

**Appendix F**  
**Baseline Studies and Monitoring Activities**

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## **Baseline Studies and Monitoring Activities**

Douglas PUD has been diligent in its efforts to collect the most current information about the Wells Project. These efforts included a thorough literature review, development of a Relicensing Library and the completion of a series of baseline relicensing studies that have focused on the ecological and social resources found within the Wells Project. Copies of the reports are available to the public in the Wells Project relicensing library.

- Aquatic Macroinvertebrate Inventory and RTE Assessment
- Bathymetric Mapping
- Bull Trout Monitoring Program
- Botanical Resources: Cover Type Mapping, RTE Plant Surveys, and Invasive Plant Species Surveys
- Effects of Water Level Fluctuations on Natural Resources within the Wells Project: A Review of Existing Information
- Limnological Investigation
- Macrophyte Identification and Distribution Study
- Recreation Visitor Use Assessment
- Temperature Monitoring
- Total Dissolved Gas Study
- White Sturgeon (*Acipenser transmontanus*) Population and Life-History Assessment, Wells Reservoir
- Wildlife Resources: Avian, Amphibian, Reptile, and Small Mammal Surveys and RTE Wildlife Surveys.

In addition to the baseline relicensing studies listed above, Douglas PUD is participating in several ongoing studies that will provide Douglas PUD and interested stakeholders with a better understanding of the Wells Project during the ILP. These include the continued collection of water temperature and meteorological data from throughout the Wells Project, the collection of two additional years of total dissolved gas data, the completion of a traditional and cultural properties (TCP) inventory and implementation of the second and third years (2006 and 2007) of the three-year bull trout monitoring program.

Full reports of the baseline studies and monitoring activities are available on the relicensing website at [www.douglaspud.org/relicensing](http://www.douglaspud.org/relicensing). Summaries of each of the 12 baseline studies are included below.

## **Aquatic Macroinvertebrate Inventory and RTE Assessment**

This study was initiated to provide baseline information on the aquatic macroinvertebrate fauna and mollusks in the Wells Project. This aquatic macroinvertebrate inventory was conducted in order to inventory the aquatic macroinvertebrate and mollusk assemblage found within the Wells Project and in order to provide information on the possible occurrence of rare, threatened and endangered (RTE) macroinvertebrate species potentially occurring within the Wells Project. Additional objectives of the study include describing habitat associations and qualitative abundance for various species categories of macroinvertebrates.

In order to achieve these objectives, benthic macroinvertebrates were sampled within representative habitats throughout the Wells Project. The abundance and richness of the aquatic macroinvertebrate fauna varied according to habitat. There were eighty-eight different taxa observed in the study area with the most abundant and diverse taxa observed in littoral areas of fast and slow water habitats. Fast water areas were more abundant but generally had the same taxa richness as slow water habitat.

Macroinvertebrate abundance in slow water littoral areas varied from 231 to 683 organisms per sample and fast water varied from 5,224 to 9,184 organisms per sample. Deepwater site abundance in the Columbia River ranged from 5 to 295 organisms per sample. In littoral areas, chironomids were consistently one of the most dominant taxa but other taxa were also important such as Gastropoda, Annelida, Crustacea, and Trichoptera. Similar taxa were important in the Methow and Okanogan rivers.

There were seventeen different mollusk species identified in the Wells Project. Of these seventeen species, nine were gastropods and eight were bivalves. The gastropods included eight native species and one non-native snail. The bivalves included seven native species and one non-native clam. There were two Washington State candidate species, the Columbia River spire snail and Columbia River limpet, found in the Methow River in relatively clean and complex substrate. The Columbia spire snail was also found in the Okanogan River in areas that once appeared to be riffle habitat. At these locations the water was about 2-meters deep and the substrate was mostly sand with fines, gravel, and cobble. These mollusks were not abundant at either site and in most instances were identified from shell fragments or dead organisms. No Federal ESA listed or Federal candidate macroinvertebrates or mollusks were found during the study in the Wells Project.

## **Bathymetric Mapping**

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. The bathymetry provides a seamless representation of the riverbed surface. The Bathymetric Mapping will be useful for such things as water temperature modeling, aquatic plant mapping and fish studies throughout the relicensing process.

