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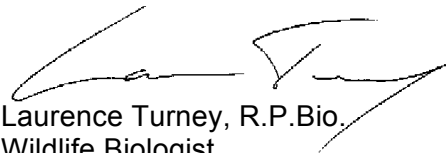
RE: Yukon Energy Corporation Southern Lakes Enhanced Storage Project - Preliminary Terrestrial Effects Assessment

Dear Jen,

Please find attached a copy of our Preliminary Terrestrial Effects Assessment for the Southern Lakes Enhanced Storage Project.

If you require any additional information please contact me at (250) 847-9772 or e-mail me at laurence@ardea.ca.

Sincerely,



Laurence Turney, R.P.Bio.
Wildlife Biologist

Introduction

Potential effects to terrestrial plants and wildlife species have been identified as a concern related to the Southern Lakes Enhanced Storage Project (the Project). This document outlines a preliminary assessment on terrestrial values based primarily on the interactions between effects on wetlands and the wildlife species that use them. The effects described are potential effects prior to the application of mitigation measures to lessen those effects. Possible mitigation measures and monitoring options are provided as discussion items that would be evaluated during the completion of the final assessment.

The intent of the preliminary assessment was to identify if there was a potential significant effect predicted from the Project on terrestrial values. This was accomplished by completing a quantitative assessment of potential changes to plant communities and selected wildlife and wildlife habitat concerns. As this is only the initial assessment of potential effects, however, many of the methods outlined have not been completed and only some of the Effects Statements, Indicators and VCs have been assessed at this point.

This Preliminary Terrestrial Effects Assessment outlines the assessment methodology proposed for the assessment of effects of the Project on terrestrial values, using information from Lewes Marsh as an indicator of the overall effects. Lewes Marsh was chosen for the preliminary assessment for a number of reasons including; it being the largest wetland complex within the Southern Lakes; it is a focal spring migration area for waterfowl and swans, and is expected to experience the largest range of change from the Project.

Wetland and Hydrologic Background

The Southern Lakes contains large wetland ecosystems that have been shaped by the dynamic water regime and topography of the area. Water levels change by 2.2 to 2.8 m on a yearly basis and have had a maximum range of 3.6 m in the last 25 years (Figure 1).

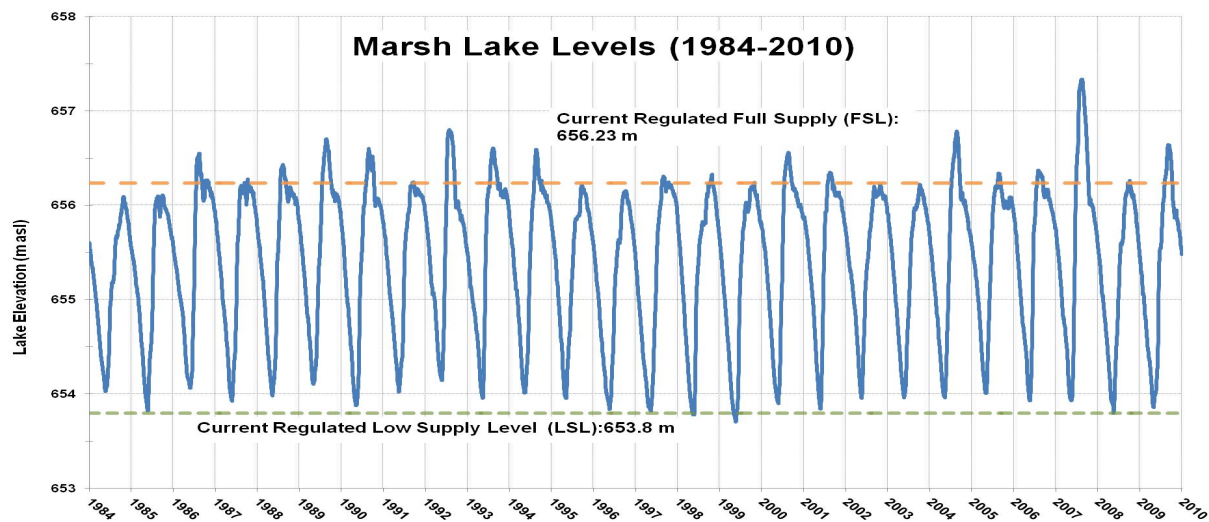


Figure 1. Range of Marsh Lake water levels from 1984 to 2010.

During the year, low water levels occurs in May with a rapid increase during the summer due to snowmelt, reaching peak levels between mid-August and early September, and a gradual decrease during the winter (Figure 2). The existing water license for Marsh Lake requires that the gates at the Lewes Control Structure remain fully open from May 15th to August 15th, with closure of the gates allowed after August 15th provided that Marsh Lake levels have dropped to below the FSL. Lake levels are maintained near the FSL, on average, from about mid-Sept to late Oct.

Preliminary Terrestrial Effects Assessment

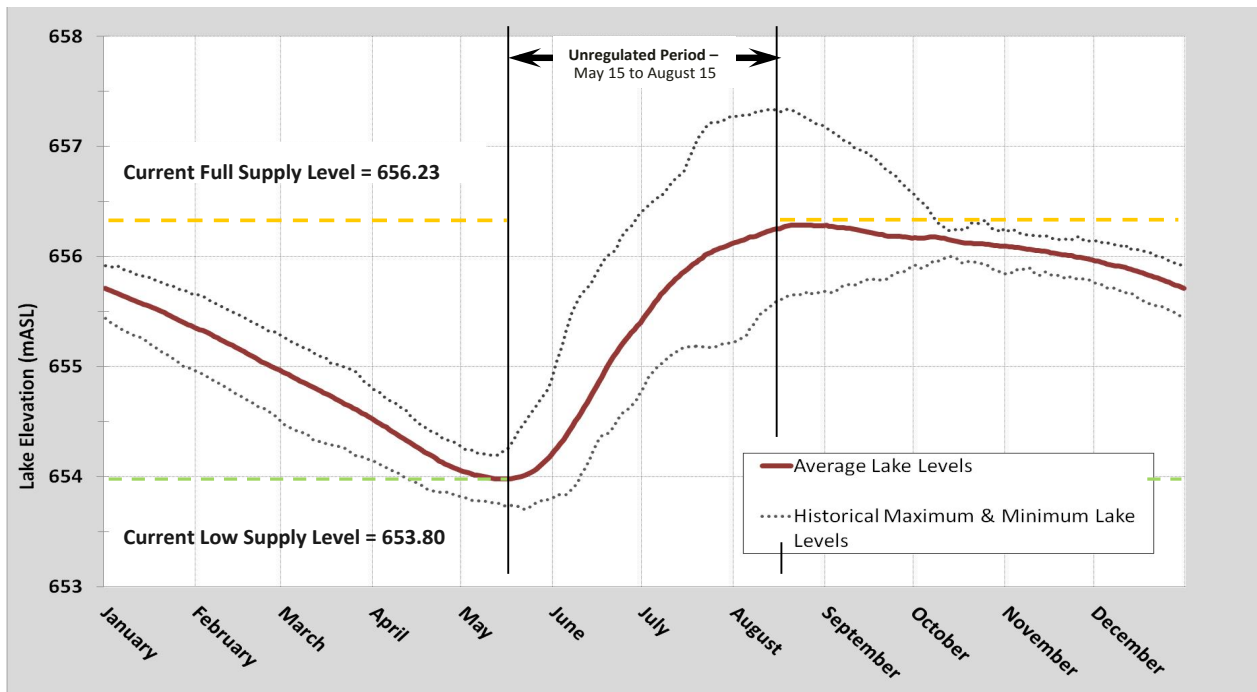


Figure 2. Annual average and range of Marsh Lake water levels (1984 to 2010).

Due to the highly dynamic nature of the Southern Lakes under baseline conditions, the plants, plant communities and wildlife have had to respond and adapt to the variability of water levels and durations within and between years.

The Project proposes to raise the FSL by 0.3 m to 656.53 and potentially lower the Low Supply Level (LSL) by 0.1 m to 653.70 m, which would change the average lake levels over the course of the year (Figure 3). A range of concerns related to these proposed changes have been

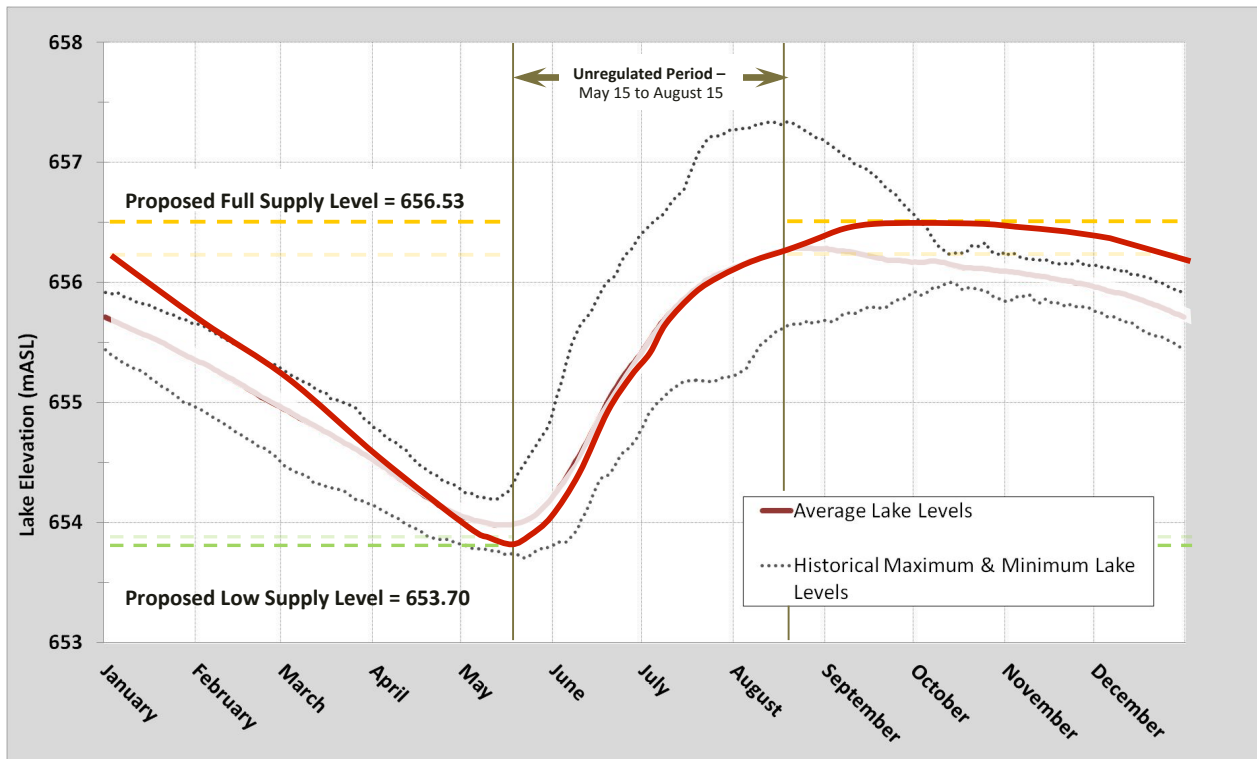


Figure 3. Proposed new water management regime and modelled average lake levels.

