5 SUMMARY OF ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

5.1.1 HYDROLOGY

SURFACE WATER REGIME

Drainage for Peatland No. 6 is planned in a way to maintain and comply as much as possible with natural flow directions and contributions to the local streams. Upon completion of the ditch network, approximately 104.3 ha and 72.2 ha of peatland will drain towards Black River and Bay de Vin River watersheds respectively compared to 124.5 ha and 52.0 ha before drainage. The variation in the aerial extent of peatland located within one watershed or the other as a result of peat drainage will, therefore, be equal to -16.2% and 38.8% respectively for Black River and Bay de Vin River, with respect to natural conditions. When considering the entire watersheds extent, drainage of Peatland No. 6 will result in a variation of -0.07% and 0.07% of their respective natural area. The difference in water input from Peatland No. 6 to the two streams will thus be insignificant.

Hydrological water budget of Peatland No. 6 was carried out to quantify potential changes to naturally occurring water fluxes. Monthly runoff was estimated using the method of Thornthwaite (1948), which allows calculation of potential and actual evapotranspiration based on climatic data and latitudinal location. The difference between precipitation and actual evapotranspiration is a surplus that is distributed between surface runoff and peat water table recharge.

Quantification of potential evapotranspiration (PET) in undisturbed conditions yielded a value of 545 mm/y. Validation of this figure was performed using reference evapotranspiration (ET) data computed by Xing *et al*. (2008) for conditions prevailing in Fredericton and adjusted for a time-varying crop coefficient reproducing the seasonal stages in Sphagnum growth. The latter method yielded a PET of 582 mm/y over an undisturbed New Brunswick peatland. Close conformity between the two results validated the use of the Thornthwaite method.

Average yearly precipitation ranges at about 1,072 mm. It appears that actual ET in undisturbed conditions would be close or equal to PET since water availability is generally not a limiting factor for a maritime bog. As such, there is a net natural water output of approximately 525 mm/y to the local watersheds. Water output would essentially take the form of subsurface acrotelm flow from the peatland toward its periphery. Some surface runoff oriented in the same directions could as well take place on a time-specific and point-specific basis.

Water budget for disturbed conditions considered a maximum readily available soil water supply of 225 mm for the peat deposits, in accordance with the storage capacity of peat present in the area. As the method of Thornthwaite (1948) does not take into account the influence of frozen conditions and storage of water in the form of snow on infiltration capacity and delayed runoff response related to spring snowmelt, minor modifications were applied to the computed runoff in order to represent monthly runoff fluctuations and timing in a more realistic manner. As such, integral (100%) non-delayed surface runoff was considered for rainfall recorded between December and March, in accordance with observations presented in Gemtec Limited (1994). In addition, snow storage depletion and subsequent contribution to runoff were modeled to reproduce the spring freshet timing and evolution of nearby Southwest Miramichi River, based on hydrological data recorded at hydrometric station 01BO001 at Blackville (Environment Canada, 2021b).

Field measurements carried out by Gemtec Limited (1991) in Peatland No. 509 showed that equivalent surface runoff coefficients with respect to incident rainfall were systematically lower than 0.2. Nevertheless, a runoff coefficient of 0.3 was used to evaluate the surface runoff discharge from the bogs during harvesting phases, to yield more conservative estimates of the total surface runoff outflow to the surrounding terrain.

The estimated monthly runoff pattern from Peatland No. 6 upon reaching its full development is presented in Figure 5-1. Runoff quantities are also presented in the form of specific runoff per unit hectare of mined peatland.

Water budget assessment for both natural (undisturbed) and developed (disturbed) conditions shows that total yearly output of water from the bog would remain more or less the same. This is because peatland drainage should have little effect on the actual evapotranspiration losses. Indeed, water available for evapotranspiration is the water that remains stored within the peat once infiltrated water has drained away freely.

Vegetation cover removal upon field preparation will result in increased surface runoff, and thus direct water losses, under important precipitation events and precipitation events taking place in previously wet conditions. However, this should have only limited effect on water availability for evapotranspiration, as water storage capacity of peat will be significantly enhanced by field drainage. As such, infiltration under low-to-average rainfall will replenish water stocks available for evapotranspiration and offset the effects of water losses via surface runoff. Vegetation cover removal will also reduce potential transpiration to about zero. On the other hand, potential evaporation is expected to increase because of the ground's reduced albedo and increased exposure to winds. Antagonistic hydrological consequences of surface modifications in relation with development activities should thus have a limited impact on actual global evapotranspiration at the field scale.

