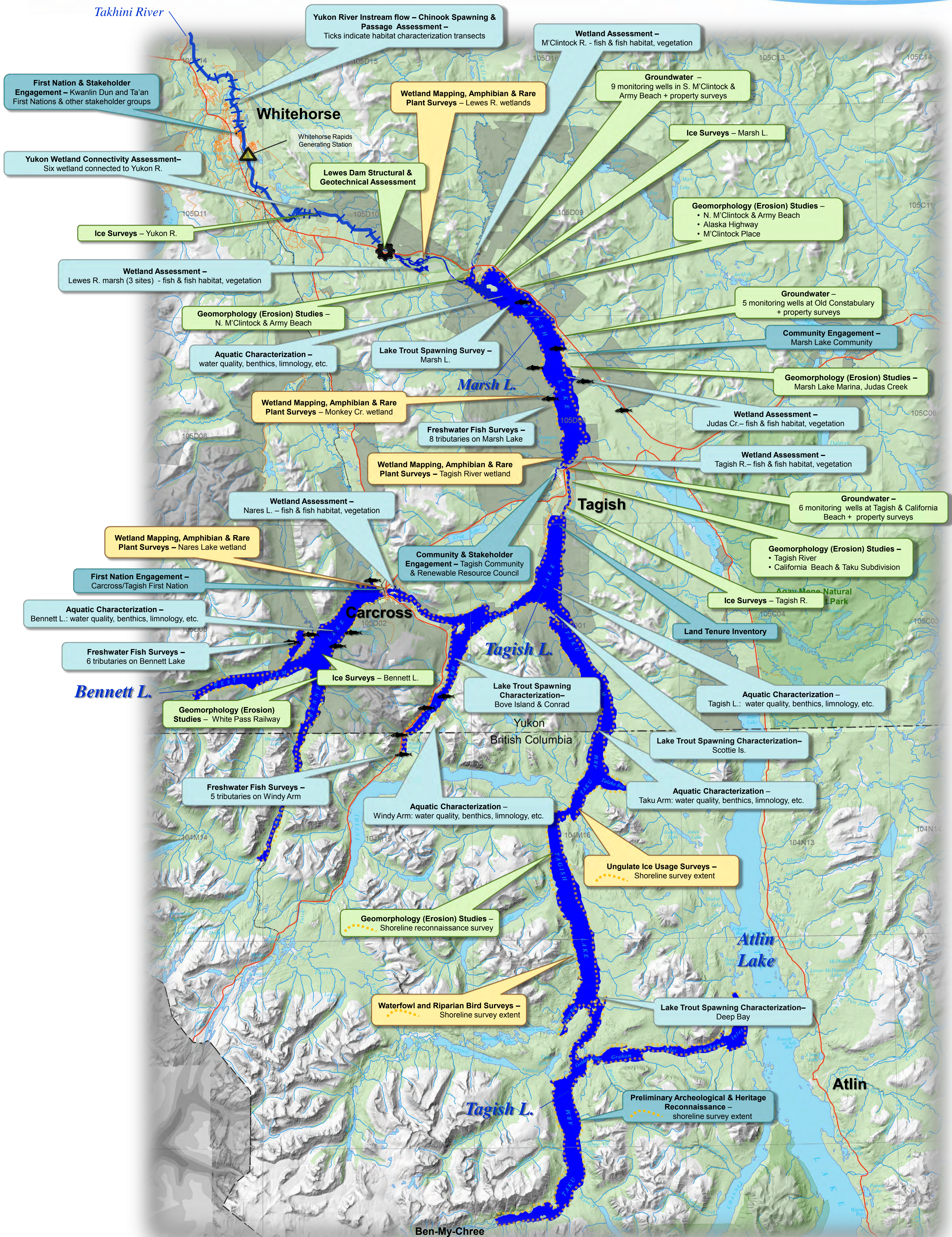


# Southern Lakes Storage Enhancement Concept

## Overview of Baseline Studies

YUKON  
ENERGY







## Water Resource Engineering, Erosion & Groundwater

<u>Study</u>	<u>Description</u>	<u>Purpose</u>
<b>1. Southern Lakes Hydrology Routing Study</b> – Northwest Hydraulic Consultants, 2010	A detailed water model of southern lakes including Marsh, Tagish, Bennett, Atlin, Fantail and Tushi Lakes using US Army Corps of Engineer’s HEC RES-Sim model. The model is calibrated to 50 years of historical record.	This model allows prediction of effects on lake level and river flows from water regulation at Lewes Control Structure.
<b>2. Hydrology Baseline Report</b> – AECOM, 2011	A summary of lake levels, flows and climate data in the southern lakes over the last 20 years.	This hydrology forms the “baseline” conditions from which potential project effects will be assessed.
<b>3. Marsh Lake Hydrology Assessment</b> – AECOM, 2011	Preliminary hydrology modeling results of changed Full Supply Level (FSL) at Lewes Control Structure	Initial set of simulated water level and river flow changes to be used in initial effects assessment.
 <b>4. Lewes Dam Structural &amp; Geotechnical Assessment</b> – AECOM, 2011*	Evaluation of the structural stability and foundation stability of the Lewes Control Structure. Included diving survey, deflection surveying and seepage modeling of the dam foundation.	To confirm safe and stable long-term performance of the control structure at the proposed FSL.
<b>5. 2010 &amp; 2011 Geomorphology Assessment</b> – AECOM, 2011*	Comprehensive aerial and ground reconnaissance to map areas of existing shoreline erosion. Follow-up in 2011 with further assessment of ice break-up erosion effects, site specific issues, surveying and bathymetry at erosion prone site (e.g. N. M’Clintock) . Preliminary wave-erosion modeling at select locations.	To identify erosion prone areas and collect necessary data to allow for future assessment of wave and erosion effects.
<b>6. Southern Lakes &amp; Yukon River Ice Survey</b> – AECOM, 2011	Collection of ice information (thickness, water temperature profile) in March and April on Marsh Lake, Bennett Lake, Tagish Lake outlet and Yukon River.	Characterization and information gathering on ice conditions for future assessment of ice cover and ice stability.
<b>7. 2009, 2010 &amp; 2011 Groundwater Monitoring</b> – AECOM 2009, 2010, 2011*	Shallow groundwater monitoring wells at 8 locations with monthly and continuous groundwater level recording	To establish the shallow groundwater trends in relation to lake level fluctuations in the vicinity of low-elevation properties.