identified that could affect plants, plant communities, wildlife habitats and wildlife species. A review of the concerns and potential effects identified three key mechanisms:

1. Changes to the hydrologic regime (duration of inundation, water levels, timing of inundation and water velocities);
2. Changes to erosion and deposition zones, rates and substrates; and
3. Changes to the ice regime (thickness, formation height, movements).

The key challenge of the preliminary terrestrial assessment has been to determine how the existing dynamics related to hydrology have created the existing plant communities and how the proposed project may fall outside the range of the natural of the system and the effects to the plants and wildlife. To provide information on how plants and plant communities develop in the dynamic environment of wetlands, a review of available information was completed in 2012. The document *A Review of Wetland Vegetation Community Dynamics in Relation to the Proposed Southern Lakes Enhanced Storage Concept* (Roberts and Turney 2012) provides valuable background information wetlands and hydrological regimes. The document also offers important information on the responses to new hydrologic regimes that can be used to predict the effects of the Project and forms the framework for the assessment undertaken.

Study Area

The Local Study Area (LSA) for terrestrial values is the project footprint, which includes Marsh, Tagish and Bennett Lakes and associated streams, wetlands and adjacent upland areas influenced by the changes in regulated water levels. It also includes the upper Yukon River and associated shoreline and wetland habitats from the outlet of Marsh Lake to the confluence of the Yukon and Takhini Rivers north of Whitehorse.

The Regional Study Area (RSA) for terrestrial values would be used to assess indirect effects that extend beyond the LSA and provide context for any cumulative effects assessment conducted. Due to the large size of the LSA and its likely encompassment of any direct and indirect effects on the terrestrial values of interest, the RSA has been initially assigned to be the same as the LSA. If significant adverse effects are identified during this assessment for a terrestrial value, then an appropriate RSA for that value will be determined so that cumulative effects can be assessed for that value.

Valued Components (VCs)

The list of potential Valued Components (VCs) for this project could include all of the plant and wildlife species (including species of concern), the wetland and upland plant communities, and the wildlife habitats that are found within the LSA that could interact with the Project. This list contains well over 200 plant and wildlife species and dozens of vegetation communities and wildlife habitats. Evaluation of this many VCs would clearly be a challenge for an effective assessment of project effects. On the other hand, the VCs for this project could also be generalized to be 'Wildlife', 'Wildlife Habitat' or 'Wetlands', which is relatively common in Assessment processes, but is also a challenge since the project effects are unlikely to be the same for all wildlife species or a general wetland category that are found within the LSA.

The solution to the above challenges related to selection of VCs was to identify representative VCs that took into account the range of plant and wildlife species using the LSA, and the range of social, economic and conservation values associated with them. The identification of the range of species and values was completed through discussions with government regulators, First Nations and the public, along with a review of available literature and the results of the baseline studies within the LSA.

Valued Component Selection Process

A common issue with the determination of VCs in effects assessments is the lack of transparency in the selection process. We determined that all assumptions we used in the selection of representative VCs would be identified and rationales provided to enable regulators and the public to understand what the VCs represented. In our VCs selection we used an iterative approach. We initially identified a set of broad plant community and wildlife species groups (e.g. wetland plant communities, waterfowl habitats, etc.) and evaluated all of the known plant communities and wildlife species for their inclusion within these broad groups. As we progressed through the individual communities and species, we added or subtracted from the broad groups until we were able to identify relatively homogenous groups that generally represented all of the known plant communities and wildlife species within the LSA that could be affected by the project. This information was tracked on an Excel spreadsheet and included reviews of key criteria such as:

- the broad plant community or wildlife species group that it was associated with;
- the conservation status of the plant or wildlife species at the Federal and Territorial/Provincial levels;
- socio-economic value (hunting, trapping, wildlife viewing, public profile) of species;
- concerns of First Nations, local communities, and regulators;
- potential vulnerability to potential project effects;
- VCs chosen for previous environmental assessments;
- species involved in current monitoring programs in the region;
- known presence and relative abundance within the study area; and
- the potential to act as an indicator or umbrella species for a range of wildlife or plant species.

Potential effects of the Project on plants, plant communities, wildlife species and wildlife habitats were also identified as part of the evaluation of VCs and tracked in the Excel spreadsheet. This information was used in the development of the Impact Statements, Pathways of Effects and Indicators.

Selection of Representative Valued Components

The representative plant communities and wildlife species VCs were determined based on the results of the review and summarizing of the individual potential VCs. A total of seven representative VCs were selected, and are summarized below, along with the rationale for their selection.

Wetland Plant Community Extent and Distribution

The wetland mapping project conducted as part of the baseline studies provided valuable information on the plants and plant communities found in representative wetlands within the LSA. Early in the VC selection process, it was identified that wetland plants and plant communities could be affected by the Project. It was also identified that the effects on plants would likely be expressed in how these plants were distributed in relation to the new water levels, particularly with respect to the change in the level and duration of wetland inundation during the growing season. This re-distribution of plants within the wetland plant communities would ultimately change the distribution and extent of these plant communities. Wetland plant communities are important wildlife habitats, used for feeding, nesting, security, etc. and a change in their distribution could affect the wildlife species that use them.

During the baseline studies, three aquatic plant species were identified as species of concern: *Isoetes echinospora*, *Crassula aquatica* and *Subularia aquatica*. They were found on level or gently sloping, silty and sandy substrates in shallow, clear water, in the warmer reaches of the wetlands. Two species, *C. aquatica* and *S. aquatica* were found along the north shore of the

west end of Nares Lake, while *C. aquatica* and *I. echinospora* were recorded along the west shore of Lewes Marsh. Proposed changes in water levels may affect the distribution of these species of concern.

Upland Plant Community Extent and Distribution

Extensive mapping of upland plant communities was not conducted within the LSA, although some communities were mapped in upland areas in conjunction with the wetland mapping. The effects on upland plant communities are expected to be restricted to areas where increased erosion due to increased wave heights may occur. Wildlife species and the habitats associated with those upland plant communities may also be affected, but is limited to a relatively small group of habitats and species.

Amphibian Habitat Extent and Distribution

Columbia spotted frog, western toad and wood frog are the only amphibian species found within the LSA. Western toad and Columbia spotted frog are both considered species of concern and amphibians as a whole are used as bio-indicators, alerting researchers to potential problems in the environment. They are also important to First Nations in the southern Yukon and are considered animal shamans and guardian spirits. They are crest emblems for three Inland Tlingit clans in the region: the Ishkaahittan of Carcross and the Ishketaan of Teslin and Atlin.

The three frog species require aquatic habitats for breeding (laying eggs and rearing tadpoles), although the timing differs for each. The overwintering habitats for Columbia spotted frog are in aquatic habitats while western toad and wood frog overwinter in terrestrial habitats. Frogs in the LSA are localized and impacts to their wetland and aquatic habitats can have an effect on their distribution and populations. The project can potentially impact these animals' habitat use and distribution because of changes to the water regime and water quality.

Aquatic Bird Habitat Extent and Distribution

Aquatic birds are those bird species that have a strong association with water features (e.g. lakes, wetlands, rivers, etc.) and include waterfowl, shorebirds and gulls. Hundreds of waterfowl and shorebird species use the LSA during migration and many species also breed in wetlands along the shoreline and in adjacent upland wetlands in the area. Many waterfowl species are hunted by the public, and First Nations, while M'Clintock Bay appears to be a critical spring staging area for Trumpeter and Tundra swans at Swan Haven, and spring bird watching Swan Haven is an important public activity. Eighteen waterfowl and shorebird species listed as species of concern have been identified within the LSA from baseline surveys and available reports and agency surveys.

Both waterfowl and shorebirds are closely tied to wetland and shoreline habitats for breeding and feeding, with the proposed changes in water levels having the potential to affect these habitats both directly (e.g. nest inundation) and indirectly (e.g. changes in available plant species for feeding on).

Terrestrial Bird Habitat Extent and Distribution

Although there are hundreds of bird species that are found in south-central Yukon and northwest British Columbia, only approximately 130 species are regularly associated with wetland and shoreline habitats, using them for breeding or feeding. Seven of the species found during baseline surveys or identified within the literature as using the LSA are listed as species of concern.

Potential effects from the Project include changes to the distribution and quality of nesting habitats within wetland shrubs and treed areas, erosion of sandy bank nesting habitats and changes to the distribution of plant species that terrestrial birds may be feeding on (e.g. seeds) or that they are used by insects that the birds feed on.

Aquatic Mammal Habitat Extent and Distribution

Aquatic mammals include mink, river otter, beaver and muskrat. Beaver and muskrat are almost completely dependent on the aquatic and wetland plant communities for food and denning, while mink and river otter also use upland habitats. These animals are both culturally important and of commercial interest as furbearers to First Nations and trappers.

