Peace Project Water Use Plan

Physical Works Terms of Reference

• GMSWORKS-21 Williston Dust Control Trials

April 2, 2008
Terms of Reference for the Peace Project Water Use Plan
Williston Dust Control Trials

1.0 Introduction

This Terms of Reference (ToR) describes the GMSWORKS#21 Williston (WLL) Dust Control Trials project ("Control Trials"). This project was proposed by the Committee for the Peace Project Water Use Plan (WUP) in the Committee Report dated December 2003. The Peace water use planning process was initiated in February 2001 and completed in May 2003.

This ToR is submitted in response to the Peace Order (Water Act, section 88, File No. 76975-35/Peace) issued by the Comptroller of Water Rights on 09 August 2007 (the “Order”). Schedule A of the Order states that:

“3. The licensee shall submit, within 9 months of the date of this Order, for approval by the Comptroller, terms of reference to:

a. conduct a dust source survey and reduce the duration and magnitude of dust storms around Williston Lake reservoir by way of dust control trials;…

This ToR provides a preliminary design for the Control Trials, a cost estimate for the work, and a tentative schedule for completing the work. The “dust source survey” component of clause 3(a) is covered by the ToR for GMSWORKS#20 WLL Dust Mapping.

1.1 First Nations Involvement

This ToR was developed through a joint planning process between BC Hydro and Tsay Keh Dene First Nation (TKD) following consultation with a team of wind erosion experts. Once developed, the ToR underwent internal review by BC Hydro and TKD. An external review process followed the internal review providing First Nations (FNs), stakeholders, and government agencies including Fisheries and Oceans Canada (DFO) and Ministry of Environment with an opportunity to comment on this document.

Implementation of this project provides an opportunity for FNs to build capacity and knowledge related to dust mitigation methodologies. It is anticipated that the FNs will be actively involved by providing personnel and local knowledge, as well as learning about the project. To facilitate transfer of knowledge, effort will be made to include FNs personnel in all aspects of the project. At a minimum, it is expected that the FNs personnel will engage in all duties typical of a field assistant in projects of this nature. Costs associated with FNs labour are a component of the overall project costs.

2.0 Description of Project

2.1 Location

The headwaters of the Peace, a tributary of the Mackenzie River, are located in north-eastern British Columbia (Figure 2-1). The Peace is formed by the confluence
of the Finlay and Parsnip rivers flowing towards each other in the Rocky Mountain Trench. At the confluence, the Peace flows east and is the only river to cut through the Rocky Mountains. Once out of the Peace Canyon the river maintains an easterly direction, crossing the B.C./Alberta border. The Peace drains into Great Slave Lake and joins the Mackenzie River before it enters the Arctic Ocean.

This project involves conducting tillage, irrigation, native vegetation, and wetland dust mitigation trials at selected locations within the Finlay Reach drawdown zone of Williston Reservoir, the hydro-power reservoir created by WAC Bennett Dam (Figure 2-1 and Section 2.2, below).

![Map of Peace River Basin]

Figure 2-1: Place Names in Peace Water Use Plan

2.2 Existing Works

**Williston Reservoir:**

Williston Reservoir covers approximately 1773 square kilometres (km²) (684.6 square miles (miles²)) at full pool and has an active storage of 393 Million cubic metres (Mm³) (32 Million acre feet (MAF)). The operating range of the reservoir for power generation is between 672.08 m (2205.0 ft.) and 642.00 m (2106.3 ft.) although special circumstances are required to draw the reservoir below 655.35 m (2150.0 ft.).
The Finlay Reach of Williston Reservoir is approximately 120 km in length and is typically 4 to 5 km wide. The dust beaches are typically found between ~670 m and ~660 m elevation in low pondage years (Figure 2-2).

Figure 2-2: Finlay Reach Beaches
3.0 Background

Since creation of the Williston Reservoir following construction of the WAC Bennett Dam, winds have picked up fine particles of silts and clays ("dust") from the exposed drawdown zone of the Finlay Reach of the reservoir. This aerial movement of particulates is of concern to residents and users of the area, particularly the TKD and Kwadacha First Nations (KFN). The village of Tsay Keh, a community of approximately 200 people, is located at the northern tip of Williston Reservoir; Kwadacha is located approximately 100 km north of the village (Figure 2-1).