## **Bull Trout Monitoring Program**

Douglas PUD has implemented a three-year Bull Trout Monitoring Plan as part of the requirements of the Wells Habitat Conservation Plan (HCP) and existing Project license. Article 61 of the Wells Project license discussed the need for a management plan and requires Douglas PUD to develop and implement plan in consultation with the US Fish and Wildlife Service, NOAA Fisheries, Washington Department of Fish and Wildlife and interested Indian Tribes. Douglas PUD has contracted with LGL Limited to trap, sort and tag appropriately sized Bull Trout at Wells Dam. The primary objective of the three-year monitoring and management plan is to radio-tag, monitor and evaluate the level of Bull Trout take associated with passage at Wells Dam. Although implementation of the Bull Trout Study is directly related to FERC's approval of the Wells HCP, information collected during the study will be useful during the Relicensing of the Wells Project. The Bull Trout Monitoring Plan is currently being conducted.

## **Botanical Resources: Cover Type Mapping, RTE Plant Surveys, and Invasive Plant Species Surveys**

In 2005, Public Utility District #1 of Douglas County (Douglas PUD) conducted a botanical resources study to collect information pertinent to the Wells Hydroelectric Integrated Licensing Process. During the study, 13 occurrences of four rare plants were observed and documented in the Wells Project Area, including little bluestem (*Schizachyrium scoparium*), chaffweed (*Centunculus minimus*), northern sweetgrass (*Hierochloe odorata*), and brittle prickly-pear (*Opuntia fragilis*). Ute ladies' tresses (*Spiranthes diluvialis*), a federally listed threatened species of orchid, was not observed during rare plant surveys conducted in 2005 despite the presence of suitable wetland habitat in the Wells Project Area.

Noxious weed surveys in the Wells Project Area mapped and documented 99 occurrences of four Class B-designate weed species, including purple loosestrife (*Lythrum salicaria*), dalmation toadflax (*Linaria dalmatica*), leafy spurge (*Euphorbia esula*), and perennial pepperweed (*Lepidium latifolium*). Although not mapped, two Class B weeds—Russian knapweed (*Acroptilon repens*) and diffuse knapweed (*Centaurea diffusa*)—were common in upland or transitional upland/wetland habitats; two Class C weeds—reed canarygrass (*Phalaris arundinacea*) and yellow flag (*Iris pseudacorus*)—were common species in Project Area wetlands and along reservoir shorelines.

Cover types were mapped and field verified on 2,539 acres of land within the Wells Project Area. Upland and wetland habitats comprised 32 percent and 31 percent of the Project Area, respectively; 26 percent of the land was agricultural and another 6.9 percent shows evidence of development. The remaining areas mapped included Upland Rock Habitats, Littoral Zone, and Bare-Disturbed-Eroded which comprised, in total, less than 5 percent of the Project Area.

## **Effects of Water Level Fluctuations on Natural Resources within the Wells Project: A Review of Existing Information**

This document presents an assessment of the effects of Wells Reservoir operations on natural resources of the Wells Project. The objectives of this study were to describe the effects of these operations on aquatic resources, with emphasis on salmonids and Pacific lamprey; terrestrial resources, with emphasis on waterfowl, amphibians, wetlands and riparian habitat; and erosion. This review found that past operations within the Wells Project lead to minimal daily fluctuations of one to two feet and infrequent operations greater than four feet. Infrequent reservoir operations below 777 msl occurred only 1.1% of the time during operations from 1990 to 2005.

The effect of consistent daily fluctuations on natural resources appeared negligible on aquatic and terrestrial resources. Investigation suggested that the effects of daily fluctuations and infrequent operations below 777 msl on anadromous salmon and bull trout are limited, due to their minimal use of habitat within the project boundary. Pacific lamprey juveniles and adults are highly mobile and do not appear to be affected by fluctuations, while a small portion of less mobile ammocoete larvae may have an increased risk of stranding and entrapment. Wetlands are well-suited to handling changes in soil moisture and water content and the short duration of past reservoir operations did not pose a threat. Waterfowl may be temporarily displaced from preferred habitat, but numerous alternative food resources and the short duration of even the deepest operational events appears to have a negligible effect on the thriving waterfowl population. Small amounts of erosion are occurring within the Project, but the contributions of reservoir operations on erosion were judged to be minor.

### **Limnological Investigation**

In preparation for relicensing of the Wells Hydroelectric Project, Douglas PUD identified the need for a comprehensive limnological investigation (biological, chemical, and physical water quality parameters) for the waters contained within the Wells Project Boundary. Implementation of the study included identifying data gaps, study design methodology, and data collection and analysis parameters necessary to create a baseline inventory that addresses requirements for Clean Water Act certification and the Wells Project relicensing process. The study objectives were to document existing water quality conditions within the Wells Reservoir and Wells Dam tailrace with reference to WDOE water quality standards. The data generated from this study were collected and managed in a manner that supports future water quality modeling efforts, (if modeling is required in the future). The CE-QUAL-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. Therefore, the CE-QUAL-W2 model (ver. 3.1) was considered the basis for making decisions regarding study design and data archiving.