The Project can potentially impact these animals' habitat use and distribution because of the potential changes in the distribution of wetland plants and communities as well as changes in access to lodges and other denning sites. Higher water levels during the winter can affect ice formation and there may be an increase in the availability of under-ice habitats.

Terrestrial Mammal Habitat Extent and Distribution

A wide variety of terrestrial mammals are found within the LSA, but only a few were identified as being closely associated with shoreline, wetland and aquatic habitats: moose, woodland caribou, grizzly bear and black bear. All of these species are of interest to the public and First Nations, some for consumptive or spiritual reasons. Grizzly bear and woodland caribou are also species of conservation concern.

Many of these species are dependent on shrub, sedge and aquatic plants for food, while the shrubby wetland habitats found in the LSA can also provide important security cover from predators. The Project can potentially impact these animals' habitat use and distribution because of potential changes in wetland plants and communities. During the winter, woodland caribou and moose move across the landscape, habitually crossing lakes and rivers at specific points to get to their destinations. Potential changes in ice thickness or open water areas due to changes in ice patterns or currents during the winter may affect these movements and use areas (e.g. use of islands by moose for calving in the spring).

Impact Statements and Pathways of Effects

The impact statements outlined below describe potential cause and effect pathways between Project activities and the VCs identified and are used to predict likely outcomes. Project activities that are expected to cause similar effects on the same VCs or related VCs due to a common mechanism were combined into a single pathway of effect.

Impact Statement HR1

Changes in the hydrologic regime (duration of inundation, water levels and timing of inundation) could affect wetland plant species, wetland plant communities, wildlife habitats and the wildlife species that use those habitats.

The pathway of effect for this potential impact can be described as:

1. Increased duration of inundation, higher and lower water levels, and changes in when inundation and drying occurs will change the amounts of water available to plant species during the growing season from April 1st to October 15th.
2. Changes in water availability will differentially affect plant species due to their tolerances to changes in water availability causing death of some plants and growth of others.
3. Differential effects to plant species will cause changes to compositions of wetland plant communities and their distribution due to differences in decomposition and colonization rates.
4. Wetland plant communities provide a range of values as wildlife habitat to various wildlife species, so changes in wetland plant communities will affect wildlife habitats and their use by wildlife species.

Impact Statement HR2

Changes in the hydrologic regime (duration of inundation, water levels and timing of inundation) could affect wildlife species directly through effects on life stages (e.g. waterfowl eggs, amphibian egg masses, etc.).

The pathway of effect for this potential impact can be described as:

1. Higher or lower water levels, duration and the timing of those changes could affect species that have vulnerable life stages with limited mobility to move out of the zone of effect (e.g. eggs, non-mobile young, etc.).
2. The effects on vulnerable life stages of some species could cause population effects on those species.

Impact Statement ER1

Changes to erosion and deposition zones, erosion and deposition rates and the substrates that could be eroded, could affect wetland plant species, wetland plant communities, wildlife habitats and the wildlife species that use those habitats.

The pathway of effect for this potential impact can be described as:

1. Changes in the erosion and deposition zones, rates of erosion and deposition and the substrates that may be eroded and deposited, could change the types and amounts of substrates that plants grow on, remove areas of growth or bury plant species.
2. Changes in substrates that plants grow on will differentially affect plant species due to their tolerances to changes in substrates causing death of some plants and growth of others.
3. Differential effects to plant species will cause changes to compositions of wetland plant communities and their distribution due to differences in decomposition and colonization rates.
4. Wetland plant communities provide a range of values as wildlife habitat to various wildlife species, so changes in wetland plant communities will affect wildlife habitats and their use by wildlife species.

Impact Statement ER2

Changes to erosion and deposition zones, erosion and deposition rates and the substrates eroded could directly affect wildlife habitats and the wildlife species that use those habitats.

The pathway of effect for this potential impact can be described as:

1. Changes in the erosion and deposition zones, rates of erosion and deposition and the substrates that may be eroded and deposited, which could remove wildlife habitat features (e.g. nests or dens in erodible banks).
2. Removal of wildlife habitat features could cause population effects on some wildlife species.

Impact Statement IR1

Changes to the ice regime (thickness, formation height, scouring) could affect wetland plant species, wetland plant communities, wildlife habitats and the wildlife species that use those habitats.

The pathway of effect for this potential impact can be described as:

1. Changes in ice thickness, formation height and scouring could affect plants species by physically damaging some plant species.
2. Changes in damage to plants will differentially affect plant species due to their tolerances to ice damage causing death of some plants and growth of others.

3. Differential effects to plant species will cause changes to compositions of wetland plant communities and their distribution due to differences in decomposition and colonization rates.
4. Wetland plant communities provide a range of values as wildlife habitat to various wildlife species, so changes in wetland plant communities will affect wildlife habitats and their use by wildlife species.

Impact Statement IR2

Changes to the ice regime (thickness, formation height, open water areas) could affect where wildlife species are able to move and use on-ice and under-ice habitats.

The pathway of effect for this potential impact can be described as:

1. Changes in current velocities in rivers or at constricted areas during the winter may affect ice thickness and open water areas; and the increased water levels in the winter may cause the ice formation level to be higher causing steeper ice angles adjacent to the shoreline as the water level goes down during the winter.
2. Changes in the ice conditions may affect how wildlife species are able to move on and under the ice during the winter, as well as change the availability of habitats during the spring as the ice melts.
3. Increased ice heights may increase under-ice habitats available for security or feeding for aquatic mammals. Increased shoreline ice angles, open water areas and thin ice may change terrestrial mammal movement patterns or increase mortality risk.

Indicators and Thresholds for Significance

To evaluate the potential effects of the Project on the representative VCs identified, a set of indicators have been developed which will allow for a quantitative analysis to be completed on most of the VCs. These indicators have been developed as an hierarchy, with Habitat Indicators as the first level, which are combined using ecological modeling techniques to evaluate Species Indicators, which then are used to evaluate the effects of the project on the representative VCs.

Habitat Indicators

These indicators are based on the assumption that effects on wetland and terrestrial habitats can be quantified based on the available wetland mapping and other mapping products.

The list of habitat indicators are provided below:

- Sandbar / Mudflat Habitats
- Shallow Aquatic Plant Habitats
- Deep Aquatic Plant Habitats
- Herb / Sedge Habitats
- Shrub Habitats
- Treed Habitats
- Cutbank Habitats
- Rocky Island Habitats
- Winter Under-Ice Habitats
- Winter On-Ice Habitats

These indicators are derived primarily from the wetland mapping completed in the baseline assessment, and the change in these habitat types from the baseline to the proposed future conditions can be calculated. Assumptions related to the amounts of available habitat within the mapped wetland and upland communities have been documented in the wetland mapping report and can be used to determine many of the habitat indicators. Some habitat indicators will not be available from the wetland mapping, and will have to be calculated based on other mapping sources such as bathymetry (e.g. Under Ice Habitats) or 1:50,000 topographic mapping (e.g. Cutbank Habitats).

Plant and Wildlife Species Indicators

The results of the assessments of the Habitat Indicators can be used to identify potential effects on plant and wildlife species habitats. Where possible, a single Species Indicator was used to represent groups of species, based on similar habitat use patterns. For example, mallard ducks were used to represent ducks such as wigeon, shovelers, teal, etc., which have similar feeding and nesting habitat requirements.

The preliminary list of Plant and Wildlife Species Indicators that have been identified are provided below:

- Rare Aquatic Plant Habitats
- Western Toad Breeding and Overwintering Habitats
- Horned Grebe Feeding and Nesting Habitats
- Merganser Feeding and Nesting Habitats
- Trumpeter Swan Feeding Habitats
- Mallard Feeding and Nesting Habitats
- Bufflehead Feeding and Nesting Habitats
- Herring Gull Nesting Habitats
- Olive-sided Flycatcher Feeding and Nesting Habitats
- Rusty Blackbird Feeding and Nesting Habitats
- Lesser Yellowlegs Feeding and Nesting Habitats
- Bank Swallow Nesting Habitats
- Common Yellowthroat Feeding and Nesting Habitats
- Grizzly Bear Feeding Habitats
- Beaver Feeding and Lodge Habitats
- Muskrat Feeding and Den Habitats
- Moose Feeding, Security and Movement Habitats
- Woodland Caribou Feeding, Security and Movement Habitats

Each of the Plant and Wildlife Species Indicators will be evaluated using combinations of the results of the evaluations of the Habitat Indicators. To evaluate each Species Indicator a simple ecological summary model will be developed that integrates the Habitat Indicator to provide an assessment of the Species Indicator. Within the models, Habitat Indicators related to the species habitat requirements will be used. In some cases, additional information other than Habitat Indicators (e.g. distance to water) or variability around a Habitat Indicator (e.g. range of winter high water levels for ice formation) may be required and integrated into the models. An example of a conceptual model for Bufflehead duck is provided below as an illustration of the model components and interactions between the components:

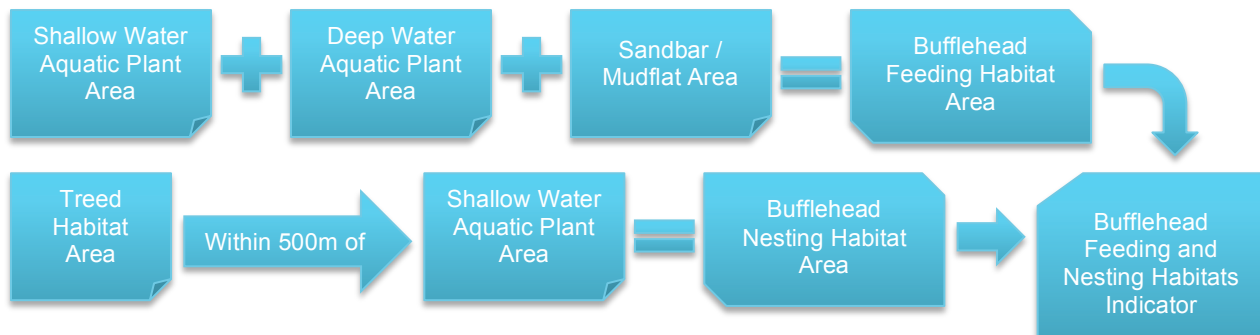


Figure 4. Conceptual model for Bufflehead Feeding and Nesting Habitats Indicator.

