FORT HILLS ENERGY CORPORATION
FORT HILLS OIL SANDS PROJECT

MCCLELLAND LAKE WETLAND COMPLEX OPERATIONAL PLAN OBJECTIVE 6

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McClelland Lake Wetland Complex Operational Plan

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7. OBJECTIVE 6: DEVELOP A RESPONSE FRAMEWORK

7.1. Introduction

The response framework provides a systematic approach for responding to the results of the effects monitoring program described under Objective 5 (Section 6). Triggers (i.e., threshold values) and limits (i.e., clear boundaries in the system not to be exceeded) are defined, and potential management actions or responses are identified if unacceptable changes or trends are detected. Specific management responses (e.g., confirming results, mitigation to reverse trends) will depend on the type and size of effect(s) detected by the effects monitoring program. The response framework builds upon information provided in the previous five objectives.

7.1.1. Sustainability Committee Input

Local Indigenous community members understand the complex connections and relationships between wetlands and waterbodies in the McClelland Lake watershed because they have spent their lifetimes living and travelling through the area, and because their parents and grandparents, friends and relations have shared knowledge of McClelland Lake and the fen. The Indigenous communities have shared with Fort Hills Energy Corporation (FHEC) that they are concerned that mining part of the fen may put the entirety of the McClelland Lake Wetland Complex (MLWC) at risk and participants in the Sustainability Committee (SC) have expressed concern that FHEC will not be able to sustain the function of the non-mined portion of the MLWC and that it might never be able to be replaced if it cannot be sustained. For that reason, the response framework is based on monitoring of sensitive indicators that will detect early changes that may be linked to mining activities within the MLWC, and each indicator has multiple triggers with different types of management responses (as described in subsequent sections).

During the Operational Plan (OP) proposal development, the SC requested that the development of the response framework include actions that would stop further development until cause of a given change has been identified and an appropriate mitigation solution is developed and implemented. This input has been incorporated into the response framework including the possibility of stopping further development within the MLWC watershed if the cause of a given change is linked back to the Fort Hills Oil Sands Project (Fort Hills Project) as described in Section 7.2.3.

7.2. Response Framework Overview

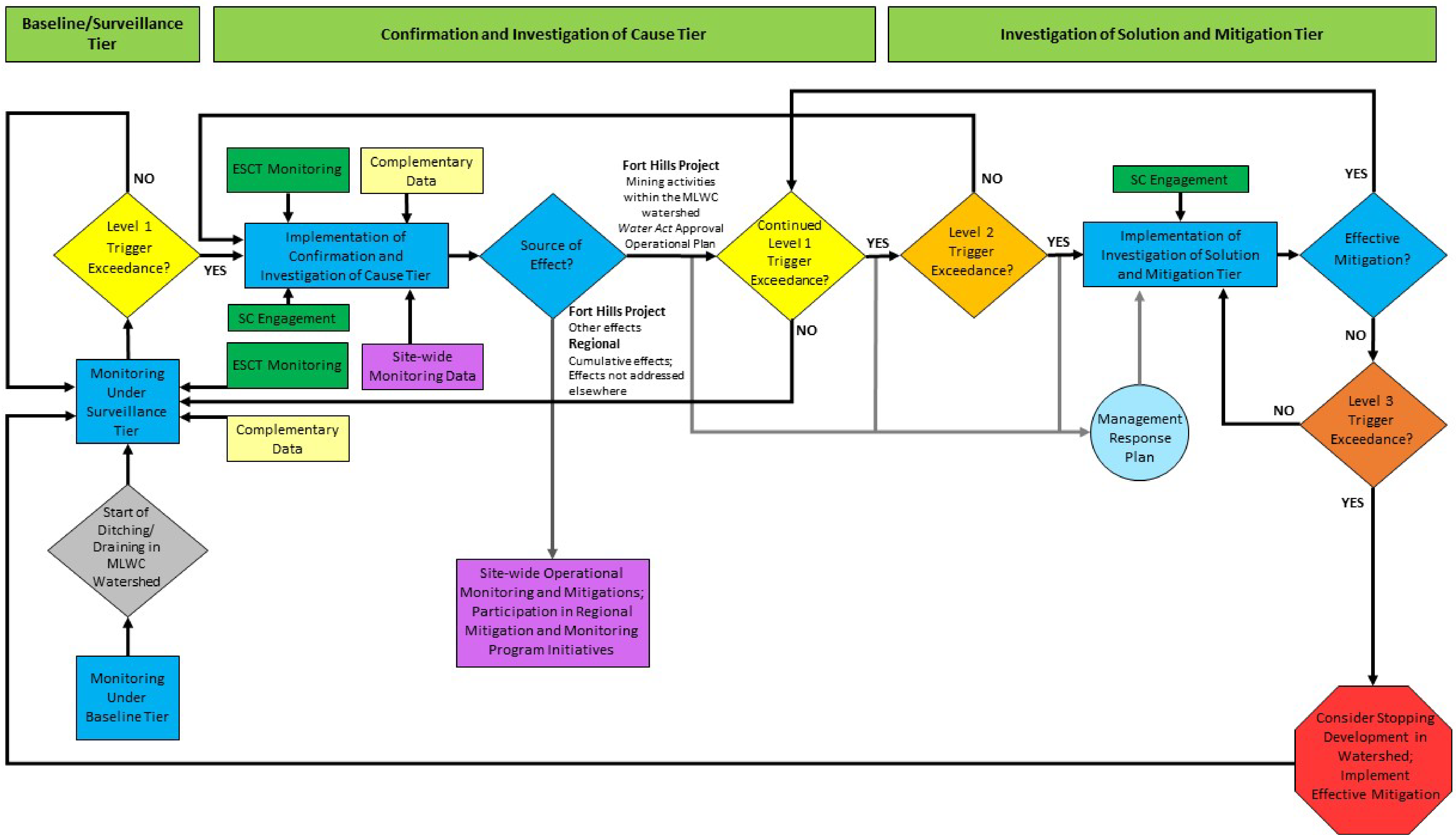
The OP is focused on monitoring changes that could be caused by the Fort Hills Project mining activities in the MLWC watershed. For the purposes of the OP, an effect will be a measured change with a possible linkage to mining activities within the MLWC watershed. Should an effect that could be related to the Fort Hills Project mining activities be detected during the effects monitoring program, a corresponding management action will occur. The level of action taken depends on the magnitude of the effect relative to an assessment threshold. The level of change or threshold value that would initiate a management action is termed a trigger.

The goal of the response framework is to identify and systematically respond to monitoring results such that the potential for significant adverse effects from the Fort Hills Project is identified, and management actions are undertaken in a timely manner to maintain ecosystem diversity and function in the non-mined portion of the MLWC. This is accomplished by implementing appropriate management actions if triggers are reached; these management actions are initiated before a significant adverse effect occurs. A trigger is defined as a level that indicates changes may be occurring, but triggers would be reached well before significant adverse effects would occur. A limit is defined as a level of change that, if exceeded, may result in a significant adverse effect to components of the environment.

For the OP, the magnitude of an effect will be determined and assessed through comparison of measurements between the MLWC and reference sites, and to pre-mining baseline data, or benchmark values. For example, a monitoring value that falls within the measured range of variation (MRV) or normal range (Section 2.5.1 [Objective 1]; Section 6.2.3 [Objective 5]) calculated from pre-mining baseline data, or is well below an applicable benchmark value, and does not contribute to an apparent trend, would not result in a trigger exceedance.

The response framework consists of limits and triggers as well as types of action that may be taken. Progression through a series of monitoring tiers (described in Section 7.2.1.1) will occur if a trigger exceedance (described in Sections 7.2.1.3 and 7.3) occurs (Figure 7.2-1). A Management Response Plan (described in Section 7.2.4) will be developed if a Level 1 trigger exceedance occurs and will be implemented if a Level 2 trigger exceedance occurs (Figure 7.2-1). The management response implemented following a Level 2 trigger exceedance will be evaluated through continued monitoring and adjusted as needed. Only when the mitigation is deemed effective (i.e., when the level for the metric that triggered the response falls below the Level 1 trigger value) will monitoring return to pre-trigger exceedance levels (the Surveillance Tier [described in Section 7.2.1.1]). If mitigation implemented following a Level 2 trigger exceedance is ineffective and a Level 3 trigger exceedance occurs as a result of the Fort Hills Project’s activities, cessation of development in the watershed will be considered until effective mitigation is implemented (Figure 7.2-1).

The specific action that is taken when a trigger level exceedance is detected, or an apparent trend is observed, will depend on the type and magnitude of the effect. Details on the limits, triggers, and types of management actions are outlined in Sections 7.2 and 7.3. Environmental, social, cultural, and traditional (ESCT) indicators and complementary data will be used to better understand observed effects and their impacts, and causes. Data from site-wide monitoring programs may also be examined to better understand observed effects.



ESCT = Environmental, Social, Cultural, and Traditional; MLWC = McClelland Lake Wetland Complex; SC = Sustainability Committee.

Figure 7.2-1: Overview of the McClelland Lake Wetland Complex Effects Monitoring Program Response Framework

7.2.1. Fundamental Principles

7.2.1.1. Tiered, Effects-Based Monitoring Approach

The response framework follows the key driver-stressor-response relationships described under Objective 2 (Section 3). A tiered, effects-based monitoring approach simplified from Canada's Oil Sands Innovation Alliance (COSIA) (COSIA 2017) will be used to monitor potential effects from the Fort Hills Project, and help identify cause and support development of mitigation actions. This will consist of four monitoring tiers:

1. Baseline Tier
2. Surveillance Tier
3. Confirmation and Investigation of Cause Tier
4. Investigation of Solution and Mitigation Tier

Monitoring under the Baseline Tier and collection of pre-mining baseline data has been ongoing for some primary effects indicators since 2008 (details are provided for each component under Objective 1 [Section 2]). The Surveillance Tier will be triggered once ditching and drainage activities for mine pit preparation start in the MLWC watershed, and monitoring will continue as outlined under the Surveillance Tier unless an effect is detected, at which time subsequent monitoring tiers will be triggered. Data collected under the Baseline Tier represent an important input to the response framework and will be used as a basis for comparisons at subsequent monitoring tiers.

- Baseline Tier: Monitoring under the Baseline Tier is completed to characterize pre-mining baseline conditions and provide a baseline against which operational changes can be assessed. New locations or parameters added under Objective 5 (Section 6) will initially have a limited pre-mining baseline dataset; therefore, monitoring will begin as early as 2022 to provide an adequate characterization of pre-mining baseline conditions at the MLWC. Data will also be collected from reference sites during the same time period to support the before-after-control-impact (BACI) model selected for data analysis.
- Surveillance Tier: The Surveillance Tier consists of monitoring the primary effects indicators and metrics identified under Objective 2 (Section 3) following the methods described under Objective 5 (Section 6) at a regular frequency to screen for potential effects from the Fort Hills Project. If a trigger level is exceeded, implementation of the Confirmation and Investigation of Cause Tier will occur.
- Confirmation and Investigation of Cause Tier: The Confirmation and Investigation of Cause Tier consists of increased monitoring frequency, monitoring at additional locations, or more detailed analysis of existing data (including primary effects indicator data, complementary data, and ESCT data) to confirm an identified potential effect. If an effect is confirmed, additional investigations will be undertaken to identify the cause of the effect.
- Investigation of Solution and Mitigation Tier: If the cause of the effect has been determined, and the effect is a result of the Fort Hills Project, appropriate management strategies to establish a solution or mitigation will be identified. The solution will be implemented, and monitoring will occur to verify that the solution is effective. If the management action is not initially successful, management actions will be re-evaluated and implemented until the metric indicating the effect

responds and starts trending back below the Level 1 trigger value. Once the issue has been resolved, monitoring will revert back to levels defined for the Surveillance Tier.

7.2.1.2. Limits

Limits are the levels of change that, if exceeded, would result in significant adverse effects to components of the environment. Thus, triggers are set (lower than limits) such that management actions can be used to prevent a limit from ever being reached. Setting appropriate limits to help identify Fort Hills Project effects, and then applying timely mitigation supports the overall OP goal of maintaining ecosystem diversity and function in the non-mined portions of the MLWC. Limits were developed separately for each primary effects indicator based on value statements (Table 7.2-1); more details can be found for each component in Section 7.3.

