

Columbia River Project Water Use Plan

Kinbasket and Arrow Lakes Reservoirs Revegetation Management Plan Annual Report: 2008

- **CLBMON-9 Kinbasket Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis**
- **CLBMON-10 Kinbasket Reservoir Inventory of Vegetation Resources**

- **CLBMON-11A Wildlife Effectiveness Monitoring of Revegetation in Kinbasket Reservoir**
- **CLBMON-11B Wildlife Effectiveness Monitoring of Revegetation and Wildlife Physical Works in the Arrow Lakes Reservoir**
- **CLBMON-12 Arrow Lakes Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis**
- **CLBMON-13 Inventory of Mosquito Populations in the Revelstoke Area**

- **CLBMON-33 Arrow Lakes Reservoir Inventory of Vegetation Resources**

- **CLBMON-35 Arrow Lakes Reservoir Plant Response to Inundation**

- **CLBWORKS-1 Kinbasket Reservoir Revegetation Program Physical Works**

- **CLBWORKS-2 Arrow Lakes Reservoir Revegetation Program Physical Works**

Conditional Water Licences for Kinbasket storage (27068 and 39432), Mica diversion (39431), Revelstoke diversion and storage (47215), and Arrow storage (27066)

BC Hydro Columbia River Project Water Use Plan Kinbasket & Arrow Reservoir Recreational Management Plan

Annual Report: 2008

1 Introduction

This document represents a summary of the status and the results of the Kinbasket & Arrow Lakes Reservoirs Revegetation Management Plan of the Columbia River Water Use Plan (WUP) monitoring programs and physical works to 31 January 2009, as per the Columbia River Order under the *Water Act*, dated 26 January 2007. There are eight monitoring programs and two physical works included within this Management Plan:

- CLBMON-9 Kinbasket Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis
- CLBMON-10 Kinbasket Reservoir Inventory of Vegetation Resources
- CLBMON-11A Wildlife Effectiveness Monitoring of Revegetation in Kinbasket Reservoir
- CLBMON-11B Wildlife Effectiveness Monitoring of Revegetation and Wildlife Physical Works in the Arrow Lakes Reservoir
- CLBMON-12 Arrow Lakes Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis
- CLBMON-13 Inventory of Mosquito Populations in the Revelstoke Area
- CLBMON-33 Arrow Lakes Reservoir Inventory of Vegetation Resources
- CLBMON-35 Arrow Lakes Reservoir Plant Response to Inundation
- CLBWORKS-1 Kinbasket Reservoir Revegetation Program Physical Works
- CLBWORKS-2 Arrow Lakes Reservoir Revegetation Program Physical Works

2 Background

The water use planning process for BC Hydro's Columbia River project was initiated in August 2000 and completed in June 2004. The conditions proposed in the WUP for the operation of the project reflect the June 2004 consensus recommendations of the Columbia River WUP Consultative Committee (CC).

In July 2006, the Columbia River Draft WUP was submitted to the Comptroller of Water Rights (CWR). The draft WUP was sent out to regulatory agencies, First Nations and interested stakeholders for review. In January 2007, the CWR approved the final WUP and issued an Order to BC Hydro to implement the conditions proposed in the Columbia River WUP and prepare the monitoring programs and physical works Terms of Reference (TOR).

An addendum to the Columbia River WUP was submitted to the CWR in July 2007 after an Environmental Assessment Certificate was issued for the Revelstoke Unit 5 Project. The addendum proposes additional terms and conditions for the Columbia River WUP, as recommended by the Revelstoke Unit 5 Core Committee in December 2006, to address incremental impacts of the operation of the fifth generating unit at Revelstoke Dam.

In August 2007, the CWR accepted the Columbia River Project WUP Addendum resulting from the Revelstoke Unit 5 Project, and issued amendments to the Columbia River Implementation Order to include the commitments made by BC Hydro to undertake additional monitoring programs and physical works associated with the Revelstoke Unit 5 Project.

The following table outlines the dates that Kinbasket and Arrow Lakes Reservoirs Revegetation Management Plan TOR have been submitted to, and approved by the CWR to date:

Physical Works TOR	Date Submitted	Date Approved
CLBMON-9 Kinbasket Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis	25 January 2008	3 March 2008
CLBMON-10 Kinbasket Reservoir Inventory of Vegetation Resources	4 April 2007	19 April 2007
CLBMON-11A Wildlife Effectiveness Monitoring of Revegetation in Kinbasket Reservoir	25 January 2008	26 February 2008
CLBMON-11B Wildlife Effectiveness Monitoring of Revegetation and Wildlife Physical Works in the Arrow Lakes Reservoir		
CLBMON-12 Arrow Lakes Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis	25 January 2008	3 March 2008
CLBMON-13 Inventory of Mosquito Populations in the Revelstoke Area	25 January 2008	26 February 2008
CLBMON-33 Arrow Lakes Reservoir Inventory of Vegetation Resources	4 April 2007	19 April 2007
CLBMON-35 Arrow Lakes Reservoir Plant Response to Inundation	25 January 2008	8 April 2008
CLBWORKS-1 Kinbasket Reservoir Revegetation Program Physical Works	27 April 2007	3 May 2007
CLBWORKS-2 Arrow Lakes Reservoir Revegetation Program Physical Works (Phase 1)	27 April 2007	3 May 2007
CLBWORKS-2 Arrow Lakes Reservoir Revegetation Program Physical Works (Phase 2)	26 February 2008	23 April 2008

As outlined in the Columbia River WUP, the Consultative Committee recommended a full review of the Columbia River Water Use Plan 13 years after implementation, unless results of the monitoring program suggest an earlier review is appropriate or

significant risks are identified that could result in a recommendation to change operations.

BC Hydro will convene a multi-party panel five years after commencing the implementation of this WUP to evaluate the effectiveness of operations and physical works in meeting the stated objectives for Arrow Lakes Reservoir and the lower Columbia River. The outcomes from this process will be used to assess any potential need to review the Arrow Lakes Reservoir component of this WUP. If a replacement Non-Treaty Storage Agreement (NTSA) is negotiated within this 5-year period, it is also recommended that agreement provisions and implications be reported out through this panel. Signing of a new NTSA is not a trigger for panel evaluation or a review of this Water Use Plan recommendation to change operations.

3 Status

The following table (Table 3-1) outlines the current status and schedule for the monitoring programs and physical works being delivered under the Kinbasket and Arrow Lakes Reservoirs Revegetation Management Plan of the Columbia River Water Use Plan.

