study plans submitted to FERC will be reviewed by Douglas PUD and the applicable Resource Work Group(s) to determine if studies proposed will fill the information needs related to the Wells Project Relicensing. Any dispute over alternative study methods, that cannot be reconciled with stakeholders, will be decided by FERC.

2.0 GOALS AND OBJECTIVES

The objective of the study is to determine the concentration of DDT and PCBs in recreational fish species and in swimming areas of the lower Okanogan River (up to RM 15.5) within the Wells Project boundary.

Tasks to be completed toward the achievement of the goal include:

- Collect and analyze sediment samples for DDT and PCBs from specific recreational sites (i.e., swim areas and boat launches) in the lower Okanogan River up to RM 15.5.
- Collect and analyze fish tissue for DDT and PCBs from recreational fish species of interest consumed by tribal and recreational anglers.

The information gathered from this monitoring effort will assist the Aquatic RWG in determining the concentration of DDT and PCBs in recreational fish species and in swimming areas of the lower Okanogan River within the Wells Project boundary. The information may inform the development of an appropriate information and education program to address the human health risks towards recreational use by the public in the lower Okanogan River.

3.0 STUDY AREA

The study area consists of waters within the Okanogan River from its confluence with the Columbia River up to RM 15.5.

4.0 BACKGROUND AND EXISTING INFORMATION

The Okanogan River originates in the Cascade Mountains north of the international border in British Columbia. The Okanogan River is characterized by a series of lakes north of international boundary and a free flowing river flowing out of Osoyoos Lake, which straddles the boundary; 78 miles to its confluence with the Columbia River (WDOE, 2004). The lower 15.5 miles of the Okanogan River before it joins with the Columbia River is considered within the Wells Project boundary.

Beginning in the early 1970s, Canadian investigators began documenting high levels of the insecticide 1,1,1-trichloro-2,2-*bis*[*p*-chlorophenyl]ethane (DDT) in fish collected from British Columbia lakes along the mainstem Okanogan River (Northcote et al., 1972). In 1983, WDOE collected data which revealed DDT and polychlorinated biphenyl (PCB) contamination in fish from the Okanogan River below the Canada border (Hopkins et al., 1985). Since then a number of WDOE surveys have verified DDT and PCB contamination in the basin (Johnson and Norton, 1990; Davis and Serdar, 1996; Johnson et al., 1997; Serdar et al., 1998, Serdar, 2003).

The WDOE Environmental Assessment Program prepared an assessment of total maximum daily loads (TMDLs) of DDT and PCBs in the lower Okanogan River basin, including Osoyoos Lake. For the purposes of the WDOE assessment, the Lower Okanogan River was defined as the portion of the river from the U.S./Canadian border at Lake Osooyos (RM 80.2) downstream to the town of Monse (RM 5.0). Sampling conducted during 2001-2002 examined DDT and PCB concentrations in the water column of the mainstem Okanogan River, water in tributary streams, sewage treatment plant (STP) effluent and sludge, and cores of bottom sediments. Composite samples of three species of fish – carp (*Cyprinus carpio*), mountain whitefish (*Prosopium williamsoni*), and smallmouth bass (*Micropterus dolomieui*) also were analyzed for DDT and PCBs. Data from these samples were used in conjunction with historical data to develop the TMDLs (Serdar, 2003).

Results of the 2001-2002 sampling (Serdar, 2003) suggest that:

1. DDT concentrations in the mainstem water column typically decreased from upstream sites (Okanogan River at Zosel Dam) to downstream sites (Okanogan River at Malott). PCBs were not detected in the mainstem.

2. Only small loads of DDT and PCBs are delivered to Osoyoos Lake and the lower Okanogan River through tributary streams and STPs.
3. Generally, lipid-normalized t-DDT and t-PCB concentrations in fish tissue decreased from sites upstream to downstream (Oroville, Riverside-Omak, Monse) with the exception of large-sized smallmouth bass which had higher concentrations downstream at the Monse site.
4. t-DDT and t-PCB concentration trends decreased in the 1980s followed by steady concentrations in the last decade in the lower Okanogan system.
5. DDT concentrations in the Osoyoos Lake core sediments were an order of magnitude higher than core sediments of approximately equal age from the Okanogan River near the mouth (Monse).
6. PCB concentrations in core samples were low, with concentrations around 1 ng/g t-PCB. Concentrations from both sites (Osoyoos Lake and lower Okanogan River: Monse) were similar suggesting that low-level PCB sources such as STPs between the lake and the river mouth keep depositional areas enriched with low levels of PCBs. Little is known about sources of PCB contamination in the lower Okanogan River basin, except that no major sources appear evident. It is notable that while PCBs in edible fish tissues may be a human health concern at the levels reported, it is not uncommon to find similar levels in other Washington waters where no discernible sources of PCB exist (Davis and Johnson, 1994).
7. Re-suspended Osoyoos Lake sediments account for nearly all of the measured DDT loads in the lower Okanogan River which may explain the disparity between DDT load delivery and measured loads in the water column of the lower mainstem Okanogan River.
8. The Colville Tribes conducted a longitudinal transect of DDT in 40 lower Okanogan River sediments from Osoyoos Lake outlet to the mouth in 2001 (Hurst and Stone 2002). Aside from two locations, little DDT was found. 60% of sites had t-DDT less than the detection limit (0.5 ng/g) and another 35% had a concentration of 1-10 ng/g (mostly less than 2 ng/g). Two sites with significant concentrations were found just below the Osoyoos Lake outlet and just downstream of Elgin Creek (RM 28.4).
9. Acute toxicity is not considered to be a concern at concentrations in the lower Okanogan River basin.
10. According to the report, there are few realistic options for obtaining meaningful reductions in DDT and PCB loading to Osoyoos Lake and the lower Okanogan River. It appears that most loading to fish occurs internally through direct or indirect exposure to sediments. Natural attenuation will eventually reduce levels through dilution and capping, especially downstream of the Similkameen River confluence.

In conjunction with the TMDL technical assessment (2003) and TMDL (2004), WDOE submitted a Detailed Implementation Plan (WDOE, 2006) to EPA as required by the Clean Water Act in July 2006. This report provides direction to assure that DDT and PCB concentrations in the waters and fish tissues from the Okanogan River and its tributaries continue to improve with the goal of meeting the regulatory standards. The report's main recommendations are the continued monitoring of fish tissues at 5 year intervals and preventative measures that would minimize the amount of contaminants entering the river from the surrounding watershed.

Currently, there is no monitoring program for toxins (DDT and PCB) in the Okanogan River watershed. WDOE's long-term monitoring station, located near Malott (RM 17) just upstream of the Wells Project boundary, samples monthly for conventional parameters and metals; however, water samples, fish tissue and sediment cores are not collected for analysis of toxins.

4.1 Aquatic Resource Work Group

As part of the preparation for the relicensing of the Wells Project, Douglas PUD established an Aquatic Resource Work Group (RWG) which began meeting informally in November, 2005. This voluntary effort was initiated to provide stakeholders with information about the Wells Project, to collaboratively identify potential resource issues related to Project operations and relevant to relicensing, and to develop preliminary study plans to be included in the Wells Pre-Application Document (PAD).

Through a series of meetings, the Aquatic RWG cooperatively developed a list of Issue Statements, Issue Determination Statements and Agreed Upon Study Plans. An Issue Statement is an agreed upon definition of a resource issue raised by a stakeholder. An Issue Determination Statement reflects the RWG's efforts to review the existing project information and to determine whether an issue matches with FERC's seven criteria and would be useful in making future relicensing decisions. Agreed Upon Study Plans are the finished products of the informal RWG process.

Based upon these meeting and discussions, the Aquatic RWG is proposing to include a study plan into the Wells PAD which will determine the concentration of DDT and PCBs in recreational fish species and in swimming areas of the lower Okanogan River within the Wells Project boundary. This study will help to inform future relicensing decisions through the 401 water quality certification process and will fill data gaps that have been identified by the Aquatic RWG.

4.2 Issue Statement

Finalized Issue Statement (6.2.1.4)

Project operations may affect the input, movement, accumulation and retention of toxins (sediment dynamics and water column) originating from the Okanogan River subbasin and their potential effects on aquatic organisms and humans.

Final Issue Determination Statement (6.2.1.4)

The Okanogan River likely contains toxins within the sediment and in the water column. These pollutants are discharged into the river from mining, industrial and agricultural activities upstream of the Project boundary. There are numerous reports by the Washington State Department of Ecology and the Colville Tribes documenting the presence and levels of toxins within the Okanogan Basin. Of the five assessments conducted on toxins in the Okanogan River most have focused on the presence of toxins within the water column, sediment and within the fish found in the Okanogan River.

The lower Okanogan DDT PCB Detailed Implementation Plan (WDOE, 2006) submitted to and approved by the Environmental Protection Agency for the purpose of providing direction to assure that DDT and PCB concentrations are reduced to a level that meet regulatory standards recommends continued monitoring of fish tissues from the lower Okanogan River.

The resource work group agrees that a study is needed during the two-year ILP study period. The study would assess the concentration of DDT and PCBs found within fish tissues collected from the lower Okanogan River. This study would also collect sediment samples from specific recreation areas located between the mouth of the Okanogan River upstream to RM 15.5.

5.0 PROJECT NEXUS

The WDOE is responsible for the protection and restoration of the state's waters. WDOE has adopted water quality standards that set limits on pollution in lakes, rivers, and marine waters in order to protect water quality. WDOE's water quality assessment of the state's waterbodies lists the status of water quality for a particular location in one of 5 categories (Category 1-5) recommended by the Environmental Protection Agency (EPA). This assessment represents the integrated report for Sections 303(d) and 305(b) of the Clean Water Act. Categories 1-4 represent the status of waters for the 305(b) report, while Category 5 represents those waters placed on the 303(d) list. Waters placed on Category 5 require the preparation of TMDLs, which are an integral tool in the work to clean up polluted waters.

The lower Okanogan River within the Project boundary was 303(d) listed for high levels of total PCB's, 4,4'-DDE and 4,4'-DDD in fish tissues in 1998. As a result of this listing, a TMDL (WDOE, 2004) was developed to address these impaired parameters in this location. Currently, the EPA-approved 303(d) list submitted in 2004 no longer includes these parameters for the lower Okanogan River as they have been re-assessed as Category 4a (impaired waters with a TMDL) waters in the Washington State Water Quality Assessment 305(b) report. The information resulting from an assessment of fish tissue and sediments in the lower Okanogan River will assist the Aquatic RWG in the development of licensing requirements through the 401 water quality certification process.

6.0 METHODOLOGY

In order to collect information that will be informative of the health risks from recreational activities within the lower Okanogan River sampling stations for fish tissue will be located throughout the lower 15.5 miles of the river. Field sampling will consist of one sampling event in May of 2008 during the spring run-off to be consistent with the 2001-2002 WDOE assessment (sampling during high water).

All methods implemented will be consistent with the 2001-2002 WDOE TMDL Technical Assessment as outlined in Serdar (2003) if appropriate in addressing the objectives of this study. Additionally, any components of the study not clearly specified in Serdar (2003) will be consistent with WDOE's "Water Quality Certification for Existing Hydropower Dams: Preliminary Guidance Manual (September 2004)." Quality assurance plans will meet State and Federal guidelines.

Sediment samples will be collected using standard aquatic toxicology protocol. Fish for fish tissue analysis will be collected either via electrofishing or angling, when appropriate. Fish species of interest will be determined by the Aquatic RWG but should be fish normally consumed by either tribal or local recreational anglers and consistent with WDOE's Detailed Implementation Plan (2006). Biological data (species, length, weight and age) will be collected for all fish samples.