The large variation between full and low pool on Williston Reservoir, coupled with the reservoir topography, exposes up to 31,000 ha of drawdown zone (between elevations 672 m and 656 m) in the Finlay and upper Parsnip arms. Not all of this area is dust source beach; approximately 20,000 ha may contribute to aeolian dust erosion in extreme years, and an estimated 5,000 ha typically contributes the majority of the dust. The annual low elevation level of the reservoir typically occurs in April and the majority of the beaches are flooded again by June. Some very high elevation beaches are flooded only in very high-pool years. The beaches are exposed to wind erosion for between two weeks and three months each year. This period of beach exposure to wind varies depending upon water levels, the reservoir recharge rate, and ice coverage of beaches.

The beaches are composed of sand, silt, and clay in different proportions depending upon the beach. The beach soils are replenished each year as sediment carried into the reservoir settles out. The soils are very loose and have few nutrients, restricting plant growth. The short growing season (late May until flooded by the rising water) and cool temperatures typical of this northern high latitude also limits vegetation.

Aeolian erosion of the beaches and consequent transport of suspended particulates was recognized as a WUP issue by the Peace WUP Committee (the “Committee”) and two physical works projects, together with a related monitoring program, were recommended by the Committee. Additional data about this issue have become available since the Committee Report was issued in 2003.

In 2007, BC Hydro, together with the TKD, contracted six outside experts in wind erosion and related issues to examine the emission of dust from Williston Reservoir and to propose a plan for mitigating those emissions. Those experts provided the Proposed Dust Mitigation Implementation Plan for Williston Reservoir, dated June 20, 2007 (the “Experts’ Report”). That report recommended a strategy based upon tillage of dust source beaches, supplemented by irrigation and wetland/vegetation-use where appropriate. Tillage controls dust by roughening the beach surface, preventing saltation of the sand particles that cause the majority of dust emissions. Irrigation controls dust by wetting the surface, preventing saltation; wetlands work similarly but keep the soils wet, inundated, or vegetated permanently. Native vegetation (non-wetland) controls dust by roughening the beach surface, preventing saltation.

The experts have hypothesised that little dust comes directly from the reservoir banks but the results of the monitoring (described in the Williston Dust Control Monitoring GMSMON#18 terms of reference), the experts’ work in the field as part of the Williston Dust Mitigation Program (of which this project is a part), and the
subsequent long-term planning for the Williston Dust Mitigation Program, may suggest that specific work on dust emissions from those banks should be investigated.

This project seeks to assess and validate mitigation techniques, including providing conclusive and defensible scientific documentation.

4.0 Benefits of the Dust Control Trials

This work will provide the knowledge for an adaptive management program of dust mitigation on a beach-by-beach basis for dust control in the future.

5.0 Design and Deliverables

5.1 Work Plan

This project has a three-year timeframe. The tillage trials portion will run for the full three years as described below. The irrigation, native vegetation, and wetlands portions are comprised of a 2008 data gathering and planning period, a 2009 initial trials period, and a 2010 expanded trials period.

5.1.1 Tillage Trials

The tillage trials are under the direction of Drs. Bill Schillinger, Bill Fryrear, and Bill Nickling.

- Tillage treatment trials will be carried out on Omineca Flats Beach (Figure 2-2) for three consecutive years, commencing in 2008.
- Tillage treatments will include twisted chisel and lister shovel tools at variable spacings.
- Experimental design, to be formalized prior to project start, will consist of a randomized complete block with five replications. Each plot is to be 250 m long x 100 m wide, laid out north-south perpendicular with the dominant wind direction. There will be 200 m buffer strips between all treatments.
- The surface of the beach will be characterized in 25 m x 25 m grid, probing to 30 cm to find the depth of suitable silt-clay soil and the texture of the surface.
- Big Spring Number Eight (BSNE) samplers will be located on the upwind and downwind boundary of each plot at 65, 125, and 185 m along plot length. Four BSNE samplers will be mounted with logarithmic spacing from the near surface to a height of 1.5 m.
- At the 125 m BSNE location (both upwind and downwind), a DustTrak aerosol monitor will be placed.
- Surface roughness after tillage will be assessed using the chain method after each major rain or wind event along the east-west transect between BSNE samplers.
- Three meteorological towers with four NRG anemometers (0.5 to 2 m height), wind vane (2 m height) will be located adjacent to the tillage experiment.
5.1.2 Irrigation Trials

The irrigation mitigation strategy requires a feasibility study, including:

- Preliminary identification and evaluation of water and irrigation management for dust mitigation in Williston Reservoir.

- Gathering necessary field information and knowledge (office and expert) for the preparation of detailed proposal (i.e., action plan) for 2009 and beyond.