Table 3-1: Status and Schedule of Columbia River WUP Monitoring Programs and Physical Works Implementation under the Kinbasket & Arrow Lakes Reservoirs Revegetation Management Plan

Monitoring Programs	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	WLR YR1	WLR YR2	WLR YR3	WLR YR4	WLR YR5 Interim Review	WLR YR6	WLR YR7	WLR YR8	WLR YR9	WLR YR10	WLR YR11	WLR YR12	WLR YR13 Final Review
CLBMON-9 Kinbasket Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis		✓	■	■	■	■	■	■	■	■	■		
CLBMON-10 Kinbasket Reservoir Inventory of Vegetation Resources	✓	u/w	■	■	■	■	■	■	■	■			
CLBMON-11A Wildlife Effectiveness Monitoring of Revegetation in Kinbasket Reservoir		✓	■	■	■	■	■	■	■	■	■	■	
CLBMON-11B Wildlife Effectiveness Monitoring of Revegetation in the Arrow Lakes Reservoir			■	■	■	■	■	■	■	■	■	■	■
CLBMON-12 Arrow Lakes Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis		✓	■	■	■	■	■	■	■	■	■		
CLBMON-13 Inventory of Mosquito Populations in the Revelstoke Area			■										
CLBMON-33 Arrow Lakes Reservoir Inventory of Vegetation Resources	✓	u/w	■	■	■	■	■	■	■	■			
CLBMON-35 Arrow Lakes Reservoir Plant Response to Inundation				■	■	■	■	■					
Physical Works													
CLBWORKS-1 Kinbasket Reservoir Revegetation Program Physical Works	✓	u/w	■	■	■								
CLBWORKS-2 Arrow Lakes Reservoir Revegetation Program Physical Works	✓	u/w	■	■	■	■							
Legend:	■ = Program to be undertaken/initiated in identified year u/w = Project is underway ✓ = Program completed for the year x = Program started, but encountered operational or hydrological delays												

4 Columbia River Project WUP Monitoring Programs - Kinbasket & Arrow Lakes Revegetation Management Plan

This section summarizes the status of the monitoring programs being implemented under the Kinbasket & Arrow Lakes Reservoirs Revegetation Management Plan of the Columbia River Water Use Plan, as per the Order under the *Water Act*, dated January 26, 2007.

4.1 CLBMON-9 Kinbasket Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis

4.1.1 Overview

In association with the Kinbasket Reservoir Revegetation Program physical works, the Columbia River Project WUP CC recommended effectiveness monitoring to ensure that the revegetation efforts are providing the intended environmental and social benefits over the long term. Given the considerable uncertainty regarding the potential effects of inundation on riparian and wetland environments, the WUP CC recognized that a monitoring program would be required to assess selected treatment techniques applied under the Kinbasket Reservoir Revegetation Program physical works, and to evaluate the effectiveness of revegetation efforts over the long term. The monitoring program was to focus on those components of the operating regime assumed to drive vegetation establishment (i.e. inundation depth, duration and timing) by imposing wet stress or dry stress over a defined period of time. This monitoring program will focus on monitoring existing vegetation and revegetated areas at the *site (local)* scale.

The objectives of this monitoring program are to:

- 1) Define and map the boundaries of the study area and define the biophysical and management strata that will structure the sampling methodology and analysis strategy for monitoring existing vegetation communities.
- 2) Document within-community responses (through monitoring of species cover, distribution, diversity, vigour, biomass and abundance) of existing vegetation communities to environmental conditions, including the current operating regime, through a plot-based assessment.
- 3) Assess the effectiveness of the revegetation program at expanding the quantity (as measured by cover, abundance and biomass) and quality (as measured by diversity, distribution and vigour) of vegetation in the drawdown zone under the current operating conditions (i.e. timing, frequency, depth and duration of inundation) over a 10 year period.
- 4) Assess the response of revegetated communities and their species assemblages to environmental conditions, including the current operating regime (i.e. inundation timing, frequency, depth and duration) through plot-based monitoring at the site level over a 10-year period.
- 5) Maintain a data collection and management database for the period of the monitoring program.

These objectives will be addressed by assessing the specified response variables at sample sites, stratified by primary topographic and biophysical criteria, under the various treatment options relative to control sites (areas of naturally established vegetation and barren sites). Vegetation responses will be monitored over a range of geographic areas within the drawdown zone of Kinbasket Reservoir, based on locations selected for treatment and control under the Kinbasket Reservoir Revegetation Program physical works.

This monitoring program involves:

- 1) Determining the species composition (i.e., distribution, distribution and vigour) of existing vegetation communities to identify species that have been successfully surviving long-term inundation;
- 2) Evaluating the cover, abundance and biomass of existing vegetation communities in relation to elevation in the drawdown zone;
- 3) Monitoring the response of existing vegetation communities at the local (site) level to the continued implementation of the operating regime for Kinbasket Reservoir and other environmental variables;
- 4) Assessing the long-term effectiveness of the revegetation program at expanding the quality (as measured by diversity, distribution and vigour) and quantity (as measured by cover, abundance and biomass) of vegetation in the drawdown zone for ecological and social benefits; and,
- 5) Assessing the costs and benefits of the revegetation prescriptions applied under the Kinbasket Reservoir Revegetation Program physical works by monitoring the response of revegetated communities to different treatments in the drawdown zone of the reservoir.

4.1.2 Status

This monitoring program was initiated in April 2008 and will be carried out bi-annually over 10 years, starting in 2009. The next program report is expected in December 2009.

4.1.3 Interpretation of Data

This year, a transect-based sampling design was developed to monitor existing vegetation and revegetated areas at the local (site) scale. In addition, selection of monitoring sites was initiated, and a sub-set of the 250 selected sites was sampled in the June and July 2008. At each sampling location (transect), data were collected on site, soil and vegetation community composition (trees, shrubs, herbs and moss/lichens) characteristics. Natural or anthropogenic factors influencing vegetation establishment were also recorded, including: domestic grazing and browsing, wildlife grazing/browsing, site modifications (seeded or planted with grass or herbs), human-influenced disturbance (e.g., ATV use), and erosion. Sampling of sites will continue in 2009, and then bi-annually from 2011 to 2017.