<b>8. Marsh Lake Groundwater Assessment Property Survey Program</b> – AECOM 2011*	Elevation surveying of below-ground property improvements (septic fields & crawl spaces) of low elevation representative properties at Army Beach/ South M’Clintock, Old Constabulary, Judas Creek and Tagish River.	To gather preliminary information of the elevation of property improvements with respect to groundwater levels and to allow for future assessment of groundwater effects on below ground improvements.



# Southern Lakes Storage Enhancement Concept

## Overview of Baseline Studies

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### Aquatic Resources

#### Study

**1. Southern Lakes Historical Data Review** – AECOM, 2010 & 2011 update\*

Summary of known information on aquatic resources in Southern Lakes, including water quality, benthic invertebrates, fish, fish habitat, etc. Expanded in 2011 to include additional fish & fish habitat information & Chinook spawning data.

To compile existing information on aquatic resources in the Southern Lakes and Yukon River to inform project baseline and identify data gaps.

**2. 2010 Aquatic Studies** – AECOM, 2011

Conducted limnology, water quality, phytoplankton, zooplankton, benthic invertebrate sampling on Marsh, Tagish and Bennett lakes.

To characterize the aquatic environment on Marsh, Tagish and Bennett lakes to support the environmental baseline.

**3. Wetland Assessments** – AECOM, 2010 & 2011

Conducted wetland assessments (including water quality, benthic invertebrate, macro-invertebrates, sediment and vegetation) using wetland CABIN protocols. Level and temperature dataloggers were installed in some of the wetlands. Fish sampling was conducted in some of the wetlands. Detailed bathymetry and topography mapping was also done in Lewes Marsh. Late winter ice and benthic invertebrate sampling was conducted in Lewes Marsh area and Swan Haven (M'Clintock bay) area.

To conduct an ecological assessment of 3 wetlands around Marsh Lake, 3 wetlands in the Lewes marsh area and 2 wetlands in Nares Lake to support the environmental baseline.

**4. Lake Trout Spawning Survey** – AECOM 2011\*

Conducted reconnaissance of potential lake trout spawning locations in Marsh Lake. Conducted detailed bathymetry of some known lake trout spawning locations around Tagish Lake. Identified habitat around Tagish and Bennett Lake to identify to potential lake trout spawning habitat via helicopter.

To gather a further understanding of the potential lake trout spawning locations around Marsh, Tagish and Bennett lakes for the effects assessment.

**5. Freshwater Fish Survey** – AECOM 2011\*

Conducted fish surveys of tributaries of Marsh, Tagish and Bennett lakes.

To gather additional information on freshwater fish utilization of the tributaries. This will be used to inform the aquatic baseline for the project.

**6. Yukon River Instream flow – Chinook Spawning & Passage Assessment** – T. R. Payne and Assoc. and AECOM 2010 and follow up in 2011

Model to assess changes in river flow on Chinook spawning habitat & minimum flows for migration.