Table 1 provides a summary list of the Habitat Indicators that would be used to evaluate the Species Indicators and ultimately the representative Valued Component.

Preliminary Terrestrial Effects Assessment

Table 1. Preliminary listing of representative valued components the impact statements affecting them and the associated species and habitat indicators used to evaluate the valued components.

| Valued Component | Impact Statement Affecting Valued Component | Species Indicators | Habitat Indicators |
|---|---|--|--|
| Wetland Plant Community Extent and Distribution | HR1 - Changes in hydrologic regime affecting plant species, communities and wildlife habitats ER1 - Changes in erosion/deposition affecting plants species, communities and wildlife habitats IR1 - Changes in ice regime affecting plant species, communities and wildlife habitats | Rare Aquatic Plant Habitat | Sandbar / Mudflat Habitats Shallow Aquatic Plant Habitats Deep Aquatic Plant Habitats Herb / Sedge Habitats Shrub Habitats Treed Habitats |
| Upland Plant Community Extent and Distribution | HR1 - Changes in hydrologic regime affecting plant species, communities and wildlife habitats ER1 - Changes in erosion/deposition affecting plants species, communities and wildlife habitats IR1 - Changes in ice regime affecting plant species, communities and wildlife habitats | | Herb / Sedge Habitats Shrub Habitats Treed Habitats |
| Amphibian Habitat Extent and Distribution | HR1 - Changes in hydrologic regime affecting plant species, communities and wildlife habitats HR2 - Changes in hydrologic regime affecting wildlife life stages ER1 - Changes in erosion/deposition affecting plants species, communities and wildlife habitats IR1 - Changes in ice regime affecting plant species, communities and wildlife habitats IR2 - Changes in ice regime affecting wildlife movements and use | Western Toad Breeding and Overwintering Habitats | Shallow Aquatic Plant Habitats Herb / Sedge Habitats Shrub Habitats Treed Habitats |

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| Valued Component | Impact Statement Affecting Valued Component | Species Indicators | Habitat Indicators |
|--|--|--|---|
| Aquatic Bird Habitat Extent and Distribution | HR1 - Changes in hydrologic regime affecting plant species, communities and wildlife habitats HR2 - Changes in hydrologic regime affecting wildlife life stages ER1 - Changes in erosion/deposition affecting plants species, communities and wildlife habitats ER2 - Changes in erosion/deposition affecting wildlife features IR1 - Changes in ice regime affecting plant species, communities and wildlife habitats IR2 - Changes in ice regime affecting wildlife movements and use | Horned Grebe Feeding and Nesting Habitats Merganser Feeding and Nesting Habitats Trumpeter Swan Feeding Habitats Mallard Feeding and Nesting Habitats Bufflehead Feeding and Nesting Habitats Herring Gull Nesting Habitats Lesser Yellowlegs Feeding and Nesting Habitats | Sandbar / Mudflat Habitats Shallow Aquatic Plant Habitats Deep Aquatic Plant Habitats Herb / Sedge Habitats Shrub Habitats Treed Habitats Cutbank Habitats Rocky Island Habitats |
| Terrestrial Bird Habitat Extent and Distribution | HR1 - Changes in hydrologic regime affecting plant species, communities and wildlife habitats ER1 - Changes in erosion/deposition affecting plants species, communities and wildlife habitats ER2 - Changes in erosion/deposition affecting wildlife features IR1 - Changes in ice regime affecting plant species, communities and wildlife habitats | Olive-sided Flycatcher Feeding and Nesting Habitats Rusty Blackbird Feeding and Nesting Habitats Common Yellowthroat Feeding and Nesting Habitats Bank Swallow Nesting Habitats | Herb / Sedge Habitats Shrub Habitats Treed Habitats Cutbank Habitats |

Preliminary Terrestrial Effects Assessment

| Valued Component | Impact Statement Affecting Valued Component | Species Indicators | Habitat Indicators |
|--|--|--|---|
| Aquatic Mammal Habitat Extent and Distribution | HR1 - Changes in hydrologic regime affecting plant species, communities and wildlife habitats HR2 - Changes in hydrologic regime affecting wildlife life stages ER1 - Changes in erosion/deposition affecting plants species, communities and wildlife habitats ER2 - Changes in erosion/deposition affecting wildlife features IR1 - Changes in ice regime affecting plant species, communities and wildlife habitats IR2 - Changes in ice regime affecting wildlife movements and use | Beaver Feeding and Lodge Habitats Muskrat Feeding and Den Habitats | Sandbar / Mudflat Habitats Shallow Aquatic Plant Habitats Deep Aquatic Plant Habitats Herb / Sedge Habitats Shrub Habitats Treed Habitats Cutbank Habitats Winter Under-Ice Habitats |
| Terrestrial Mammal Habitat Extent and Distribution | HR1 - Changes in hydrologic regime affecting plant species, communities and wildlife habitats ER1 - Changes in erosion/deposition affecting plants species, communities and wildlife habitats ER2 - Changes in erosion/deposition affecting wildlife features IR1 - Changes in ice regime affecting plant species, communities and wildlife habitats IR2 - Changes in ice regime affecting wildlife movements and use | Grizzly Bear Feeding Habitats Moose Feeding, Security and Movement Habitats Woodland Caribou Feeding, Security and Movement Habitats | Shallow Aquatic Plant Habitats Herb / Sedge Habitats Shrub Habitats Winter On-Ice Habitats |

Thresholds for Significance

The potential effects on the representative VCs will be dependent on the results obtained from the Species and Habitat Indicators and how they combine together. In general, the analyses will determine the area of the Habitat and Species Indicators under baseline conditions and in the future under the proposed Project conditions. Comparisons of the change in habitat areas (habitat extent) and the change in habitat overlap (habitat distribution) from baseline to future conditions will be used to determine if significant changes have occurred. A threshold of significance of **10% change in habitat area** has been set to identify when an indicator has had a significant change between the baseline and post-Project times.

Impact Assessment Methodology

Introduction

The assessment of effects to plants and wildlife species and their habitats is based primarily on the assessment of effects to wetland plant communities due to the changes during the growing season in water levels, timing of those water level changes and the duration of those changes. Considerable effort was undertaken during the baseline studies to document and map representative wetland plant communities and their use by wildlife species. As well, detailed elevation measurements of the transition zones between wetland communities and the bathymetry of selected wetlands were completed. This information was gathered to allow for the modeling and prediction of the potential changes in wetland plant communities as water levels changed under the proposed Project conditions. To provide information that would allow the predictions of the potential wetland plant communities, an extensive literature review was completed and a review paper completed by Roberts and Turney (2012). Finally, an intensive review of historic water levels and the hydrologic regime of the Southern Lakes was completed, along with modeling of the proposed Project hydrologic regime. This review of historic and projected modeling of water levels, duration and timing provided valuable information on the range of natural variation within the system that the wetland plant communities have evolved in and how the projected Project changes would compare to that historic range.

Assessment Methods

The following sections outline the steps taken and methods used to complete the preliminary assessment of effects to terrestrial values.

Development of Indicators and Indicator Models

Habitat Indicators and Species Indicators have been developed to provide quantitative information for the assessment of the Impact Statements on the Terrestrial Valued Components. These Indicators have been developed to cover the range of information required to assess effects on the VCs. Preliminary models for each of the Species Indicators have also been developed, incorporating appropriate Habitat Indicators and any additional information required to provide quantitative data on the Species Indicators.

Prior to completing and submitting the environmental assessment, it is anticipated that the list of Habitat and Species Indicators and the preliminary models developed for the Species Indicators will be reviewed in a workshop format by regulators and other interested parties. This will provide an opportunity to outline the assessment methodology and gain acceptance of the methods, indicators and models used, prior to submission of an Environmental Assessment document. If additional Indicators or refinements of the models occur from these reviews, they will be incorporated into the final terrestrial assessment.

Analysis of Historic and Projected Hydrologic Regime

The historic and projected hydrologic regimes were reviewed to determine the average, 10th and 90th percentiles of Marsh and Tagish Lake levels and the duration of inundation at various elevation levels. The historic information was used to identify the conditions that the existing wetland and upland plant communities have developed under. The amount of time that water is present and the depth of that water during the growing season (April 1st to October 15th) is the prime factor in determining plant survival and their distribution, which determines plant community extent and distribution. For example many conifer tree species will not survive if their roots are under more than 10 cm of water for more than 10 days, while many willow species are able to tolerate up to 60 days under water and some sedge and grass species are able to survive for more than 90 days under more than 30 cm of water.

A comparison of the average water levels under Project conditions against the historic 10th and 90th percentile water levels during the growing season identified that the Project average water level is within the historic range of variability from April 1st to September 15th (Figure 5). This suggests that the higher water levels occurring under Project conditions from September 15th to October 15th, which are outside of the historic range of variability, will have the potential to effect plants and plant communities. For the preliminary assessment, this fall period from September 15th to October 15th was focussed on as a critical analysis factor for determining potential effects of the Project on plants and plant communities.