The study is based on accumulating a time series of observations, and, as such, strong inferences can only be made once several years of data have been collected. However, even this first year of the study provided a number of interesting results relevant to monitoring of revegetated areas. Diversity of species and vegetation types was found to increase with elevation from 741 m to the upper limit of the drawdown zone at 754 m. This is to be expected, as the upper limit of the drawdown zone is least affected by inundation regime. Some key species differ in terms of their tolerance to wet stress; for example, cottonwood has one of the widest amplitudes of all studied species, wider even than that of Kellogg's sedge. Cottonwood has been encountered in the interval of 743-755 m; willows, on the other hand, are much less tolerant to the hydrological regime of Kinbasket: they were only reported in the elevation range of 750-754 m ASL. Judging by these data, cottonwood seems more promising than willows for revegetation efforts (CLBWORKS-1).

Of significance was the presence of three species of rare plants (as identified by the British Columbia Conservation Data Centre): *Carex crawei*, *Mimulus breviflorus*, and *Senecio plattensis*.

4.2 CLBMON-10 Kinbasket Reservoir Inventory of Vegetation Resources

4.2.1 Overview

During the Columbia River project WUP process, the WUP CC made several assumptions regarding vegetation tolerances to inundation and responses to changes in the hydrologic pattern, based on information gained from studies in the Arrow Lakes Reservoir. Given differences in the elevation, climate and operating regime of the two reservoirs, the WUP CC recognized the inherent uncertainties of any assumptions related to the response of vegetation to reservoir operating conditions, and acknowledged the importance of long-term data collection for assessing the effects of the operating regime on vegetation at different spatial scales.

The Kinbasket Reservoir Inventory of Vegetation Resources monitoring program will address key uncertainties related to the relative contribution and importance of the current reservoir operating regime (i.e. timing, duration and depth of inundation, and multi-year stresses) on the maintenance of existing vegetation communities delineated at the landscape scale.

The objectives of this monitoring program are to:

- 1) Identify and spatially delineate existing riparian and wetland vegetation communities within the drawdown zone;
- 2) Measure the spatial extent, structure and composition (i.e. distribution and diversity) of the communities in the drawdown zone at repeated time intervals over a 10 year period;
- 3) Assess whether there are changes in the spatial extent, structure and composition of the communities in the drawdown zone over the monitoring period;

- 4) Assess whether observed changes in the spatial extent, structure and composition are attributable to the current operating regime of the reservoir; and,
- 5) Provide information on the effectiveness of the current operating regime at maintaining the existing spatial extent, structure and composition of the communities in the drawdown zone.

These objectives will be addressed through a landscape level analysis of vegetation community changes over time in response to the current operating regime of Kinbasket Reservoir.

This monitoring program involves evaluating changes in the existing vegetation communities in the reservoir drawdown zone between elevations 741m and 754m, using a combination of aerial photographic interpretation at 1:5,000 scale, and field measurements of biomonitoring transects.

4.2.2 Status

This monitoring program was initiated in June 2007 and continued in 2008. After 2008, the program will be carried out bi-annually until 2016. The next program report is expected in December 2010.

4.2.3 Interpretation of Data

In 2008, 1,233 ha were mapped across 15 geographic areas. The reduction in spatial extent mapped compared to 2007 is related to the time of year when the aerial photos were flown (30 May in 2007; 25 July in 2008 due to weather delays). The later date of photo acquisition was associated with an increase in reservoir elevation levels, which resulted in inundation of portions of the area of interest. The 18 vegetation communities identified in 2007 were still present in 2008; however, the persistence and spatial extent of some of these communities varied. Bush Arm continued to be the most diverse in 2008 with all 18 communities mapped for that landscape unit (*cf.* 17 in 2008), followed by Canoe Reach at 15 (*cf.* 14 in 2007), and Encampment Creek at 13 (*cf.* 12 in 2007), a pattern that is consistent with the species richness data. The CH (Common Horsetail) community continues to be the only community distributed across all landscape units sampled. In 2008, two new landscape units were mapped (Sprague Bay and Succour Creek). Each of these units is relatively diverse with 11 communities at Sprague Bay and 13 at Succour Creek.

In 2007, 195 species of vascular plants were documented in the drawdown zone of Kinbasket Reservoir; in 2008, this number dropped to 119. The drop in species richness observed in 2008 may be related to several factors, including plant phenology as it relates to environmental conditions, woody debris removal, reservoir dynamics (i.e., sedimentation and erosion), and potential observer bias.

4.3 CLBMON-11A Wildlife Effectiveness Monitoring of Revegetation in Kinbasket Reservoir

4.3.1 Overview

The WUP CC supported reservoir-wide revegetation in the Kinbasket Reservoir to increase vegetation growth in the drawdown zones in lieu of maintaining lower reservoir levels. One of the primary objectives of the revegetation program is to provide benefits to wildlife through increased habitat diversity. In association with the revegetation program, the WUP CC recommended effectiveness monitoring to ensure that the revegetation program provides the intended environmental benefits. The rationale for the monitoring program is to assess the effectiveness of revegetation in Kinbasket Reservoir at enhancing wildlife habitat by monitoring wildlife utilization patterns of revegetated habitats in the drawdown zone.

The CC recommended that baseline data be collected in Years 1 and 2, followed by monitoring every other year. In Years 5 and 10, results from this study and related studies will be evaluated to assess how effectively the revegetation program is enhancing wildlife habitat.

The objectives of this study are to:

- 1) Develop an effectiveness-monitoring program to assess the success of revegetation program in Kinbasket Reservoir at increasing wildlife utilization of the drawdown zone and assess the potential effects of revegetation on wildlife populations.
- 2) Monitor wildlife indicator taxa to assess the effects of revegetating the drawdown zone on those taxa and their utilization of drawdown habitat in Kinbasket Reservoir.

The proposed monitoring indicators¹ include:

- a. Small mammals
 - b. Ungulates
 - c. Terrestrial Arthropods
 - d. Avian nest mortality
 - e. Amphibian and reptiles
- 3) Assess how effective the revegetation efforts are at improving habitat for wildlife in the drawdown zone between 741 m and 754 m elevation.
 - 4) Report and provide recommendations on the effectiveness of the revegetation program at improving habitat for wildlife in the drawdown zone in Years 5 and 10 (2012 and 2018, respectively).

¹d and e will be monitored separately under CLBMON-36: Kinbasket and Arrow Lakes Reservoirs Nest Mortality of Migratory Birds and CLBMON-37: Kinbasket and Arrow Lakes Amphibian and Reptile Life History and Habitat Use Assessment. Both studies are to be initiated in 2008.