Collected instream flow data from various transects on the Yukon River from Lewes River Bridge to the Takhini River. Data collected was then modeled to assess changes in river flows on Chinook spawning and passage. Verification of the model's optimal spawning flows was completed by a local fisheries biologist.

**7. Wetland Connectivity Assessment** – T.R. Payne & Assoc., 2011, additional work by AECOM in 2011

To obtain an understanding of the connection of wetlands of the Yukon River at various river flows. Wetlands are important for fish utilization.

Assess the hydraulic relationship of 6 wetlands adjacent to the Yukon River at various river flows and levels. Including detailed surveying and bathymetry of the connections to the river.

\* Indicates report in preparation



# Southern Lakes Storage Enhancement Concept

## Overview of Baseline Studies

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### Terrestrial Resources

#### Study

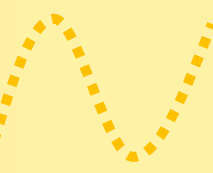
#### Description

#### Purpose

**1. Wetland Mapping** – Ardea Biological 2011\*

Terrestrial Ecosystem Mapping, (TEM, detailed vegetation mapping) of Lewes, Tagish River, Nares and Monkey Creek at 1:20,000 scale.

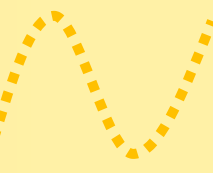
Mapping and characterization of wetland environment. Allows for future assessment and wildlife suitability mapping and assessment.



**2. Waterfowl and Riparian Bird Surveys** – Ardea Biological 2011\*

6 aerial surveys in 2010 of Marsh, Tagish and Bennett Lakes to supplement existing bird surveys. Work also included review of existing literature (CWS, Ducks Unlimited, etc.) and ground-based breeding bird surveys. Summary and mapping of extent of open water (and variability) in spring break-up.

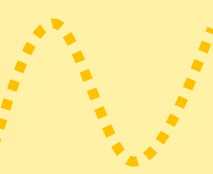
Data gap filling to provide additional information of bird usage of the Southern Lakes. Also mapping of open water in spring from CWS historical photo record to determine variability and extent of open water during spring break-up.



**3. Aquatic Mammal Surveys** – Ardea Biological 2011\*

6 aerial surveys in 2010 of Marsh, Tagish and Bennett Lakes to supplement known information about aquatic mammals. Included muskrat push-up surveys and literature review (trapping records, etc.)

Data gap filling to provide additional information of aquatic mammal usage of the Southern Lakes.



**4. Ungulate Surveys** – Ardea Biological 2011\*

2 aerial surveys in 2010 of Marsh, Tagish and Bennett Lakes to review/confirm moose and caribou usage and crossing of ice. Includes review of existing literature, collar data, etc. Wetland mapping includes ungulate habitat suitability mapping.

To identify where and how ungulates are using and crossing the ice. Also assessment of obstructions (ice shelves, etc.) to wildlife movement.

**5. Amphibian Survey** – Ardea Biological 2011\*

Identification and survey of amphibian presence and usage in 4 wetland complexes (see Wetland Mapping)

Collection of baseline information on amphibians & amphibian habitat for future assessment.

**6. Rare Plant Survey** – Ardea Biological 2011\*

Identification and survey of rare plant presence in 4 wetland complexes (see Wetland Mapping)

Collection of baseline information on presence and distribution of rare plants for future assessment.

### Community

#### Study

#### Description

#### Purpose

**1. Marsh Lake Land Tenure Inventory** – AECOM. 2011

Identification of land tenure adjacent to Marsh, Tagish and Bennett Lakes.

Inventory of land ownership, including government, First Nations and private land holders adjacent to Marsh Lake, Tagish River, Tagish Lake & Bennett Lake

**2. Community & FN Engagement** – Yukon Energy, 2010 & 2011

Regular meetings with Marsh Lake and Tagish communities, First Nations and other stakeholder groups (YCS, Ducks Unlimited, Canadian Wildlife Service, Renewable Resource Councils, etc.)

To regularly inform community, FNs and stakeholders about the Southern Lakes Storage concept, current studies and to identify interests & concerns interests about the project concept, the design and results/outcomes of the baseline studies, the potential effects of the concept, and the mitigation and monitoring that might be required should a project proceed.



**3. Preliminary Archeological & Heritage Reconnaissance** – EcoFor 2011\*

Review known archeological & heritage sites along 766 km of Southern Lakes' shoreline in Yukon and BC. Aerial survey to assess known and potential sites that may be susceptible to erosion.

To identify sites that may be affected by changing lake levels (primarily through erosion) and may warrant further site assessment.

\* Indicates report in preparation