All sediments samples and fish tissue samples will be stored to meet quality specifications prior to transport and delivery to a qualified laboratory for analysis. Parameter analysis will also be consistent with Serdar (2003) and will consist of tests to determine the concentrations of all DDT analogs and PCBs per each sample.

7.0 STAFFING AND EQUIPMENT REQUIREMENTS

Based upon discussions with the Aquatic RWG regarding specific study design and study needs, Douglas PUD will secure the assistance of a qualified consultant to conduct the field portion of the study in addition to a qualified water quality and toxicology laboratory to analyze samples.

The technical skills necessary to complete the study are knowledge of aquatic toxicology with an emphasis on transport and accumulation, water quality sampling equipment and protocol consistent with WDOE's preliminary guidance manual, motor boat operation and safety, data acquisition and management, and Washington State water quality standards.

A Washington State Collection Permit will be required for fish sampling. The consulting firm contracted to implement the field sampling portion of the study will be responsible for obtaining this permit prior to the start of the study.

8.0 BUDGET

The total estimated hours for the Lower Okanogan River DDT/PCB assessment is approximately 185 person hours. The allocation of these hours is approximately 25 hours for study plan development; 36 hours for coordination and permitting; 76 hours for field activities; and 48 hours for data analysis and reporting. Labor costs are estimated to be $25,000. Equipment costs and expenses related to field activities (sediment sampling equipment, boat use, travel, shipping, etc.) are estimated to be $6,000. Laboratory costs for the analysis of fish tissue and sediments are estimated to be $20,000. Total planning level costs for this effort are approximately $51,000.

9.0 SCHEDULE

Planning for this study will begin in late 2007, shortly after the issuance of FERC's Study Plan Determination in October 2007. Activities to obtain a Washington State Scientific Collectors Permit will be implemented during late 2007. Field sampling will take place during the spring of 2008 with an Initial Study Report due to stakeholders by October 2008. A final report will be provided to FERC and the stakeholders by October 2009.

10.0 REFERENCES

Davis, D. and D. Serdar. 1996. Washington State Pesticide Monitoring Program - 1994 Fish Tissue and Sediment Sampling Report. Washington State Department of Ecology, Olympia, WA. Ecology Pub. No. 96-352.

Hopkins, B., D. Clark, and M. Stinson. 1985. Basic Water Monitoring Program Fish Tissue and Sediment Sampling for 1984. Ecology Pub. No. 85-7, Washington State Department of Ecology, Olympia, WA.

Johnson, A. and D. Norton. 1990. 1989 Lakes and Reservoir Water Quality Assessment Program: Survey of Chemical Contaminants in Ten Washington Lakes. Washington State Department of Ecology, Olympia, WA.

Johnson, A., D. Serdar, and D. Davis. 1997. DDT Sources to the Okanogan River and Lake Osoyoos. Memorandum to Jim Milton, Washington State Department of Ecology, Olympia, WA.

Northcote, T.G., T.G. Halsey, and S.J. MacDonald. 1972. Fish as Indicators of Water Quality in the Okanogan Basin Lakes, British Columbia. British Columbia Department of Recreation and Conservation, Fish and Wildlife Branch, Victoria, B.C.

Serdar, D. 2003. TMDL Technical Assessment of DDT and PCBs in the Lower Okanogan River basin. Department of Ecology, Olympia, WA. Ecology Pub No. 03-03-013.

Serdar, D., D. Davis, and A. Johnson. 1998. DDT in Osoyoos Lake Fish. Washington State Department of Ecology, Olympia, WA. Ecology Pub. No. 98-337.

WDOE (Washington Department of Ecology). 2006. Lower Okanogan DDT PCB. Water Quality Implementation Plan (Detailed Implementation Plan). Department of Ecology. Central Regional Office, Yakima, WA. Ecology Pub. No. 06-10-031.

WDOE (Washington Department of Ecology). 2004. Lower Okanogan River Basin DDT and PCBs Total Maximum Daily Load. Submittal Report. Department of Ecology, Olympia, WA. Ecology Pub. No. 04-10-043.

AN INVESTIGATION INTO THE TOTAL DISSOLVED GAS DYNAMICS OF THE WELLS PROJECT (AQUATIC ISSUE 6.2.1.5)

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

December, 2006

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington

For copies of this study plan, contact:

Public Utility District No. 1 of Douglas County
Attention: Relicensing
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4497
Phone: (509)884-7191
E-Mail: relicensing@dcpud.org

ABSTRACT:

The current Wells Hydroelectric Project (Wells Project) license will expire on May 31, 2012. The Public Utility District No. 1 of Douglas County (Douglas PUD) owns and operates the Wells Project and is using the Integrated Licensing Process (ILP) for relicensing as promulgated by Federal Energy Regulatory Commission (FERC) regulations issued July 23, 2003 (18 CFR Part 5). As part of the Wells relicensing process, Douglas PUD is required to obtain a water quality certificate in accordance with section 401 of the Clean Water Act. The Washington State Department of Ecology (WDOE) is responsible for the issuance of a 401 certificate as well as administering the state's Water Quality Standards. As part of the 401 certification process, WDOE must determine that the Wells Project is in compliance with state water quality standards for total dissolved gas (TDG).

The Aquatic Resource Work Group (RWG), which is composed of stakeholders (including WDOE) and Douglas PUD staff, was formed for the purposes of identifying issues and information gaps that may require study during the relicensing of the Wells Project. The Aquatic RWG, through a series of technical meetings, is proposing a study intended to further examine the TDG production dynamics at the Wells Project. The specific objectives of this study are contingent upon the results from TDG studies scheduled for 2006 and 2007.

TDG may become a water quality concern when gases supersaturate a river, lake or stream. The plunging water caused by spill at hydroelectric facilities may elevate TDG to levels that result in impaired health or even death for aquatic life residing or migrating within the affected area. Since 2003, Douglas PUD has been engaged in the assessment of TDG production dynamics at Wells Dam.

In spring of 2006, Douglas PUD examined whether or not operational scenarios (i.e. spill shaping) were able to minimize TDG production to a level that is capable of meeting the Washington State water quality standard for TDG production at Wells Dam during high flows up to 7Q10 flows (246 kcfs at Wells Dam). The 7Q10 flow is defined as the highest average flow which occurs for seven consecutive days in a once-in-ten-year period. At 7Q10 flows and above, water quality standards for TDG do not apply. Preliminary results of the study (EES et al., 2006) suggest that at 7Q10 flows specific operating scenarios that concentrate spill flows (crowned spill and full gate shapes) produce significantly lower levels of TDG in the Wells Dam tailrace. Further analysis of the data will provide a logical framework in which to base decisions focusing on the scope of continued TDG activities (i.e., more spill studies, modeling,) at Wells Dam during the 2-year ILP study period. Contingent upon the results of the 2006 and 2007 TDG studies, additional research into TDG at Wells Dam may or may not be needed.

1.0 INTRODUCTION

1.1 General Description of the Wells Hydroelectric Project

The Wells Hydroelectric Project (Wells Project) is located at river mile (RM) 515.8 on the Columbia River in the State of Washington. Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (COE), and 42 miles upstream from the Rocky Reach Hydroelectric Project owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam (Figure 1.1-1).

The Wells Project is the chief generating resource for Public Utility District No. 1 of Douglas County (Douglas PUD). It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides the hydrocombine, which is 1,130 feet long, 168 feet wide, with a crest elevation of 795 feet in height.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The normal maximum surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at elevation of 781. The normal maximum water surface elevation of the reservoir is 781 feet (Figure 1.1-1).

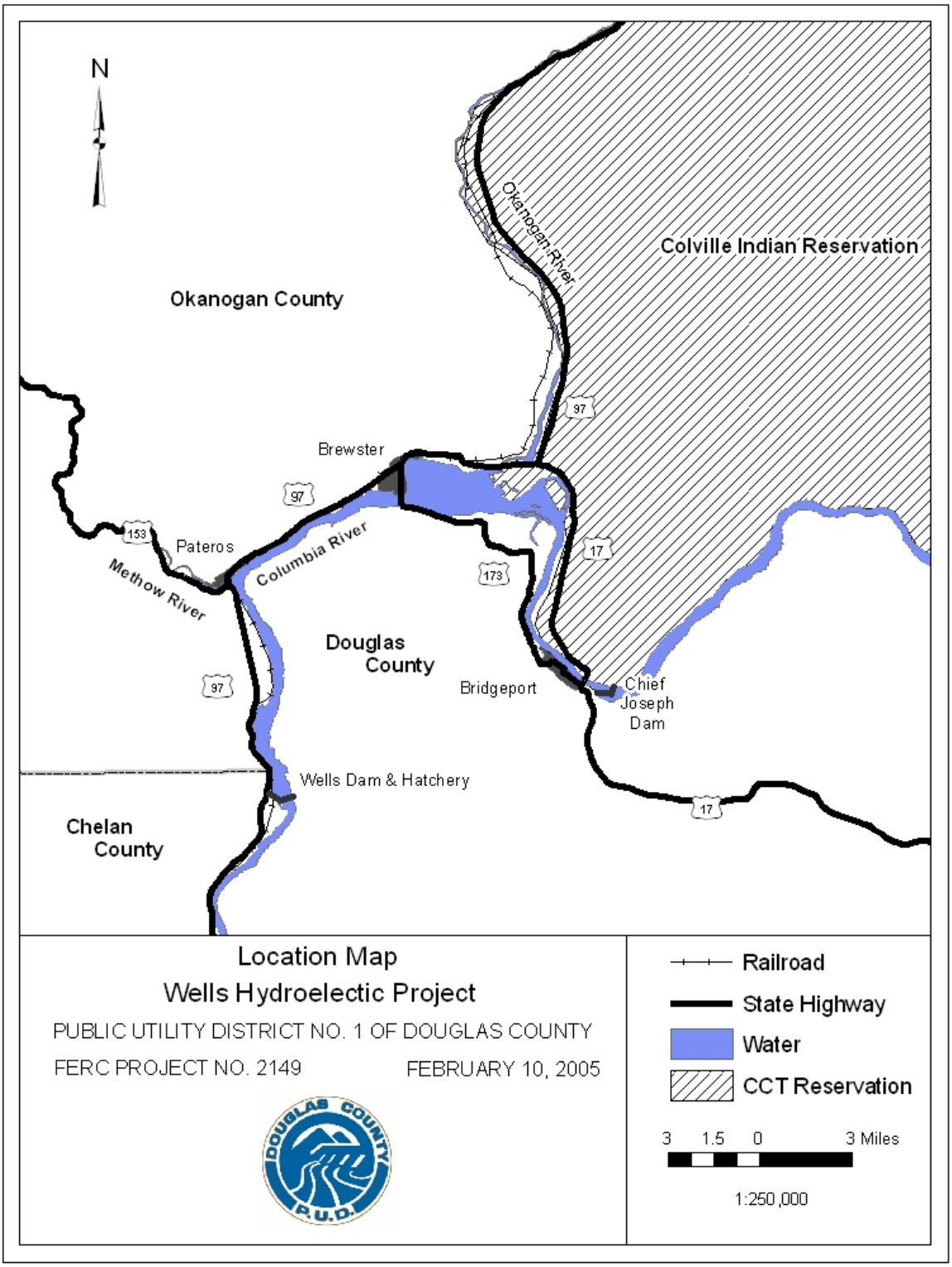

Figure 1.1-1 Location Map of the Wells Project

1.2 Relicensing Process

The current Wells Project license will expire on May 31, 2012. Douglas PUD is using the Integrated Licensing Process (ILP) as promulgated by FERC regulations issued July 23, 2003 (18 CFR Part 5). Various state and federal agencies, tribes, local governments, non-governmental organizations and the general public will participate in the Wells Project ILP. During the ILP, information needs related to the relicensing of the Wells Project will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b).