4.3.2 Status

This monitoring program was initiated in May 2008 and will be carried out over 11 years. A draft report was received in January 2009. The final report is expected in April 2009. Results from the draft report are highlighted below. In addition to the technical report, a sampling protocol was also prepared to detail the sampling procedures used in this study.

4.3.3 Interpretation of Data

In 2008, 24 transects were established in 12 sites in Kinbasket Reservoir; six sites each in the North Canoe Reach (CNR) and Bush Arm (BSA). Transects were paired with one located in the drawdown zone between 742 m and 754 m ASL and one immediately above the drawdown zone. The selection of sites was based on river reach, planned re-vegetation enhancements and community type. Study sites were dominated by one of three representative vegetation associations: equisetum, sedge/grass, and willow shrub.

Data was collected on seasonal ungulate utilization, small mammal abundance and diversity, and terrestrial arthropod biomass, abundance and diversity. A total of 360 ungulate pellet count plots, 3600 trap-night-equivalents for small mammal, and over 500 trap-day-equivalents of terrestrial arthropod sampling were completed between June 1 and August 11, 2008. As this study is based on the collection of data over time, strong inferences can only be made once several years of data have been collected. As such, only preliminary results are presented below and must be interpreted cautiously.

Deer (*Odocoileus sp.*) and moose pellets (*Alces alces*) were both detected throughout the study area, whereas elk (*Cervus canadensis*) were only found in the Bush Arm plots. Deer were the most often detected species for a total of 56%, followed by elk and moose (*Alces alces*), 23% and 21% respectively. Analysis showed greater ungulate pellet detections in sedge/grass communities than in the other vegetation types and no pellets were detected in the equisetum type.

A total of 601 small mammals from 11 species were captured during live-capture small mammal sampling. Of the total number of captures, 60% were recaptured animals. Four species: deer mouse (*Peromyscus maniculatus*), southern red-backed vole (*Myodes gapperi*), longtailed vole (*Microtus longicaudus*), and meadow vole (*Microtus pennsylvanicus*), represented >97% of all captures. *P. maniculatus* was the most frequently caught species accounting for 89% of all captures. *Myodes gapperi* and *longicaudus* were recorded only in Canoe Reach study sites within sedge community type. *M. pennsylvanicus* was predominantly caught in the Bush Arm Region within the willow community types. Incidental captures included: 1 short tailed weasel (*Mustela erminea*), 1 bushy-tailed woodrat (*Neotoma cinerea*), 8 masked shrews (*Sorex cinereus*), 1 unidentified *Sorex* spp., 1 American red squirrel (*Tamiasciurus hudsonicus*), 2 least chipmunks (*Tamias minimus*), and 1 western jumping mouse (*Zapus princeps*). Preliminary data collected during the first year of this monitoring program revealed that small mammals appear to have a preference for sedge/grass vegetation in the Kinbasket Reservoir study area.

Terrestrial arthropod sampling yielded several kilograms of dry-weight biomass and a total of 37,586 individual arthropods, which were counted and classified into 16 Orders and 88 Families. The predominant Order captured was Diptera (flies), which represented over 83.5% of all sorted individuals. The next most common Orders within the samples were Hymenoptera (bees, wasps) and Lepidoptera (moths, butterflies) which combined for about 13% of all the arthropods classified. Homoptera (true bugs) and Coleoptera (beetles) both represented approximately 1% of the total.

Terrestrial arthropod biomass varied considerably across transects from 13.74 mg to over 276.27 mg per 24 hour period. Overall, insect biomass tended to be higher in the Willow community type followed by the sedge/grass, and then the willow shrub communities. Terrestrial arthropod data collected during the first year of this monitoring program provides substantial baseline information for future comparison and monitoring.

The results of data collected in Year 1 will be used to refine the study design in future years.

4.4 CLBMON-11B Wildlife Effectiveness Monitoring of Revegetation and Wildlife Physical Works in the Arrow Lakes Reservoir

4.4.1 Overview

The WUP CC supported reservoir-wide revegetation and wildlife physical works to enhance wildlife habitat in drawdown zone of the Arrow Lakes Reservoir. In association with these programs, the WUP CC recommended effectiveness monitoring to ensure that the physical works provide the intended environmental benefits. The rationale for the monitoring program is to assess the effectiveness of the revegetation and wildlife physical works in Arrow Lakes Reservoir by monitoring wildlife utilization patterns of revegetated and enhanced habitats in the drawdown zone.

The CC recommended that baseline data be collected in Years 1 and 2, followed by monitoring every other year. In Years 5 and 10, results from this study and related studies will be evaluated to assess the effectiveness of the revegetation program.

The objectives of this study are to:

- 1) Develop an effectiveness-monitoring program to assess the success of the revegetation and wildlife physical works programs in Arrow Lakes Reservoir at increasing wildlife utilization of the drawdown zone and assess the potential effects of revegetation on wildlife populations.
- 2) Monitor wildlife indicator² taxa to assess the effects of the revegetation and the wildlife physical works on those taxa and their utilization of drawdown zone habitat in the Arrow Lakes Reservoir.
- 3) Report and provide recommendations on the effectiveness of the revegetation

² The suite of monitoring indicators has not been determined as of yet, as the Terms of Reference has been deferred until 2009.

and wildlife physical works at improving habitat for wildlife in the drawdown zone in Years 5 and 10.

4.4.2 Status

The Terms of Reference for this program have been deferred until 2009; the Terms of Reference will be submitted for approval in March 2009. Consequently, the monitoring program has not been initiated. Monitoring will commence in 2009 and will be carried out over 10 years. The first program report is expected in March 2010.

4.4.3 Interpretation of Data

At this time there are no data to interpret for this monitoring program.

4.5 CLBMON-12 Arrow Lakes Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis

4.5.1 Overview

The final decision of the Columbia River Project WUP CC to support a revegetation program for the mid Columbia River (Revelstoke Reach) and the Arrow Lakes Reservoir was based on the assumption that the soft operational constraints operating regime would be effective in maintaining current levels of vegetation, and that revegetation activities would be a more cost-effective means of restoring and expanding vegetation cover for ecological and social benefits than imposing hard constraints on operation of the reservoir. In accepting soft constraints for the Arrow Lakes Reservoir, the WUP CC recognized that the uncertainty associated with the response of vegetation communities to flexible operations on a yearly basis needed to be addressed, and consequently recommended a monitoring approach comprised of a series of interlinked studies at different spatial scales to investigate the effects of the operating regime on riparian and wetland vegetation at the landscape, site and organism level. This monitoring program will focus on monitoring existing vegetation and revegetated areas at the *site (local)* scale.