Table 7.2-1: Proposed Limit for Each Primary Effects Indicator

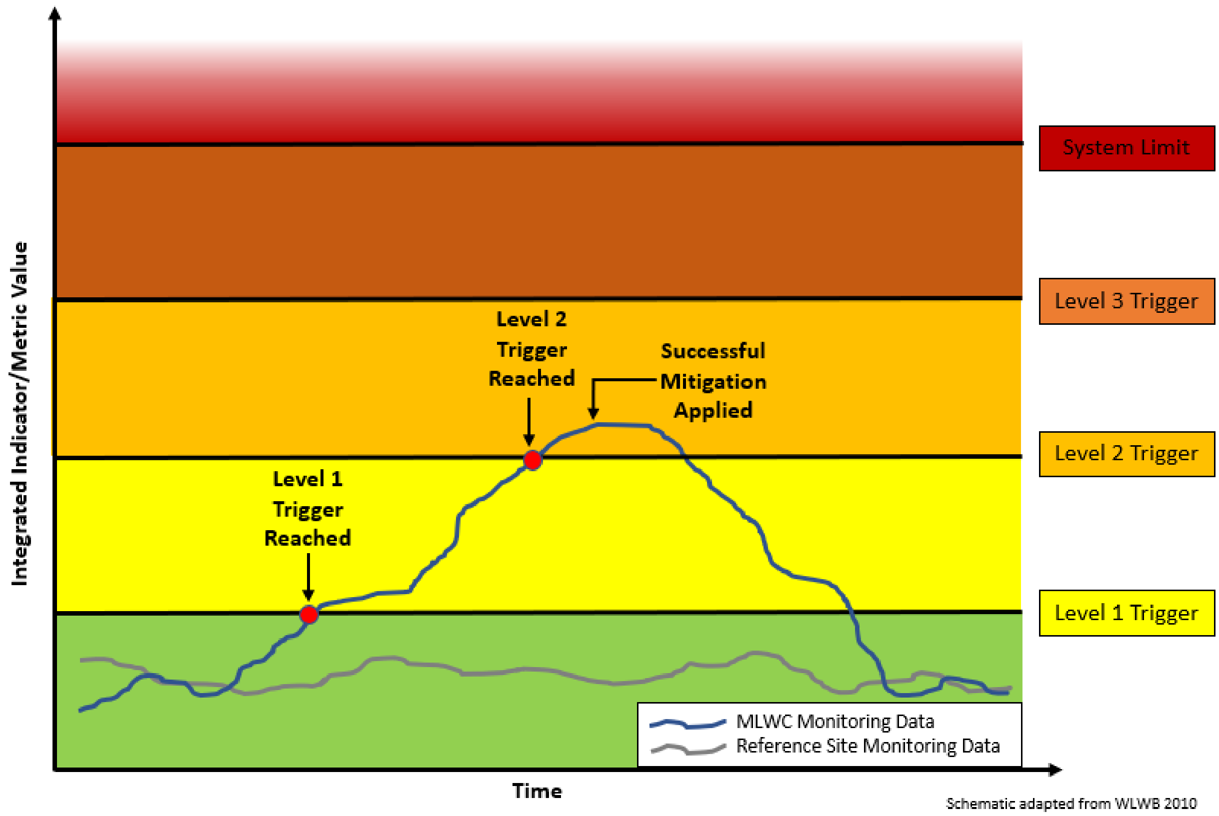
Primary Effects Indicator	Value Statement	System Limit Not to be Reached
Hydrogeology	Functionality and biodiversity within the MLWC, including McClelland Lake, are sustained by maintaining groundwater levels and gradients within the bounds of recorded/simulated data and without affecting surface water levels adversely.	Groundwater levels (outside of fen) or vertical gradients across the peat/sand interface (within fen) occur beyond 3 standard deviations from the mean **AND** surface water levels are outside of acceptable limits.
Surface Water Hydrology	Functionality and biodiversity within the MLWC, including McClelland Lake, are sustained by maintaining surface and near-surface water levels within the bounds of recorded/simulated data.	Surface or near-surface water levels occur beyond 3 standard deviations from the mean or maximum/minimum of recorded/simulated level, for more than one open-water season.
Water Quality	Functionality and biodiversity within the MLWC, including McClelland Lake, are sustained by maintaining water quality in the fen such that plant community characteristics are preserved, and in the lake such that aquatic life is protected.	Water quality conditions in the MLWC are outside of site-specific water quality benchmarks for the protection of vegetation (in the wetland) or aquatic life (in the lake).
Aquatic Resources	The trophic status of McClelland Lake will not change as a result of mining activities.	The trophic status of McClelland Lake has changed as a result of mining activities.
Vegetation	Self-sustaining and ecologically effective ecosystems are maintained.	Self-sustaining and ecologically effective ecosystems are not maintained (e.g., cannot support the range of native species and ecological processes normally provided by the ecosystem, such as peat accumulation).

MLWC = McClelland Lake Wetland Complex.

7.2.1.3. Triggers

Triggers are thresholds or levels of environmental change or effect that initiate certain types of management response and mitigation actions. They are linked to quantitative pre-mining baseline and reference site data, modelling data, or benchmarks associated with changes to measurements for specific components relative to baseline levels, and consider severity, frequency, and spatial extent. Trigger levels are set to ensure that the limits defined for the system (Table 7.2-1) are never reached and that trends towards the limits are mitigated if they begin to appear. Trigger levels will be refined as additional pre-mining baseline data are collected during the period before ditching and draining activities begin in the MLWC watershed. In addition, effectiveness of triggers will be regularly re-evaluated, and trigger levels may be updated to improve effectiveness. The relationship between the first two trigger levels, monitoring data and mitigation can be seen in Figure 7.2-2; if the response framework is effective, the Level 3 trigger should not be reached. Three levels of triggers are defined by their relationship to the limits of the system:

- Level 1: effects beyond trigger values are measurable but values occur well below/above the upper/lower limit of the system. Level 1 triggers include consideration of standard deviations and temporal trends for hydrogeology (Section 7.3.1) and surface water hydrology (Section 7.3.2), and MLWC normal ranges and BACI or trend analysis results for water quality (Section 7.3.3), aquatic resources (Section 7.3.4), and vegetation (Section 7.3.5). If a Level 1 trigger is exceeded, management actions including implementation of the Confirmation and Investigation of Cause Tier and development of a Management Response Plan will occur (Section 7.2.3).
- Level 2: measured effects are trending towards the limits of the system but are still well below/above these values. As for Level 1 triggers, Level 2 triggers include consideration of standard deviations, temporal trends, normal ranges, and BACI results. However, boundaries are set wider for hydrogeology and surface water hydrology. For water quality, aquatic resources and vegetation, Level 2 trigger levels reflect persistent effects beyond the MLWC normal range. If a Level 2 trigger is exceeded, management actions including implementation of the Investigation of Solution and Mitigation Tier and application of mitigation measures will occur, as appropriate (Section 7.2.3). Level 2 triggers are discussed in detail for each component in Sections 7.3.1 to 7.3.5.
- Level 3: measured effects continue to trend towards the limits of the system, and mitigation applied for the Level 2 trigger has not been effective. Level 3 triggers are defined for hydrogeology and surface water hydrology based on standard deviations and documented effects for related components (e.g., hydrogeology triggers are related to documented surface water hydrology effects). Because Level 3 triggers should not be reached if the response framework is effective, and because they may need to be tailored to the effect that has been documented, Level 3 triggers will be defined once the parameters of concern are identified for water quality, aquatic resources and vegetation. Specifically, Level 3 triggers for water quality, aquatic resources and vegetation will be based on outcomes of both the Investigation of Cause Tier and Investigation of Solution and Mitigation Tier initiated when the Level 1 and Level 2 triggers were exceeded, and not ahead of time. Management actions for a Level 3 trigger exceedance are discussed in Section 7.2.3.



MLWC = McClelland Lake Wetland Complex.

Figure 7.2-2: Hypothetical Relationship between Monitoring Data, Trigger Levels, and Management Actions

7.2.2. Monitoring Frequency

Frequency of data collection is component-specific and varies by monitoring tier for some components. While groundwater levels and surface water hydrology would be monitored continuously during the non-frozen period within all monitoring tiers, the monitoring frequency for water quality, aquatic resources, and vegetation varies across monitoring tiers and is standardized by season (Table 7.2-2). The monitoring frequencies provided for the Baseline Tier in Table 7.2-2 apply to all the monitoring locations at both the MLWC and reference sites described under Section 6.2.2 (Objective 5).

Table 7.2-2: Monitoring Frequency for Each Primary Effects Indicator and Monitoring Tier

Monitoring Type	Primary Effects Indicator	Monitoring Frequency			
		Baseline Tier	Surveillance Tier	Confirmation and Investigation of Cause Tier	Investigation of Solution and Mitigation Tier
Early warning monitoring	Hydrogeology	Twice per day (data logger), twice per year (manual and data logger download)	Twice per day (data logger), twice per year (manual and data logger download)	Twice per day (data logger), twice per year (manual and data logger download)	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
	Surface water hydrology	Continuous (data logger), every two months (site visit for manual measurement and data download)	Continuous (data logger), every two months (site visit for manual measurement and data download)	Continuous (data logger), every two months (site visit for manual measurement and data download)	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
	Groundwater quality	Three times per year (spring, summer, fall)	Three times per year (spring, summer, fall)	Up to four times per year[(a)]	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
	Surface water quality	Three times per year (spring, summer, fall)	Three times per year (spring, summer, fall)	Up to four times per year[(a)]	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
Integrated wetland monitoring	Hydrogeology	Twice per day (transducer), twice per year (manual)	Twice per day (transducer), twice per year (manual)	Twice per day (transducer), twice per year (manual)	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
	Surface water hydrology	Continuous (data logger), every two months (site visit for manual measurement and data download)	Continuous (data logger), every two months (site visit for manual measurement and data download)	Continuous (data logger), every two months (site visit for manual measurement and data download)	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
	Groundwater quality	Three times per year (spring, summer, fall) at MLWC	Three times per year (spring, summer, fall) at MLWC	Up to four times per year[(a)]	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
	Surface water quality	Three times per year (spring, summer, fall) at MLWC, ALWC, and GGWC	Three times per year (spring, summer, fall) at MLWC, ALWC, and GGWC	Up to four times per year[(a)]	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
	Vegetation	Once per year in summer for a minimum of three years at MLWC, ALWC, GGWC, and once every four years thereafter	Once every four years in summer at MLWC, ALWC, GGWC	Once every two years in summer at MLWC, ALWC, GGWC (if appropriate based on documented effects) or targeted re-sampling of certain plots/sites	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
Integrated wetland monitoring – grid	Surface water hydrology (water table)	Full grid once per year in summer for a minimum of three years at MLWC, and once every two years thereafter	Partial grid once every two years in summer at MLWC	Full grid once every year in summer at MLWC (if appropriate based on documented effects) or targeted re-sampling of certain plots or areas	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
	Surface water quality				
	Vegetation				

Table 7.2-2: Monitoring Frequency for Each Primary Effects Indicator and Monitoring Tier

Monitoring Type	Primary Effects Indicator	Monitoring Frequency			
		Baseline Tier	Surveillance Tier	Confirmation and Investigation of Cause Tier	Investigation of Solution and Mitigation Tier
Lake monitoring	Surface water hydrology	Continuous (data logger), every two months (site visit for manual measurement and data download)	Continuous (data logger), every two months (site visit for manual measurement and data download)	Continuous (data logger), every two months (site visit for manual measurement and data download)	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
	Surface water quality	Four times per year (spring, summer, fall, winter)[(b)] at McClelland Lake, Audet Lake and Birch Lake	Four times per year (spring, summer, fall, winter)[(b)] at McClelland Lake, Audet Lake and Birch Lake	Four times per year (spring, summer, fall, winter)[(b)] at McClelland Lake, Audet Lake and Birch Lake	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier
	Aquatic resources	Once per year in summer at McClelland Lake, Audet Lake and Birch Lake	Once per year in summer at McClelland Lake, Audet Lake and Birch Lake	TBD – depends on monitoring results	TBD – dependent on monitoring results, but likely as frequently as in previous monitoring tier

(a) Increase in sampling frequency will be determined when the Confirmation and Investigation of Cause Tier is triggered, and in considerations with other measures (e.g., increase in quality control sampling, additional parameters tests, increase of sampling locations).

(b) spring = April to May; summer = June to August; fall = September to October; winter = November to March.

ALWC = Audet Lake Wetland Complex; GGWC = Gipsy-Gordon Wetland Complex; MLWC = McClelland Lake Wetland Complex; TBD = to be determined.