18 CFR § 5.9(b) Content of study request. Any information or study request must:

(1) Describe the goals and objectives of each study and the information to be obtained;
(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
(4) Describe existing information concerning the subject of the study proposal, and the need for additional information;
(5) Explain any nexus between project operation and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;
(6) Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate, considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

All study plans submitted to FERC will be reviewed by Douglas PUD and the applicable Resource Work Group(s) to determine if studies proposed will fill the information needs related to the Wells Project Relicensing. Any dispute over alternative study methods, that cannot be reconciled with stakeholders, will be decided by FERC.

2.0 GOALS AND OBJECTIVES

The goal of the study is to better define the relationship between spill operations at Wells Dam and resultant downstream total dissolved gas pressures and, if needed, identify possible measures to improve operational performance related to TDG.

The Washington State Department of Ecology (WDOE) is the agency responsible for administering the State Water Quality Standards and for the issuance of 401 water quality certificates for hydroelectric relicensing processes in Washington. The information gathered from this study will assist WDOE in determining the extent to which a Project's spill operations affect TDG in excess of the specified numeric criteria. This determination will also assist

WDOE in the development of an implementation schedule as it applies to the 401 certification process.

3.0 STUDY AREA

The study area will consist of Wells Dam (RM 515.8) including the Wells Dam forebay and tailrace area. Additional TDG information may be collected in the Rocky Reach forebay (Figure 1.1-1).

4.0 BACKGROUND AND EXISTING INFORMATION

WDOE has established water quality standards in an effort to protect the beneficial uses of State water and water bodies. The Washington standards include both numeric and narrative criteria. The narrative standards address beneficial uses that include, but are not limited to, the ecological significance of water quality to aquatic biota. The importance of water quality to the health of rare, threatened, and endangered populations is also described in the narrative standards.

Dissolved gasses in water occur when gases in the atmosphere come into contact with water and when biological activity, such as photosynthesis or respiration, place metabolized gases into solution. Optimal water quality conditions of dissolved gas for fish are considered to be close to the barometric pressure seen at the air-water interface. Dissolved gas may become a water quality issue when gasses supersaturate a river, lake or stream (Klinge 2005). Plunging water may cause an increase in total dissolved gas of a body of water as air bubbles become entrained, pushed to depth and forced into solution due to increased pressure. This phenomenon occurs naturally at waterfalls or artificially at dams. Spill at hydroelectric projects occur when river flows exceed the hydraulic capacity of the dam due to limited generation capacity or a lack of demand for power. Hydroelectric dams on the Columbia River also provide safe passage routes for migrating juvenile salmonids through spill. High levels of TDG have been shown to cause air embolisms (gas bubble trauma) in fish that result in impaired health or even death. Many variables contribute to dissolved gas supersaturation, including existing forebay gas concentrations, spill flow rates, tailwater bathymetry, air entrainment, spill plunge depths, entrainment flows, and temperature of the water (Klinge 2005).

Based upon the Washington state water quality standards developed by WDOE, TDG measurements shall not exceed 110 percent at any point of measurement in any state water body. However, water quality standards for TDG do not apply during natural flood flow conditions. Natural flood conditions are defined as any event which exceeds the highest flow that occurs for seven consecutive days in a ten-year period. These natural flood condition flows are termed 7Q10 flows.

In addition to allowances for natural flood flows, dams on the Columbia and Snake rivers, have an exception to the 110 percent TDG standard to allow for passage of juvenile fish downstream over the dams rather than through the turbines through the issuance of a waiver by WDOE. On the Columbia and Snake rivers there are three separate standards. First, in the tailrace of a dam, TDG shall not exceed 125 percent as measured in any one-hour period. Further, TDG shall not

exceed 120 percent in the tailrace of a dam and shall not exceed 115 percent in the forebay of the next dam downstream as measured as an average of the 12 highest consecutive hourly readings in any one day (24-hour period). This exception is based on a risk analysis study conducted by National Marine Fisheries Service (NMFS). The study weighed the benefits of spilling water to assist juvenile salmon in avoiding turbine mortalities against the mortalities of fish exposed to harmful levels of dissolved gas.

Starting in 1998 Douglas PUD initiated a rigorous TDG monitoring program at Wells Dam including the installation of forebay and tailrace fixed station sensors and regular maintenance and calibration of the two stations. Since initiating the monitoring program, a more accurate description of the TDG dynamic at Wells Dam has been developed. During normal fish bypass operations (7-11% spill of total discharge), TDG values in the immediate Wells Tailrace are only elevated above ambient levels by 1-2%. The fish bypass spill equation for Wells Dam indicates that for every 4% of water spilled, TDG values are elevated above ambient conditions by one percent (Klinge, 2001, 2002, 2003, 2004 and 2005).

In order to gain a better understanding of the TDG generation dynamic at Wells Dam, Douglas PUD has recently initiated a series of assessments aimed at gaining a better understanding of TDG production dynamics resulting from spill operations at Wells Dam. The District undertook studies to evaluate spill at Wells Dam during the 2003 and 2004 fish passage seasons (CBE 2003 and 2004). Both studies employed an array of data loggers arranged in a grid throughout the Wells Dam tailrace. The studies indicated that the tailrace fixed monitoring stations exhibited a delayed response to operational changes by Wells Dam when compared to mid- and upstream locations. Despite this delay, averages of the twelve highest daily TDG saturations (the compliance measure used by the State of Washington) varied little between stations.

The 2003 study also attempted to determine the fate of powerhouse released water by comparing upstream and downstream volume weighted TDG saturations. The results of these efforts were limited by the range of tested flow conditions, but implied that the TDG pressures of powerhouse released water may have been influenced by spillway operation. The 2004 study generally supported previous findings, indicating that Wells Powerhouse released water was gassed by spilled water.

In 2005, Douglas PUD initiated several spill tests to examine the relationship between water spilled over the dam and the production of TDG (CBE, 2006). The two objectives of the study were to determine the degree to which Wells Powerhouse released water is influenced by spillway operation (i.e., dilution or absorption) and to explore ameliorative operational scenarios to reduce TDG production. A variety of scenarios were examined during this spill study, including spill over loaded and unloaded units and flat versus crowned spill configurations. Due to the low snow pack experienced during the 2005 water-year, only low and medium spill volumes were examined (spill Q was between 34 and 50 kcfs with total river Q between 106 and 178 kcfs).

In spring of 2006, Douglas PUD examined TDG production at Wells Dam during high flows up to 7Q10 flows (246 kcfs at Wells Dam) and whether or not operational scenarios (i.e., spill shaping) were able to minimize TDG production to a level that is capable of meeting the

Washington state water quality standard for TDG. Preliminary results of the study (EES et al., 2006) suggest that at 7Q10 flows, specific operating scenarios that concentrate spill flows (crowned spill and full gate shapes) produce significantly lower levels of TDG in the Wells Dam tailrace. Further analysis of the data will provide a logical framework in which to base decisions focusing on the scope of continued TDG activities (i.e., more spill studies, physical modeling, computational fluid dynamics model, etc.) at Wells Dam.

4.1 Aquatic Resource Work Group

As part of the preparation for the relicensing of the Wells Project, Douglas PUD established an Aquatic Resource Work Group (RWG) which began meeting informally in November, 2005. This voluntary effort was initiated to provide stakeholders with information about the Wells Project, to collaboratively identify potential resource issues related to Project operations and relevant to relicensing, and to develop preliminary study plans to be included in the Wells Pre-Application Document (PAD).

Through a series of meetings, the Aquatic RWG cooperatively developed a list of Issue Statements, Issue Determination Statements and Agreed Upon Study Plans. An Issue Statement is an agreed upon definition of a resource issue raised by a stakeholder. An Issue Determination Statement reflects the RWGs' efforts to review the existing project information and to determine whether an issue matches with FERC's seven criteria and would be useful in making future relicensing decisions. Agreed Upon Study Plans are the finished products of the informal RWG process.

Based upon these meetings and discussions, the Aquatic RWG is proposing to include a study plan into the Wells PAD which addresses the expected need for continued investigations into the TDG dynamics of the Wells Project. This study will help to inform future relicensing decisions through the 401 water quality certification process and will fill data gaps that have been identified by the Aquatic RWG.

4.2 Issue Statement

Finalized Issue Statement (Issue 6.2.1.5)

Wells Dam may affect compliance with Total Dissolved Gas (TDG) standards in the Wells Tailrace and Rocky Reach Forebay.

Final Issue Determination Statement (Issue 6.2.1.5)

Wells Dam can have an effect on compliance with the TDG standard. The resource work group believes that additional information is necessary in the form of continued monitoring and that these data will be meaningful with respect to 401 Water Quality Certification. Douglas PUD has been implementing studies at Wells Dam to address TDG production dynamics. The need for future studies during the two-year ILP study period (2008-2009) is dependent upon TDG studies scheduled for 2006 and 2007.

5.0 PROJECT NEXUS

TDG may become a water quality concern when gases supersaturate a river, lake or stream. The plunging water caused by spill at hydroelectric facilities may elevate TDG to levels that result in impaired health or even death for aquatic life residing or migrating within the affected area.

The WDOE is responsible for the protection and restoration of the state's waters. WDOE has adopted water quality standards that set limits on pollution in lakes, rivers, and marine waters in order to protect water quality. On July 1, 2003, WDOE completed the first major overhaul of the state's water quality standards in a decade. A significant revision presented in the 2003 water quality standards classifies fresh water by actual use, rather than by class as was done in the 1997 standards. These revisions were adopted in order to make the 2003 standards less complicated to interpret and provide future flexibility as the uses of a water body evolve.

Congress passed the Clean Water Act in 1972, and designated the US Environmental Protection Agency (EPA) as the administering federal agency. This federal law requires that a state's water quality standards protect the surface waters of the US for beneficial uses, such as recreation, agriculture, domestic and industrial use, and habitat for aquatic life. State water quality standards, or amendments to these standards, do not take regulatory effect for the purposes of the Clean Water Act until they have been approved by EPA. EPA is currently reviewing the water quality standards adopted by the State of Washington in 2003 and partial approval has occurred. Full approval is expected before Douglas PUD files its license application (2010) and Section 401 certification is issued (2012). Due to this, the 2003 standards, as they apply to TDG in the Wells Project, will be used.

The new water quality standard for TDG for the Columbia River at a hydroelectric project is:

- Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection.

However, as discussed in Section 4.0, an exception to the above standard is allowed through the issuance of a TDG waiver by WDOE. The information resulting from continued activities associated with TDG at Wells Dam will assist the Aquatic RWG in the development of licensing requirements through the 401 water certification process.

6.0 METHODOLOGY

Given that TDG assessments at hydroelectric projects are often a multi-year, stepwise approach where future actions are based upon knowledge gained from past studies, Douglas PUD's future actions with regards to TDG production at Wells Dam will be dependent upon the information collected during the 2006 and 2007 spill studies. Based upon the results of these studies and based upon discussions with the Aquatic RWG, Douglas PUD will implement one or more of the following predetermined studies. Currently, there are several different studies that may be implemented pending the results of the 2006 and 2007 studies:

Option 1 If results of the 2006 and 2007 studies show that Wells Dam can maintain TDG levels below the levels specified by the TDG waiver issued by WDOE at flow levels at and below the 7Q10 flow of 246 kcfs during the fish spill season (120% in the Wells Tailrace and 115% in the Rocky Reach forebay), given that incoming TDG levels are less than 115%, Douglas PUD will include this information in its 401 water quality certification application to demonstrate that it is able to meet the state water quality standard for TDG. In this case, it is expected that no additional TDG studies are needed to inform the development and approval of the 401 water quality certification (based on information presented elsewhere that it can meet the 110% standard during non-fish spill).

