

Columbia River Project Water Use Plan
Monitoring Program Terms of Reference
KINBASKET RESERVOIR
FISH AND WILDLIFE INFORMATION PLAN

- **CLBMON-7 Kinbasket Reservoir Rainbow Trout Life History and Habitat Use Assessment**

24 October 2007

Terms of Reference for the Columbia River Project Water Use Plan Monitoring Programs Kinbasket Reservoir Fish and Wildlife Information Plan

1.0 OVERVIEW

This document presents Terms of Reference for monitoring programs under the Kinbasket Reservoir Fish and Wildlife Information Plan (Table 1). These programs will evaluate the potential effects of Mica Dam and Kinbasket Reservoir operations on fish habitat and fish populations, wildlife habitat and wildlife populations.

This document provides detailed Terms of Reference for the following programs:

- 1) CLBMON-1 Mica Dam Total Gas Pressure Monitoring and Abatement Program: a 2-year study to determine dissolved gas supersaturation with synchronous condense operation of Units 3 and 4 in relation to Units 1 and 2, which have been previously monitored.
- 2) CLBMON-2 Kinbasket and Revelstoke Reservoirs Kokanee Population Monitoring: a 12-year program to monitor trends in the biological characteristics, distribution and abundance of kokanee populations in Kinbasket and Revelstoke reservoirs, and provide information required to link the effects of reservoir operation to population levels.
- 3) CLBMON-3 Kinbasket and Revelstoke Reservoirs Ecological Productivity Monitoring Program: a 12-year study to define the trophic web mechanisms and dynamics of Kinbasket and Revelstoke reservoirs, and determine if changes in pelagic productivity are associated with reservoir operations.
- 4) CLBMON-4 Kinbasket Reservoir Fish Stranding Assessment: a 3-year study to qualitatively evaluate the extent of fish stranding caused by the annual drawdown of Kinbasket Reservoir.
- 5) CLBMON-5 Kinbasket Reservoir Burbot Life History and Habitat Use Assessment: a 3-year study to obtain baseline data on the biological characteristics of burbot populations in Kinbasket Reservoir, and provide information to evaluate potential effects of reservoir operation on burbot population productivity
- 6) CLBMON-6 Kinbasket Reservoir Bull Trout Life History and Habitat Use Assessment: a 3-year study to obtain baseline data on the life history and habitat characteristics of juvenile bull trout in Kinbasket Reservoir, and provide preliminary information to determine if reservoir operations could have an effect on bull trout populations.
- 7) CLBMON-7 Kinbasket Reservoir Rainbow Trout Life History and Habitat Use Assessment: a 3-year study to obtain baseline data on the biological characteristics of rainbow trout in Kinbasket Reservoir, and provide the information required to evaluate the impacts of reservoir water levels on the productivity of rainbow trout populations.
- 8) CLBMON-8 Kinbasket Reservoir Monitoring of the Valemount Peatland: a 3-year monitoring program to address key uncertainties regarding the relative contribution and importance of the current reservoir operating regime to the erosion processes affecting the

wetland, obtain an inventory of plant and wildlife species, and determine whether the long-term viability of the wetland, and associated plant and animal species, are being affected by erosion processes related to reservoir operations, and how these effects may be mitigated.

Table 1 Kinbasket Reservoir Fish and Wildlife Information Plan Monitoring Program Terms of Reference Submission Information

Name of Monitoring Program	Order Clause Fulfilled	Submitted with this Package	Previously Submitted To CWR	Submission Date	Leave to Commence
CLBMON-1 Mica Dam Total Gas Pressure Monitoring and Abatement Program	Schedule A: 5.a	Yes	No	24 October 2007	No
CLBMON-2 Kinbasket and Revelstoke Reservoirs Kokanee Population Monitoring	Schedule A: 5.b Schedule B: 1.a	Yes	No	24 October 2007	No
CLBMON-3 Kinbasket and Revelstoke Reservoirs Ecological Productivity Monitoring Program	Schedule A: 5.c Schedule B: 1.b	Yes	No	24 October 2007	No
CLBMON-4 Kinbasket Reservoir Fish Stranding Assessment	Schedule A: 5.d	Yes	No	24 October 2007	No
CLBMON-5 Kinbasket Reservoir Burbot Life History and Habitat Use Assessment	Schedule A: 5.e	Yes	No	24 October 2007	No
CLBMON-6 Kinbasket Reservoir Bull Trout Life History and Habitat Use Assessment	Schedule A: 5.f	Yes	No	24 October 2007	No
CLBMON-7 Kinbasket Reservoir Rainbow Trout Life History and Habitat Use Assessment	Schedule A: 5.g	Yes	No	24 October 2007	No
CLBMON-8 Kinbasket Reservoir Monitoring of the Valemount Peatland	Schedule A: 5.h	Yes	No	24 October 2007	No