7.2.3. Trigger Assessment Frequency

Monitoring of water levels and water quality will occur at the frequency described in Section 7.2.2, but the assessment against the proposed triggers will be adjusted spatially and temporally if effects occur and as activities are carried out within the MLWC watershed.

The advantages of the proposed trigger assessment frequency within the response framework are:

- Early warning monitoring can be initiated while pre-mining baseline data are being collected, starting in 2022.
- Testing of the triggers can be undertaken before water management design features are installed.
- Additional data collected from 2022 until installation of water management design features can be used to reassess and fine-tune proposed triggers, if required, before water management design features are installed and become operational.
- The response and assessment can be adapted to changing conditions within the MLWC.

7.2.3.1. Pre-Mitigation Period

The pre-mitigation period of the response framework emphasizes the early warning locations on the mine side of the proposed cutoff wall. During this period, while data will be collected from all monitoring locations at the frequency noted in Table 7.2-2, the detailed assessment against triggers will be conducted as follows:

- All locations will be assessed against the triggers on the following schedule:
  - Surface water levels, groundwater levels and groundwater gradients: three times yearly – the end of winter, after freshet, and at the end of autumn
  - Surface water and groundwater chemistry: twice yearly (June and December)
- The exception to this will be the location farthest upgradient from McClelland Lake. At this location, the trigger assessment frequency will be increased to every two months for surface water levels and groundwater levels and gradients.

If effects are detected and confirmed at the upgradient location, the increased trigger assessment frequency will then be initiated at the next location in progression towards McClelland Lake. The proposed framework will allow the detection of effects at early warning locations on the mine side of the proposed cutoff wall to inform the potential timing for implementation of water management design features.

During this stage before mitigation features are installed, the management response will be limited to assessment of the timing of water management design features until the proposed working pad is constructed.

7.2.3.2. Mitigation Construction and Operation Period

As the water management design features are installed and become operational, it is expected that the results of monitoring during the pre-mitigation period will be used to fine-tune trigger assessment frequency. Monitoring data from the pre-mitigation period will be used to provide a greater understanding of responsiveness of monitoring points in the fen to changes in groundwater and surface water levels. In this way, trigger assessment frequency can be adapted to fen behaviour during periods of changing hydrological conditions. As discussed under Objective 4 (Section 5), where the proposed plan for monitoring during operation of the water management design features has been provided, data for groundwater and surface water levels will be assessed on a more frequent basis to allow for changes in water resupply to the MLWC.

It is expected that groundwater level and gradient, and surface water level trigger assessments will be increased at monitoring locations closest to the proposed activities as required. The frequency of the trigger assessment may be increased depending on activities and the results of the assessment, and additional locations will be added at the increased frequency as the water management design features become operational.

Due to sampling frequency and analysis constraints for groundwater and surface water quality, it is anticipated that a full trigger analysis (including BACI analysis, as discussed in Section 7.3.3) will be undertaken twice yearly.

7.2.4. Management Response

Exceedance of triggers will bring about a management response, and higher monitoring tiers will be implemented until issues are understood and resolved (in the case of a trigger being exceeded as a result of the Fort Hills Project). The management response framework follows the approach described by Wek'èezhìi Land and Water Board (WLWB) (WLWB 2010) and Mackenzie Valley Land and Water Board/Gwich'in Land and Water Board (MVLWB/GNWT 2019). The relationship between Level 1, 2 and 3 triggers and application of mitigation is shown in Figure 7.2-2. Management actions will occur within the response framework for effects related to Fort Hills Project operations within the MLWC watershed. Specific management actions will depend on the type and severity of effect detected.

If multiple trigger exceedances are observed, an investigation will be initiated to understand potential linkages between metrics, and to relate effects to the driver-stressor-response pathways identified under Objective 2 (Section 3). If monitoring results show an abrupt change (e.g., if a metric value increases from below a Level 1 trigger value to above a Level 2 trigger value within a single monitoring period), the sequence of management response actions will occur as outlined in Sections 7.2.4.1 to 7.2.4.3, but possibly at an accelerated pace. Management responses that would be implemented following Level 1, 2 and 3 triggers are described in the following sections.

7.2.4.1. Level 1 Trigger Exceedance

A Level 1 trigger exceedance is intended to provide an early warning that effects are being observed that may require mitigation if data continue trending in the same direction. The management response that will occur for a Level 1 trigger exceedance is:

- Implement the Confirmation and Investigation of Cause Tier, which may include increased monitoring frequency and assessment of triggers, monitoring at additional locations, monitoring of additional parameters, or more detailed analysis of existing data. The purpose of the Confirmation and Investigation of Cause Tier is to confirm that an effect has occurred (e.g., rule out measurement errors or natural variability) and identify the cause of the effect. The Confirmation and Investigation of Cause Tier will also consider applicable ESCT monitoring data, complementary data and site-wide monitoring data, if applicable.
- Develop site-specific benchmarks for water quality to protect vegetation, as applicable.
- Develop a Management Response Plan to better understand the metric that exceeded the Level 1 trigger. The goals of the Management Response Plan are to:
    - Address and document key uncertainties identified by the Level 1 trigger exceedance, including investigation of any trends and ecological implications.
    - Explore relationships between metrics if a Level 1 trigger exceedance occurs for more than one metric.
    - Explore modelling assumptions and results, where applicable.
    - Identify and document promising mitigative actions.
    - Review and refine triggers, as needed, based on outcomes of Confirmation and Investigation of Cause monitoring.

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The Management Response Plan will be updated as the understanding of the system evolves. It will provide a record of management responses considered, and outcomes of management responses implemented.

Monitoring for metrics where a Level 1 trigger did not occur will continue under the Surveillance Tier unless a change to the monitoring regime of a related metric is warranted under the Confirmation and Investigation of Cause Tier.

7.2.4.2. Level 2 Trigger Exceedance

The management response that will occur for a Level 2 trigger exceedance is:

- Assuming the Level 2 trigger exceedance follows a Level 1 trigger exceedance and the Confirmation and Investigation of Cause Tier has been implemented (and it is determined that the exceedance is a direct result of Fort Hills Project activities), implement the Investigation of Solution and Mitigation Tier, which includes identification of solutions to address the Level 2 trigger exceedance. If the Level 2 trigger exceedance occurred abruptly and a Level 1 trigger was not detected first, monitoring under the Confirmation and Investigation of Cause Tier would need to be initiated before solutions could effectively be investigated. Engagement with the SC will occur.
- Update Management Response Plan to include:
  - identification of appropriate contingency mitigation measures
  - documentation of mitigation plans
  - identification of Level 3 trigger values
- As appropriate (and provided the exceedance is a direct result of Fort Hills Project activities), prepare and implement contingency mitigation measures to slow, stop, or reverse the trend, as defined by the Management Response Plan.
- Continue monitoring to evaluate the success of any mitigation measures implemented and increase trigger assessment frequency if appropriate; if mitigation is implemented and not effective, investigate and implement alternative solutions until mitigation is successful and monitoring can return to the Surveillance Tier, or a Level 3 trigger is reached (Figure 7.2-1).

As for a Level 1 trigger exceedance, monitoring for metrics where a Level 2 trigger exceedance did not occur will continue under the Surveillance Tier unless a change to the monitoring regime of a related metric is warranted under the Investigation of Solution and Mitigation Tier.

7.2.4.3. Level 3 Trigger Exceedance

The management response that will occur for a Level 3 trigger exceedance, which is determined to be a direct result of Fort Hills Project activities, is:

- Continue monitoring to confirm the Level 3 trigger exceedance.
- Identify, evaluate, and implement mitigation measures to stop or reverse the observed trend so the overall limit of the system is not reached. Update the Management Response Plan to document planned mitigation and report the environmental response.
- Consider stopping further development within the MLWC watershed until the cause of the trigger exceedance has been identified and an effective mitigation solution is developed and implemented.

The decision to stop further development within the MLWC would be based on a weight of evidence approach in which results from each component are integrated to build a holistic understanding of documented ecosystem effects. Once effects are understood, and if determined to be the result of Fort Hills Project operations, the implications of stopping development within the MLWC watershed would be carefully evaluated.

The time required to implement solutions may vary depending on when the issue is first identified; however, solutions will be implemented in as timely a manner as possible. Issues may be identified via informal observation, or in the fall or winter through analysis of the data gathered during the field season when compiling the report. Implementation of solutions can be dependent on season. For example, frozen conditions may be required to mitigate potential impacts to the surrounding environment. Trigger assessment frequency will be increased where applicable.

7.3. Response Framework Implementation

7.3.1. Hydrogeology

As outlined under Objective 3 (Section 4), the Fort Hills Project has the potential to alter surface water and groundwater levels, which can result in changes to ecosystem and aquatic resources within the MLWC, many of which are important cultural resources including food and medicine. Traditional knowledge has helped improve understanding of connectivity of groundwater and surface waters (as described in Objectives 1, 2 and 3). The natural range of variability of surface water is related to groundwater variability. Indigenous Traditional Knowledge (ITK) and longer-term climate information has shown that water tables have varied in the long term in a way that reflects conditions that are both drier (lower groundwater levels) and wetter (higher groundwater levels) than the measured range of available data (the MRV). Use of the MRV, rather than expanding to the full natural range of variability, is a conservative approach to developing triggers for hydrogeology.

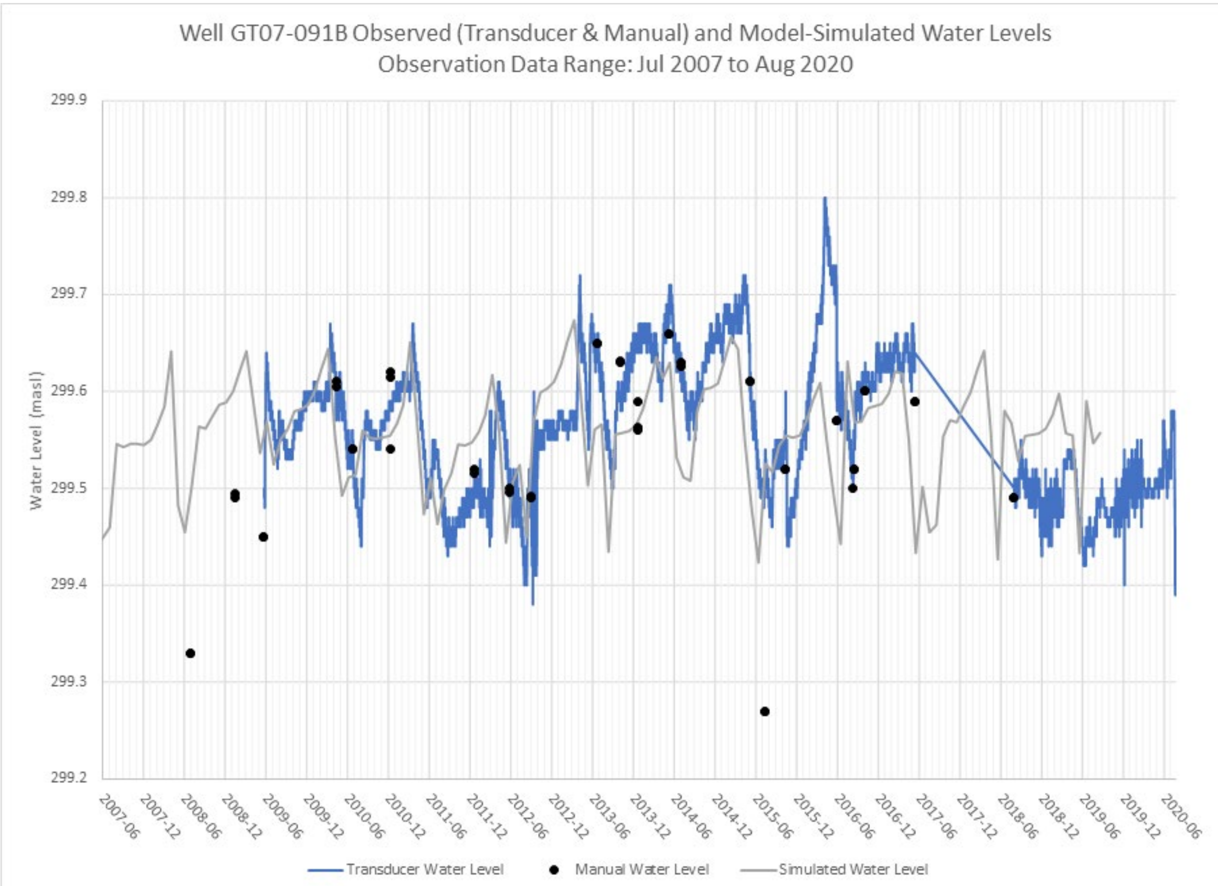
Limits, triggers, monitoring frequency and potential management responses to address these potential effects to hydrogeology are provided in Sections 7.3.1.1 to 7.3.1.4.