Option 2 If the 2006 and 2007 study results show that Wells Dam cannot maintain TDG levels below the levels specified by the TDG waiver allowed under state law, during flow levels that are at or below the 7Q10 flow of 246 kcfs (120% in the Wells Tailrace and 115% in the Rocky Reach forebay), provided that incoming TDG levels are also at or below 115%, Douglas PUD, in cooperation with WDOE, will begin working on strategies, within an adaptive management framework, towards compliance of the TDG state standard. These adaptive management strategies will begin during the 2008-2009 relicensing study period and are expected to include:

2a. If results of the 2006 and 2007 studies show that during the fish spill season, specific Wells Dam operations at or below 7Q10 flows produce TDG levels within a reasonable deviation (120% + 2% in the Wells Tailrace and 115% in the Rocky Reach forebay) allowed under the state waiver, Douglas PUD, in cooperation with the Aquatic RWG and FERC, may conduct the following studies:

1. Develop a TDG model for the Wells Project. The model will be used to determine whether compliance with the water quality standard can be achieved through strictly operational means.

   If the model shows that compliance can be achieved through operational means, Douglas PUD will initiate additional spill tests at the Project, utilizing lessons learned from the model, toward verifying compliance with the TDG standard.

   If the model shows that compliance cannot be achieved through operational means, Douglas PUD will initiate activities specified in 2b.

2b. If results of the 2006 and 2007 studies show that specific Wells Dam operations at or below 7Q10 flows produce TDG levels that are above WDOE's TDG waiver by more than 2%, then Douglas PUD, in cooperation with the Aquatic RWG and FERC, is expected to conduct the following studies:

1. Develop and implement a hydraulic model(s) to address possible operational and/or structural solutions toward compliance with the TDG standard.

If the hydraulic model shows that compliance can be achieved through operational and/or structural solutions, Douglas PUD will conduct a feasibility analysis to evaluate the cost of the measures and the potential negative impact on existing fish passage and survival. If a reasonable and feasible measure is identified from this exercise, Douglas PUD will implement and test this measure toward compliance with meeting the standard.

If WDOE, in consultation with the other members of the Aquatic RWG, determines that there are no reasonable and feasible operational and/or structural modifications that can improve or meet TDG levels allowed under the state waiver, Douglas PUD may**,** in consultation with the Aquatic RWG and EPA, initiate work toward a Use Attainability Analysis (UAA) or site-specific study.

7.0 STAFFING AND EQUIPMENT REQUIREMENTS

Based upon results of the 2006 and 2007 TDG studies and based upon discussions with the Aquatic RWG regarding study design and study needs, Douglas PUD will begin acquiring the necessary field equipment and/or the assistance of consultant services to complete the study. Existing Wells Dam infrastructure and planned operational scenarios will also be necessary for study implementation and will be coordinated between consultants and Wells Project staff.

The technical skills necessary to complete the study are knowledge of water quality monitoring instrumentation, field techniques consistent with WDOE's preliminary guidance manual, motor boat operation and safety, TDG data acquisition and management, and the Washington State water quality standards and 401 certification process.

If biological monitoring is required, a take permit to sample and examine ESA listed species may be required. In this event, the consultants selected to implement the biological monitoring will work with Douglas PUD staff toward obtaining the necessary permits, in a timely manner.

8.0 BUDGET

Study cost will be contingent upon which of the two adaptive management strategies is selected based upon the results of the 2006 study. Following the selection of the most appropriate strategy, a qualified consulting firm will be selected. This consultant will work with Douglas PUD to better refine the specific scope of work and budget for the 2007-2009 TDG study. Preliminary planning level costs for the three potential TDG study options can be found below:

Option 1:
Should the results of the 2006 and 2007 study indicate that Option 1 is the preferred study option toward the development of information for the 401 certification, then Douglas PUD will focus on implementing its annual TDG compliance monitoring program at Wells Dam as described in Section 4.0. The total estimated hours for the implementation of the 2007-2009 TDG compliance monitoring is 420 person hours. These hours are specifically dedicated to the deployment and maintenance of TDG monitoring equipment and data management. Total planning level costs for Option 1, including equipment costs, is $48,000.

Option 2a:
Should the results of the 2006 and 2007 study indicate that Option 2a is the preferred study option, then Douglas PUD will develop a TDG Model, conduct a one-year TDG Dynamics Study and conduct three years of the annual TDG compliance monitoring program. Preliminary planning level costs for the development of a TDG model is $240,000. The development of a TDG model is expected to take one full year to develop, run and prepare a summary report. Planning level costs for the one-year TDG dynamics study is $340,000 assuming that the scope of this study is similar to the study conducted in 2006 at Wells Dam. This study would take place after the results of the TDG Model were available and the operations suggested by the model were implemented at the Project. The costs associated with continuing the three year annual TDG compliance monitoring program remains as estimated above, $48,000. Total planning level costs associated with Option 2a is $628,000.

Option 2b:
Should the results of the 2006 and 2007 study indicate that Option 2b is the preferred study option, then Douglas PUD will focus on the development of a Hydraulic Model and will implement a Feasibility Analysis to evaluate the cost of the measures and the potential negative impact on existing fish passage and fish survival. The planning level costs for the development of a Hydraulic Model for TDG at Wells is expected to range from $244,000 to $350,000 depending upon whether the model is numeric or whether the model includes both numeric and physical modeling components. The planning level cost to complete the Feasibility Analysis is $125,000. The costs associated with continuing the three year annual TDG compliance monitoring program remains as estimated above, $48,000. Total planning level costs associated with Option 2b ranges from $417,000 to $523,000 depending upon the scope and scale of the Hydraulic Model.

9.0 SCHEDULE

The need for this study and the study scope, objectives, and timing are entirely dependent upon the results of the 2006 and 2007 TDG studies. Should Wells Dam be capable of meeting the standard then Option 1, Section 6.0 will be implemented (no additional studies needed for TDG).

However, should Wells Dam remain out of compliance with the standard, then one of the two study paths identified by Option 2, Section 6.0 will be implemented following FERC's issuance of the Study Plan Determination in October 2007. Results from the 2008 study will be provided in the form of an Initial Study Report in October 2008. A final report of all of the TDG related studies will be provided to FERC and the Aquatic RWG by October 2009.

10.0 REFERENCES

Columbia Basin Environmental (CBE). 2006. Wells Dam Spillway Total Dissolved Gas Evaluation 2005. Columbia Basin Environmental The Dalles, OR; For Public Utility District No. 1 of Douglas County, East Wenatchee, WA.

CBE. 2004. Wells Dam Spillway Total Dissolved Gas Evaluation 23 May to 6 June 2004. Columbia Basin Environmental The Dalles, OR; For Public Utility District No. 1 of Douglas County, East Wenatchee, WA 98802, December 2004.

CBE. 2003. Wells Dam Spillway Total Dissolved Gas Evaluation 27 May to 10 June 2003. Columbia Basin Environmental The Dalles, OR; For Public Utility District No. 1 of Douglas County, East Wenatchee, WA 98802, December 2003.

EES Consulting, Inc., J. Carroll, ENSR, and Parametrix. 2006. Total Dissolved Gas Production Dynamics. Wells Hydroelectric Project, FERC No. 2149. Prepared for Public Utility District No. 1 of Douglas County, East Wenatchee, WA.

Klinge, R. 2005. Wells Dam Total Dissolved Gas Abatement Plan for 2005 and 2006. Public Utility District No. 1 of Douglas County, East Wenatchee, WA.

Klinge, R. 2004. Wells Dam Total Dissolved Gas Abatement Plan for 2004. Public Utility District No. 1 of Douglas County, East Wenatchee, WA.

Klinge, R. 2003. Wells Dam Total Dissolved Gas Abatement Plan for 2003. Public Utility District No. 1 of Douglas County, East Wenatchee, WA.

Klinge, R. 2002. Wells Dam Total Dissolved Gas Abatement Plan for 2002. Public Utility District No. 1 of Douglas County, East Wenatchee, WA.

Klinge, R. 2001. Wells Dam Total Dissolved Gas Abatement Plan for 2001. Public Utility District No. 1 of Douglas County, East Wenatchee, WA.

DEVELOPMENT OF A WATER TEMPERATURE MODEL RELATING PROJECT OPERATIONS TO COMPLIANCE WITH THE WASHINGTON STATE AND EPA WATER QUALITY STANDARDS (AQUATIC ISSUE 6.2.1.6)

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

December, 2006

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington

For copies of this study plan, contact:

Public Utility District No. 1 of Douglas County
Attention: Relicensing
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4497
Phone: (509)884-7191
E-Mail: relicensing@dcpud.org

ABSTRACT:

The current Wells Hydroelectric Project (Wells Project) license will expire on May 31, 2012. The Public Utility District No. 1 of Douglas County (Douglas PUD) owns and operates the Wells Project and is using the Integrated Licensing Process (ILP) for relicensing as promulgated by Federal Energy Regulatory Commission (FERC) regulations issued July 23, 2003 (18 CFR Part 5). As part of the Wells Project relicensing process, Douglas PUD is required to obtain a water quality certificate in accordance with section 401 of the Clean Water Act. The Washington State Department of Ecology (WDOE) is responsible for the issuance of a 401 certificate as well as administering the state's Water Quality Standards. As part of the 401 certification process, WDOE must determine that the Wells Project is in compliance with state water quality standards for temperature.

The Aquatic Resource Work Group (RWG), which is composed of stakeholders (including WDOE) and Douglas PUD staff, was formed for the purposes of identifying issues that may require study during Wells Project relicensing. The RWG has identified the need to develop a water temperature model relating project operations to compliance with the Washington State water quality standards.

The development of a water temperature model has been WDOE's preferred method for assessing project effects on water quality. In 2005, Douglas PUD began the initial steps for the development of a water quality model through the collection of detailed bathymetric, meteorological and water temperature data. With guidance from consultants with expertise in water quality modeling, Douglas PUD identified the CE-QUAL-W2 (W2 model) model as being appropriate for assessing temperature effects of the operation of the Wells Project. The W2 model is widely used to support the establishment of TMDLs for Washington waters and is the generally accepted model for evaluating the effects of hydroelectric projects on state waters. Therefore, the W2 model was considered the basis for making decisions regarding data needs and data archiving.

Starting in 2005, Douglas PUD conducted a data review and data gap analysis which resulted in the implementation of a data collection program to ensure that the appropriate model-specific parameters were being collected from within and adjacent to the Wells Project. Data collected during the new monitoring program are being archived in a format that is complementary to future water quality modeling efforts. This data collection program was initiated in 2006 and will continue through 2007 for use in model development during the ILP study period.

Methodologies for W2 model development consist of a data collection component and a model development/implementation component. The data collection component in W2 model development consists of activities such as site review and field reconnaissance, data gap analyses, preliminary data collection design and implementation of data collection programs. The model development/implementation component consists of model input data preparation, model development, hydrodynamic and temperature calibration, sensitivity analyses and hypothesis testing. Douglas PUD is currently (2005-2007) implementing the data collection component.

W2 model development and implementation will proceed in consultation with the Aquatic RWG. Model results will clarify the effects of Project operations as they relate to the state's narrative and/or numeric standards for temperature and will produce model output that will be important to the Wells Project 401 certification process.