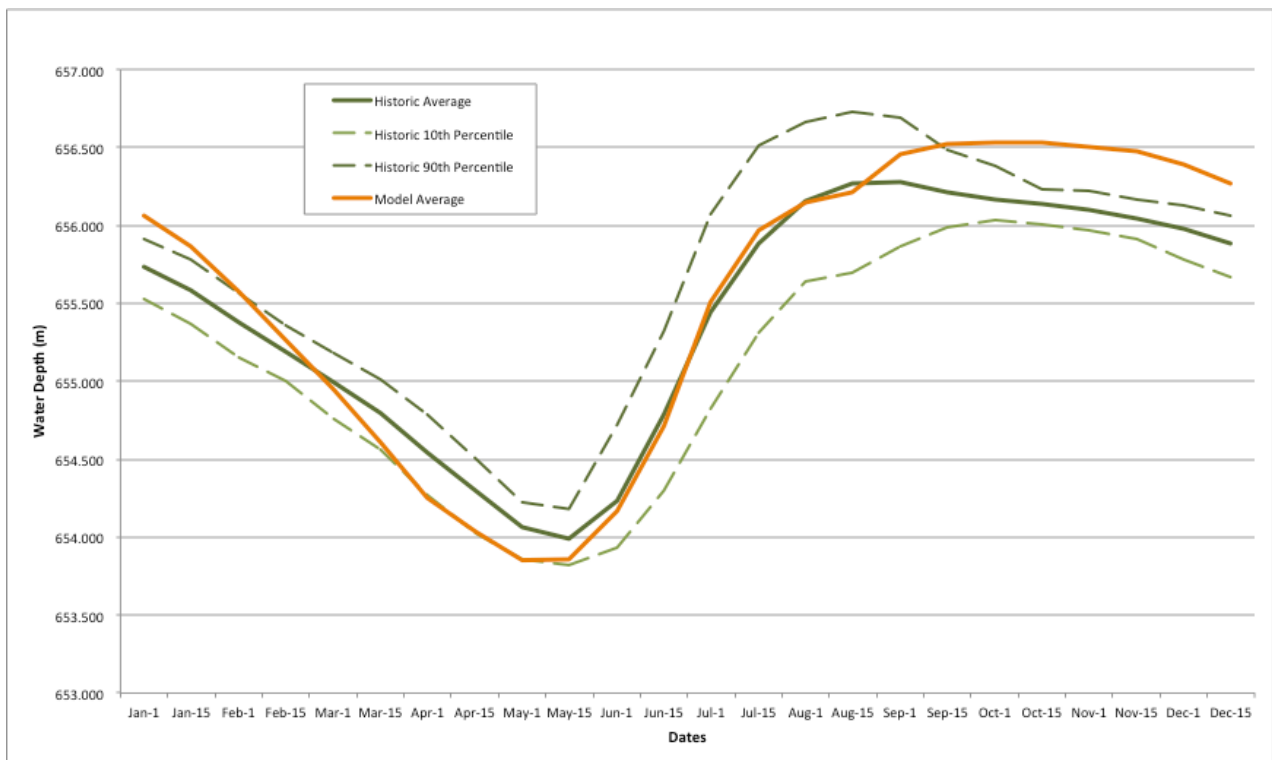


Figure 5. Comparison of Project average water levels against Historic average 10th and 90th percentile water levels.

As identified in the Introduction, information on the tolerances of plant species to inundation and their regeneration abilities was researched and is provided in a background document: *A Review of Wetland Vegetation Community Dynamics in Relation to the Proposed Southern Lakes Enhanced Storage Concept* (Roberts and Turney 2012). This document is an important background resource for understanding the assumptions used in the effects analysis and will be available as part of the final assessment documentation.

Development of Assessment Scenarios

Under the proposed Project of a 0.3 m higher FSL and potential 0.1 m lower LSL, the available information and research suggests that there will be some shifts in the distribution and extent of wetland plants and plant communities. As the timing of the shifts and time to establish the new complex of wetland plant communities will be variable and dependant on the plants within the communities, it is important that realistic time frames be identified for the assessment. It is assumed that the plant communities will have established a new equilibrium with the project conditions approximately 10 to 15 years after the new water levels have been established. This timeframe is based on the time it will take for shrub communities to fully establish, although herbaceous communities will likely be established sooner (e.g. within 5 to 10 years).

There may also be some direct effects on wildlife habitats and features that could occur within a very short timeframe. It is important to identify when the proposed Project may have the greatest effect on plants and communities, and the wildlife that use those habitats, so that possible mitigation measures can be identified to reduce those effects. During the assessment process, short-term effects (e.g. reduction in willow availability) that could be reduced by mitigation measures (e.g. planting willow in upland areas) will be identified.

Based on the above, two scenarios were identified for analysis:

- **Baseline** - this is the current condition of the VCs and Indicators within the LSA and is a function of the past hydrologic regime on the plants, plant communities and wildlife species.
- **Post Project +15** - this will be the predicted condition of the VCs and Indicators within the LSA expected to occur approximately 15 years after the establishment of the new FSL and LSL proposed by the Project.

Development of Required Mapping Layers for Analysis

The development of digital mapping layers for the analysis of potential effects is an important component to the assessment process. Since the initiation of the project we collected significant baseline data for plant species, wetland ecosystems, bathymetry, wildlife use, etc. We created new data layers from the baseline data and interpreted existing data to create data layers using a variety of sources and Geographic Information Systems (GIS) analysis techniques. Our intent was to develop an assessment that provided as much quantitative analyses as possible, as well as allowing for reviewers to understand the complex dynamics of the existing Southern Lakes system.

The following digital mapping layers are required to complete the analyses of potential effects:

- Wetland community mapping of selected wetlands in the LSA (Lewes Marsh, Nares Lake, Monkey Beach, South Marsh).
- Bathymetry/elevation mapping of selected wetlands in the LSA (detailed mapping available for Lewes Marsh and Nares Lake, less detailed for Monkey Beach, South Marsh).
- Bathymetry/elevation mapping of areas outside of the mapped wetlands (less detailed).
- Using available digital ortho-photography, topographic maps and local knowledge identify treed, cutbank and rocky island habitats outside of the mapped wetland community mapping areas within the LSA.
- Using available digital ortho-photography and local knowledge identify potential erosion-prone and deposition areas that may be affected by higher water levels in the fall within the LSA under Baseline and post Project conditions.

- Using the bathymetry/elevation mapping and winter water level heights identify potential ice formation layers to allow calculation of winter under ice habitats and potential ice-shelf angles within the LSA under Baseline and post Project conditions.

For the preliminary analysis, mapping layers were only completed for the Lewes Marsh area, with additional layers required to complete the analysis of potential effects on the other wetland areas.

Analysis of Indicators and Indicator Models under Assessment Scenarios

The areas of plant communities identified within the Lewes Marsh wetland mapping were used to analyse the habitat indicators under historic and Project conditions. As outlined in the *Analysis of Historic and Projected Hydrologic Regime* section above, the critical period identified within the growing season is the period from September 15th to October 15th when the water levels under Project conditions will be above the historic 90th percentile and therefore outside of the historic variability. Current historic conditions indicate that the highest water average water levels occur on September 1st. Under Project conditions, the average water levels will range from 0.310 m to 0.389 m above historic average water levels and from 0.043 m to 0.299 m above the historic 90th percentile water level values over the 30 days from September 15th to October 15th. As plant survival can be affected for some species within 10 days of being underwater, the 30-day period of high water is likely to cause some changes in plant and plant community distributions.

For our analyses, we chose the highest water levels under historic conditions (September 1st) and Project conditions (October 15th) for our comparisons. These dates provide the highest average water level values that the plants and plant communities would be subjected to during the respective growing seasons and are assumed to significant influences on the plants and plant community development. We projected the historic and Project high water levels (September 1st and October 15th respectively) onto a combination of the bathymetry/elevation and the wetland community mapping to determine the range of elevations of the wetland communities in relation to the historic and Project water levels. We were then able to compare the areas of the wetland plant communities that occurred under the different water levels, providing for a semi-quantitative assessment of the potential effects of the Project on the habitat indicators.

To help illustrate our analysis, several examples are outlined in the following figures. Figure 6 shows the Willow - Bluejoint (WC) shrub community, which under baseline conditions, occurs along a gradient at the September 1st high water level from -1.0 m to + 0.5 (i.e. portions of the WC community are located under water, while other portions are above the high water level). Under Project conditions (high water levels on October 15th), it is expected that there will be a small increase in the area under water from -1.5 m to -0.4 m and a decrease in area from -0.4 m to +0.5 m. Overall, however the general pattern of the curve is similar between the historic and Project conditions, suggesting that there may be little change in the distribution of the WC community.

In contrast, under historic conditions, the Willow Shrub (WS) community is primarily located between -0.4 m to 0.1 m, while under Project conditions the majority of the original area of this community will be in deeper water from -0.6 m and 0.0 m (Figure 7). This increase in area under higher water levels suggests that WS habitat may be affected under Project conditions and that it may switch to a WC community type, which is more tolerant of higher water levels. We believe that there may be a decrease in the WS habitats, but that it may not change the overall Shrub Habitat indicator as both of these communities are Shrub Habitats.

The effects identified in the above examples are expected across a number of plant communities and Habitat indicators, with shifts occurring along boundaries between Herb /

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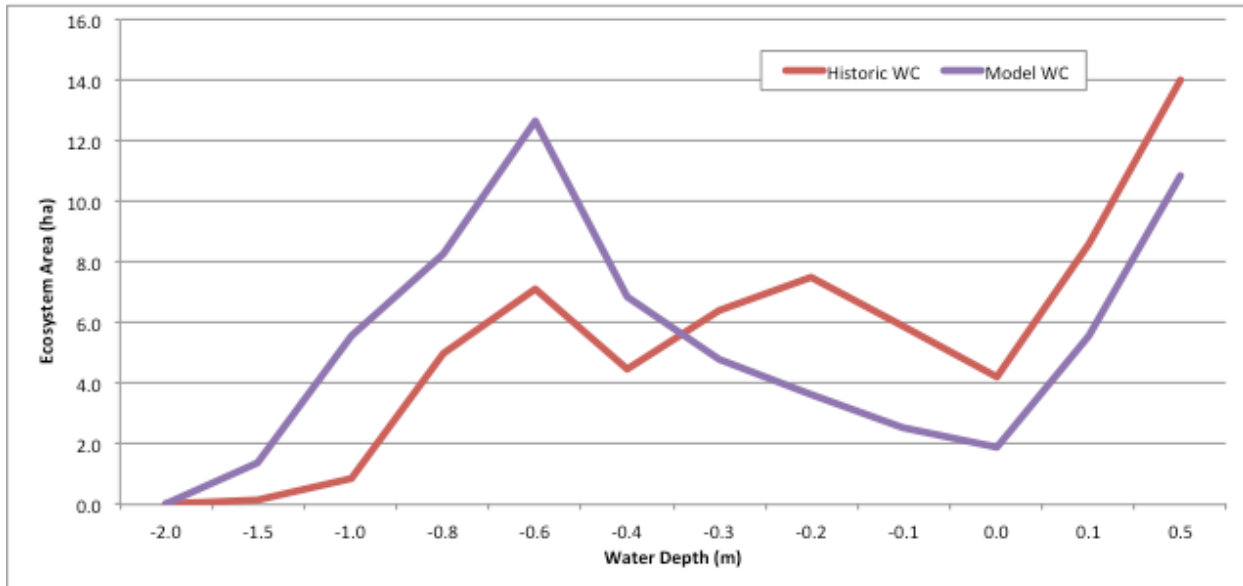


Figure 6. Comparison of the area of Willow - Bluejoint (WC) ecosystem under historic and Project conditions in relation to highest water levels during the fall (September 1st for historic and October 15th for Project conditions).