2.0 MONITORING PROGRAM RATIONALE

Early on in the Columbia River Water Use planning (WUP) process, the WUP Consultative Committee (WUP CC) recognized that there was a great deal of uncertainty regarding whether the lack of constraints on operation of Kinbasket Reservoir was having a significant impact on fish and wildlife and associated habitat. A number of key hypothesized impacts were identified during the issue scoping phase (e.g., entrainment at Mica Dam, and interruption of natural sturgeon recruitment processes).

However, a general lack of data on the relative abundance, distribution, life history and seasonal patterns of habitat use and supporting ecosystem processes in the upper Columbia River and Kinbasket Reservoir, precluded incorporation of these concerns into Water Use Plan assessments.

The WUP CC explored alternative ways of operating Kinbasket Reservoir to provide benefits to fish and wildlife by imposing minimum elevation constraints. However, the ability to track the performance of the alternatives was limited to use of habitat-based measures (pelagic productivity), which were developed based on limited site-specific data and professional judgment. Initial modeling results showed that some improvements to pelagic productivity could be achieved through a minimum elevation constraint, but that this constraint would incur a high cost in foregone power generation. While the WUP CC agreed to stop exploring water management options for Kinbasket Reservoir for more cost-effective non-operational works, it was acknowledged that this decision was based on a number of uncertain assumptions about reservoir ecology and the influence of reservoir operations. The WUP CC underscored the need for better information to support future decision-making as a key outcome of the Columbia River Water Use planning process.

The operational link for many of the proposed monitoring studies, developed to address current data gaps, was considered tenuous given that there were no operational changes being considered for Kinbasket Reservoir. However, the WUP CC recognized that a large obstacle to recommending operational or physical works for the reservoir was the lack of quantitative data on fish and wildlife populations. Therefore, the proposed monitoring studies were accepted as meeting the Water Use Plan monitoring criteria, because they are the only tool available to validate the assumptions made by the WUP CC when deciding on operational changes.

Although no operating changes were considered for Revelstoke Reservoir, the WUP CC recommended that some of the fish-related studies in Kinbasket be linked to studies in Revelstoke to provide a comparison of trends to inform on operational impacts.