1.0 INTRODUCTION

1.1 General Description of the Wells Hydroelectric Project

The Wells Hydroelectric Project (Wells Project) is located at river mile (RM) 515.8 on the Columbia River in the State of Washington. Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (COE), and 42 miles upstream from the Rocky Reach Hydroelectric Project owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam.

The Wells Project is the chief generating resource for Public Utility District No. 1 of Douglas County (Douglas PUD). It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides the hydrocombine, which is 1,130 feet long, 168 feet wide, with a crest elevation of 795 feet in height.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The normal maximum surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at elevation of 781. The normal maximum water surface elevation of the reservoir is 781 feet (Figure 1.1-1).

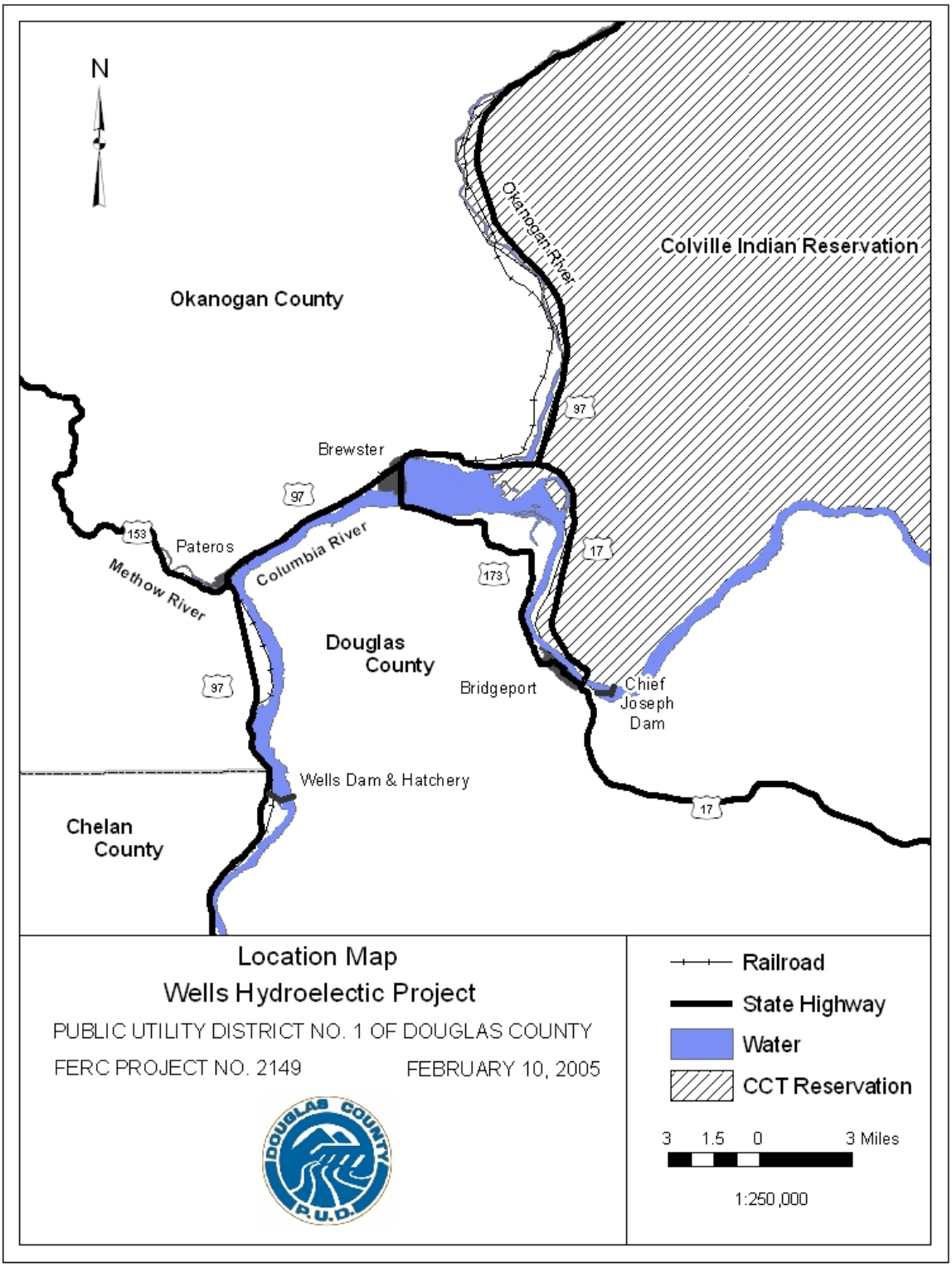

Figure 1.1-1 Location Map of the Wells Project

1.2 Relicensing Process

The current Wells Project license will expire on May 31, 2012. Douglas PUD is using the Integrated Licensing Process (ILP) as promulgated by FERC regulations issued July 23, 2003 (18 CFR Part 5). Various state and federal agencies, tribes, local governments, non-governmental organizations and the general public will participate in the Wells Project ILP. During the ILP, information needs related to the relicensing of the Wells Project will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b).

18 CFR § 5.9(b) Content of study request. Any information or study request must:

(1) Describe the goals and objectives of each study and the information to be obtained;
(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
(4) Describe existing information concerning the subject of the study proposal, and the need for additional information;
(5) Explain any nexus between project operation and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;
(6) Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate, considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

All study plans submitted to FERC will be reviewed by Douglas PUD and the applicable Resource Work Group(s) to determine if studies proposed will fill the information needs related to the Wells Project Relicensing. Any dispute over alternative study methods, that cannot be reconciled with stakeholders, will be decided by FERC.

2.0 GOALS AND OBJECTIVES

The objective of the study is to develop a temperature model (e.g., CE-QUAL-W2) to assess the effects of Wells Project operations on water temperatures at Wells Dam and within the Wells Reservoir as they relate to compliance with the Washington State Water Quality Standards and the 401 certification process.

The Washington State Department of Ecology (WDOE) is the agency responsible for administering the State Water Quality Standards and for the issuance of 401 water quality certificates for hydroelectric relicensing processes in Washington. The information gathered from this modeling effort will assist WDOE in determining the extent to which a Project's operations affect water temperature in excess of the narrative and/or numeric criteria. This

determination will also assist WDOE in the development of an implementation schedule as it applies to the 401 certification process.

3.0 STUDY AREA

The study area is defined as the waters within the Wells Reservoir. This consists of the mainstem Columbia River upstream of Wells Dam to the tailrace of Chief Joseph Dam, and the Okanogan (to RM 15.5) and Methow (to RM 1.5) rivers within Project boundary (Figure 1.1-1).

4.0 BACKGROUND AND EXISTING INFORMATION

In preparation for the development of a temperature model, Douglas PUD assessed the suite of models available. The CE-QUAL-W2 (W2 model) model is widely used to support the establishment of TMDLs for Washington waters and is a generally accepted model for evaluating the effects of hydroelectric projects. Therefore, the W2 model was considered the basis for making decisions regarding data needs and data archiving. With guidance for consultants having expertise in water quality modeling, Douglas PUD conducted a review on the types of information being collected within the Wells Project and whether the data currently collected was sufficient and in a complimentary format to support W2 model development. In response to the data review, Douglas PUD modified existing monitoring programs and in some cases initiated new programs in order to collect the necessary types of information for the W2 model.

Flow Data

Water flowing into the Wells Project originates from Chief Joseph Dam, on the Columbia River, and from the Okanogan and Methow rivers. Continuous hourly flow data from Chief Joseph Dam, located upstream of Wells Dam, are available from the Columbia River Operational Hydromet Management System (CROHMS) database. A stream gage station located near the town of Malott, WA, measures flow in the Okanogan River (USGS Gage No. 12447200) several miles upstream of the location where the Okanogan River enters the Wells Project. A stream gage station located near Pateros measures flow in the Methow River (USGS Gage No. 12449950) at the point where the river enters the Wells Project. All three of the boundary water monitoring stations provide Douglas PUD with hourly flow data.

Water flowing out of the Wells Project must first pass through Wells Dam. Douglas PUD collects and records hourly flow data for the water passing through the turbines, spillways and adult fish ladders at Wells Dam. Additionally, there is a United States Geological Survey (USGS) gauging station downstream of Wells Dam that also collects river flow information and is reflective of water passing through Wells Dam.

Temperature Data

Beginning in 2001, an extensive water temperature monitoring effort was initiated in order to better understand the temperature dynamics throughout the Wells Reservoir. Temperature data were collected at four locations (RM 544, RM 532, RM 530, RM 516) in the Columbia River

and at one location in both the Methow (RM 1.5) and Okanogan rivers (RM 13). Data were collected hourly using Onset tidbit temperature loggers. Monitoring start and end dates varied from year to year but generally began in the spring and ended in late fall. Quality assurance and control prior to deploying and upon retrieving temperature loggers were implemented to ensure that data collected were accurate (Douglas PUD, 2005). Due to sensor loss or sensor malfunction in some years, the availability of data at some of these monitoring locations is sporadic.

An additional component of the water temperature monitoring effort launched in 2001 was to profile vertical temperatures at the RM 516 location in the Columbia River at the Wells Dam forebay. The temperature station was located along the east portion of the forebay, in what had been the original channel of the Columbia River prior to the construction of the Wells Project. Each year between 2001-2005, temperature loggers were deployed at 3 different depths between 5 and 90 feet and approximately 30 feet apart from one another. Results reflected the limited storage capacity of the Wells Reservoir and showed no measurable thermal stratification.

Starting in 2006 and following the completion of the data review and data gap analysis, Douglas PUD expanded the Wells Reservoir temperature monitoring season to cover the entire year and implemented a more frequent downloading schedule to avoid temperature data gaps. Douglas PUD also added additional monitoring stations at the mouths of the Okanogan (RM 0.5) and Methow (RM 0.1) rivers. This collective data, which documents incoming water temperatures to the Wells Project (boundary conditions), as well as other sites throughout the Wells Reservoir including the Wells Dam forebay, will be integral in the development of a W2 temperature model.

Meteorological Data Collection

Site specific weather information is an integral component for the development of water temperature models which can be used to support 401 water quality certification. Weather information characteristic of the entire Wells Reservoir was unavailable up until 2005 when Douglas PUD began collecting site specific meteorological data. Douglas PUD identified three sites that would most effectively characterize weather trends in the Wells Reservoir.

These sites were Chief Joseph Dam (upper reservoir area), Bridgeport Bar (mid-reservoir area) and the Wells Project forebay (lower reservoir area). Since reliable meteorological information was already available near Chief Joseph Dam, NRG systems weather stations were erected at the other two identified sites in order to collect the suite of parameters that are required in support of water temperature modeling. The parameters collected were air temperature, relative humidity, dew point temperature, solar incidence, cloud cover, wind speed, and wind direction.

Bathymetric Data Collection

In March 2005, Douglas PUD contracted with GeoEngineers to conduct a detailed bathymetric survey of the Wells Reservoir and tailrace using multibeam sonar and GPS technology. Contour maps of the reservoir bottom were produced at 1-foot contour intervals, and a digital elevation

model (DEM) was produced at a pixel resolution of 10-feet. The DEM provides a seamless representation of the riverbed surface.

4.1 Aquatic Resource Work Group

As part of the preparation for the relicensing of the Wells Project, Douglas PUD established an Aquatic Resource Work Group (RWG) which began meeting informally in November, 2005. This voluntary effort was initiated to provide stakeholders with information about the Wells Project, to collaboratively identify potential resource issues related to Project operations and relevant to relicensing, and to develop preliminary study plans to be included in the Wells Pre-Application Document (PAD).