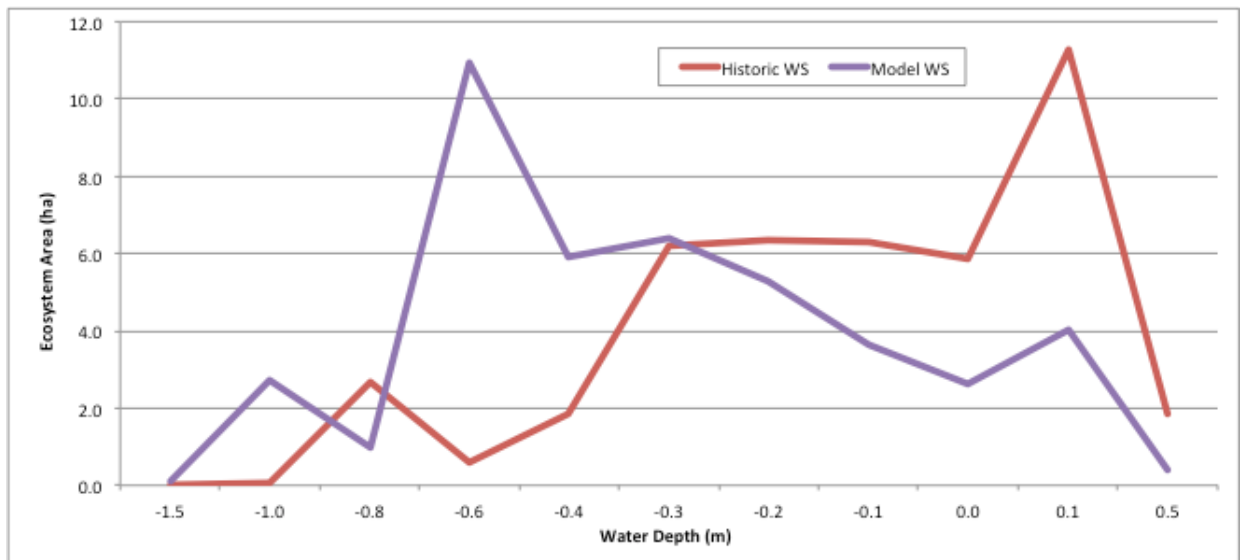


Figure 7. Comparison of the area of Willow Shrub (WS) ecosystem under historic and Project conditions in relation to highest water levels during the fall (September 1st for historic and October 15th for Project conditions).

Sedge and Shallow Water Aquatics habitats; between Herb / Sedge and Shrub habitats; and between Shrub and Treed habitats. The exact locations and total area of these shifts have not been fully assessed, but the preliminary assessment suggests that overall the increase in area covered by water will increase wetland plant communities, which will cause an increase in wetland Habitat indicators such as Shallow Water Aquatics, Herb / Sedge and Shrub habitats. Treed habitats along the edges of the wetlands will decrease in area due to the shallow gradient at the edges of wetlands, but within the LSA overall, the change in area of Treed habitats will be very small.

Preliminary Terrestrial Effects Assessment

A summary of the preliminary assessment for the Habitat indicators within the Lewes Marsh area is provided in Table 2.

Table 2. Summary of the preliminary assessment of habitat indicators under Project conditions for the Lewes Marsh area.

| Habitat Indicators | Map Code | Map Unit Name | Preliminary Assessment |
|-----------------------|----------|---|--|
| Sandbar / Mudflat | BE | Beach | Beach and mudflat habitats are limited in the mapped portions of Lewes Marsh. There are no expected changes to the area of these habitats from the Project. Overall it is expected that Sandbar / Mudflat Habitats may increase due to increased overall area under water. |
| | MU | Mudflat | |
| Cutbank | CB | Cutbank | Cutbank habitats have a very limited area and are found above the high water levels under historic conditions. The erosion analysis provided by AECOM (Pearson and Gillman 2013) identifies some areas of cutbank that may experience erosion within M'Clintock Bay, but not within the Yukon River, Tagish River or Tagish Lakes areas. Where erosion is expected, mitigation measures are expected to limit the effects. |
| Shallow Aquatic Plant | BM | Brown Mosses | Both BM and PM habitats are not expected to change as they extend into deep waters (> 1.5 m) normally and Project changes are within their natural range. Some Herb / Sedge habitat will likely become Shallow Aquatic Plant habitat. Overall it is expected that Shallow Aquatic Plant Habitats may increase due to increased overall area under water. |
| | PM | Pondweed - Mare's tail - Mixed Aquatics | |
| Deep Aquatic Plant | PP | Pondweed Deep Pond | Both PP and SR habitats are not expected to change as they extend into deep waters (> 1.5 m) normally and Project changes are within their natural range. Overall it is expected that Deep Aquatic Plant Habitats may increase due to increased overall area under water. |
| | SR | Spike rush Mudflats | |
| Herb / Sedge | AS | Awne d sedge | Some ecosystems such as the BW may lose area at the lower end of their elevation range due to increased water levels. These areas may change to Shallow Water Aquatic habitats such as PM. As well, the TH ecosystem has a very narrow range under historic conditions and the increased water levels may increase wetter Herb / Sedge types such as SF or SC. Increased water levels could also increase Herb / Sedge habitats where they are adjacent to Shrub habitats. Overall, it is expected that there will be an increase in Herb / Sedge Habitat due to the increased area under water, although monitoring and mitigation measures may be required to reduce effects to individual ecosystem types. |
| | BR | Bulrush Marsh | |
| | BW | Beaked sedge - Water sedge | |
| | HS | Swamp horsetail - Beaked sedge | |
| | MA | Mannagrass | |
| | SC | Sedge - Cinquefoil | |
| | SF | Sedge Fen | |
| Shrub | TC | Tea-leaved willow - Sedge - Cinquefoil | Some ecosystems such as the WS may lose area at the lower end of their elevation range due to increased water levels. These areas may change to TS habitats as they overlap at that water level. Increased water levels could also increase Herb / Shrub habitats where they are adjacent to Shrub habitats (e.g. WC, TS). Ecosystems at higher elevations may increase adjacent to Treed habitats, where increased water levels affect tree growth or establishment. |
| | TS | Tea-leaved willow - Sedge - Brown moss | |
| | WB | Willow - Scrub birch | |
| | WC | Willow - Bluejoint | |
| | WF | Willow - Sedge | |

Preliminary Terrestrial Effects Assessment

| Habitat Indicators | Map Code | Map Unit Name | Preliminary Assessment |
|---------------------------|----------|---------------------------------|---|
| Shrub | WS | Willow Shrub | Overall, it is expected that there will be an increase in Shrub Habitat due to the increased area under water, although monitoring and mitigation measures may be required to reduce effects to individual ecosystem types. |
| Treed | SB | Sw - Balsam Poplar - Willow | The SM ecosystem is not expected to be affected as it is above the proposed Project water levels. There will be slight decreases in most other Treed habitats as they become wetter sites, likely changing to Shrub habitat types. The SP habitat may increase as it has widest range and some other Treed habitat may shift to that type. |
| | SG | Sw - Willow - Glowmoss | |
| | SM | Sw - Feathermoss | |
| | SP | SwAt - Willow | Overall, there will likely be a small decrease in Treed Habitats within the LSA adjacent to wetlands and lakes. Monitoring and mitigation measures may be required to reduce effects to individual ecosystem types. |
| | SS | SwPI - Soopolalie - Kinnikinick | |
| Rocky Island Habitats | | | No Rocky Island habitat types were mapped within the Lewes Marsh wetland mapping, most of these habitat types are found within Tagish Lake and will be incorporated into the final effects assessment. |
| Winter Under Ice Habitats | | | Winter Under Ice habitats were identified as vegetated habitats below the high water levels on December 1 under average historic (655.978 m) and Project conditions (656.389 m). There is a 27% increase in available Under Ice habitats under Project conditions, with available Herb / Sedge habitats increasing by approximately 7% and Shrub habitats by approximately 74%. Overall there is expected to be a positive increase in Winter Under Ice Habitat. |

Analysis of Indicator Models under Assessment Scenarios

The analyses of the indicator models have not been completed at this point due to time and analysis constraints. The results available from the preliminary assessment of Lewes Marsh, however, suggest that due to the limited changes in most of the habitat indicators it is likely that the results from the indicator models will show that the effects are limited as well. For example, the Trumpeter Swan feeding habitat indicator is based on the Sandbar / Mudflat and Shallow Water Aquatic Plant indicators, both of which are not expected to be significantly affected by the Project, suggesting that there will be no significant effect to the area or location of Trumpeter Swans feeding habitats.