The study approach and methods used during this investigation were consistent with WDOE's "Water Quality Certification for Existing Hydropower Dams: Preliminary

Guidance Manual (September 2004).” Quality assurance plans were consistent with State and Federal guidelines. The laboratories used to analyze water quality samples were fully certified to conduct the analyses included in this study.

The study design was structured to evaluate the effects of Project operations and structures on water quality. The selection of sample sites were based on the anticipated data needs for future water quality modeling. A total of nine sampling sites, which included mainstem sites, tributaries and lateral habitats were selected to document the biological, physical and chemical water quality variability of the Wells Project. Water quality sampling was seasonal with one sample event scheduled for each month of May, August, October and February. An additional sampling event was scheduled in July and September to provide for monthly sampling frequency in the summer. Phytoplankton sampling occurred concurrently with water chemistry sampling. Periphyton sampling also occurred during all sampling events except October (five total sample events). This sampling scheme documented water quality during periods when potential exceedences are most probable and focused on periods when water quality is more temporally dynamic.

This report describes the methods and results for this study.

### **Macrophyte Identification and Distribution Study**

In August and September of 2005, the Public Utility District No. 1 of Douglas County conducted a study to address the species composition, relative abundance and spatial distribution of macrophyte beds within the waters of the Wells Hydroelectric Project (Wells Project). Study methods consisted of an initial estimation of probable locations of macrophytes using detailed bathymetry and high resolution orthophotography.

Macrophyte locations were estimated based upon water depth and based upon results from studies in nearby reservoirs. The estimated location of aquatic plant beds were then mapped using a Geographic Information System (GIS). The estimated locations were then field verified through a comprehensive survey of the Wells Reservoir to determine presence or absence of macrophyte beds in the estimated locations. During the field verification surveys, relative abundance and species composition data was collected and categorized into aquatic plant community types. Information collected was integrated into a final continuous macrophyte map layer in the GIS.

Sixty-one transects totaling 396 sample points were completed during the 2005 study. Depths of up to 30 feet were sampled and sampling points along transects were completed at intervals of 5 feet or less. A total of 9 aquatic plant species were documented. The two most dominant species in samples (samples in which the dominant species consisted of greater than 60% of the sample) collected were common waterweed (*Elodea canadensis*) and leafy pondweed (*Potamogeton foliosus*) at 24.7% and 16.7%, respectively. Both of these species are native to the Mid-Columbia River Basin. Non-native Eurasian watermilfoil (*Myriophyllum spicatum*) (EWM), which is an invasive species of concern, was dominant in only 6.3% of samples (25/396) collected. All of these samples were collected at depths between 4 and 15 feet. Samples in which no

plants were identified (absent) consisted of 41.7% of all samples taken throughout the Wells Reservoir and supported the concept that macrophyte communities maintain a patchy distribution.

The study found that in general, macrophyte communities in the Wells Project were patchy and were distributed by depth. Water depth proved to be the most consistent variable in predicting the distribution of macrophyte communities in the Wells Reservoir. This observation was similar to the results from studies conducted in downstream reservoirs (Rocky Reach, Priest Rapids, Wanapum reservoirs).

In general, macrophyte communities did not recruit to depths of less than 4 feet in the Wells Project. Depths between 5 and 15 feet were characterized by a species composition where native species were dominant. In locations where Eurasian watermilfoil was present, this species was most often sub-dominant and present at relatively low densities (less than 10% milfoil). From depths of 15 to 24 feet, species composition consisted exclusively of native species. From 24 feet to 30 feet, macrophyte communities were absent most likely due to the limited availability of light at these depths. Overall, the study identified a total of 2,379 acres of macrophyte beds out of a total surface area of 9,740 acres.

### **Recreation Visitor Use Assessment**

The current Wells Hydroelectric Project License will expire May 31, 2012. The Public Utility District No. 1 of Douglas County (Douglas PUD) owns and operates the Wells Hydroelectric Project and is utilizing the Integrated Licensing Process (ILP) to relicense the Wells Project as required by FERC regulations issued July 23, 2003 (18 CFR Part 5). The primary goals of this study were to assist in the preparation of the Pre-Application Document (PAD) Recreation and Land Use Section, and to describe use levels, preferences, attitudes, and characteristics of the Project Area's primary recreation user groups. Specific objectives include:

- Describing recreation respondent's characteristics;
- Describing user preferences for recreation settings and facilities;
- Identifying possible recreation conflicts, crowding, or personal safety issues;
- Describing users' attitudes toward management actions;
- Describing recreation respondents' activities; and
- Identifying the amount, activity type, and spatial and temporal distribution of existing recreation use.