Through a series of meetings, the Aquatic RWG cooperatively developed a list of Issue Statements, Issue Determination Statements and Agreed Upon Study Plans. An Issue Statement is an agreed upon definition of a resource issue raised by a stakeholder. An Issue Determination Statement reflects the RWG's efforts to review the existing project information and to determine whether an issue matches with FERC's seven criteria and would be useful in making future relicensing decisions. Agreed Upon Study Plans are the finished products of the informal RWG process.

Based upon these meetings and discussions, the Aquatic RWG is proposing to include a study plan into the Wells PAD which addresses the effect of Project operations on compliance with temperature standards in the Wells Project (6.2.1.6). The need for this study was agreed to by all of the members of the Aquatic RWG, including Douglas PUD. This study will help to inform future relicensing decisions and will fill data gaps that have been identified by the Aquatic RWG.

4.2 Issue Statement

Issue Statement (6.2.1.6)

Project operations may affect compliance with temperature standards in the Wells Project.

Issue Determination Statement (6.2.1.6)

The Wells Project can have an effect on compliance with the water temperature standard. The Aquatic Resource Work Group members agree that studies to address this issue are feasible and the results will be meaningful for the 401 Water Quality Certification Process. Douglas PUD is currently collecting temperature data throughout the Wells Project. Furthermore, Douglas PUD has established weather stations to collect meteorological data in key locations of the Wells Reservoir. These data sets will be utilized to develop a temperature model (i.e., CE-QUAL-W2) to assess the Wells Project's effect on water temperatures.

The Resource Work Group believes that a study to develop a temperature model is necessary to determine compliance with the state's water quality standards. The resource work group agrees that this study (development of specific water temperature models) should be implemented during the two-year ILP study period.

Toward this goal, Douglas PUD will continue to collect water temperature and meteorological data during 2006 and 2007 for use in the development of a temperature model to be used in 2008 and/or 2009. Data may continue to be collected in 2008 and 2009, if necessary.

5.0 PROJECT NEXUS

The WDOE is responsible for the protection and restoration of the state's waters. WDOE has adopted standards that set water quality criteria for lakes, rivers, and marine waters in order to protect water quality and dependent uses. On July 1, 2003, WDOE completed the first major review and modification of the state's water quality standards in a decade. A significant revision presented in the 2003 water quality standards classifies fresh water by use, rather than by class as was done in the 1997 standards. These revisions were adopted in order to make the 2003 standards less complicated to interpret and provide greater flexibility as the uses of a water body evolve.

Congress passed the Clean Water Act in 1972, and designated the US Environmental Protection Agency (EPA) as the administering federal agency. This federal law requires that a state's water quality standards protect the surface waters of the US for beneficial uses, such as recreation, agriculture, domestic and industrial use, and habitat for aquatic life. State water quality standards, or amendments to these standards, do not take regulatory effect for the purposes of the Clean Water Act until they have been approved by EPA. EPA has completed an initial review of the water quality standards (WQS) adopted by the State of Washington in 2003 and has requested that WDOE revise some of the proposed WQS. Currently, WDOE is in the process of addressing EPA's comments and approval of the 2003 WQS is expected before Douglas PUD files its license application (2010) and Section 401 certification is issued (2012). Due to this, the 2003 standards as they apply to temperature in the Wells Project will be used.

The new WQS for water temperature within the Wells Project includes a number of numerical and narrative criteria. Those most pertinent to the Project are:

For the tributary reaches that are within the Wells Project boundary (Okanogan River from RM 0 to RM 15.5 and the Methow River from RM 0 to RM 1.5),

- Water temperature shall not exceed 17.5°C (63.5°F), where water temperature is measured by the 7-day average of the daily maximum temperatures (7-DADMax);

- When a water body's temperature is warmer than 17.5°C (or within 0.3°C (0.54°F) of 17.5°C) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C (0.54°F);

- When the natural condition of the water is cooler than 17.5°C the allowable rate of warming up to, but not exceeding, the numeric criteria (17.5°C) from human actions is restricted as follows:

  - Incremental temperature increases resulting from individual point source

activities must not, at any time, exceed 28/(T.+5) as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge);

- Incremental temperature increases resulting from the combined effect of all nonpoint source activities in the water body must not, at any time, exceed 2.8°C (5.04°F).

For the mainstem Columbia River that is within the Wells Project boundary,

- Water temperature shall not exceed 18.0°C (63.5°F), where water temperature is measured by the 7-day average of the daily maximum temperatures (7-DADMax);

- When a water body's temperature is warmer than 18.0°C (or within 0.3°C (0.54°F) of 18.0°C) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C (0.54°F);

- When the natural condition of the water is cooler than 18.0°C the allowable rate of warming up to, but not exceeding, the numeric criteria (18.0°C) from human actions is restricted as follows:

  - Incremental temperature increases resulting from individual point source activities must not, at any time, exceed 28/(T.+5) as measured at the edge of a mixing zone boundary (where "T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge);

  - Incremental temperature increases resulting from the combined effect of all nonpoint source activities in the water body must not, at any time, exceed 2.8°C (5.04°F).

The temperature of water flowing into and through the Wells Reservoir typically begins warming in March while reaching peak annual temperatures in August through early September. During this time period, incoming water into the Wells Project can exceed both the 7-DADMax numeric criteria of 17.5 °C and 18.0°C. A portion of the mainstem Columbia River encompassing Wells Dam is on the 2004 303(d) list as an impaired waterbody for temperature.

Water temperature is one of a multitude of environmental factors that may affect salmonid populations in the mid-Columbia River basin. Concerns have been raised that increasing temperature levels above a given threshold can begin to cause upstream migration delays, promote disease, and increase the probability of mortality for salmonids at all life history stages. Natural ambient water temperatures often exceed lethal tolerance levels for salmonids in the Lower Okanogan River (NMFS, 2002). Yet, the Okanogan watershed currently supports healthy

runs of anadromous summer/fall Chinook salmon and sockeye salmon, and smaller runs of steelhead (NMFS, 2002).

Currently, sufficient information is not available to examine the contribution of Wells Project operations to the warming of water temperatures above the conditions which would occur without the Project in place or with regard to the state's numeric criteria. The information resulting from a temperature model will assist the Aquatic RWG in the understanding of temperature effects due to Project operations as required by FERC's study criteria (18 CFR §5.9(b)(5)).

6.0 METHODOLOGY

The W2 model is widely used to support the establishment of TMDLs for Washington waters and is a generally accepted model for evaluating the effects of hydroelectric projects on various water quality parameters (EES Consulting, 2006).

The development of a W2 model consists of two major components; data collection for model input and model development/implementation. The data collection component in W2 model development consists of activities such as site review and field reconnaissance, data gap analyses, preliminary data collection design and implementation of data collection programs. The model development/implementation component consists of model input data preparation, model development, hydrodynamic and temperature calibration, sensitivity analyses and hypothesis testing.

Douglas PUD has already begun and will continue activities associated with the data collection component as described in Section 4.0 in preparation for the development of a W2 model. The information collected by these activities was developed through guidance from consultants specializing in water quality modeling and with extensive W2 modeling experience. There are a suite of consulting firms that specialize in water quality model development and application within Washington State. Prior to the start of the 2-year ILP study period (2008-2009), Douglas PUD will secure the services of a qualified consultant to develop a W2 model for Wells Dam and the Wells Reservoir. Model development will generally not require access to Wells Project facilities; however, it may be necessary to grant access in order to clarify specific components of the modeling process. The W2 model will provide insight into whether the Wells Project is in compliance with the temperature criteria as specified in the Washington State water quality standards and provide useful information for the Wells Project 401 certification process.

7.0 STAFFING AND EQUIPMENT REQUIREMENTS

The equipment necessary to complete the data collection component of the W2 model has already been acquired by Douglas PUD. Cost and level of effort associated with the implementation and maintenance of data collection programs currently being implemented to support future W2 model development has been absorbed by Douglas PUD.

The technical skills necessary to complete the study are a strong knowledge of W2 model development, experimental design, and quantitative analyses and their applicability to the

Washington State water quality standards, 401 water quality certification, and hydroelectric relicensing processes.

Douglas PUD is currently engaged in the data collection component of the study. However, a contractor will be hired to conduct the model development/implementation component of the study. The persons or firms responsible for analysis are yet to be determined.

No permits will be required in order to complete this study.

8.0 BUDGET

As mentioned in Section 4.0, field activities to begin collecting the necessary parameter data to develop a W2 temperature model are currently in progress. Total estimated hours for the implementation of these activities is approximately 250 person hours. These hours are all associated with deployment and maintenance of data logging equipment and is estimated to be $12,500. Equipment costs and expenses related to field implementation (weather stations, temperature loggers, boat use, travel, etc.) is estimated to be $15,000. Total costs for the data collection effort is approximately $27,500.

The total estimated hours for the development of a W2 temperature model is approximately 1,021 person hours. The allocation of these hours is approximately 25 hours for study planning and site visit; 182 hours for preparation of model input data; 630 hours for model development, analysis, and compliance assessment; and 184 hours for reporting, meetings, and quality assurance/control processes. Total costs for model development are estimated to be $100,000.

Total planning level cost for this effort is approximately $127,500.

9.0 SCHEDULE

Data collection of all the necessary parameters for the development of a W2 model began in 2006 and will continue through 2007. The development of a model integrating the information collected from 2006-2007 will take place after the issuance of FERC's Study Plan Determination in October 2007. It is expected that this effort will take most of 2008 and/or 2009 to complete. An Initial Study Report will be provided to the Aquatic RWG, stakeholders and FERC in October 2008 with a final report summarizing the processes of model development, analyses, and results by October 2009. The information provided in the final report will be useful in discussions related to the Wells Project relicensing and 401 certification process.

10.0 REFERENCES

Douglas PUD (Public Utility District No.1 of Douglas County). 2005. Wells Dam Total Dissolved Gas Abatement Plan For 2005 and 2006. Prepared by Rick Klinge, Public Utility District No. 1 of Douglas County, East Wenatchee, WA.

EES Consulting (EES Consulting, Inc.). 2006. Comprehensive Limnological Investigation, Wells Hydroelectric Project, FERC NO. 2149. Prepared by EES Consulting Inc., Kirkland, WA for Public Utility District No. 1 of Douglas County, East Wenatchee, WA.

NMFS (National Marine Fisheries Service). 2002. Anadromous Fish Agreements and Habitat Conservation Plans: Final Environmental Impact Statement for the Wells, Rocky Reach, and Rock Island Hydroelectric Projects. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service.

CONTINUED MONITORING OF DO, pH, AND TURBIDITY IN THE WELLS FOREBAY AND LOWER OKANOGAN RIVER (AQUATIC ISSUE 6.2.1.7)

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

December, 2006

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington

For copies of this study plan, contact:

Public Utility District No. 1 of Douglas County
Attention: Relicensing
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4497
Phone: (509)884-7191
E-Mail: relicensing@dcpud.org

ABSTRACT:

The current Wells Hydroelectric Project (Wells Project) license will expire on May 31, 2012. The Public Utility District No. 1 of Douglas County (Douglas PUD) owns and operates the Wells Project and is using the Integrated Licensing Process (ILP) for relicensing as promulgated by Federal Energy Regulatory Commission (FERC) regulations issued July 23, 2003 (18 CFR Part 5). As part of the Wells Project relicensing process, Douglas PUD is required to obtain a water quality certificate pertinent to section 401 of the Clean Water Act. The Washington State Department of Ecology (WDOE) is responsible for the issuance of a 401 certificate as well as administering the state's Water Quality Standards. As part of the 401 certification process, WDOE must determine that the Wells Project is in compliance with state water quality standards for dissolved oxygen (DO), pH, and turbidity.