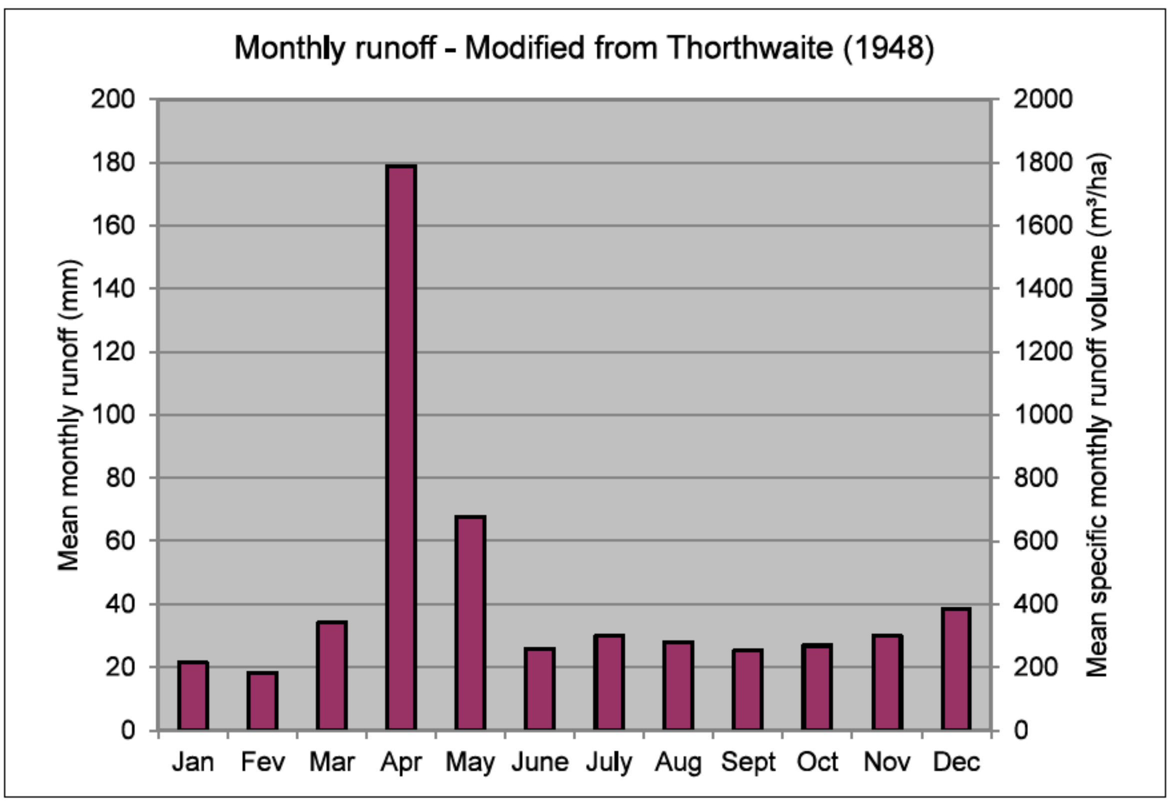

Figure 5-1 **Estimated Monthly Runoff in Harvest Areas for Peatland No. 6**

Ditching will affect the rate and timing at which water drains away from the bog. Water discharge at the network outlets will initiate infiltration, subsurface hypodermic flow and overland flow, the latter decreasing as water will move away from the release points until becoming non-existent. Hence drained water will essentially be reintegrated in the natural subsurface flow system. Drainage network outlets will be installed at a minimum distance of 50 m from the nearest watercourse to prevent runoff from reaching the natural surface drainage network.

No drainage water or surface runoff from Peatland No. 6 harvest fields will discharge directly to Black River. Natural hydrological regime of the river will thus be maintained, and no significant modification is expected on the intensity or timing of the spring freshet or peak flows in response to rainfall events. Consequently, peat harvesting within the Black River watershed will have no significant impact on naturally occurring erosion and sedimentation processes within Black River or its tributaries.