Respondents completing the survey were primarily male, Caucasian, with some college or college degree, employed full-time, with total household incomes of greater than \$30,000 per year. Respondents to the survey indicated that they generally visit the Wells Project Survey Area to spend time with their family. Just over 25% of respondents were from surrounding communities, with just under 75% from outside the area.

Wells respondents were relatively split as to whether they stayed overnight or were on a day trip visiting the area. The overall group size for overnight respondents was slightly higher than that of day trippers, and the majority of those staying overnight stayed at an RV park or campground. The majority of respondents identified Wells as their primary destination (79%).

Recreation use levels were estimated for peak and non-peak weekday, weekend, and holiday days, with substantially increased use identified during peak seasons at the Pateros, Brewster, and Bridgeport resource areas. The greatest estimated use occurred in the Bridgeport, Brewster, and Pateros resource areas during peak season.

The most frequently mentioned activities included relaxing/camping, fishing from a boat, speed/sport boating, fishing from shore, and swimming. The majority of respondents surveyed at the six resource areas encompassing the Wells Project area were predominantly indifferent to the number of people encountered as approximately 70 percent reported there was *neither too many nor too few people* at their primary destination.

Generally, respondents were satisfied with facilities, with the only rating below a '7' identified for the Okanogan boat ramp. The highest levels of crowding were reporting at the RV Campgrounds and Wildlife areas, with an overall mean of 4.8 and 5.4 respectively. The majority of respondents did not feel more controls were needed to prevent user conflicts, controls to prevent environmental damage, and that enough educational/interpretive opportunities exist.

Overall, respondents rated their experience as 7.7 on a 10 point scale.

### **Temperature Monitoring**

Beginning in 2001, an extensive water temperature monitoring effort was initiated by Douglas PUD in order to better understand the temperature dynamics throughout the Wells Reservoir. Temperature data have been collected at four locations in the Columbia River (RM 544, RM 532, RM 530, RM 516) and at one location in both the Methow (RM 1.5) and Okanogan rivers (RM 17). 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 measures were implemented prior to deploying and upon retrieving temperature loggers to ensure that data collected was accurate (Douglas PUD 2005). Due to sensor loss and sensor malfunction in some years, the availability of data at some of these monitoring locations is limited.

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 hung 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 that no measurable thermal stratification was observed.

In 2006, 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 data will be useful in the potential development of future temperature models that may be necessary for 401 Water Quality Certification.

### **Total Dissolved Gas Study**

Douglas PUD undertook a study at Wells Dam, located on the Columbia River, to describe total dissolved gas pressures resulting from spill operation by the dam. An array of water quality data loggers were installed in the Wells Dam tailwater for a period of two weeks between 27 May and 10 June, 2003 and programmed to record water temperatures and total dissolved gas pressures along a fifteen-minute interval.

Data indicated that total dissolved gas saturations measured approximately three miles downstream of the project were greater than would have been expected based on the volume of spill reported by the dam. It was estimated that gassing of turbine releases contributed an additional 1.3% to the downstream total dissolved gas saturation. This implied that rather than diluting spillway releases, thus redistributing the total dissolved gas mass, the total pressures of powerhouse releases were increased.

Tracing total dissolved gas saturations through the Wells Dam receiving waters indicated a rapid decrease in total pressures in the immediate tailrace (up to 1.7% decrease per mile for the first 3 miles) followed by a more gradual decrease (decrease of approximately 0.3% per mile) through the subsequent 36 mile long reservoir.

### **White Sturgeon (*Acipenser transmontanus*) Population and Life-History Assessment, Wells Reservoir**

In an attempt to gain insight into the Wells Reservoir populations of white sturgeon (*Acipenser transmontanus*), the Public Utility District No. 1 of Douglas County (Douglas PUD), in cooperation with Central Washington University, initiated a multi-year white sturgeon population and life-history assessment. The primary objective of the multi-year sturgeon study was to collect population structure and seasonal movement information for sturgeon greater than 50 cm in total length residing within the Wells Reservoir. This multi-year assessment was initiated in the summer of 2001 and continued until the fall of 2003.