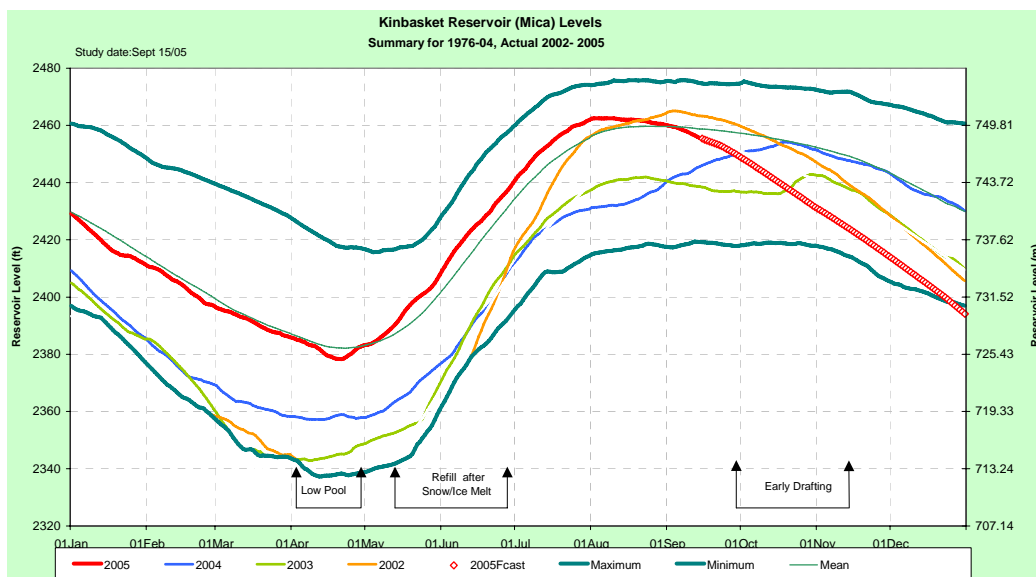


Figure 1 Seasonal pattern of water level drawdown and refill for Kinbasket Reservoir

Monitoring Study No. CLBMON-7

Kinbasket Reservoir Rainbow Trout Life History and Habitat Use Assessment

1.0 MONITORING PROGRAM RATIONALE

1.1 Background

Rainbow trout were identified by the Columbia River Water Use Plan Consultative Committee (WUP CC) as a key fish species of concern in Kinbasket Reservoir because of their importance to the sport fishery, and the potential for links between reservoir operations and rainbow trout population productivity. Since the formation of Kinbasket Reservoir in 1973, a rainbow trout population has developed in the reservoir (RL&L 2001). Creel surveys conducted on the reservoir between 1994 and 2001 (Pole 1995, 1996; Bray 2002) found that rainbow trout made up between 20 and 47% of the total catch. However, to date, there have been no detailed studies of the life history or habitat use of these populations within Kinbasket Reservoir and its tributaries.

The two primary issues of concern identified by the WUP CC related to potential effects of low reservoir elevations on access to spawning tributaries, as well as potential effects of reservoir refill on inundation of stream spawning habitats within the drawdown zone and subsequent effects on egg and fry survival. Although the timing of rainbow trout spawning in tributaries of Kinbasket Reservoir has not been documented, rainbow trout typically spawn in spring (mid April to late June), with fry emerging from the gravel 4 to 8 weeks after spawning (Scott and Crossman 1998). On average, the reservoir reaches its low pool elevation in April-May, after which time the reservoir quickly refills between May and July (Figure 1). This refill period coincides with the expected timing of rainbow trout spawning and incubation period (April through August). At present, there are no available data regarding potential barriers to fish passage caused by low water conditions during rainbow trout spawning, because past tributary access studies have been undertaken at higher reservoir levels. Further, there is no information related to presence of rainbow trout spawning in the drawdown zone of the reservoir.

To address these concerns, the WUP CC recommended that a rainbow trout life history and habitat use assessment be undertaken in Kinbasket Reservoir. The objectives of the monitoring program will be to determine: a) biological characteristics, focusing specifically on the timing and location of rainbow trout spawning; b) upstream access of spawners to tributary streams in relation to reservoir water levels; and c) timing and extent of inundation of rainbow trout spawning habitat within the drawdown zone. The results of this study will allow a better assessment of the potential impacts of the current operating regime of Kinbasket Reservoir on the productivity of rainbow trout populations.

1.2 Management Questions

The fundamental management questions to be addressed through this life history and habitat use assessment are:

- 1) What are some of the basic biological characteristics of rainbow trout in Kinbasket Reservoir?
- 2) Does operation of Kinbasket Reservoir result in blockage or reduced success of upstream migration of rainbow trout spawners in tributary streams?
- 3) Does operation of Kinbasket Reservoir cause the flooding of rainbow trout spawning habitat within the drawdown zone and lower sections of tributaries, causing adverse effects on egg and fry survival?
- 4) Can modifications be made to the operation of Kinbasket Reservoir to protect or enhance these rainbow trout populations?

This proposed monitoring program will provide a baseline dataset to establish basic biological characteristics of rainbow trout populations in Kinbasket Reservoir. This baseline dataset will provide: the information required to better address uncertainties regarding the current status and productivity of the reservoir rainbow trout populations; factors affecting rainbow trout productivity; and the response of these rainbow trout populations to potential future changes in reservoir operations.