7.3.1.1. Limits

The upper limit for groundwater levels is based on linking changes to effects on surface water levels and vegetation within the fen. Changes in groundwater levels as a result of Fort Hills Project activities that result in changes to surface water levels that are considered unacceptable must be avoided. The upper limit occurs when a change in groundwater levels (at wells located outside of fen) or gradients across the peat/sand interface (at monitoring well pairs within the fen) results in or is associated with an unacceptable change in surface water levels, based on surface water hydrology limits.

7.3.1.2. Triggers

The triggers for groundwater levels are based on different criteria for locations within the fen (well pairs) and locations in the uplands (single wells). Variability in groundwater levels will be compared to the MRV (over three to five years of baseline data collection), and triggers will be linked to changes in surface water levels as described in the following subsections. Field measurement of water levels over time to better establish a baseline is a critical step in development of triggers for groundwater levels. For groundwater, triggers will be based on measured data; the MRV generally shows more variability than the modelled range (Figure 7.3-1) and a minimum of three years of baseline data will be collected at each monitoring well prior to trigger calculation. In addition, several data points in the fen area have measured groundwater data dating back to 2008, which provides a significant measured baseline for trigger generation



masl = metres above sea level.

Figure 7.3-1: Simulated vs Measured Data at GT07-091B (sand well)

7.3.1.2.1. Fen Locations (Monitoring Well Pairs)

Fen locations consist of pairs of monitoring wells, with wells completed in the lower peat and upper sand. Triggers for these locations will be based on vertical gradients between wells (across the peat-sand interface). Although groundwater levels within the sand are variable over the year, showing seasonal effects, these level changes are mirrored in the lower peat levels (Figure 7.3-2a). Assessment of available measured water levels data indicates that the vertical gradient shows no effect of seasonality and remains relatively flat and consistent (Figure 7.3-2b). This eliminates the need for seasonally variable triggers within the fen, and also provides a measure of whether groundwater levels are supporting the fen (by maintaining the vertical gradient). The triggers for vertical gradient within the fen will not include a trigger based on a change in gradient direction; most of the vertical gradients across the peat-sand interface are close to or fluctuate around neutral, as shown in Tables 2.5-4 through 2.5-7 in Section 2.5.4.1.4, Objective 1. Using a change in gradient direction as a trigger has the potential to result in a significant number of trigger exceedances for variability that is within the historical data range. The critical parameter for vertical gradient triggers is the magnitude of the vertical gradient; when the vertical gradient is outside historical values, this indicates a potential change that may produce conditions outside the previously observed range.

Level 1 trigger:

- surface water levels at nearby monitoring locations that exceed the surface water hydrology Level 1 trigger (Section 7.3.2.2) **AND** vertical gradients across the sand/peat interface that are two standard deviations above/below the mean of the MRV

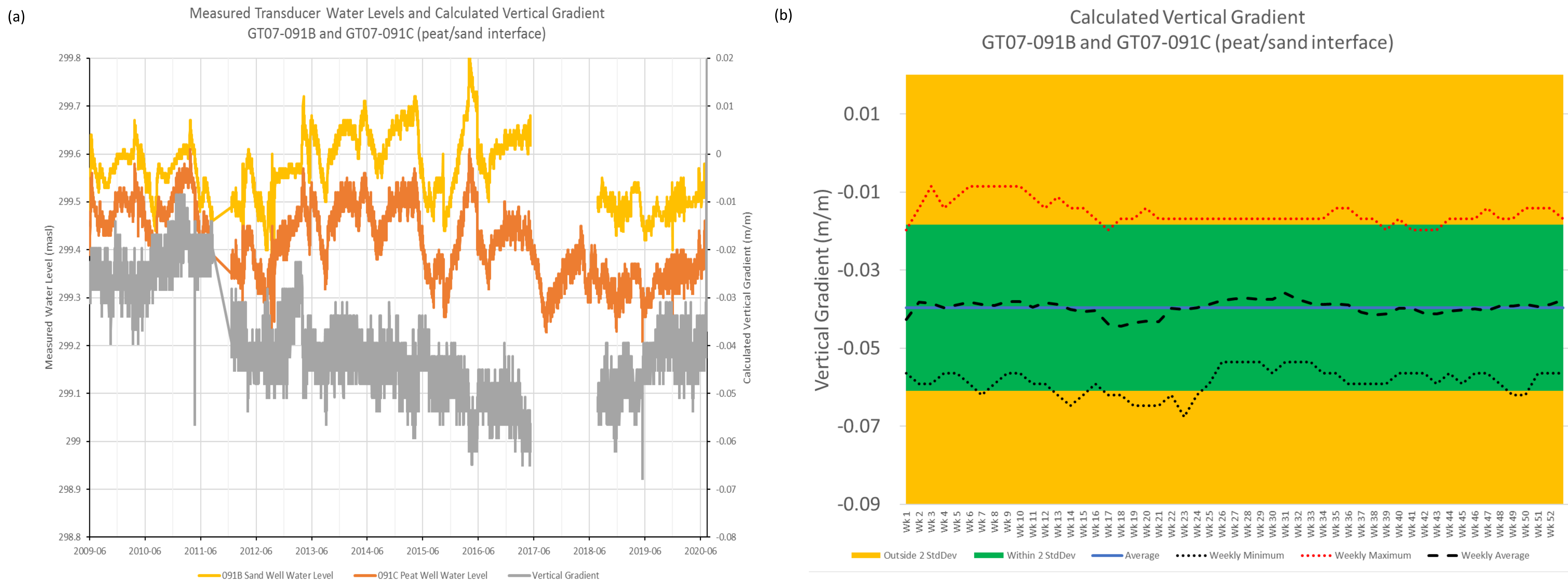
Level 2 trigger:

- surface water levels at nearby monitoring locations that exceed the surface water hydrology Level 2 trigger (Section 7.3.2.2) **AND** vertical gradients across the sand/peat interface that are two standard deviations above/below the mean of the MRV

Level 3 trigger:

- surface water levels at nearby monitoring locations that exceed the surface water hydrology Level 3 trigger (Section 7.3.2.2) **AND** vertical gradients across the sand/peat interface that are two standard deviations above/below the mean of the MRV

The Level 1, 2 and 3 triggers will be based on a minimum of 3 to 5 years of data for both groundwater and surface water levels.



masl = metres above sea level; m/m = metres per metre; StdDev = standard deviation.

Figure 7.3-2: GT07-091 Peat/Sand Interface, Measured Water Levels (a) and Vertical Gradient Plus and Minus Two Standard Deviations (b)

7.3.1.2.2. Upland Locations (Individual Monitoring Wells)

Upland locations will use groundwater elevations as the basis for triggers. These locations are single-well locations; as such, triggers for these locations will be based on the range of measured groundwater elevations. In these locations, seasonal effects are observed (Figure 7.3-3).

Level 1 trigger:

- surface water levels at nearby monitoring locations that exceed the surface water hydrology Level 1 trigger (Section 7.3.2.2) **AND** groundwater levels at individual monitoring wells two standard deviations above/below the mean of the MRV

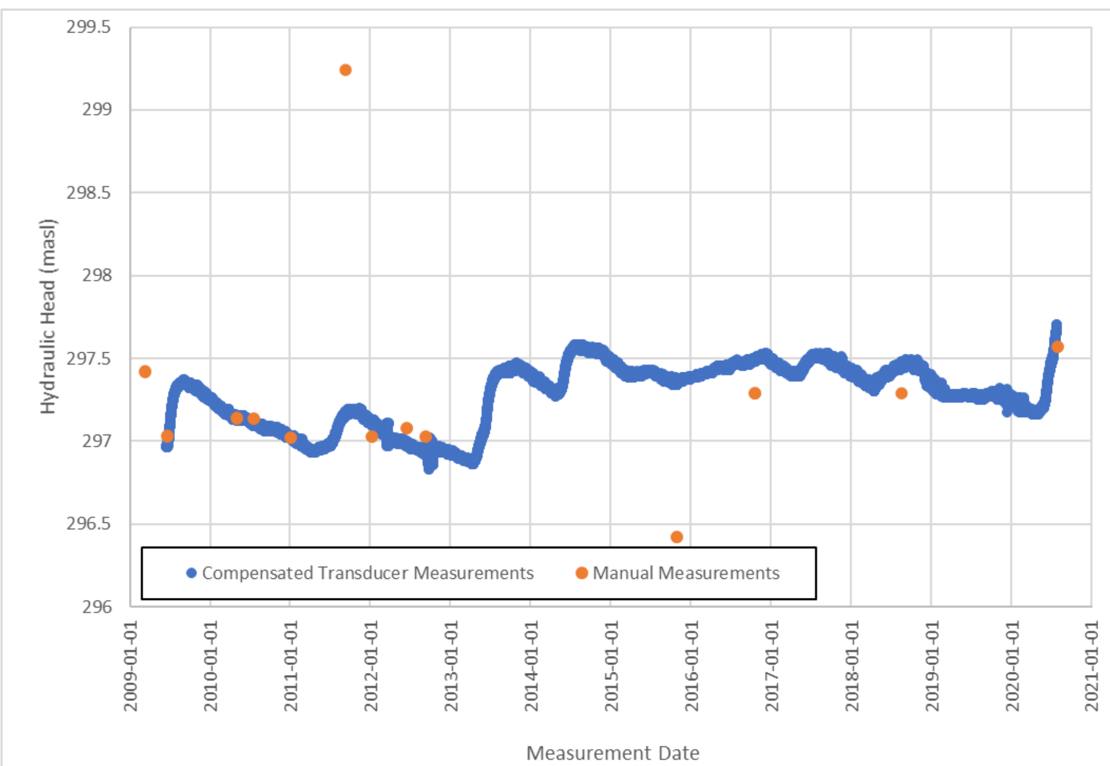
Level 2 trigger:

- surface water levels at nearby monitoring locations that exceed the surface water hydrology Level 2 trigger (Section 7.3.2.2) **AND** groundwater levels at individual monitoring wells two standard deviations above/below the mean of the MRV

Level 3 trigger:

- surface water levels at nearby monitoring locations that exceed the surface water hydrology Level 3 trigger (Section 7.3.2.2) **AND** groundwater levels at individual monitoring wells two standard deviations above/below the mean of the MRV

The Level 1, 2 and 3 triggers will be based on a minimum of 3 to 5 years of data for both groundwater and surface water levels.



masl = meters above sea level.

Figure 7.3-3: MW08-12 Manual Water Levels and Compensated Transducer Water Levels

7.3.1.3. Monitoring Frequency

Groundwater level monitoring sampling intensity will be the same for all monitoring types. Groundwater levels will be measured by pressure transducers twice per day. Pressure transducers will be coordinated across all wells at the site to allow for comparisons of levels measured at the same time. Pressure transducer data will be supported by twice yearly visits to measure manual water levels in instrumented wells and assess transducer condition (wear, drift and battery life). The manual water levels will be used to ensure transducer hanging depths are properly corrected, and to provide measurements in the case of loss of data due to transducer error.

7.3.1.4. Potential Management Response

Potential management responses for groundwater levels involve optimization of the water supply systems for the fen. In particular, groundwater levels in the North Outwash Plain (NOP) and in the surface sands underlying the fen may be affected by the injection wells in the NOP. If triggers for vertical gradients within the fen indicate the need for a management response, the rate of injection in the NOP can be altered (reduced to reduce vertical gradients or increased to increase vertical gradients).

Similarly, in the Fort Hills Upland Complex (FHUC), groundwater levels may be affected by the pumping wells and potential management responses will rely on optimization of the water management system in the FHUC area.

7.3.2. Surface Water Hydrology

As outlined under Objective 3 (Section 4), the Fort Hills Project has the potential to alter surface water hydrology, which can result in changes to the wetland ecosystem and aquatic resources within the MLWC. ITK has helped improve understanding of flows, water levels and connectivity to the plants and animals of the fen and lake. ITK of surface water has helped inform the natural range of variation of surface waters and is supported by longer term climate information and historical air photos. The natural range of variation includes water levels that reflect conditions that are both drier (lower lake and creek levels) and wetter (higher lake and creek levels) than the measured range of data (the MRV). Use of the MRV, rather than expanding to the full natural range of variation is a conservative approach to developing triggers for hydrology. Limits, triggers, monitoring frequency and potential management responses to address potential effects to surface water hydrology are provided in Sections 7.3.2.1 to 7.3.2.4.