Work in 2008 is under the direction of Dr. Sietaan Chieng and focuses on an assessment of water sources (surface and subsurface streams, ponds, etc.) for irrigation activities (i.e., maintaining plant growth, reclamation/restoration of wetlands, etc.), and preparing a plan for future years work. Specific 2008 tasks include:

- Collect information (BC Hydro documents and field reconnaissance) on existing water sources (surface and subsurface streams, ground water, etc.), water table fluctuation data and hydrology information on reservoir, maps and aerial photos of existing wetlands.

- Create working scale maps.

- Conduct a reconnaissance survey and selection of areas for field trials.

- Small scale field trial for dyking (i.e., outlets control) of wetlands for water retention in wetland, including monitoring of dyked area.

- Small field trial for dyking (i.e., surrounding the area by using berm) of wetlands (combined with item above), including monitoring of dyked area.

- Field trial of using (wood) logs for water retention
  - for berm constructions
  - for ice/water traps formation (i.e., extend moist period of sand)

The results of the 2008 trials will be used by BC Hydro and TKD to jointly develop a plan for subsequent years.

5.1.3 Native Vegetation Trials

The native vegetation mitigation strategy requires a feasibility study, including:

- Preliminary identification and evaluation of native plants for dust mitigation in Williston Reservoir.

- Gathering necessary field information and knowledge (office and expert) for the preparation of detailed proposal (i.e., action plan) for 2009 and beyond.

Work in 2008 is under the direction of Dr. Many Vaartnou and focuses on assessing existing vegetation in the proximity, via a rapid reconnaissance survey, for value in future restoration, initiating field trials with seed of currently available native northern grasses, and initiating seed increase of these species. Specific 2008 tasks include:

- Initial overview visit

- Preparing working scale maps (1:80,000)
• Rapid reconnaissance survey to identify the native grasses and, if possible, collect available seeds in the area
• Identify what vegetation can be used in the area, known or unknown
• Initiate native seed multiplication
• Setup of plot trials
• Stakes for plot identification (60)
• Assessment of plot trial

The results of the 2008 trials will be used by BC Hydro and TKD to jointly develop a plan for subsequent years.

5.1.4 **Wetlands Trials**

The wetland mitigation strategy requires a feasibility study, including:

• Preliminary identification and evaluation of wetlands for dust mitigation in Williston Reservoir.
• Gathering necessary field information and knowledge (office and expert) for the preparation of detailed proposal (i.e., action plan) for 2009 and beyond.

Work in 2008 is under the direction of Dr. Abimbola Abiola and focuses on assessing the opportunities to maintain and enhance existing wetland areas. Specific 2008 tasks include:

• Sampling soil for agrological soil analysis.
• Obtaining soil analysis for agrological purpose.
• Soil temperature data collection for the growth season.
• Small field trials with native plants such as *Equisetum sp*.
• Analysis of organic matter and nutrient effects on existing native plants in the wetland areas.
• Evaluate wood debris for composting.
• Monitor ecology of the areas dyked by the irrigation portion of this project.

The results of the 2008 trials will be used by BC Hydro and TKD to jointly develop a plan for subsequent years.

5.2 **Deliverables**

This project includes the following deliverables:

• All data collected, in appropriate electronic format.
• Final report on the results of the 2008 work, including a description of field methodology, analytical techniques, assumptions, and detailed as-built drawings and maps where appropriate.
• A draft plan for post-2008 work for the irrigation, native vegetation, and wetlands portions of the project.

• Annual reports on the trial results, including a description of field methodology, analytical techniques, assumptions, and detailed as-built drawings and maps where appropriate.

• Final reports on all trials at the end of the trial period, including conclusions and recommendations for future dust mitigation measures.

• Presentations to the FNs communities and Chief and Council of results-to-date (annually), the post-2008 plans for irrigation, native vegetation, and wetlands, and the final conclusions and recommendations.

6.0 Schedule

The following are the milestone dates for the work:

• Submission of Terms of Reference to the Comptroller of Water Rights – March 2008.


• Annual Reports – October of each year.

• Final Project Report – October 2010.

7.0 Cost Objectives

Table 7-1 sets forth the estimated costs associated with this three-year project. The following should be noted in regards to the budget:

• Includes labour services only; required equipment has been acquired as part of other dust mitigation work in the reservoir;

• The FNs labour component is approximately $60,000/year, with an additional amount for irrigation, vegetation, and wetlands to be determined following the feasibility studies of those strategies;

• Work scope for Years 2 and 3 of the irrigation, vegetation, and wetlands strategies will be defined following completion of the Year 1 feasibility studies;

• Archaeological work required to complete this project is not a component of the budget. Such work will be completed as part of archaeological work for other dust mitigation work in the reservoir.

Table 7-1: Estimated Cost of the Dust Control Trials Project

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