Assessment of Impact Statements on Valued Components

The preliminary assessment of the Impact Statements on the Valued Components is provided in the following section, based on the available information for Lewes Marsh. This preliminary assessment provides a high-level review of potential impacts on the Valued Components and is meant to highlight any significant effects that may be caused by the Project. Quantitative information from the Habitat Indicators was used and then a qualitative assessment of the Species Indicators was completed based on that quantitative information. For the final effects assessment, quantitative assessments will be completed for the majority of the Habitat and Species Indicators.

Preliminary Impact Ratings and Significance

Preliminary impact ratings and significance have been identified for potential effects of the Project along with potential mitigation measures that could be applied to minimize those effects. The final effects assessment will determine which effects may be significant and apply mitigation measures to identify any residual effects of the Project and their significance.

Impact Rating Criteria

Impact rating criteria are used to identify potentially significant adverse effects. These criteria include direction, geographic extent, duration, frequency, reversibility, and magnitude. Likelihood and confidence are qualifiers that may be used in the significance determination. The impact rating criteria are provided in Table 3.

Table 3. Summary of impact rating criteria and qualifiers for terrestrial values.

| Criteria | Rating Term | Definition |
|-------------------|--------------------|--|
| Direction | Positive | Beneficial change. |
| | Neutral | No change. |
| | Negative | Adverse change. |
| Geographic Extent | Local | Effect is limited to the Local Study Area. |
| | Regional | Effect extends to the Regional Study Area. |
| | Extra-regional | Effect extends beyond the Regional Study Area. |
| Duration | Short-term | Effect last one season. |
| | Medium-term | Effect lasts for project life, which is the remaining term of water license (2014 to 2025). |
| | Long-term | Effect lasts beyond term of water license (past 2025). |
| | Permanent | Effects are permanent. |
| Frequency | Once | Effect occurs once (e.g. mitigation). |
| | Intermittent | Effect occurs occasionally or periodically during license term. |
| | Seasonal | Effect occurs seasonally throughout license term. |
| | Continuous | Effect occurs continually throughout license term. |
| Reversibility | Reversible | Effect is reversed after the activity ceases. |
| | Non-Reversible | Effect will not be reversed when activity ceases. |
| Magnitude | Negligible | No measurable impacts on baseline habitats or species life requisites or functions. (e.g. breeding, feeding, etc.). |
| | Low | A change that is expected to affect less than 5% of baseline habitat; or is expected to have minimal effect on species' life requisites or functions. |
| | Moderate | A change that is expected to affect between 5% and 10% of baseline habitat; or is expected to affect one of a species' life requisites or functions. |
| | High | A change that is expected to affect more than 10% of baseline habitat; or is expected to significantly affect a species' life requisites or functions. |
| Qualifiers | | |
| Likelihood | Low | Impact has low likelihood of occurring |
| | Moderate | Impact has moderate likelihood of occurring |
| | High | Impact has high likelihood of occurring |

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| Criteria | Rating Term | Definition |
|------------|-------------|--|
| Confidence | Low | Data unavailable, limited or highly variable; analysis primarily qualitative or quantitative analysis limited, no peer review completed |
| | Moderate | Good quality data, but has some limitations temporally or spatially; quantitative analyses completed but qualitative interpretation required, some peer review completed |
| | High | Good quality data with good temporal and spatial coverage; primarily quantitative analyses, with statistical rigor and peer review completed |

Direction

The direction of an impact describes the long-term change of the VC relative to baseline conditions as negative, neutral or positive. An effect was considered negative if the habitat or species indicators were determined to be less than baseline conditions. A positive direction was identified if the habitat or species indicators increased over baseline conditions. A neutral direction was identified for effects that similar (i.e. within 10%) of baseline conditions.

Geographic Extent

The geographic extent is described as local if the predicted effect does not extend beyond the LSA; Regional if it extends into the RSA and Extra-regional if the effect reaches beyond the RSA.

Duration

Duration is defined as the length of time a predicted impact will last. Duration is defined as short-term, medium-term, long-term and permanent. Most effects related to plants and plant communities were considered to be non-permanent as they are reversible if the Project activity ceases (i.e. returned to the existing license regime).

Frequency

Frequency describes how often an impact occurs and is defined as once, intermittent, seasonal or continuous. Seasonal frequency is considered as a regular, annual frequency occurring at specific times of the year, but is not continuous throughout the year. Continuous would be events or an activity that occurs throughout the year for the duration of the Project.

Reversibility

Reversibility is an indicator of the potential of recovery from a predicted impact and is defined as reversible or non-reversible. Most of the effects of the project are reversible within a reasonable timeframe. For this reason, some potentially significant effects can be considered as lower risk, given the fact that the effects could be reversed through adjustment of water management, including reversal to baseline water management conditions.

Magnitude

Magnitude describes the overall impact of Project activities on the VC, combining the ratings of all criteria measured against the threshold for the indicator. To assign magnitude, some element of professional judgment is needed.

Likelihood

The likelihood (or probability) of the impact occurring based on the available information used for the assessment.

Confidence

The degree of confidence in data or analysis techniques used to assess the impact.

Significance Rating Before Mitigation

Significance indicates whether a Project is likely to cause unacceptable adverse environmental effects, taking into account the implementation of mitigation measures. Significance of an impact is determined by the magnitude of the residual impact. Adverse residual effects of moderate or high magnitude have the potential to have significant adverse effects, depending upon the regional extent and duration of the impact. Consideration of the likelihood of the impact occurring and the degree of confidence in the data used in the assessment are also considered in assigning significance. Significance was determined using the significance rating criteria summarized in Table 4.

Table 4. Significance rating criteria.

| Impact Magnitude | Geographic Extent | Duration | Significance |
|-------------------------|--------------------------|-----------------|---------------------|
| No effect | Any geographic extent | Any duration | Not Significant |
| Low | Any geographic extent | Any duration | Not Significant |
| Moderate | Local | Any duration | Not Significant |
| | Regional | Permanent | Significant |
| | Beyond Regional | | |
| High | Local | Short-Term | Not Significant |
| | | Medium-Term | Significant |
| | | Long-Term | |
| | | Permanent | |
| | Regional | Any duration | Significant |
| | Beyond Regional | | |

Potential Monitoring and Mitigation Options

A number of potential mitigation options could be used to minimize the potential effects of the Project on the VCs. Monitoring will likely also be required to provide information on how well the mitigation measures are working as well as confirm the predicted effects from the Project. The following outlines some potential mitigation and monitoring options for the VCs.

Wetland and Upland Plant Community Extent and Distribution

Mitigation Options

- Incremental change in water levels over time (e.g. 2-3 years) to decrease potential effects, allow for the development of mitigation and for monitoring of plant and plant community responses.
- Identify plant communities likely to change the most and develop strategies to reduce those changes.
- Accelerate or decelerate transitions from one plant community type to another to reduce effects (e.g. plant shrub species [i.e. willows] on boundaries between Shrub and Treed Habitats).
- Look at engineered solutions to protect important plant communities (e.g. place berms to reduce water flows into areas or incrementally elevate communities through addition of soil).

Monitoring Options

- Monitor rate of vegetation change (death, colonization, decomposition, invasion etc.) with changing water conditions.

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- Monitor seed bank viability and success at various depths.
- Monitor water clarity/quality.

Amphibian Habitat Extent and Distribution

Mitigation Options

- Reduce potential for overwintering/breeding failure by incremental change in water levels over time.

Monitoring Options

- Monitor current breeding areas for continued use.
- Identify and monitor overwintering areas.

Aquatic and Terrestrial Bird Habitat Extent and Distribution

Mitigation Options

- Incremental change in water levels over time to decrease potential effects and allow for monitoring of bird responses.
- Establish artificial nest structures for Bald Eagles, Osprey, cavity nesting ducks to reduce potential effects of tree death on these structures.

Monitoring Options

- Monitor nesting success of aquatic and terrestrial birds during incremental increases of water levels.

Aquatic and Terrestrial Mammal Habitat Extent and Distribution

Mitigation Options

- Incremental change in water levels over time to decrease potential effects and allow for monitoring of aquatic and terrestrial mammal responses.
- Establish artificial den structures for muskrat to reduce potential effects of increased winter water levels on these structures.

Monitoring Options

- Monitor the location and use of beaver lodges and muskrat pushups (i.e. active/not active) during the summer and winter period within a range of wetlands in the LSA.
- Monitor under-ice use by aquatic and terrestrial mammals.
- Monitor for winter wildlife mortalities related to changes in ice dynamics.

Preliminary Effects Assessment

The preliminary effects assessment for terrestrial values within the Lewes Marsh area from the proposed Project is provided in Table 5. A discussion of the effects is outlined in the sections below.

Wetland Plant Community Extent and Distribution

In general, it is expected that wetland plants and plant communities will be positively affected by the Project as there will be an overall increase in the area of wetland communities with the increased water levels. Wetland plant communities are expected to shift to higher elevation areas due to the higher water levels. The extent and distribution of the wetland plant communities will shift, but there is no expected significant loss of wetland plant species or communities. It is not expected that changes to erosion and deposition or the ice regime will significantly affect wetland plants or communities.