The objectives of this monitoring program are to:

- 1) Determine the species composition (i.e., distribution, distribution and vigour) of existing vegetation communities, b) to identify species that have been successfully surviving long-term inundation;
- 2) Evaluate the abundance and biomass of existing vegetation communities in relation to elevation in the drawdown zone;
- 3) Monitor the response of existing vegetation communities at the local (site) level to the continued implementation of the soft constraints operating regime and other environmental variables;
- 4) Assess the long-term effectiveness of the revegetation program at restoring and expanding the quality (as measured by diversity, distribution and vigour) and

quantity (as measured by cover, abundance and biomass) of vegetation in the drawdown zone for ecological and social benefits; and,

- 5) Assess the costs and benefits of the recommended revegetation prescriptions applied under the Arrow Lakes Reservoir Revegetation Program physical works) by monitoring the response of revegetated communities to different treatments in the drawdown zones of the reservoir.

These objectives will be addressed by assessing the specified response variables at sample sites, stratified by primary topographic and biophysical criteria, under the various treatment options relative to control sites (areas of naturally established vegetation and barren reference sites). Vegetation responses will be monitored over a range of geographic areas within the drawdown zone of Arrow Lakes Reservoir, based on locations selected for treatment under the Arrow Lakes Reservoir Revegetation Program.

This monitoring program involves:

- 1) Determining the species composition (i.e., distribution, distribution and vigour) of existing vegetation communities to identify species that have been successfully surviving long-term inundation;
- 2) Evaluating the cover, abundance and biomass of existing vegetation communities in relation to elevation in the drawdown zone;
- 3) Monitoring the response of existing vegetation communities at the local (site) level to the continued implementation of the soft constraints operating regime for the Arrow Lakes Reservoir and other environmental variables;
- 4) Assessing the long-term effectiveness of the revegetation program at expanding the quality (as measured by diversity, distribution and vigour) and quantity (as measured by cover, abundance and biomass) of vegetation in the drawdown zone for ecological and social benefits; and,
- 5) Assessing the costs and benefits of the revegetation prescriptions applied under the Arrow Lakes Reservoir Revegetation Program physical works by monitoring the response of revegetated communities to different treatments in the drawdown zone of the reservoir.

4.5.2 Status

This monitoring program was initiated in April 2008 and will be carried out bi-annually over 10 years, starting in 2009. The next program report is expected in December 2009.

4.5.3 Interpretation of Data

The Revegetation Monitoring and Vegetation Composition Analysis program in the Arrow Lakes Reservoir (CLBMON-12) has collected one year of vegetation, soils and productivity data in May and June of 2008. Repeated fixed quadrats were used to

observe changes in vegetation over time, as well as soils and productivity analysis of the dominant vegetation type in the reservoir.

The CLBMON-12 project is a site-specific extension of the landscape level analysis of vegetation change in the reservoir (CLBMON-33 Arrow Lakes Reservoir Inventory of Vegetation Resources). CLBMON-12 uses the same classification system as CLBMON-33, similar elevation zones and mapped distributions of types, but is more detailed, taking place at a larger scale. The CLBMON-12 project answers the need to characterize the vegetation composition before treatments under CLBWORKS-2, the Arrow Lakes Reservoir Revegetation Program

As part of this year's field work, fixed plots were established for comparisons over time between three main elevation bands, between vegetation community types, and between treatments being implemented in the reservoir to enhance vegetation cover and diversity. Permanent vegetation measurement quadrats were established in the vegetation community types at each of three elevation bands, with replication. In total, 106 plots were established in the Arrow Lakes proper and 34 plots in Revelstoke Reach. Sampling of sites will continue in 2009, and then bi-annually from 2011 to 2017.

Results indicate that vegetation communities are mainly dominated by a few species, with inundation-tolerant and somewhat weedy plants being very common. There appears to be a strong relationship between vegetation development and soil moisture and nutrient regimes, which has positive implications for the revegetation treatments planned under CLBWORKS-2 Arrow Lakes Reservoir Revegetation Program. At middle and lower elevations, Reed Canary grass and lenticular sedge tend to form continuous and often high cover, where depth and duration of inundation appears to limit the survival of more riparian species, such as cottonwood, willows, conifers and herbaceous plants. In these environments, it is apparent that dominance by these aggressive species may be a limiting factor for the enhancement of biodiversity of plants in the Arrow Lakes Reservoir.

4.6 CLBMON-13 Inventory of Mosquito Populations in the Revelstoke Area

4.6.1 Overview

The WUP CC recommended that studies be undertaken to gain a better understanding of the life history and habitat requirements of mosquito species occupying habitats in the Revelstoke area to determine any effect that dam discharge and reservoir operations may have on mosquito levels in the area. The WUP CC recommended research studies to address uncertainties related to:

- The species of mosquito that inhabit the Revelstoke area, and which species are likely to be a nuisance to humans/livestock;
- Habitat and vegetation types occupied by mosquitoes in relation to the zone of influence of BC Hydro operations;
- Areas that constitute prime mosquito breeding grounds;

- Critical discharges and durations of flooding at which mosquito hatching occurs;
- Environmental and biotic factors affecting egg hatching and larval survival (e.g., seasonal temperatures, precipitation, predators);
- Effects of vegetation management and wildlife physical works in the drawdown zone on mosquito production (species and abundance); and
- The risk of potential mosquito vectors for West Nile virus (WNV) in the Revelstoke area.

Given the interrelation of the mosquito studies recommended by the WUP CC, four studies were combined into a single study to ensure integration of study results. This study will be conducted in 2009. The key objective of the study is to determine whether there are water management strategies and operating alternatives that could be implemented to minimize potential impacts on mosquito production in the Revelstoke area.

Study indicators include:

- a. Mosquito larvae and pupae presence, abundance, and distribution
- b. The presence, abundance, and distribution of adult mosquitoes including those species most likely to be vectors of WNV
- c. Water levels and temperature

This study will entail mosquito larval and pupal dip-net sampling, trapping of adult mosquitoes using light, gravid, and emergence traps, and monitoring water levels and temperatures in the drawdown zone. The study will also compile historical climate data, document evidence of mosquito nuisance, and map potential breeding grounds for different mosquito species.