7.3.2.1. Limits

The limits for surface water hydrology will be defined based on recorded seasonal water levels. However, there will be some uncertainty associated with using limited recorded water levels in the non-mined portion of the MLWC and in McClelland Lake to define the limits. To reduce the uncertainty, long-term simulated water levels (i.e., simulated using climate data and the calibrated/validated integrated hydrological model) can be used to supplement the limited recorded data to define the limits and triggers until sufficient monitoring data are collected by the program.

Upper and lower limits for surface water hydrology are defined based on recorded/simulated seasonal water levels in the non-mined portion of the MLWC and in McClelland Lake (red shading in Figure 7.3-4), combined with persistence of the effect. The Level 3 trigger (shown as the boundary between the orange and red shading in Figure 7.3-4) will be governed either by three standard deviations from the mean or by the maximum/minimum of recorded/simulated water levels by season, whichever is lower/more conservative. The limit for surface water hydrology would be reached if a change equivalent to a Level 3 trigger is observed during more than one open-water season, in either direction. Water levels beyond these limits could adversely affect the function of the MLWC ecosystem and specifically the function of the wetland within the non-mined portion of the MLWC. Within the range of these limits, it is expected that the ecosystem has some level of tolerance to variations in water levels. The surface water hydrology limits are set such that management actions can be used to prevent a limit from being reached.

7.3.2.2. Triggers

Means and standard deviations for near-surface/surface water levels within the non-mined portion of the MLWC and water level for McClelland Lake were used to establish criteria for different levels of triggers for surface water hydrology. Measured seasonal variation in the water levels recorded under the effects monitoring program (Objective 5; Section 6) will be compared to the triggers every season (i.e., end of winter, after freshet, and at the end of autumn) in line with frequency of trigger assessments described in Section 7.2.3 to determine whether responses or actions are required, once ditching and draining activities commence in the MLWC watershed. Comparison with trends at reference sites will allow local effects related to Fort Hills Project activities within the MLWC watershed to be differentiated from regional effects.

For surface water hydrology, trigger levels are defined as:

Level 1 trigger (outer edge of green shading in Figure 7.3-4):

- surface water levels one standard deviation above/below mean water levels **AND** a statistically significant increasing/decreasing temporal trend is observed at the MLWC, but not at the reference site(s)

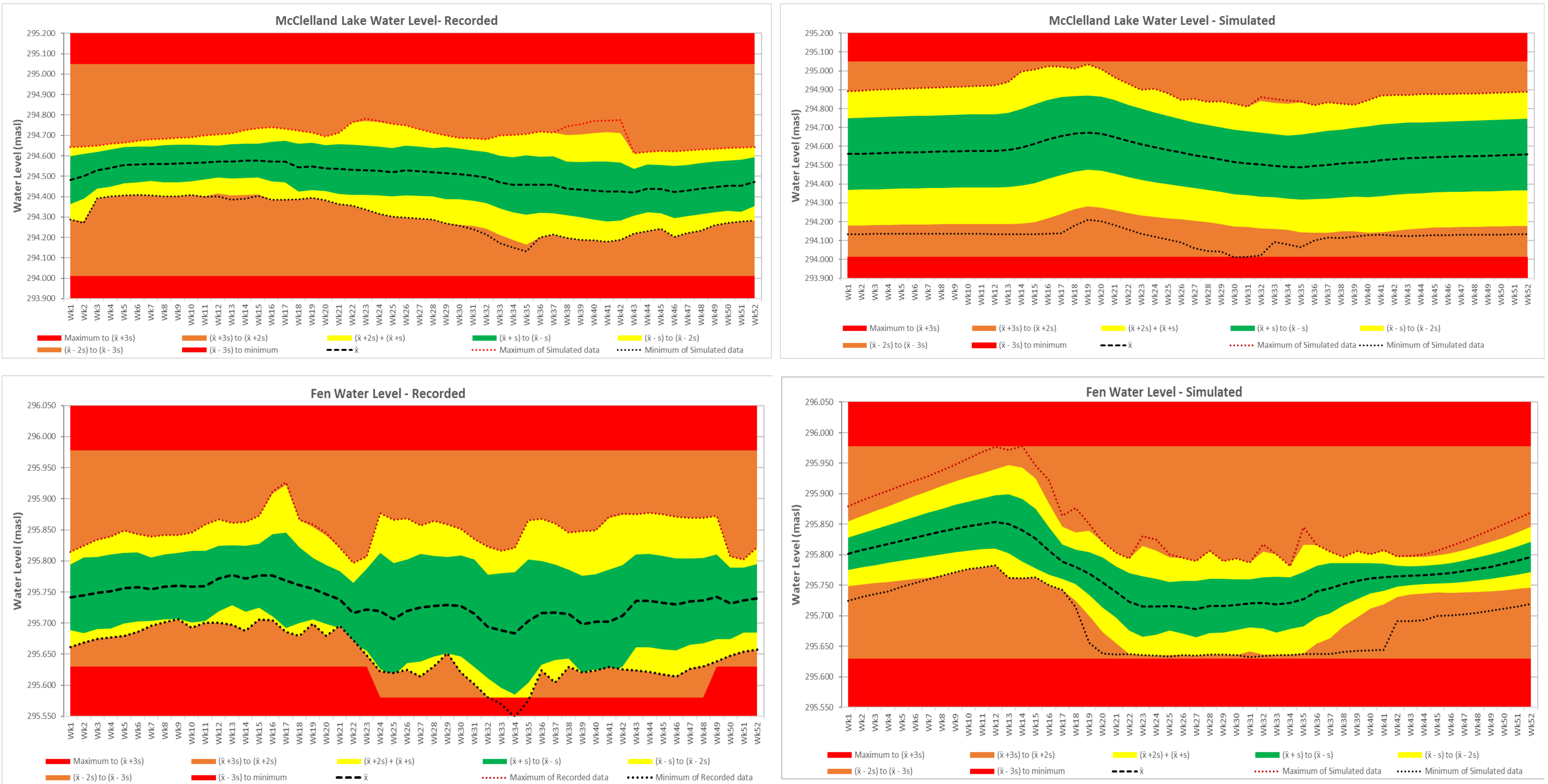
Level 2 trigger (outer edge of yellow shading in Figure 7.3-4):

- surface water levels two standard deviations above/below mean water levels **AND** a statistically significant increasing/decreasing temporal trend is observed at the MLWC, but not at the reference site(s)

Level 3 trigger (outer edge of orange shading in Figure 7.3-4):

- surface water levels approximately three standard deviations above/below mean water levels **AND** a statistically significant increasing/decreasing temporal trend is observed at the MLWC, but not at the reference site(s)

Evaluation of trends for Level 1, 2 and 3 triggers will be based on a minimum of 3 to 5 years of data.



masl = metres above sea level; s = standard deviation; x̄ = mean.

Note: The upper limit of orange shading is defined as either three standard deviations from the mean or the maximum/minimum of recoded/simulated water levels, whichever is lower/more conservative.

Figure 7.3-4: Trigger Levels for Surface Water Hydrology

7.3.2.3. Monitoring Frequency

Continuous water level monitoring is considered essential to characterize changes throughout the year. Water levels in the fen and the lake are currently logged automatically every 30 minutes, or hourly at a minimum, and summarized daily. The stations will be visited on an approximately two-month interval to conduct data logger downloads and for preliminary quality assurance to check function, data reliability, and maintenance needs. Alternatively, data from continuous water level monitoring can be remotely downloaded from data loggers; water level monitoring frequency will remain the same throughout the Baseline, Surveillance, and Confirmation and Investigation of Cause Tiers.

Records logged under uniform pressure conditions by all water level loggers will be examined every two years to verify the continued calibration of the instruments and identify, if necessary, the need for sensor calibration or instrument replacement. Measurements of well top and temporary benchmark elevation, using high-precision real time kinematic global positioning systems (RTK-GPS), will be verified or corrected by examining the relationship between surveyed and published elevation values of local control points. Data obtained from data loggers will be compiled and compensated for variations in barometric pressure. Anomalies introduced as a result of the physical manipulation of the logger will be identified by referencing site data, and corrected if necessary.

Climate observations are conducted to observe ambient conditions impacting surface water quantity. As a result, the sampling intensity for climate observations should remain constant throughout the Baseline, Surveillance, and Confirmation and Investigation of Cause Tiers.

Climate parameters logged automatically will be monitored every 30 minutes, or hourly at a minimum, and summarized daily. The stations will be visited on an approximately two-month interval to conduct data logger downloads and for preliminary quality assurance to check function, data reliability, and maintenance needs during the ice-free period.

7.3.2.4. Potential Management Response

In general, management responses will follow those described in Section 7.2.3. Exceedance of water level triggers will bring about a management response until issues are understood and resolved, in the case of the triggers being exceeded as a direct result of Fort Hills Project activities. Management actions will occur within the response framework for effects related to Fort Hills Project operations within the MLWC watershed, and specific management actions will depend on the type and severity of effect detected.

The response framework will include further investigation of causes, identification of mitigation options, and developing management action. To develop the management action, trends of water levels measured within the MLWC will also be compared to data collected at the reference sites.

Potential management responses for surface water hydrology involve optimization of the water supply systems for the fen. In particular, surface water levels in the non-mined portion of the MLWC and in McClelland Lake may be affected by surface water supply downstream of the cutoff wall in the non-mined portion of the MLWC or changes in groundwater. If triggers for surface water levels within the non-mined portion of the MLWC indicate the need for management response, the rate of surface water supply can be altered (reduced to reduce water levels or increased to increase water levels). Additional water supply will come from Athabasca River as described in detail under Objective 4 in Section 5.2.3.

7.3.3. Water Quality

As outlined under Objective 3 (Section 4), the Fort Hills Project has the potential to alter water quantity and water quality, which can result in changes to wetland plant communities in the fen and aquatic resources in McClelland Lake. ITK has helped improve understanding of water quality and connectivity to the plants and animals of the fen and lake. Observations of declines in regional water quality and experience with other industrial developments have raised concerns related to existing water quality in McClelland Lake and future water quality in the lake during Fort Hills Project construction and operation. While these concerns have reduced the willingness to drink water from McClelland Lake, Indigenous people continue to use water from McClelland Lake for other domestic purposes. Access to clean/safe water is critically linked to traditional land use and the ability to exercise Indigenous rights in the MLWC. The natural range of variation for water quality, as informed by ITK, reflects a higher quality of water than current day conditions and the MRV. Information from the paleoecology program (Objective 1 [Section 2]) indicates water quality historically was affected by fluctuations in water levels, forest fires and combustion (such as increases in vehicular traffic).

The approach to developing limits for water quality is informed by water quality benchmarks and understanding of water quality parameters important for the functionality of the fen. Limits, triggers, monitoring frequency and potential management responses to address these potential effects to water quality are provided in Sections 7.3.3.1 to 7.3.3.4.

7.3.3.1. Limits

Surface water and groundwater quality in the MLWC should be maintained such that they will not change the functionality and diversity in the non-mined portion of the MLWC, or alter the aquatic ecosystem in McClelland Lake. These conditions will be maintained by defining water quality benchmarks for the protection of vegetation or aquatic life, and applying mitigation, if necessary, to maintain surface water and groundwater quality below benchmarks. Water quality benchmarks (which represent the limits for this monitoring program) are numerical values that will be determined as a management response action when a Level 1 trigger is reached, on a parameter-by-parameter basis (Section 7.2.3.2). Water quality benchmarks will be based on site-specific conditions, and defined based on biological responses (e.g., changes in plant community characteristics within the fen and changes to primary productivity in the lake) that provide a direct indication of actual effects due to mining activities.

If required by the application of the response framework (i.e., upon exceedance of the Level 1 trigger), two types of benchmarks may be derived for water quality indicators: one set for the fen and one set for McClelland Lake. Water quality benchmarks derived for surface water and groundwater quality within the fen will consist of a range of values within which the fen ecosystem function is maintained (i.e., based on the limits of tolerance by wetland vegetation), while water quality limits for McClelland Lake will consist of site-specific water quality benchmarks for the protection of aquatic life. Site-specific benchmarks will be derived using procedures outlined for developing Canadian water quality guidelines (CCME 2003).

7.3.3.2. Triggers

Triggers for surface water quality will be based on different criteria than groundwater quality. Surface water quality data are available for reference sites, which will provide the basis for BACI analysis and defining regional normal ranges.