The Aquatic Resource Work Group (RWG), which is composed of stakeholders (including WDOE) and Douglas PUD staff, was formed for the purposes of identifying issues and information gaps that may require study during the relicensing of the Wells Hydroelectric Project. The Aquatic RWG, through a series of technical meetings, is proposing a study to collect additional DO, pH, and turbidity data from within the Wells Project.

Douglas PUD and other state and federal agencies have monitoring programs in place that collect water quality information related to these parameters at various scopes and frequencies. This study will augment the established sampling regimes and will provide additional information related to DO, pH and turbidity from within the Wells Project.

Sampling locations for the study are the Lower Okanogan River within Project boundary and the Wells Dam forebay. Study implementation is planned for 2008 with sampling occurring during periods where the probability of exceedance with the water quality standard is highest (between mid-July and mid-September).

A technical summary of the monitoring study will be produced to assist the Aquatic RWG in determining whether the Wells Project is in compliance with the state's water quality standards for these parameters which are a necessary component of the 401 water quality certification process.

1.0 INTRODUCTION

1.1 General Description of the Wells Hydroelectric Project

The Wells Hydroelectric Project (Wells Project) is located at river mile (RM) 515.8 on the Columbia River in the State of Washington. Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (COE), and 42 miles upstream from the Rocky Reach Hydroelectric Project owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from the Wells Dam.

The Wells Project is the chief generating resource for Public Utility District No. 1 of Douglas County (Douglas PUD). It includes ten generating units with a nameplate rating of 774,300 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both sides the hydrocombine, which is 1,130 feet long, 168 feet wide, with a crest elevation of 795 feet in height.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan rivers are tributaries of the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The normal maximum surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre feet at elevation of 781. The normal maximum water surface elevation of the reservoir is 781 feet (Figure 1.1-1).

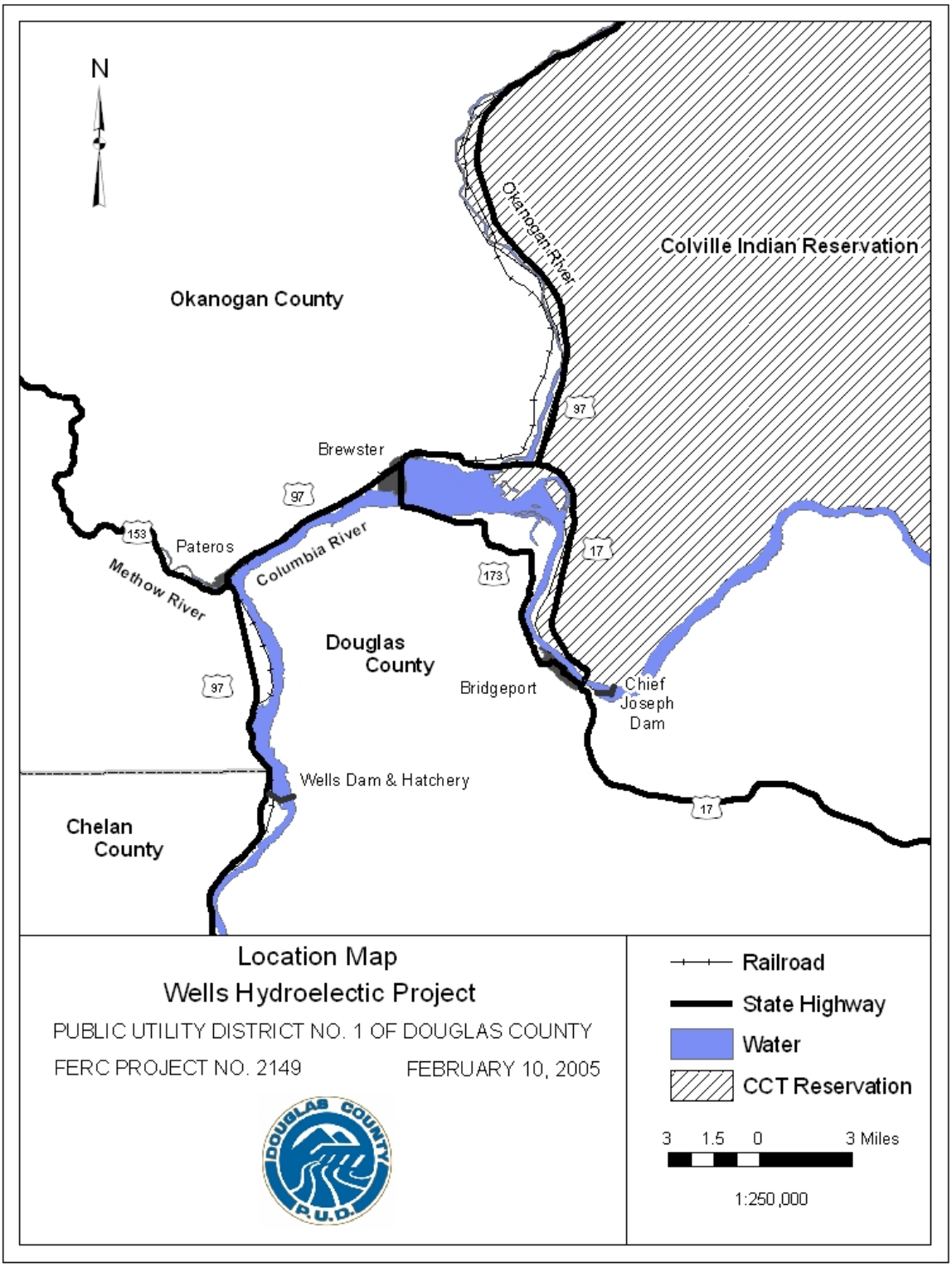

Figure 1.1-1 Location Map of the Wells Project

1.2 Relicensing Process

The current Wells Project license will expire on May 31, 2012. Douglas PUD is using the Integrated Licensing Process (ILP) as promulgated by FERC regulations issued July 23, 2003 (18 CFR Part 5). Various state and federal agencies, tribes, local governments, non-governmental organizations and the general public will participate in the Wells Project ILP. During the ILP, information needs related to the relicensing of the Wells Project will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b).

18 CFR § 5.9(b) Content of study request. Any information or study request must:

(1) Describe the goals and objectives of each study and the information to be obtained;
(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
(3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
(4) Describe existing information concerning the subject of the study proposal, and the need for additional information;
(5) Explain any nexus between project operation and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;
(6) Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate, considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

All study plans submitted to FERC will be reviewed by Douglas PUD and the applicable Resource Work Group(s) to determine if studies proposed will fill the information needs related to Wells Project Relicensing. Any dispute over alternative study methods that cannot be reconciled with stakeholders will be decided by FERC.

2.0 GOALS AND OBJECTIVES

The objective of the study is to continue monitoring dissolved oxygen (DO), pH, and turbidity in the Wells Dam forebay and Lower Okanogan River within the Wells Project boundary.

The Washington State Department of Ecology (WDOE) is the agency responsible for administering the state Water Quality Standards and for the issuance of 401 water quality certificates for hydroelectric relicensing processes in Washington. The information gathered from this monitoring effort will assist WDOE in determining the extent to which Project operations have an affect on compliance with the specified numeric criteria for DO, pH and turbidity. This determination will also assist WDOE in the development of an implementation schedule as it applies to the 401 certification process.

3.0 STUDY AREA

The study area consists of waters within the Wells Project with a particular emphasis on the Wells Forebay and the Lower Okanogan River from its confluence with the Columbia River up to river mile (RM) 15.5 (Figure 1.1-1).

4.0 BACKGROUND AND EXISTING INFORMATION

WDOE has established water quality standards in an effort to protect the beneficial uses of state water and water bodies. The Washington standards include both numeric and narrative criteria. The narrative standards address beneficial uses that include, but are not limited to, the ecological significance of water quality to aquatic biota. The importance of water quality to the health of rare, threatened, and endangered populations is also described in the narrative standards.

DO levels are an extremely important variable for aquatic life and govern the chemical dynamics of a water body. DO levels are influenced by a suite of factors including the level of biological activity in the water, turbulence, and temperature (EES Consulting, 2006).

Turbidity is the measure of the light scattering from suspended particles in water. After light enters water, it is absorbed, reflected or refracted by dissolved organic substances, pigmented (phytoplankton) and colored particulates and by the water itself. Light is scattered by inorganic particulates. Turbidity is a good indicator of a waterbodies trophic status when combined with nutrient and chlorophyll data. Transparency also regulates primary productivity and trophic dynamics which ultimately can affect fish populations. There is a direct relationship between turbidity, water transparency and the depth at which macrophytes grow (EES Consulting, 2006).

The term pH is used to describe the acidity or hydrogen ion level of a liquid. Factors influencing the pH of a water body include the chemical composition of soils in the watershed, photosynthetic activity, pollutants, and respiration of organisms (EES Consulting, 2006). pH levels which are extremely acidic or basic can adversely impact aquatic life and may be representative of metals and other pollutants present within a watershed.

Factors and activities affecting water quality in the Wells Project include 1) nonpoint source pollution from agricultural runoff and irrigation return flow, 2) point source pollution from mines, municipal and industrial sources upstream and outside of the Wells Project boundary, 3) depletion of instream flows from water diversions and consumptive uses, 4) watershed management in the tributaries and Upper Columbia River above Wells Dam, 5) the operation of large water storage facilities located upstream of Wells Dam on the mainstem Columbia and in the Okanogan watershed, and 6) effects related to operations of the Wells Project.

Under section 303(d) of the 1972 Clean Water Act, states are required to list all water body segments that do not meet the state water quality standards. Within the Wells Project boundary, specific water reaches have been put on the state's 303(d) list in the past for various parameters. However, the lower Okanogan River within Project boundary as well as all other areas within the Wells Project is not on the 2002/2004 303(d) list with respects to the parameters of interest.

Douglas PUD and state and federal agencies have implemented monitoring programs to collect information within or adjacent to the Wells Project at various scopes and frequencies. The programs collect a variety of biological, chemical, and physical water quality parameters and typically include the three parameters of interest (DO, pH, and turbidity). Data collected from these monitoring activities suggest that waters within the Wells Project are generally in compliance with the state standards. During times when Wells Project waters are in exceedance of the stated numeric criteria for these parameters, waters entering the Wells Project are also out of compliance.

Douglas PUD Monitoring Activities

In August, 2005, Douglas PUD began monitoring DO and pH in the Wells Dam forebay when the probability of low DO levels was highest. The results of this monitoring effort indicated that DO levels were not below 8.0 mg/L and pH levels were not outside of the specified range of 6.5 to 8.5, which are the state water quality numeric criteria (WAC 173-201A as amended July 1, 2003). In response to requests made by WDOE, Douglas PUD has continued implementing seasonal monitoring, for the summer months of 2006, for these parameters at the Wells Dam forebay. At Wells Dam, Secchi disk readings are taken to measure water transparency which is inversely correlated to turbidity. Sampling occurs daily during the adult fish passage assessment period of May 1st to November 15th. Measurements are recorded in feet of visibility and reliable information adhering to a standard protocol has been collected since 1998. During the monitoring period, Secchi disk readings ranged from 2 feet during spring run-off to 16 feet by late summer (Douglas PUD, 2006).