4.6.2 Status

This inventory program has not yet been initiated. Terms of Reference were submitted to the CWR on 25 January 2008, and Leave to Commence was received on 26 February 2008. Sampling will commence in June 2009 and will be carried out over one year. The program report is expected in December 2009.

4.6.3 Interpretation of Data

At this time there are no data to interpret for this inventory program.

4.7 CLBMON-33 Arrow Lakes Reservoir Inventory of Vegetation Resources

4.7.1 Overview

During the Columbia River project WUP process, the WUP CC made several assumptions regarding vegetation tolerances to inundation and responses to changes in the hydrologic pattern, based on information gained from studies in the

Arrow Lakes Reservoir. Given differences in the elevation, climate and operating regime of the two reservoirs, the WUP CC recognized the inherent uncertainties of any assumptions related to the response of vegetation to reservoir operating conditions, and acknowledged the importance of long-term data collection for assessing the effects of the operating regime on vegetation at different spatial scales.

The Arrow Lakes Reservoir Inventory of Vegetation Resources monitoring program will address key uncertainties related to the relative contribution and importance of the soft constraints reservoir operating regime (i.e. timing, duration and depth of inundation, and multi-year stresses) on the maintenance of existing vegetation communities delineated at the landscape scale.

The objectives of this monitoring program are to:

- 1) Identify and spatially delineate existing riparian and wetland vegetation communities within the drawdown zone;
- 2) Measure the spatial extent, structure and composition (i.e. distribution and diversity) of the communities in the drawdown zone at repeated time intervals over a 10 year period;
- 3) Assess whether there are changes in the spatial extent, structure and composition of the communities in the drawdown zone over the monitoring period;
- 4) Assess whether observed changes in the spatial extent, structure and composition are attributable to the soft constraints operating regime of the reservoir; and,
- 5) Provide information on the effectiveness of the soft constraints operating regime at maintaining the existing spatial extent, structure and composition of the communities in the drawdown zone.

These objectives will be addressed through a landscape level analysis of vegetation community changes over time in response to the soft constraints operating regime.

This monitoring program involves evaluating changes in the existing vegetation communities in the reservoir drawdown zone between elevations 434m and 440m, using a combination of aerial photographic interpretation at 1:5,000 scale and field measurements in biomonitoring plots.

4.7.2 Status

This monitoring program was initiated in June 2007 and continued in 2008. After 2008, the program will be carried out bi-annually until 2016. The next program report is expected in December 2010.

4.7.3 Interpretation of Data

The landscape level inventory of vegetation resources in the Arrow Lakes Reservoir (CLBMON-33) has collected two years of data, using repeated aerial photography, electronically compiled image mosaics based on the photography, and field verification. The inventory tracks vegetation community changes over time in response to the Soft Constraints Operating Regime. The study focuses on changes in the existing vegetation communities in the reservoir drawdown zone between elevations 434 m and 440 m.

The 1:5,000 scale mapping and landscape level vegetation classification and habitat suitability mapping for eight wildlife taxa was completed in 2007. Ground truthing and corrections to the mapped database were completed in 2008. Some of the measurements done during fieldwork for a concurrent project (CLBMON-12) were directly applicable to the CLBMON-33 project, such as vegetation heights and covers in landscape level vegetation community types. These were analysed using simple graphs and statistics, while a more complete database was compiled from as yet unfinished 2007 versus 2008 imagery. A subset of initial monitoring plots established in 2007 was also re-evaluated in 2008.

This year (2008), the field work was conducted in May and June of 2008, with the goal of carrying out more field work in the fall; however, high fall reservoir levels prevented a comparison between the states of the vegetation in the fall of 2007 versus the state of the vegetation in the fall of 2008. Field re-assessments of approximately 25 of the 2007 field plots were compiled to refine the classification of vegetation community types. A total of 173 species and taxa were observed in 2008 in the plots throughout the reservoir.

The results of the mapping analysis show that for the most part, very little change in vegetation was evident between 2007 and 2008, especially in vegetation types that did not have much plant cover in 2007. Higher elevation vegetation seems to have undergone more change than lower elevation vegetation between 2007 and 2008. Some increases in vegetation cover and height occurred in either sheltered and/or moist sites. A loss of vegetation has occurred in only a small number of locations and those losses are related to erosion, primarily.

Going forward, the inventory will continue to be implemented biannually from 2010 to 2016.

4.8 CLBMON-35 Arrow Lakes Reservoir Plant Response to Inundation

4.8.1 Overview

From 1991 to 1993, wetland trials were conducted in the Revelstoke Reach portion of Arrow Lakes Reservoir to examine the feasibility of establishing a perennial cover of native wetland species for dust control in the drawdown zone. Long-term monitoring of the survival of these species and monitoring of permanent plots yielded valuable information regarding individual species tolerances to water level fluctuations as a result of the reservoir operating regime. However, these plots did not span the full range of elevations now occupied by natural vegetation within the drawdown zone (approximately 440m to 430m), and was no subsequent testing of

the absolute limits of plant endurance or which aspects of the reservoir operating regime (i.e. inundation timing, frequency, depth or duration) are the most significant for plant survival. This lack of specific information hindered the WUP CC's ability to assess the performance of operating alternatives for Arrow Lakes Reservoir on existing vegetation communities. Numerous assumptions were built into the vegetation performance measures, which the WUP Consultative Committee (WUP CC) acknowledged, needed to be tested to improve future decision making regarding reservoir management.

This monitoring program will be implemented at the scale of the individual organism (plant spatial scale) to document the responses of individual plants to the stresses imposed by the soft constraints operating regime. The program will address existing uncertainties regarding the relative contribution and importance of timing, frequency, depth and duration of inundation on plant survival at different sizes and ages, and the effect of multi-year stresses on trends in plant viability.

The objectives of this monitoring program are to:

- 1) evaluate the responses of plants of different species and ages to timing, frequency, duration and depth of inundation; and,
- 2) provide organism-level information required to link the effects of reservoir operations to larger-scale trends in vegetation composition, structure and spatial extent.

These objectives will be addressed through an experimental approach, involving both reciprocal field transplants and greenhouse culture, to determine the relative importance of timing, frequency, duration and depth of inundation to survival of plants of different species and ages (seedlings and mature plants).