No drainage water or surface runoff from Peatland No. 6 will discharge directly in the Bay du Vin River. Indeed, all network outlets will be located at least 50 m away from the nearest tributary. No significant impact is expected regarding the intensity or timing of the spring freshet or peak flows in response to rainfall events. Consequently, peat harvesting within the Bay du Vin River watershed will have no significant impact on naturally occurring erosion and sedimentation processes within Bay du Vin River or its tributaries.

The construction of bog roads will not require crossing existing watercourses. Around Peatland No. 6, the use of existing forest roads will be privileged, but a portion of the access road that will be constructed will cross Vandy Brook. A culvert will be installed in compliance with the *Guidelines for Roads and Watercourse Crossings* (Natural Resources, 2004) to ensure stream discharge.

SURFACE WATER QUALITY

Drainage water and surface runoff originating from peatland developments can have elevated suspended particles (solids) content. In addition, they will likely exhibit a relative acidity, especially for drainage water.

All harvest fields of Peatland No. 6 will drain to the ditch network discharging into sedimentation ponds, where the bulk of the transported suspended solids (essentially peat particles) will be able to settle. Subsequent discharge from sedimentation ponds will take the form of overland flow to adjacent undisturbed low-lying vegetated lands, which will allow the settling of residual peat particles. This technique has proven to be efficient at limiting the impact on water quality (Thibault, 1998). It has been implemented and tested at many harvested peatlands in New Brunswick.

The combination of the two suspended solids management measures will ensure efficient peat particles interception. Considering the relatively flat topography down-gradient from the final release points and the space between such points and the nearest tributary of Black River or Bay du Vin River (≥ 1 km for ponds 1 and 2 (Black River watershed), ≥ 50 m for pond 3 (Bay du Vin River watershed)), no significant discharge of suspended solids to the local rivers or their tributaries is expected.

Peat drainage water released to lands surrounding Peatland No. 6 harvest fields will display a high acidity. Arsenic, aluminum and iron concentrations of peat drainage water may also be above CCME criteria for freshwater aquatic life protection. High acidity will mostly occur during the initial drainage phase. The pH of water discharging from the peatland will subsequently increase as the relative contribution of water initially stored in the peat deposits to the overall discharge decreases, and as a result of enhanced surface runoff and more rapid peat drainage in response to rainfall. Exposure of underlying mineral soil or more alkaline peat will also contribute in progressively increasing the pH of water discharging from the peatland. As the discharging water becomes less acidic, aluminum and iron concentrations will tend to decrease (Shotyk, 1986).

A similar tendency is expected for arsenic whose presence in peat originates from airborne deposition (Shotyk *et al.*, 1996). On the other hand, phosphorus concentrations in discharging water will tend to increase due to the acceleration of organic matter decomposition as a result of peat field drainage (Thibault, 1998).

MITIGATION MEASURES FOR SURFACE WATER

All drainage water from the developed area will be directed to sedimentation ponds for treatment before being discharged to the environment or directed to low-lying undisturbed land to be diffused as overland flow. In all cases, both measures (sedimentation pond + diffuse overland flow) will be used. No water discharge will occur within 50 m of a tributary of Black River or Bay du Vin River ensuring adequate filtration of drainage water.

As a result of the particle settlement that will take place inside sedimentation ponds, these structures will actively contribute to the reduction of suspended peat content in discharge water. In addition, their outlets will be designed and built in a way that induces diffuse water flow through the existing vegetation, upon water discharge. Temporary retention of water inside ponds will also have a positive effect on water flow at the drainage subnetworks outlets, as it dampers peak flows and allows a more uniform water discharge over time, regarding magnitude.

Studies carried out in New Brunswick showed that sedimentation ponds and diffuse overland discharge contribute to both controlling flows at the sedimentation pond outlets downstream of the drainage network and improving the quality of discharge water (Gemtec Limited, 1993). According to the guidelines for peat mining operations (Thibault, 1998), diffuse overland flow is more efficient than sedimentation ponds for reducing sediment load in drainage water.