7.3.3.2.1. Surface Water Quality

Preliminary normal ranges for the MLWC (including the fen and McClelland Lake) have been calculated for each water quality indicator using pre-mining baseline datasets from the MLWC, and will be re-calculated as additional data are collected under the Baseline Tier, prior to commencement of ditching and draining activities in the MLWC watershed. In addition, BACI results based on data from reference sites and temporal trends will be evaluated. The utility of the BACI model will be re-evaluated after 3 or 4 years. After re-evaluation, once the "before" and "after" periods become unbalanced (e.g., 5 to 8 years, or two re-evaluation cycles), BACI may be replaced with trend analysis for comparison of temporal trends between the MLWC and reference wetlands.

Because the Level 3 trigger will depend upon the nature of the documented effect, it will be defined once the parameters of concern are identified. The Level 3 trigger for surface water quality will likely be related to further increases in concentrations towards the benchmarks defined once the Level 1 trigger is reached.

Water quality data obtained under the effects monitoring program (Objective 5 [Section 6]) will be compared to the following trigger levels to determine if a trigger is reached:

Level 1 trigger:

- indicator value outside MLWC normal range **AND** statistically significant BACI result indicating a change at the MLWC that has not occurred at reference sites

Level 2 trigger:

- exceedance of Level 1 trigger for three consecutive years **AND** indicator value reached 75% of the site-specific benchmark

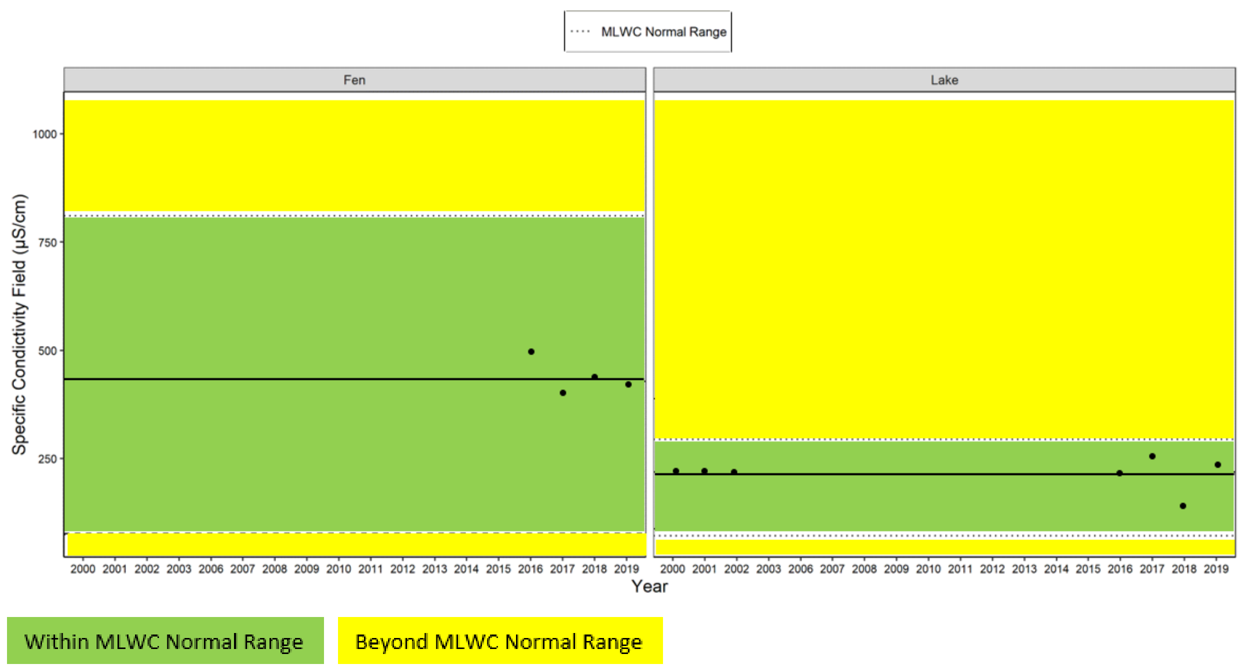
  OR

- statistically significant trend towards the limit, with most recent concentrations at 75% of the site-specific benchmark

Level 3 trigger:

- to be determined

For comparisons to normal ranges, annual average concentration for each key indicator at each monitoring location will be used. An example of how measured values will be compared to normal ranges for baseline data at the MLWC and reference sites is shown in Figure 7.3-5. While mean values calculated for all sites within the fen and McClelland Lake for a given year will be compared with the normal range bounds to assess triggers, site-level responses will also be considered to characterize spatial and site-specific effects.



Note: Black circles represent yearly means from all stations and the black horizontal line represents the mean of all samples. MLWC = McClelland Lake Wetland Complex; µS/cm = microsiemens per centimetre.

Figure 7.3-5: Normal Ranges and Mean Field Specific Conductivity Measured in the Fen and McClelland Lake During the Pre-Mining Baseline Period

If required by a trigger exceedance, objectives of a water quality Management Response Plan will be to:

- address key uncertainties
- explore relationships among metrics
- explore modelling results where applicable
- identify potential mitigation
- review and refine triggers and benchmarks

The responses to a Level 1 trigger consist of elevation of monitoring effort to the Confirmation and Investigation of Cause Tier, development of a site-specific benchmark for the affected parameter, and development of a Management Response Plan. Therefore, a Level 1 trigger would initiate a set of actions that are useful to prepare for mitigating potential continued increasing trends. Additional conditions included in the Level 2 trigger (i.e., persistent exceedance of the MLWC normal range and indicator value above 75% of the benchmark) indicate an additional change of meaningful magnitude, but one that remains below the system limit. The condition in the Level 2 trigger tied to benchmarks is based on the rationale that water quality changes might be acceptable if they do not affect functionality or diversity of the wetland. Although an increased concentration related to surrounding development that is at 75% of the benchmark is not expected to result in adverse toxicological effects, it indicates a level of concern that requires mitigation to reverse the trend before the benchmark (and hence the defined system limit) is reached.

7.3.3.2.2. Groundwater Quality

Preliminary normal ranges for MLWC have been calculated for each groundwater quality indicator using pre-mining baseline datasets from the MLWC. These normal ranges will be re-calculated as additional data are collected under the Baseline Tier, prior to commencement of ditching and draining activities in the MLWC watershed. Baseline groundwater quality data are not available from the reference sites. As for surface water quality, Level 2 and 3 triggers will be based on benchmarks defined once a Level 1 trigger is reached.

Groundwater quality data obtained under the effects monitoring program (Objective 5 [Section 6]) will be compared to the following trigger conditions to determine if a trigger is reached:

Level 1 trigger:

- indicator value outside MLWC normal range

  OR

- groundwater levels at the location exceed a Level 1 trigger

Level 2 trigger:

- indicator value outside MLWC normal range for three consecutive years

  OR

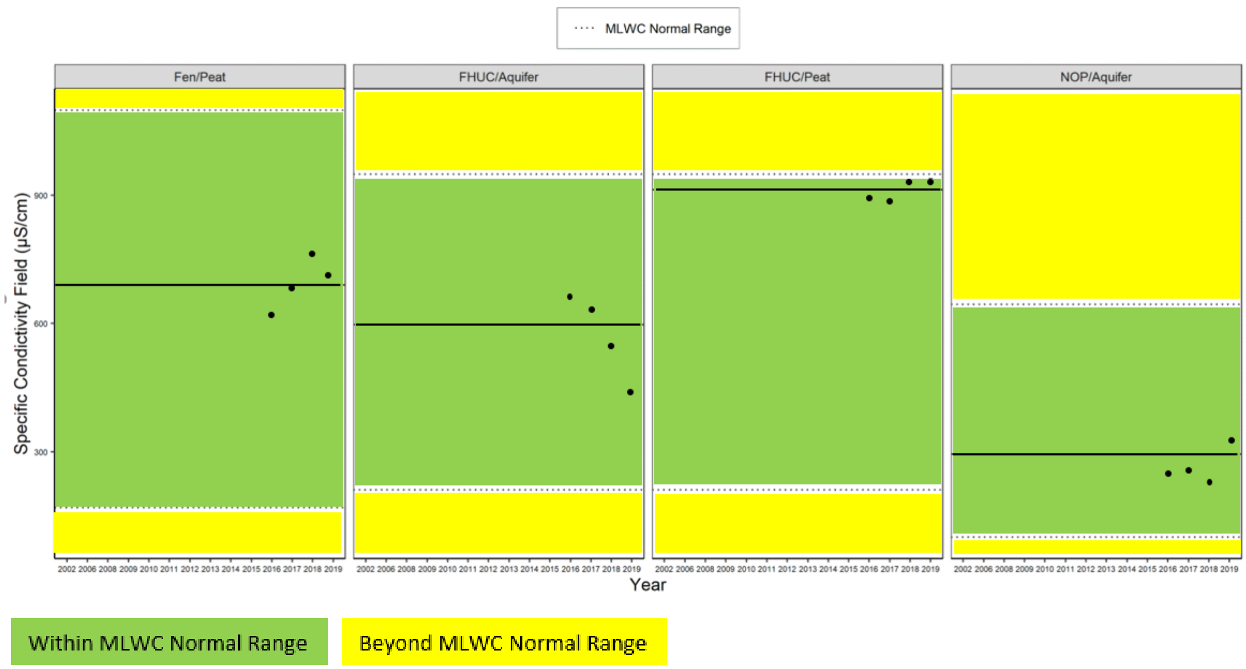
- groundwater levels at the location exceed a Level 2 trigger

Level 3 trigger:

- to be determined

A change in groundwater level could affect water chemistry, and actions initiated for groundwater triggers will also include mitigation actions towards maintaining or improving water quality.

For comparison to normal ranges, annual average concentration for each metric at each monitoring location will be used. An example of how measured values will be examined for trends and compared to normal ranges for pre-mining baseline data at the MLWC is shown in Figure 7.3-6.



Note: Black circles represent yearly means from all stations and the black horizontal line represents the mean of all samples.
FHUC = Fort Hills Upland Complex; MLWC = McClelland Lake Wetland Complex; NOP = North Outwash Plain;
µS/cm = microsiemens per centimetre.

Figure 7.3-6: Normal Range and Mean Field Specific Conductivity Measured in Groundwater Samples at MLWC During the Pre-Mining Baseline Period

7.3.3.3. Monitoring Frequency

Surface water and groundwater quality sample collection in the fen under the Baseline and Surveillance Tiers will be conducted annually, three times per year (spring, summer, and fall). This monitoring will occur at water quality locations described under Objective 5 (Section 6) for both early warning and integrated monitoring within the MLWC and the two reference sites (Table 7.2-2). Surface water quality samples will also be collected for grid-based wetland monitoring in summer in coordination with the vegetation monitoring program (Section 7.3.5.3).

Water quality samples will be collected from McClelland Lake and the two reference lakes annually, four times per year (spring, summer, fall, and winter) at the locations described under Objective 5 (Section 6). Sampling frequency may intensify if a trigger is reached and deemed necessary under the Confirmation and Investigation of Cause Tier.

7.3.3.4. Potential Management Response

Exceedance of water quality triggers will bring about a management response and monitoring will enter higher monitoring tiers until issues are understood or resolved, as described in Section 7.2.3. Specifically, if a trigger exceedance occurs for one of the key indicators, monitoring under the Confirmation and Investigation of Cause Tier will be initiated and may consist of analysis of additional water quality parameters, intensification of sampling frequency, sampling from additional locations, and/or increase of quality control samples. Water quality benchmarks that are site-specific and vegetation-driven will be developed as a component of the Management Response Plan. These benchmarks will be developed when water quality guidelines for the protection of aquatic life do not exist or are not applicable. Level 3 triggers for water quality key indicators will be defined if a Level 2 trigger is reached and will be set in relation to the limits (e.g., as percentage of benchmarks or guidelines). Because Level 3 triggers should not be reached if the response framework is effective, Level 3 triggers are defined once the parameter(s) of concern is/are identified (i.e., based on monitoring in the Confirmation and Investigation of Cause Tier initiated when the Level 2 trigger was exceeded).