This assessment will specifically address uncertainties regarding the potential impacts of reservoir operations on rainbow trout spawning success, including the effects of low reservoir elevations on spawner access to tributary streams, and the effect of inundation of stream spawning habitats within the drawdown zone on egg and fry survival.

1.3 Management Hypotheses

The primary hypothesis (and sub-hypotheses) associated with these management questions are associated with direct operational impacts of Kinbasket Reservoir on rainbow trout populations.

H₁: The productivity of rainbow trout populations is limited by habitat impacts directly related to operation of Kinbasket Reservoir.

H_{1A}: Operation of the reservoir restricts upstream passage of rainbow trout spawners to reservoir tributaries due to low water elevations.

H_{1B}: Operation of the reservoir reduces rainbow trout egg and fry survival due to inundation of spawning habitats within the drawdown zone.

Rainbow trout are typically obligate stream spawners (Scott and Crossman 1998), and self-sustaining shoreline spawning populations are rare. If rainbow trout are found to spawn in lower sections of tributaries within the drawdown zone, there is the potential for the eggs and fry to be adversely affected as the reservoir water levels increase during freshet. Adverse impacts would occur if water velocities are reduced, resulting in insufficient flow through the spawning gravel to supply oxygen to the incubating eggs or alevin (yolk sac fry) and remove waste products. Fry that survive to emergence may also suffer high predation rates in the reservoir environment compared to the more typical stream environment. Any adverse effects on rainbow trout eggs and fry are expected to be reflected in reduced spawning success, which could reduce the productivity of rainbow trout populations.

Sections of tributary streams located within the drawdown zone of Kinbasket Reservoir have been thoroughly surveyed for barriers to fish passage during summer and fall reservoir water elevations (i.e., ≥ 732 m), and the characteristics of barriers present at these elevations are relatively well established (Triton 1990; Fielden et al. 1992; Oliver 2001; Golder 2003). While no barriers to upstream fish passage have been identified for streams known or expected to support rainbow trout spawning, these previous surveys did not occur during the spring period when reservoir water levels are at their lowest and when rainbow trout typically spawn. The occurrence of minimum annual water levels during spring (average minimum of 725 m) could lead to the formation of barriers not present during other times of the year.

1.4 Key Water Use Decision Affected

The proposed monitoring program will provide information required to support more informed decision-making with respect to the need to balance storage in Kinbasket Reservoir with impacts on fish populations in the reservoir. Specifically, it will provide information that is required to support future decisions around maintaining the current operating regime or modifying operations through adjusting seasonal minimum or maximum elevations to protect adfluvial rainbow trout populations.

2.0 MONITORING PROGRAM PROPOSAL

2.1 Objectives and Scope

The primary objectives of this monitoring program are to obtain baseline data on the biological characteristics of rainbow trout in Kinbasket Reservoir, and to provide the information required to evaluate the impacts of reservoir water levels on the productivity of rainbow trout populations. The study will focus on adfluvial rainbow trout populations in Kinbasket Reservoir (i.e., not fluvial populations restricted to tributaries), and it will target adult fish.

The study will be conducted over a 3-year period, and will be initiated in Year 2 (2009) of implementation of the Columbia River Water Use Plan.

2.2 Approach

Rainbow trout life history and habitat use will be assessed using primarily radio telemetry. Basic biological characteristics, such as age, size and maturity will be assessed for any rainbow trout captured. Rainbow trout suitable for tagging will be implanted with radio telemetry tags and tracked during their spawning season using aerial surveys. Ground reconnaissance surveys will be used to assess potential rainbow trout spawning tributaries in the drawdown zones for barriers to upstream fish passage, as well as to detect the presence of rainbow trout spawning activity and quality of spawning habitat.

2.3 Tasks

2.3.1 Task 1: Project Coordination

Project co-ordination will involve the general administration and technical oversight of the assessment study, which will include, but not be limited to: 1) budget management; 2) staff selection; 3) logistics co-ordination; 4) technical oversight in field and analysis components; and 5) facilitation of data transfer among relevant studies.

A safety plan must be developed and submitted in accordance with BC Hydro procedures and guidelines. Specific safety training may be required.