In 2005, Douglas PUD contracted with EES Consulting to conduct a comprehensive limnological investigation of Wells Project waters (EES Consulting, 2006). The year long study was conducted at nine sites (7 sites in the Columbia River and 1 site in the Methow and Okanogan rivers) in order to characterize water quality and seasonal trends in the Wells Project. Water quality sampling was scheduled seasonally with one sample event scheduled for each season. Spring sampling was conducted in May, fall monitoring was conducted in October, and winter sampling occurred in February (2006). Summer sampling was conducted more frequently when water quality exceedances were more likely and temporal changes more dynamic (July, August and September). Results of the study found DO levels at 1m depth in Wells Project waters increased from upriver to downriver at the sites sampled; the average difference (May through October) was 1.07 mg/L. All surface water measurements had DO values greater than 8.0 mg/L. pH for Wells Project waters generally varied between 7.5 and 8.25, which is slightly above neutral. There were no measured exceedances of the water quality standard for pH. Turbidity in the Wells Reservoir showed relatively little seasonal variation with an annual average of 0.98 Nephelometric Turbidity Units (NTU). Longitudinal variation in turbidity was also minimal. Low turbidity in the reservoir is partially due to the large upstream storage reservoir capacity that allows fines to settle out. Turbidity in the Okanogan River was consistently higher than in the Wells Reservoir. Turbidity in the Methow River was higher than in the Wells Reservoir in May (due to sediment load) and in August due to phytoplankton growth. The only turbidity reading over 5 NTU was in the Methow River during May (EES Consulting, 2006).

WDOE Monitoring Activities

WDOE has conducted monthly water quality monitoring at locations on the Okanogan River near Malott (station 49A070) upstream of the Wells Project boundary at approximately RM 17 and on the Methow River near Pateros (station 48A070) upstream of the Wells Project boundary at approximately RM 5. Both stations are considered "long-term" stations by WDOE and provide the most reliable information for the quality of water entering the Wells Reservoir from tributary inflow. It is important to note that data collected from these stations are representative of water quality conditions outside of the Wells Project boundary. Data are typically collected as grab samples on a monthly basis. A variety of water quality parameters including DO, pH, and turbidity information as well as site compliance are available at http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html. Table 4.0-1 provides the range of values for the parameters of interest observed at these two long-term monitoring stations since 2001.

Table 4.0-1. The range of DO, pH and turbidity values observed from monthly grab samples collected upstream of the Wells Project on the Okanogan (RM 17) and Methow rivers (RM 5). Data from WDOE long-term monitoring stations 2001-2005.

Okanogan River (RM 17)	**2001**	**2002**	**2003**	**2004**	**2005**
DO (mg/L)	7.32-13.87	8.8-13.63	8.32-13.3	8.16-14.08	7.24-14.11
pH	7.87-8.45	7.83-8.39	7.81-8.35	7.48-8.55	7.85-8.44
Turbidity (NTU)	0.8-5.5	1.0-19.0	0.8-22.0	0.9-75.0	0.8-7.8
Methow River (RM 5)					
DO (mg/L)	9.56-14.48	9.8-13.8	9.34-14.2	9.18-14.69	9.28-14.36
pH	8.04-8.74	7.46-8.53	7.71-8.48	7.73-8.58	7.78-8.38
Turbidity (NTU)	0.5-2.9	0.5-3.8	0.5-6.0	0.5-8.8	0.9-5.7

United States Geological Survey (USGS) Monitoring Activities

The USGS studies surface-water quality in cooperation with local and state governments and with other federal agencies. Monitoring programs consist of collection, analysis and data archiving and dissemination of data and information describing the quality of surface water resources. Similar to WDOE, the USGS has monitoring stations on both the Okanogan (12447200) and Methow (122449950) rivers near Malott and Pateros, respectively; however, the data collected at these stations appear to be incomplete and therefore less reliable in providing representative data for tributary water quality than data furnished by WDOE (Douglas PUD, 2006). Data can be accessed via the Internet at: http://nwis.waterdata.usgs.gov/wa/nwis/qwdata

4.1 Aquatic Resource Work Group

As part of the preparation for the relicensing of the Wells Project, Douglas PUD established an Aquatic Resource Work Group (RWG) which began meeting informally in November, 2005. This voluntary effort was initiated to provide stakeholders with information about the Wells Project, to collaboratively identify potential resource issues related to Project operations and relevant to relicensing, and to develop preliminary study plans to be included in the Wells Pre-Application Document (PAD).

Through a series of meetings, the Aquatic RWG cooperatively developed a list of Issue Statements, Issue Determination Statements and Agreed Upon Study Plans. An Issue Statement is an agreed upon definition of a resource issue raised by a stakeholder. An Issue Determination Statement reflects the RWG's efforts to review the existing project information and to determine whether an issue matches with FERC's seven criteria and would be useful in making future relicensing decisions. Agreed Upon Study Plans are the finished products of the informal RWG process.

Based upon these discussions, the Aquatic RWG is proposing to include a study plan into the Wells PAD which addresses the continued monitoring of DO, pH, and turbidity in the Wells Forebay and inundated portion of the Okanogan River. The need for this study was agreed to by all of the members of the Aquatic RWG, including Douglas PUD. This study will help to inform future relicensing decisions through the 401 water quality certification process and will fill data gaps that have been identified by the Aquatic RWG.

4.2 Issue Statement

Issue Statement (6.2.1.7)

Project operations may affect compliance with DO, pH and turbidity standards in the Wells Project.

Issue Determination Statement (6.2.1.7)

The Wells Project may have an effect on compliance with the standards for DO, pH and turbidity. Currently, Douglas PUD has collected water quality data toward the evaluation of meeting the numeric criteria for these parameters. Initial data collected during the 2005 baseline limnological assessment indicates that Douglas PUD is in compliance with the Washington State Standard for these parameters. However, additional monitoring is required to make a final determination.

The resource work group agrees that a study during the two-year ILP study period is necessary. The study will focus on the collection of DO, pH and turbidity in the Wells Project especially focusing on data collection from the Okanogan River and at Wells Dam.

5.0 PROJECT NEXUS

The WDOE is responsible for the protection and restoration of the state's waters. WDOE has adopted water quality standards that set limits on pollution in lakes, rivers, and marine waters in order to protect water quality. On July 1, 2003, WDOE completed the first major overhaul of the state's water quality standards in a decade. A significant revision presented in the 2003 water quality standards classifies fresh water by actual use, rather than by class as was done in the 1997 standards. These revisions were adopted in order to make the 2003 standards less complicated to interpret and provide future flexibility as the uses of a water body evolve.

Congress passed the Clean Water Act in 1972, and designated the U.S. Environmental Protection Agency (EPA) as the administering federal agency. This federal law requires that a state's water quality standards protect the surface waters of the U.S. for beneficial uses, such as recreation, agriculture, domestic and industrial use, and habitat for aquatic life. State water quality standards, or amendments to these standards, do not take regulatory effect for the purposes of the Clean Water Act until they have been approved by EPA. EPA is currently reviewing the water quality standards adopted by the State of Washington in 2003 and partial approval has occurred. Full approval is expected before Douglas PUD files its license application (2010) and Section 401 certification is issued (2012). Due to this, the 2003 standards will be used for the purposes of this study.

The new water quality standards for DO, pH, and turbidity include a number of numerical and narrative criteria. Those most pertinent to the Wells Project are:

- Freshwater – dissolved oxygen shall exceed 8.0 mg/L in waters that have a designated aquatic life use of salmonid spawning, rearing and migration. Dissolved oxygen shall exceed 6.5 mg/L in waters that have a designated aquatic life use of salmonid rearing and migration only.
- pH shall be within the range of 6.5 to 8.5 (freshwater with human–caused variation within the above range of less than 0.5 units.
- Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

Whether it is by the reduction in the level of oxygen available for aquatic life, low pH levels indicative of heavily polluted waters, or increased sediment transport, which can reduce transparency and affect productivity at varying trophic levels, DO, pH, and turbidity are environmental variables critical to the health of a waterbody and therefore the aquatic life that live there.

The information resulting from continued monitoring of DO, pH, and turbidity will assist the Aquatic RWG in the development of licensing requirements through the 401 water certification process.

6.0 METHODOLOGY

In order to collect information that will be informative of the effects of Wells Project operations on the water quality parameters of interest and whether these parameters are in compliance with the Washington State water quality standards, sampling stations will be located in the following locations:

- Okanogan River at Project boundary (RM 15.5),
- Okanogan River near Monse (RM 5.0),
- Okanogan River upstream of the confluence with the Columbia River (RM 0.5),
- Wells Dam forebay (RM 516).

Data will also be available from the WDOE monitoring station (station 49A070) located near Malott on the Okanogan River (RM 17) to supplement the collected information. A review of the current Wells Forebay monitoring program will be conducted for its suitability to the study objectives. Any agreed upon modifications to this existing Wells Forebay monitoring program will be implemented during the first year of the 2-year ILP study period (2008).

Currently, WDOE is proposing to conduct continued DO monitoring in the Lower Okanogan River in 2008. Although study methodology is currently being developed, Douglas PUD will coordinate with WDOE in order to maintain consistent sampling practices so that DO information collected during this time period will be comparable between all sites where information is collected. Monitoring will occur between mid-July and mid-September when the probability of exceedances for these parameters is highest. Although WDOE is not proposing to monitor pH and turbidity during this time period, Douglas PUD will continue to monitor these parameters to meet Washington State's credible data criteria.

At each of the three stations located in the Lower Okanogan River and at the station in the Wells Dam forebay, dissolved oxygen (DO), pH, and turbidity will be measured continuously using a Hydrolab minisonde or other appropriate instrumentation. Instruments will be calibrated prior to each field visit according to the manufacturer's specifications. Winkler titrations will be performed at appropriate intervals to ensure the dissolved oxygen probe is functioning properly. The probe will be re-calibrated if the result of the Winkler titration and probe reading differed by more than 0.2 mg/L. At each monitoring site, instrumentation will be placed so as to best represent the overall river condition.

Quality assurance plans will meet state and Federal guidelines. Based upon the data collected and discussions with the Aquatic RWG, a determination will be made as to whether the information collected in 2008 is sufficient or whether a second year of data collection is necessary.

7.0 STAFFING AND EQUIPMENT REQUIREMENTS

Based upon discussions with the Aquatic RWG regarding study design and study needs, Douglas PUD will begin acquiring the necessary field equipment and/or the assistance of consultant services to complete the study.

The technical skills necessary to complete the study are knowledge of water quality monitoring instrumentation, field techniques consistent with WDOE's preliminary guidance manual, motor boat operation and safety, data acquisition and management, and Washington State water quality standards.

No permits will be required in order to complete this study.

8.0 BUDGET

The total estimated hours for the implementation of the DO, pH, and turbidity monitoring study for 2008 is approximately 360 person hours. The allocation of these hours is approximately 20 hours for study plan development; 280 hours for field activities (deployment, servicing, retrieval); and 60 hours for data management, data analysis and reporting. Labor costs are estimated to be $40,000. Equipment costs and expenses related to field implementation (travel, sensor rental, boat use, etc.) are estimated to be $35,000. Total planning level cost for this effort is approximately $75,000.

9.0 SCHEDULE

Planning for this study will begin shortly after the issuance of FERC's Study Plan Determination in October 2007. Equipment will be purchased during 2007 depending upon FERC's Study Plan Determination. Preliminary results of monitoring in late 2007 and 2008 will be provided in an Initial Study Report and will be filed with FERC along with the Initial Study Report due in October 2008. A technical summary of the processes, data collected, and results will be produced for use by the Aquatic RWG in discussions related to the Wells Project relicensing and 401 certification process. A final study report detailing the results of the study will be provided by October 2009.

10.0 REFERENCES

EES Consulting (EES Consulting, Inc.). 2006. Comprehensive Limnological Investigation, Wells Hydroelectric Project, FERC NO. 2149. Prepared by EES Consulting Inc., Kirkland, WA for Public Utility District No. 1 of Douglas County, East Wenatchee, WA.