This monitoring program involves a 5-year field program to investigate the effects of variable water levels encountered during these years under the soft constraints operating regime. In addition, greenhouse experiments will be implemented for four successive years to allow for controlled experimental testing of a range of inundation conditions imposed by the operating regime and/or to test alternate species

4.8.2 Status

This monitoring program has not yet been initiated. Terms of Reference were submitted to the CWR on 25 January 2008, and Leave to Commence was received on 8 April 2008. Monitoring will commence in April 2010 and will be carried out over five years. The first program report is expected in December 2010.

4.8.3 Interpretation of Data

At this time there are no data to interpret for this monitoring program.

5 Summary of Columbia River Project WUP Physical Works - Kinbasket & Arrow Lakes Revegetation Management Plan

This section summarizes the status of the physical works being implemented under the Kinbasket & Arrow Lakes Reservoirs Revegetation Management Plan of the Columbia River Water Use Plan, as per the Order under the *Water Act*, dated January 26, 2007.

5.1 CLBWORKS-1 Kinbasket Reservoir Revegetation Program Physical Work

5.1.1 Overview

The Columbia River Project WUP CC recognized the value of vegetation for improving aesthetic quality, controlling dust, protecting cultural heritage sites from erosion and human access, and enhancing littoral productivity and wildlife habitat. Therefore, the WUP CC supported a reservoir-wide planting and enhancement program in lieu of operational changes during the growing season, to maximize vegetation growth in the drawdown zone and to facilitate the development of long-term self-sustaining riparian vegetation. This program will target the upper elevations of the Kinbasket Reservoir drawdown zone between elevations 747 m and 754 m, and investigations will be undertaken to examine the feasibility of extending vegetation into lower portions of the drawdown zone, to a lower limit of 741 m.

The objectives of this physical work are to:

- 1) maximize vegetation growth in the drawdown zone;
- 2) provide benefits to littoral productivity and wildlife habitat through increased plant species diversity;
- 3) improve shoreline stability through targeted planting, where possible;
- 4) increase the species diversity of native plants, particularly those of interest to First Nations; and,
- 5) provide increased protection for known archaeological sites, where possible.

These objectives will be achieved through application of a variety of prescriptions in suitable sites that specifically target the above values.

5.1.2 Status

This physical work was initiated in June 2007 and will be carried out over five years. The next physical works report for the revegetation program is expected in December 2009.

For 2008, project tasks included: the verification of potential revegetation sites, revegetation prescription development and implementation (including the planting of trees, shrubs, and sedges), seed collections (for sowing nursery stock and direct sowing), follow up monitoring and reporting. With the goal of grouping revegetation

sites in a discreet geographical area for cost efficiencies, all 2008 treatments occurred in or adjacent to Bush Arm on Sites 83, 84, 85, 86, 87, 88, and 103.

Approximately 10,000 live stakes were cut for this project, resulting in 14,000 stakes planted. Live staking of willow, black cottonwood and red-osier dogwood was applied at all sites except Site 103. Generally, live staking was applied at or above 751 m; however, test plantings occurred down to 747 m.

A small number of willow, wild rose and cottonwood seedlings (500) were planted on Sites 83 and 103 at or above 752 m.

A total of 43,000 sedge seedlings (lenticular sedge, woolgrass and small fruited bulrush) were planted on Sites 83, 85, 86 and 103. The treatments were applied as operational trials (plantings that sought to cover a discreet landscape feature) and test plots (5 m x 10 m rectangles). This treatment occurred between 746 m and 754 m in elevation and on a variety of substrates, including sand, silt and clay.

Seed was applied at Sites 83, 84, 87, 88 and 103. Three native seed mixes were developed and applied to the debris management areas (Sites 84, 87 and 88). The upland mix was applied to a portion of Site 83. Alsike clover was intersown with planted lenticular sedge seedlings and as a mix with sedge seed on Site 83. Coated lenticular sedge seed was applied to a small portion of Sites 87 and 103.

Preliminary results from spring and fall 2008 monitoring show mixed results. The livestaking had the most variable results, with survival of willows (measured in October 2008) ranging between 27 and 39 percent; red-osier dogwood survival ranged between 31 and 95 percent, while cottonwood survival was between 41 and 100 percent. Spring monitoring of the planted sedge seedlings revealed 100 percent survival in the first month. Fall monitoring did not occur; however, qualitative observations showed high survival, except where erosional events had occurred.

5.2 CLBWORKS-2 Arrow Lakes Reservoir Revegetation Program Physical Work

5.2.1 Overview

The Columbia River Project WUP CC recognized the value of vegetation for improving aesthetic quality, controlling dust, protecting cultural heritage sites from erosion and human access, and enhancing littoral productivity and wildlife habitat. Based on the success of vegetation treatments for dust control in Revelstoke Reach (the mid Columbia River), the WUP CC agreed that establishing permanent vegetation cover in the drawdown zone of Arrow Lakes Reservoir and Revelstoke Reach was the best option for achieving the multiple objectives set by the committee. This program will target the upper elevations of the Arrow Lakes Reservoir drawdown zone between elevations 434m and 440m.

The objectives of this physical work are to:

- 1) maximize vegetation growth in the drawdown zone;

- 2) provide benefits to littoral productivity and wildlife habitat through increased plant species diversity;
- 3) improve shoreline stability through targeted planting, where possible;
- 4) increase the species diversity of native plants, particularly those of interest to First Nations; and,
- 5) provide increased protection for known archaeological sites, where possible.

These objectives will be achieved through application of a variety of prescriptions in suitable sites that specifically target the above values.

5.2.2 Status

This physical works was initiated in June 2007 and continued on a small scale basis in 2008. Implementation of the physical work will be carried out over five cumulative years, as described in the TOR (CLBWORKS-2 Years 2 and 3). These TOR were submitted to the CWR on 26 February 2008, and Leave to Commence was received on 23 April 2008. The final two years of the revegetation program (Years 4 and 5) will be implemented in conjunction with CLBWORKS-30 Arrow Lakes Reservoir Wildlife Physical Works to ensure that revegetation efforts are targeting those areas where wildlife habitat benefits can be maximized.

The next physical works report for the revegetation program is expected in December 2009.

The major activities in 2008 were the setup and implementation of a fertilization trial at Burton in the Arrow Lakes Reservoir. There were three main treatments: fertilization on silty sand, coarse sand and on 3,000 planted lenticular sedge seedlings. These treatments all occurred in June 2008, just prior to inundation. An additional 3,000 seedlings were planted in areas outside of the fertilization treatment in irregular polygons in June 2008. In the fall of 2008, roughly 9,000 lenticular sedge and 400 Columbia sedge seedlings were planted in the drawdown zone near the towns of Burton and Nakusp.