Prior to the implementation of this study, no information on white sturgeon was available for fish found within the Wells Reservoir. The information collected during this study

was compared to the sturgeon information collected from previous studies in reservoirs upstream and downstream of the Wells Project.

For the purposes of this study, the Wells Reservoir was defined as the water located immediately downstream from Chief Joseph Dam (RM 545.3) to the forebay of Wells Dam (RM) 515.8 on the Columbia River in Washington State and included the lower 15.5 miles of the Okanogan River.

During the summers of 2001 and 2002, a total of 129 setlines were deployed in the Wells Reservoir. Sturgeon captured by these setlines were measured, tagged with passive integrated transponder tags (PIT-tags) and were marked by removing designated scoots. Some of the fish were also radio-tagged and had pectoral fin rays removed for age analysis.

In total, 13 unique white sturgeon were captured during the 2-year capture portion of the study. Twelve of the captured fish were PIT tagged. Subsequently, 5 recapture events were recorded for a total of 18 capture events during the mark-recapture period. Results of the two-year mark-recapture portion of the study indicated that the sturgeon population in Wells Reservoir is small (less than 217 fish). A Modified Schnabel variable capture probability model was used to estimate the abundance of sturgeon found within the Wells Reservoir. The results of the model indicated that the probable abundance for this population ranges from 13 to 217 adult fish with a point estimate of 31 fish over 50 cm in length.

The length of the fish captured and tagged ranged from 60-202 cm. Eleven of the 13 fish were determined to be between six and 30 years of age demonstrating that all of these fish recruited to the Wells Reservoir after Wells Dam was completed in 1967 with strong year class recruitment between the years 1972 to 1978 and again between 1988 to 1996.

Radio-tags were applied to six of the 13 sturgeon captured during 2001 and 2002. One of the radio-tagged fish was a juvenile fish (65 cm) estimated to be 6 years old. The juvenile fish moved regularly but was never further than 2 miles upstream or downstream from the original capture and release location. None of the five adult radio-tagged fish were detected downstream from Brewster (RM 530) or upstream of Park Island (RM 538). One of the five mature fish radio-tagged made several upstream movements into the lower Okanogan River during the spring of 2002 and two different radio-tagged mature sized sturgeon made movements into the lower Okanogan River during the spring of 2003.

The general results of the study are consistent with the findings of the white sturgeon population assessment in the neighboring Rocky Reach Reservoir and provide useful baseline information in which to frame future studies and management decisions.

## **Wildlife Resources: Avian, Amphibian, Reptile, and Small Mammal Surveys and RTE Wildlife Survey**

In 2005, Douglas PUD conducted a wildlife resources study to collect information pertinent to the Wells Hydroelectric Project ILP. The primary objective of the study was to document the occurrence, distribution, and habitat use of birds, amphibians, reptiles, and small mammals on Project lands, including those species listed as rare, threatened, or endangered (RTE). Only one federally listed species was documented, bald eagle (federally listed as threatened), and only one state listed species was documented, the American white pelican (state listed as threatened).

Surveys also documented the presence of 120 bird species in the Project area. In terms of passerine (perching bird) species, the European starling was the most abundant, followed by the red-winged blackbird. Other commonly detected land birds included the white-crowned sparrow, California quail, American robin, northern rough-winged swallow, and Brewer's blackbird. Results of avian point count surveys indicate that the study area supports the greatest species diversity during the breeding season when neo-tropical migrant species are nesting. However, during the fall, the greatest abundance of birds occurs in the study area when single and mixed species flocks move into the region during southward migration. The largest relative abundance of birds was recorded at stations centered in wetland habitat during the breeding season. In general, avian abundance and species richness in agricultural areas were low compared to wetland and riparian habitat types.

The four amphibian species documented in 2005 included Pacific treefrog, Great Basin spadefoot toad, bullfrog, and long-toed salamander. Seven reptile species were detected during the 2005 surveys: painted turtle, gopher snake, yellow-bellied racer, sagebrush lizard, western terrestrial garter snake, common garter snake, and western rattlesnake.

Twelve small mammal species were captured in 2005, with the deer mouse being the most common species. Other species documented included the bushy-tailed woodrat, cottontail rabbit, long-tailed weasel, western harvest mouse, meadow vole, montane vole, vagrant shrew, masked shrew, house mouse, Great Basin pocket mouse, and sagebrush vole. Eight other mammal species were detected incidentally. Total small mammal capture rates were by far the greatest in riparian habitat, followed by wetland and idle agriculture.