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Table 5. Preliminary effects ratings for Terrestrial Values within the Lewes Marsh area of the Southern Lakes Local Study Area.

| Valued Component | Impact Statement | Preliminary Impact Rating | | | | | | | | Significance |
|--|------------------|---------------------------|--------|------------|--------------|----------------|------------|------------|------------|---------------------------------|
| | | Direction | Extent | Duration | Frequency | Reversibility | Magnitude | Likelihood | Confidence | |
| Wetland Plant Community Extent and Distribution | HR1 | Positive | Local | Long-term | Continuous | Reversible | High | Moderate | Moderate | Possibly Significant (Positive) |
| | ER1 | Neutral | Local | Long-term | Continuous | Reversible | Low | Moderate | Moderate | Not Significant |
| | IR1 | Negative | Local | Long-term | Intermittent | Reversible | Moderate | Moderate | Low | Not Significant |
| Upland Plant Community Extent and Distribution | HR1 | Negative | Local | Long-term | Continuous | Reversible | Low | Moderate | Moderate | Not Significant |
| | ER1 | Negative | Local | Long-term | Continuous | Reversible | Low | Moderate | Moderate | Not Significant |
| | IR1 | Negative | Local | Long-term | Intermittent | Reversible | Moderate | Moderate | Low | Not Significant |
| Amphibian Habitat Extent and Distribution | HR1 | Positive | Local | Long-term | Continuous | Reversible | Moderate | Moderate | Moderate | Not Significant |
| | HR2 | Negative | Local | Short-term | Intermittent | Reversible | Low | Moderate | Moderate | Not Significant |
| | ER1 | Negative | Local | Long-term | Continuous | Reversible | Low | Moderate | Moderate | Not Significant |
| | IR1 | Neutral | Local | Long-term | Intermittent | Reversible | Low | Low | Low | Not Significant |
| | IR2 | Negative | Local | Short-term | Intermittent | Reversible | Low | Low | Low | Not Significant |
| Aquatic Bird Habitat Extent and Distribution | HR1 | Positive | Local | Long-term | Continuous | Reversible | Moderate | Moderate | Moderate | Not Significant |
| | HR2 | Negative | Local | Short-term | Intermittent | Reversible | Low | Moderate | Moderate | Not Significant |
| | ER1 | Neutral | Local | Long-term | Continuous | Reversible | Negligible | Moderate | Moderate | Not Significant |
| | ER2 | Negative | Local | Permanent | Continuous | Non-Reversible | Low | Moderate | Moderate | Not Significant |
| | IR1 | Negative | Local | Long-term | Intermittent | Reversible | Low | Low | Low | Not Significant |
| | IR2 | Negative | Local | Short-term | Intermittent | Reversible | Negligible | Low | Low | Not Significant |
| Terrestrial Bird Habitat Extent and Distribution | HR1 | Positive | Local | Long-term | Continuous | Reversible | High | Moderate | Moderate | Possibly Significant (Positive) |
| | ER1 | Negative | Local | Long-term | Continuous | Reversible | Negligible | Moderate | Moderate | Not Significant |
| | ER2 | Negative | Local | Permanent | Continuous | Non-Reversible | Low | Moderate | Moderate | Not Significant |
| | IR1 | Negative | Local | Long-term | Intermittent | Reversible | Low | Low | Low | Not Significant |
| Aquatic Mammal Habitat Extent and Distribution | HR1 | Positive | Local | Long-term | Continuous | Reversible | High | Moderate | Moderate | Possibly Significant (Positive) |
| | HR2 | Negative | Local | Short-term | Intermittent | Reversible | Low | Moderate | Moderate | Not Significant |
| | ER1 | Negative | Local | Long-term | Continuous | Reversible | Negligible | Moderate | Moderate | Not Significant |

Preliminary Terrestrial Effects Assessment

| Valued Component | Impact Statement | Preliminary Impact Rating | | | | | | | | Significance |
|--|------------------|---------------------------|--------|------------|--------------|----------------|------------|------------|------------|---------------------------------|
| | | Direction | Extent | Duration | Frequency | Reversibility | Magnitude | Likelihood | Confidence | |
| Aquatic Mammal Habitat Extent and Distribution | ER2 | Negative | Local | Permanent | Continuous | Non-Reversible | Low | Moderate | Moderate | Not Significant |
| | IR1 | Negative | Local | Long-term | Intermittent | Reversible | Low | Low | Low | Not Significant |
| | IR2 | Positive | Local | Short-term | Intermittent | Reversible | Low | Low | Low | Not Significant |
| Terrestrial Mammal Habitat Extent and Distribution | HR1 | Positive | Local | Long-term | Continuous | Reversible | High | Moderate | Moderate | Possibly Significant (Positive) |
| | ER1 | Neutral | Local | Long-term | Continuous | Reversible | Negligible | Moderate | Moderate | Not Significant |
| | ER2 | Negative | Local | Permanent | Continuous | Non-Reversible | Negligible | Moderate | Moderate | Not Significant |
| | IR1 | Negative | Local | Long-term | Intermittent | Reversible | Low | Low | Low | Not Significant |
| | IR2 | Negative | Local | Short-term | Intermittent | Reversible | Low | Low | Low | Not Significant |

Recommendations:

Review and implement appropriate mitigation measures and monitor responses of wetland plants and plant communities for at least 5 to 10 years.

Upland Plant Community Extent and Distribution

With increased water levels under the Project conditions, some upland plants and plant communities may be affected, although not significantly. Higher water levels will affect shoreline upland plants and plant communities within the LSA, with areas of very shallow gradients (e.g. adjacent to wetlands and low gradient beaches) affected most. Plant species that are less tolerant of higher water tables such as some conifer species may be affected the greatest. Higher water levels during winter will cause ice to form at higher levels, which may increase ice damage and scouring of upland plants and plant communities. Some increased erosion and deposition may also occur in upland areas with the higher water levels. These effects are not expected to be significant however due to the relatively small amount of area affected in relation to the available area of upland plant species and plant communities within the LSA.

Recommendations:

Review and implement appropriate mitigation measures and monitor responses of upland plants and plant communities for at least 5 years.

Amphibian Habitat Extent and Distribution

There are no expected significant effects to amphibian habitats due to the Project. Currently, amphibian breeding habitats are located where the influence of water levels from the major lakes is limited and proposed increases and decreases in water levels are not expected to affect these habitats significantly. Amphibian aquatic and upland overwintering areas may have limited effects due to changes to erosion, deposition or ice regimes, although the majority of these habitats are outside the area of influence from these effects.

Recommendations:

Review and implement appropriate mitigation measures and monitor responses of amphibians for 3 to 5 years.

Aquatic Bird Habitat Extent and Distribution

Aquatic birds feed primarily within the Sandbar / Mudflat, Shallow Aquatic Plant and Herb / Sedge Habitats and can breed in a variety of wetland and upland habitats, although they tend to use the Herb / Sedge and Shrub habitats more often. The Project is expected to increase available feeding habitats by increasing the area and extent of those habitats, although they may shift locations to higher elevations than they are currently. No significant effects to aquatic bird habitat are expected from changes in erosion, deposition patterns or ice regime on plant species or wildlife features. Available nesting habitats are not expected to change, as similar types of habitats will be available under Project conditions. There will also not be any changes in effects related to nest inundation under Project conditions as the rate of water rise under Project and Current conditions will remain the same. This assumption is based on the Lewes Control Structure remaining open from May 15th to August 15th in both scenarios and therefore the rate and amount of water rise from year to year would be dependent on natural snow melt and rain patterns and not on any Project conditions.

Recommendations:

Review and implement appropriate mitigation measures and monitor responses of aquatic birds for 3 to 5 years.

Terrestrial Bird Habitat Extent and Distribution

There is a potential for a significant positive effect on terrestrial bird nesting and feeding habitats due to an increase in the area and extent of Herb / Sedge and Shrub Habitats, although they may shift locations to higher elevations than they are currently. A short-term decrease in available Shrub habitats due to shrub die-off and lag time in establishment of shrub species may occur, but this can be mitigated through planting and a gradual increase in inundation over time. No significant effects to terrestrial bird habitat are expected from changes in erosion, deposition patterns or ice regime on plant species or wildlife features. There will also not be any changes in effects related to nest inundation under Project conditions as the rate of water rise under Project and Current conditions will remain the same. This assumption is based on the Lewes Control Structure remaining open from May 15th to August 15th in both scenarios and therefore the rate and amount of water rise from year to year would be dependent on natural snow melt and rain patterns and not on any Project conditions.

Recommendations:

Review and implement appropriate mitigation measures and monitor responses of terrestrial birds for 3 to 5 years.

Aquatic Mammal Habitat Extent and Distribution

Aquatic mammal feeding habitat may potentially increase significantly under Project conditions as there is expected to be an increase in the area of Herb / Sedge and Shrub Habitats with the increase in water levels. As outlined in the terrestrial bird assessment, there may be a short-term decrease in shrubs, which would require mitigation measures such as planting to reduce the potential effects. There are no significant effects to aquatic mammal habitats due to erosion or deposition and there is a potential for an increase in available under-ice habitats, which would increase security and feeding habitats for aquatic mammals. There may be a negative effect on winter denning habitat for muskrat and beaver due to the increased water levels, which would require mitigation measures such as a gradual increase in water levels over several years and/or the development of artificial denning structures.

Recommendations:

Review and implement appropriate mitigation measures and monitor responses of aquatic mammals for 3 to 5 years.

Terrestrial Mammal Habitat Extent and Distribution

The area of available Herb / Sedge and Shrub Habitats are expected to increase under Project conditions, providing a potential significant positive increase to terrestrial mammal feeding habitat for species such as moose and bears. There may be a short-term decrease in Shrub Habitats due to die-off of shrub species due to the higher water levels, which could be mitigated by planting shrub species and gradual increase in water levels over time. There are no expected significant negative effects to terrestrial mammal feeding habitats due to changes in erosion and deposition of sediments or the ice regime. Changes in potential movement patterns by terrestrial mammals due to changes in the slope of near-shore ice is not expected to be significant as movements occur along low-slope shorelines and the ice would continue to follow the natural slope of these areas. The potential for changes to ice-formation or thinning patterns is also not considered to be significant as there is no expected changes to water velocities or circulation patterns due to the increased water levels over the winter and into the spring.

Recommendations:

Review and implement appropriate mitigation measures and monitor responses of terrestrial mammals for 3 to 5 years.

References

- Pearson, F. and J. Gilman. 2013. Erosion Effects Initial Assessment. Unpublished Memo dated January 3, 2013 to K. Wood, AECOM. Whitehorse, YK. 17 pages.
- Roberts, A. and L. Turney. 2012. A Review of Wetland Vegetation Community Dynamics in Relation to the Proposed Yukon Energy Southern Lakes Storage Concept. Unpublished report prepared for AECOM Canada Ltd. and Yukon Energy Corporation by Ardea Biological Consulting Ltd., Smithers, BC. 25 pages.