7.3.4. Aquatic Resources

As outlined under Objective 3 (Section 4), the Fort Hills Project has the potential to alter water quantity and water quality, which can result in changes to primary productivity in McClelland Lake. ITK has helped improve the understanding of how water quality and aquatic resources of the lake are linked to vegetation and wildlife use. ITK of aquatic resources has included information on fish populations in the lake, lake vegetation and aquatic birds (Objective 1 [Section 2]). The natural range of variability for aquatic resources can also be informed by paleoecology (Objective 1 [Section 2]). Information captured in the sediments beneath the lake has shown three major periods of algal community changes:

- high primary production, and diverse algal and anoxygenic bacteria community composition between ca. 1695 and 1840, when water levels were lower
- variable primary production between ca. 1850 and 1970, in response to changes in water levels and watershed inputs
- a noticeable increase in primary production, and increased cyanobacteria and golden algae, likely due to a warming climate and increased wildfires, from ca. 1970 to present.

The approach to developing limits for aquatic resources is informed by this understanding of algal communities that are parameters important for the functionality of the lake. The key aspect of the algal community selected for monitoring is primary productivity.

Limits, triggers, monitoring frequency and potential management responses to address these potential effects for aquatic resources are provided in Sections 7.3.4.1 to 7.3.4.4.

7.3.4.1. Limits

Chlorophyll *a* was selected for inclusion in the effects monitoring program and response framework under the aquatic resources indicator. Water quality should not be impaired such that the primary productivity of McClelland Lake is changed to a degree that would substantially alter the aquatic ecosystem. Based on this approach, the limit defined for the aquatic resources indicator is a change in trophic status of McClelland Lake as a result of mining activities. Trophic status will be categorized according to internationally accepted criteria (e.g., Organization for Economic Cooperation and Development criteria).

7.3.4.2. Triggers

Triggers will apply to chlorophyll *a* concentration in McClelland Lake. The use of these triggers is provisional on obtaining a reliable dataset during monitoring under the Baseline Tier such that chlorophyll *a* concentration can be defensibly compared between monitoring tiers. The use of normal ranges is conditional on the suitability of data collected during monitoring under the Baseline Tier for evaluating lake trophic status. Normal ranges for the Level 1 trigger will be calculated using the pre-mining baseline dataset for McClelland Lake, which will also be used to establish the baseline trophic

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status of the lake. The normal range will be recalculated as additional data are collected under the Baseline Tier prior to mining activities in the MLWC watershed. In addition, BACI results and temporal trends will be evaluated.

The following trigger levels will be compared with monitoring results obtained under the effects monitoring program (Objective 5 [Section 6]) to determine if a trigger is reached:

Level 1 trigger:

- chlorophyll *a* concentration outside MLWC normal range **AND** statistically significant BACI result detected for chlorophyll *a* concentration, indicating a change at MLWC that has not occurred at reference sites

Level 2 trigger:

- exceedance of Level 1 trigger for three consecutive years **AND** statistically significant trend in chlorophyll *a* concentration towards the next trophic status category, with the most recent concentrations within 25% of the boundary of the next trophic category

Level 3 trigger:

- to be determined

7.3.4.3. Monitoring Frequency

Chlorophyll *a* samples will be collected from McClelland Lake, Audet Lake and Birch Lake in conjunction with surface water quality samples, as detailed in Section 7.3.3.3, and will include yearly sampling during the summer at three to five surface water quality locations under the Baseline and Surveillance Tiers.

7.3.4.4. Potential Management Response

Exceedance of triggers will bring about a management response, and monitoring will enter higher monitoring tiers until issues are understood or resolved as described in Section 7.2.3. Specifically, if a trigger exceedance occurs, monitoring under the Confirmation and Investigation of Cause Tier would be initiated. Additional chlorophyll *a* samples may be collected throughout the summer and each sampling event may include additional sampling locations and parameters (e.g., detailed nutrients) to better understand trends in lake chlorophyll *a* concentrations. Additional metrics to assess lake trophic status may be utilized to better understand the ecological significance of the observed change. Mitigation measures to control the change in lake trophic status may be investigated and implemented based on which trigger was exceeded. Triggers may be reviewed and refined based on outcomes of Confirmation and Investigation of Cause monitoring.

7.3.5. Vegetation

As outlined under Objective 3 (Section 4), the Fort Hills Project has the potential to alter water quantity and water quality within the non-mined portion of the MLWC, which can result in changes to wetland plant communities. ITK has helped improve understanding of water quality and connectivity to the plants and animals of the fen and lake. ITK holders have noted that the condition and location of plants within an area does naturally change over time; however, the changes they have observed in the past few decades are beyond their expectations. Some culturally important plant species are now very rare or are no longer available within MLWC. Some community members question the health and purity of plants in the area. ITK holders noted that changes in the distribution of plants is an indicator of site-specific changes, and is related to water levels (or drying) of the site. The natural range of variation for vegetation as informed by ITK reflects a more diverse and healthy vegetation community than the MRV. The approach to developing limits for vegetation is currently based on the measured parameters for vegetation characterizing the pre-mining condition and recognizing that the health and abundance of culturally significant plant communities are important to the communities and the functionality of the fen. Limits, triggers, monitoring frequency, and potential management responses related to these effects for vegetation are provided in Sections 7.3.5.1 to 7.3.5.4.

7.3.5.1. Limits

Self-sustaining ecosystems are those that will be maintained into the future. They are healthy, functioning and robust ecosystems that are capable of withstanding environmental change and accommodating stochastic processes (i.e., random or unpredictable changes). Ecologically effective ecosystems are those that can support the range of native species and ecological and evolutionary processes normally provided by the ecosystem (Noss 1990).

Relative abundance of plant functional groups was selected for inclusion in the effects monitoring program and response framework under the vegetation indicator. The relative abundance of plant functional groups should not be reduced or altered such that ecological effectiveness or function is impaired. Based on this vegetation metric, the limits defined for the vegetation indicator would be reached if plant communities do not continue to be self-sustaining or ecologically effective ecosystems are not maintained.

7.3.5.2. Triggers

Triggers will apply to the following vegetation metrics (i.e., relative abundance of plant functional groups) identified under Objective 2 (Section 3):

- string indicator species
- moderate-rich fen indicator species
- extreme-rich fen indicator species
- eutrophication indicator species

Normal ranges for Level 1 triggers have been calculated for each metric using pre-mining baseline datasets from long-term vegetation monitoring locations within the MLWC and will be recalculated as additional data are collected under the Baseline Tier prior to mining activities in the MLWC watershed. In addition, BACI results and temporal trends will be evaluated. The utility of the BACI model will be re-evaluated after approximately five years and may be replaced with trend analysis once the number of "before" and "after" years becomes unbalanced.

Because the Level 3 trigger will depend upon the nature of the documented effect, it will be defined once the parameters of concern are identified. The Level 3 trigger for vegetation may be based on population dynamics of one or a few species, or shifts in composition of the entire plant community. The Level 3 trigger for vegetation will be tailored to account for documented effects in the physical environment.

The trigger levels will be compared with monitoring results obtained under the effects monitoring program (Objective 5 [Section 6]) to determine if a trigger is reached:

Level 1 trigger:

- indicator value outside MLWC normal range **AND** statistically significant BACI or trend analysis result indicating a change at the MLWC that has not occurred at reference sites

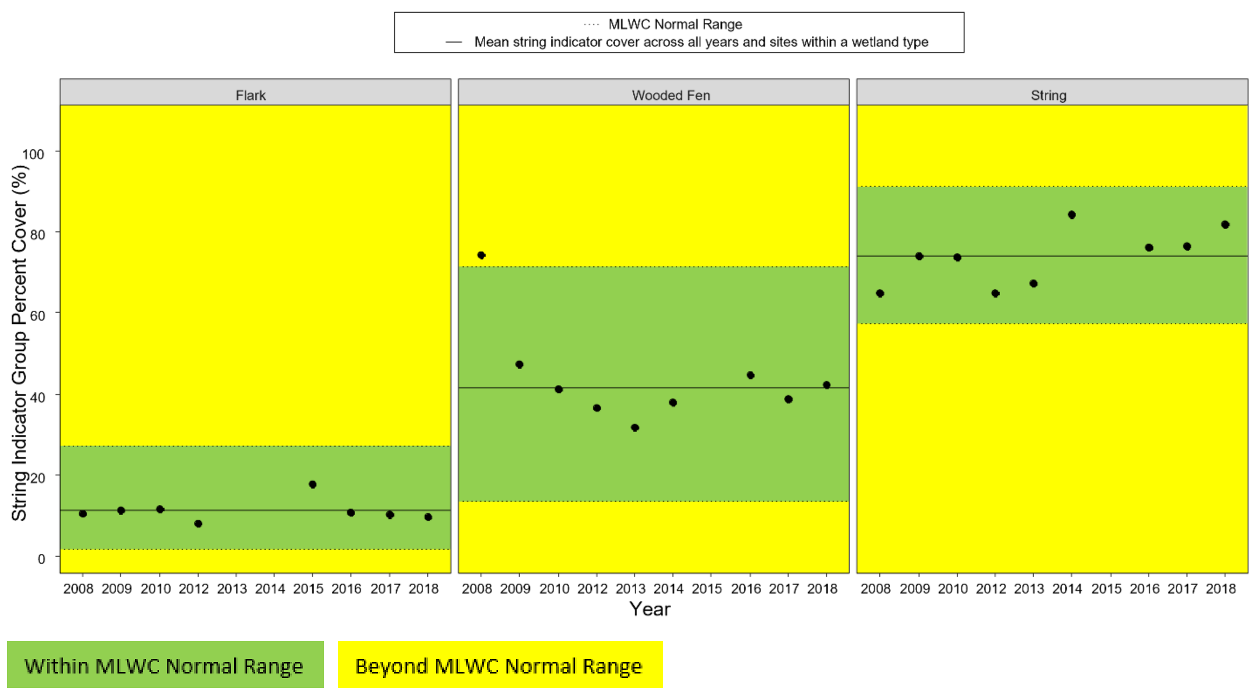
Level 2 trigger:

- exceedance of Level 1 trigger for three consecutive years

Level 3 trigger:

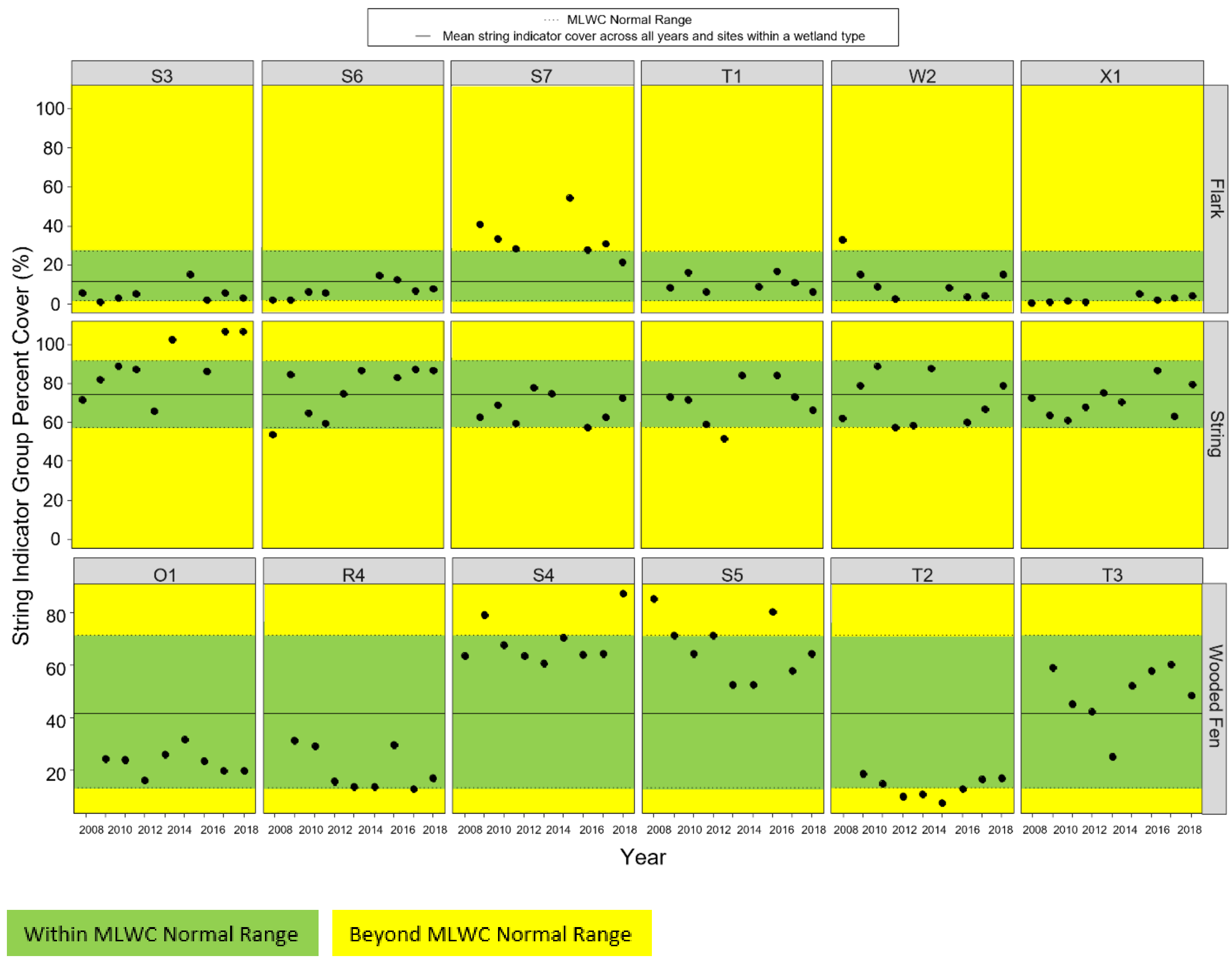
- to be determined

An example of how measured values will be compared to normal ranges for baseline data at the MLWC is shown in Figure 7.3-7 and Figure 7.3-8. Some values occur outside the normal range when data are considered at the site scale, which reflects the pre-mining baseline within-MLWC plant community variation in the dataset documented by Golder (2018). While annual means calculated for all sites within each fen type for a given year will be compared with normal range bounds to assess triggers (Figure 7.3-7), site-level responses will also be considered to characterize spatial and site-specific effects and evaluate whether site-level departures from the normal range warrant further investigation (Figure 7.3-8).