To allow for seedlings to be grown in 2009 with Arrow Reservoir provenance stock, seed from lenticular and Columbia sedge was collected at Burton in late June 2008, just prior to inundation.

Fertilization trials initiated in 2008 will be monitored in 2009 to evaluate the effectiveness of using fertilizer to enhance desired plant growth in the reservoir environment. Initial planting trials have provided direct experience to project team members to maximise efficiency in future efforts, and have established baseline monitoring points for guiding future plantings.

A major impediment to this project has been the operating regime in the Arrow Reservoir for 2008, combined with the late release of the contract. In the spring, this factor resulted in the preferred sites for the fertilization trial being flooded prior to treatment, resulting in new areas being selected with different substrates. The spring planting and fertilization was hampered by all sites being inundated within days of the treatments. Seed collection was also hampered sedge seed being flooded just as it

was ripening. The fall planting was challenged by the implementation of the Fall Storage Agreement, which resulted in water levels remaining near full pool. As a result, the freshly planted seedlings were inundated for the entire fall growing season, giving them little to no time for root establishment prior to flooding.

6 Columbia River Project WUP Monitoring Programs and Physical Works Costs

The following table summarizes the approved costs of the monitoring programs and physical works under the Kinbasket & Arrow Lakes Reservoirs Revegetation Management Plan of the Columbia River WUP, as well as the Actual Costs to 31 January 2009.

Table 6-1: Columbia River WUP Monitoring Programs and Physical Works Costs

Monitoring Programs	Activity	Costs approved by CWR	Total Forecast (Life to Date Actuals and Forecast)	Variance Total to Approved	Explanation	Corrective Action
KINBASKET & ARROW RESERVOIRS REVEGETATION MANAGEMENT PLAN						
CLBMON#9 KIN MONITORING OF REVEGETATION EFFORTS						
	Direct Management	\$105,958	\$96,919	\$9,039	Found cost efficiencies in first year of study	Track management costs to determine need for resubmission of ToR budget to CWR
	Implementation	\$682,711	\$665,787	\$16,924	Contractor did not spend all allocated funds but delivered on full scope of annual workplan	Remaining 2008 funds will be added to implementation costs for 2009 to enable refinement of study design.
CLBMON#10 KIN INVENTORY OF VEGETATION RESOURCES						
	Direct Management	\$97,315	\$91,025	\$6,290	Found cost efficiencies in second year of study due to contract being awarded to consultant delivering on other Columbia WLR work	Track costs to determine need for resubmission of ToR budget to CWR
	Implementation	\$1,083,142	\$1,067,404	\$15,738	Efficiencies found through internal delivery of Digital Elevation Model	Remaining 2008 funds will be added to implementation costs for 2010
CLBMON#11a KIN REVEGETATION WILDLIFE EFFECTIVENESS MONITORING OF REVEGETATION						
	Direct Management	\$185,103	\$185,129.11	(\$26)		
	Implementation	\$2,001,597	\$1,878,590	\$123,007	Forecast reflects contract value for 2008, 2009 and 2010 work without increased helicopter costs.	Contract to be amended to include increased helicopter costs if consultant chooses to use a twin-engine helicopter as part of study. If contract amendment is not required, ToR budget will be revised accordingly and resubmitted to CWR
CLBMON#11b ARROW REVEGETATION & WILDLIFE PHYSICAL WORKS						
	Direct Management					
	Implementation					ToR to be submitted for CWR approval (march 2009)
CLBMON#12 ARROW REVEGETATION MONITORING AND VEGETATION COMPOSITION ANALYSIS						
	Direct Management	\$110,327	\$97,529	\$12,798	Cost efficiencies found in first year of study	Track costs in 2009 to determine need for resubmission of ToR budget to CWR
	Implementation	\$489,386	\$489,052	\$334	Slight underspend	Remaining 2008 funds will be added to implementation costs for 2009
CLBMON#13 MID COL MONITORING: MOSQUITO POPULATIONS						
	Direct Management	\$26,962	\$30,316	(\$3,354)	Slight increase in management costs relative to approved budget due to increased time anticipated in agency liaison (CRD) and report review.	Resubmit ToR budget to CWR
	Implementation	\$84,688	\$84,688	\$0	Study not yet initiated	
CLBMON#33 ARROW INVENTORY VEGETATION						
	Direct Management	\$89,191	\$77,903	\$11,288	Cost efficiencies found in second year of study due to contract being awarded to consultant delivering on other Columbia WLR work	Track costs to determine need for resubmission of ToR budget to CWR
	Implementation	\$1,212,168	\$1,159,665	\$52,503	Efficiencies found through internal delivery of Digital Elevation Model. In addition, contractor did not spend all allocated funds but delivered on full scope of annual workplan	Remaining 2008 funds will be added to refine study design.
CLBMON#35 ARROW PLANT RESPONSE TO INUNDATION						
	Direct Management	\$79,836	\$79,836	\$0		
	Implementation	\$220,081	\$220,081	\$0	Study not yet initiated	
CLBWORKS#1 KINBASKET: REVEGETATION 1800/1500						
	Direct Management	\$117,026	\$116,727	\$299	Slight underspend	Remaining funds will be added to 2009 budget
	Implementation	\$2,449,714	\$2,449,093	\$621	Slight underspend	Remaining funds will be added to 2009 budget
CLBWORKS#2 ARR & MID COL: REVEGETATION - Phase 1						
	Direct Management	\$37,732	\$35,077	\$2,655	Phase 1 is complete - slightly underspent	Remaining funds will be rolled into Phase 3 via submission of Phase 3 TOR and budget
	Implementation	\$104,718	\$101,400	\$3,318	Phase 1 is complete - slightly underspent	Remaining funds will be rolled into Phase 3 via submission of Phase 3 TOR and budget
CLBWORKS#2 ARR & MID COL: REVEGETATION - Phase 2						
	Direct Management	\$46,846	\$43,995	\$2,851	Found cost efficiencies in first two years of project	Track management costs to determine need for resubmission of ToR budget to CWR
	Implementation	\$1,589,569	\$1,521,148	\$68,421	Contract value does not include 5% contingency in approved budget	NA
CLBWORKS#2 ARR & MID COL: REVEGETATION - Phase 3						
	Direct Management					
	Implementation					ToR to be submitted for CWR approval pending Phase 2 results