2.3.2 Task 2: Field Studies

Adult rainbow trout will be targeted for capture and radio tagging, with most capture effort expended in the first two years of the study. It is expected that angling will be the primary method for capture. All captured rainbow trout will be sampled for biological characteristics (e.g., length, weight, scales) and marked with an external tag. A small tissue sample from each fish will be archived in 100% ethanol in the event that samples will be needed for some future project. Samples will be archived at the BC Hydro Revelstoke office. Radio telemetry tags will be surgically implanted on up to 45 rainbow trout that are judged to be likely to spawn within the study time frame. Attempts should be made to capture rainbow trout from as wide a geographic area as possible (e.g., both the Canoe and Columbia reaches).

Fixed wing aerial tracking will be conducted to track the movements of radio tagged fish and assist in identifying spawning locations. It is expected that flights will occur every 2 weeks at the start of the sampling program, and every week once spawners are detected in tributaries to determine immigration, residence, and emigration timing and rates. Coverage of Kinbasket tributaries via fixed wing can be time consuming and it is possible that flights could originate out of Revelstoke or Golden.

Once detections in tributaries have been made, ground surveys will provide more specific habitat data and may be used to examine potential rainbow trout spawning streams where they cross the reservoir drawdown zone. Ground surveys may be conducted by vehicle or boat depending on the location. These surveys will be used to assess habitat characteristics of suspected or known spawning sites as well as changes to habitat over the period of incubation (e.g., with respect to reservoir levels).

Presence and distribution data reported in past studies (e.g., Fielden *et al.* 1992; Oliver 2001; RL&L 2001) may assist in determining additional tributaries that may support spawning rainbow trout. For instance, Fielden *et al.* (1992) observed that rainbow trout tended to avoid Kinbasket Reservoir tributaries with glacial origins, possibly due to reduced habitat quality for rainbow trout spawning. Oliver (2001) suggested that the existence of alluvial fans at the reservoir confluence may promote rainbow trout spawning in the drawdown zone.

Habitat characteristics at suspected or confirmed rainbow trout spawning locations will be quantified using the methodology outlined in the Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Standards and Procedures (RIC 2001). Assessed habitat

characteristics will include: water temperature; water velocity; turbidity; gradient; channel width; water depth; substrate size composition; and potential barriers to fish passage. Reservoir water levels may be obtained through BC Hydro.

2.3.3 Task 3: Data Analysis and Reporting

Brief technical reports will be prepared after the first and second years of the monitoring program. A final report will be prepared in Year 3 at completion of the study to summarize the results of the study, which will outline how the findings relate to the ecological hypothesis and key management questions. The final report will include:

- a) an executive summary;
- b) a description of the methods employed;
- c) a data summary;
- d) a comparison of results between years; and
- e) a detailed summary of the findings as they relate to the ecological hypothesis and the key management questions.

Reports will follow the standard format that is being developed for WUP monitoring programs. All reports will be provided in hard copy and as Microsoft Word and Adobe Acrobat (*.pdf) format, and all maps and figures will be provided either as embedded objects in the Word file or as separate files.

2.4 Interpretation of Monitoring Program Results

The proposed monitoring program will provide valuable information to address two key areas of uncertainty related to the operational impacts of Kinbasket Reservoir on rainbow trout populations.

The program will provide a baseline dataset of basic biological characteristics of adult rainbow trout in Kinbasket Reservoir. This baseline dataset will provide the ability to better assess the current status and productivity of Kinbasket Reservoir rainbow trout populations, and potential factors affecting rainbow trout productivity. Specifically, the assessment will focus on the potential effects of low reservoir water levels and reservoir inundation on rainbow trout spawning success.

2.5 Schedule

The monitoring program will be initiated in Year 2 of implementation of the Columbia River Water Use Plan (2009), and will be conducted over a 3-year period. Depending on capture and tagging success, it may be necessary to extend the period of study to include an additional year of tracking. It is unknown if enough mature rainbow trout will be tagged and tracked to spawning locations in three years, and methods may require some refinement following the first year of study.

2.6 Budget

The total annual budget for the monitoring program is estimated at \$120,150 (in 2004 dollars). The budget breakdown by task and year is provided below in Table 1.

3.0 REFERENCES

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