Note: Mean values for all sites combined.
% = percent; MLWC = McClelland Lake Wetland Complex.

Figure 7.3-7: Mean String Indicator Group Cover within Each Fen Type During the Pre-Mining Baseline Data Collection Period



%= percent; MLWC = McClelland Lake Wetland Complex.

Figure 7.3-8: String Indicator Group Cover within Each Site During the Pre-Mining Baseline Data Collection Period

While a response outside the normal range defined for a particular vegetation parameter might indicate an effect, a management response likely will not be triggered unless two or more vegetation parameters, or a vegetation parameter and a related water level or water quality parameter also indicate an effect. Consideration of linkages among monitoring components is important, particularly for biological receptors that respond to changes in the physical environment. Detailed investigation and mitigation for water levels or water quality characteristics may provide the timeliest reversal of effects in the biological system.

7.3.5.3. Monitoring Frequency

As a component of integrated wetland monitoring under the Surveillance Tier, monitoring at long-term vegetation monitoring locations will be completed once every four years at each sampling location as described under Objective 5 (Section 6). Sampling at reference sites will follow the same frequency and will occur during the same years. If a Level 1 trigger is reached, sampling frequency may increase to once every two years (if appropriate based on documented effects); alternatively, sampling frequency for a related metric may be adjusted if a linkage to vegetation effects is demonstrated. Specifically, vegetation effects are expected to be linked to surface water hydrology and surface water quality effects (which, in turn, are expected to be related to groundwater quantity and quality effects). Thus, if plant community effects beyond a Level 1 trigger are documented, monitoring in the Confirmation and Investigation of Cause Tier may bring about an increase in monitoring frequency for a potentially related metric until the cause of the plant community effect is established.

Grid-based wetland monitoring will be carried out every two years under the Surveillance Tier to capture vegetation changes that may be occurring within the wetland. Vegetation monitoring will be conducted in coordination with surface water quality monitoring.

For both types of vegetation monitoring, surveys will be carried out in mid-summer to coincide with peak growth periods for many plant species. This will improve species identification, reduce variation between sampling seasons, and allow for rigorous assessment of vigour, independent of senescence.

7.3.5.4. Potential Management Responses

A management response will be initiated if a vegetation metric exceeds or falls below a Level 1 trigger value. Reaching a Level 1 trigger value for any of the plant functional group metrics would initiate an investigation into site-specific trends and plot-level species composition changes to identify where the change occurred and the spatial extent of the occurrence. In addition, complementary data and ESCT information would be examined to determine if they support the documented effect. Ultimately, the investigation of cause would look towards surface water level and/or surface water quality changes, and the proposed management response may be tied to mitigation of surface water level and/or surface water quality effects.

The cause of effects identified through monitoring if a Level 1 trigger is reached will inform subsequent monitoring and management actions. If vegetation effects are related to water level or water quality associated with the cutoff wall and mining within the MLWC watershed and a Level 2 trigger is reached, mitigation will occur through the mitigation system described under Objective 4 (Section 5).

7.3.6. Environmental, Social, Cultural, and Traditional Economic Values and Land Use

The work on developing the approach and methods for monitoring of the ESCT indicators continues to progress at the SC. FHEC is committed to continue to support this work and to work with the SC to implement the ESCT monitoring program. Once the approach and methods have been developed, further work will develop how the ESCT indicators inform other triggers. It is expected that the information collected through the ESCT program will be summarized and shared with the SC for review and discussion. As discussed in Section 7.2.3, the ESCT monitoring data will inform the effects monitoring program response framework, where appropriate. Information sharing and discussions on the functionality of the fen can take place in meetings, workshops or during on-the-land gatherings.

7.4. Reporting

Following authorization of the OP, many of the monitoring programs initiated to document pre-mining baseline conditions within the MLWC watershed will continue. For primary effects indicators identified under Objective 2 (Section 3), some aspects of existing monitoring programs may be updated, or components/monitoring locations added. Monitoring of these primary effects indicators will continue under the Baseline Tier, as described in Section 7.2.1.1.

As per *Water Act* Approval 151363-01-00 (as amended) Condition 3.12, Progress Reports will continue to be provided to Alberta Energy Regulator (AER) on January 31st of each year until the OP is authorized, which is assumed to occur in 2023. Progress Reports are expected to be filed in January 2022, January 2023 and January 2024.

FHEC proposes that a comprehensive report describing monitoring activities and outcomes for both the integrated monitoring and the ESCT program, as well as updates on other activities occurring under the OP, will be provided to the AER and shared with the SC annually, starting in 2025. Summary updates can be shared with the SC during meetings, workshops or on-the-land gatherings, preferably coordinated with the ESCT program.

Results from the primary effects indicator monitoring will be reported for each of the indicator metrics. For each metric, reports will indicate whether there was a trigger exceedance, and if there was an exceedance, which level trigger was exceeded. An example of how this could be summarized visually is provided in Figure 7.4-1.

If a Level 1 trigger is exceeded for any indicators, a Management Response Plan will be prepared and submitted as a component of the annual report for that indicator. The Management Response Plan will be updated each year to document the investigation and results, and to describe the status of past exceedances, report on any new exceedances, and describe mitigative actions considered, implemented, and evaluated for success. If trends are on a sharp trajectory, the Management Response Plan may need to be updated more regularly (e.g., every two or three months) and will be shared with the AER and the SC as updated. Effectiveness of trigger levels to appropriately trigger a management response when needed will be re-evaluated approximately every three years, and triggers will be redefined as needed. When special studies are needed to evaluate the success of mitigation actions, details will be included in the Management Response Plan.

Collection of additional pre-mining baseline data within the Baseline Tier will commence in 2022. Ditching and draining in the MLWC watershed is planned to begin in 2025 and monitoring under the Surveillance Tier will start at that time. The monitoring frequency for each component of the effects monitoring program under each monitoring tier is summarized in Section 7.2.2 and additional details are provided in Section 7.3.

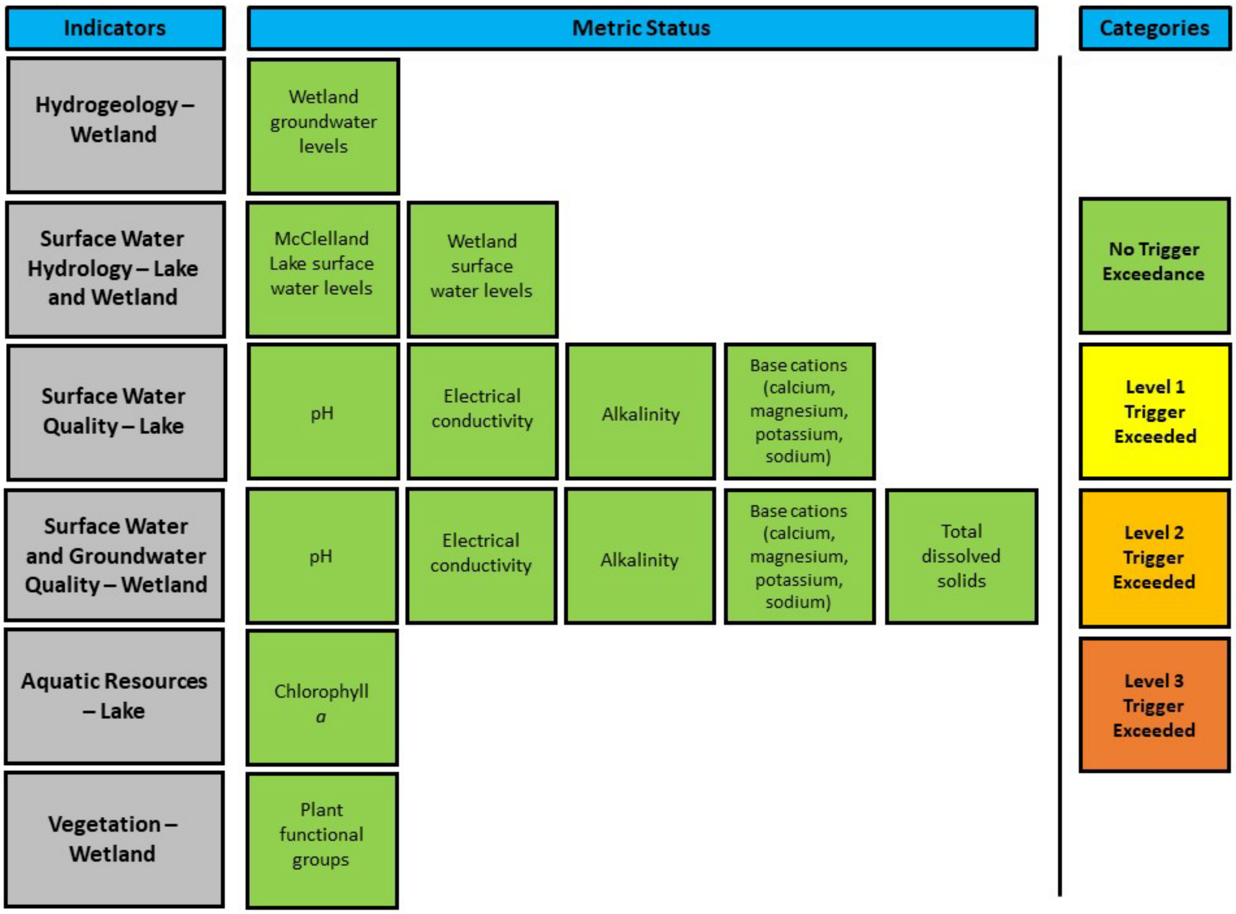


Figure 7.4-1: Example Figure Showing Status for Each Metric

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ABBREVIATIONS, ACRONYMS, AND UNITS

Abbreviations and Acronyms

Abbreviation/Acronym	Definition
AER	Alberta Energy Regulator
ALWC	Audet Lake Wetland Complex
BACI	before-after-control-impact
ca.	circa
CCME	Canadian Council of Ministers of the Environment
COSIA	Canada's Oil Sands Innovation Alliance
e.g.,	for example
ESCT	environmental, social, cultural, and traditional economic values and land use
Fort Hills Project	Fort Hills Oil Sands Project
FHEC	Fort Hills Energy Corporation
FHUC	Fort Hills Upland Complex
GGWC	Gipsy Gordon Wetland Complex
GNWT	Gwich'in Land and Water Board
i.e.,	that is
ITK	Indigenous Traditional Knowledge
MLWC	McClelland Lake Wetland Complex
MRV	measured range of variability
MVLWB	Mackenzie Valley Land and Water Board
NOP	North Outwash Plain
OP	Operational Plan
RTK-GPS	real time kinematic global positioning systems
SC	Sustainability Committee
TBD	to be determined
WL	water level
WLWB	Wek'èezhìi Land and Water Board

Units

Unit	Definition
%	percent
masl	metres above seal level
m/m	metres per metre
µS/cm	microsiemens per centimetre