Theriault & Hachey proposes combining the two methods in all areas where drainage water may eventually reach a downstream brook. All in all, 100% of Peatland No. 6's area will drain toward outlets where both mitigation methods are implemented.

Theriault & Hachey will regularly inspect ponds and outlets to ensure that they are in good order and functioning properly. In the event that flow channels form at the outlets, mitigation measures will be implemented to prevent or correct any apparent erosion process. All ditches and all sedimentation ponds will be cleaned of peat at the end of each harvesting season, or whenever required.

Water quality at discharge points will be the subject of regular monitoring, starting upon the beginning of construction and fields opening, and taking place until the restoration phase. Environmental monitoring will include analysis of water quality at selected drainage network outlets, including sedimentation pond outlets (see Section 5.4 Monitoring Program).

Progressive opening of the harvest fields also represents another mitigation measure, as it limits the area under harvesting to a minimum, as well as the ensuing effects.

Mitigation measures primarily related to surface water flow include progressive restoration of the harvest fields, once harvesting will be completed in a given area. This will allow the restoration of the natural hydrological regime of the peat fields, and thus eliminate most of the impacts on peatland surface water flow in the short term. Revegetation of the former harvest fields will contribute to restoring the natural hydrological regime since a large percentage of water is lost through evapotranspiration in peatlands. It is estimated that the acrotelm may rebuild in 17 years following Sphagnum Revegetation, thus returning to natural bog water level fluctuations (McCarter and Price, 2013; Lucchese, *et al.*, 2010). Creation of open water bodies and dikes to retain water on site and raise the water table regulates surface runoff, restores the water storage capacity of the peat, and improves water quality.

A series of mitigation measures aimed at reducing impacts of access road construction will be implemented based on the *Guidelines for Road and Watercourse Crossings* (Natural Resources, 2004). Such measures target preventing erosion and sediment control. For instance, existing vegetation will be protected, silt fences and straw bales will be used to trap sediment, and geotextile will be used to prevent stream banks erosion.

5.1.2 HYDROGEOLOGY

GROUNDWATER REGIME

The two types of groundwater are considered:

- Groundwater of the local aquifer, which is contained within the Paleozoic bedrock.
- Perched groundwater contained in the peat deposits.

The hydrogeological interactions between the peat deposits and the underlying formations, including the Paleozoic bedrock, are low. Therefore, no significant impact is expected on the local aquifer as a result of the proposed peat development expansion. No significant impact on the availability of groundwater for local down-gradient users is expected. No impact is expected on groundwater availability for local users installed up-gradient from the peatland.

Ditching and drainage activities will result in the lowering of the water table in the harvested area. The lowering of the water table will take place during the construction phase and will be kept at a locally low level throughout the operation phase. The water table drop will not extend more than about 25 to 50 m beyond the harvested area (Landry & Rochefort, 2012) as most of the peat deposit (catotelm) has a low hydraulic conductivity. A slight local rise in the level of the surficial water table is expected at the sedimentation ponds release points due to greater infiltration resulting from increased water availability.

The 50 cm layer of peat that will be left after peat harvesting has ended will remain saturated and will help maintain a high water table in the harvested sites. The progressive decommissioning will lead to a recovery of the perched groundwater as ditches are blocked, and open water bodies are created. It is expected that residual impact on peat deposits groundwater will be low.

GROUNDWATER QUALITY

Peat harvesting does not involve the use of chemicals or other hazardous materials except for petroleum products for equipment. Water quality in the perched (peat) aquifer could be potentially affected by accidental petroleum spills during the construction and operation phases. The spatial extent of the impact would, however, be point-specific. Implementation of emergency response actions would allow efficient containment before appropriate clean-up, and restoration procedures would further mitigate the associated negative impacts (See Environmental Protection Plan (EPP) at Appendix I). Moreover, peat has the property of absorbing oil and other petroleum products, and it is used to clean up oil spills. Hence, no chemicals or other hazardous materials may be released into the surrounding environment.

No impact is expected on water quality in the bedrock aquifer. Hence, no alteration to the quality of groundwater that may be utilized as potable water supply in nearby domestic wells is expected.

MITIGATION MEASURES FOR GROUNDWATER

Drainage and harvesting will only affect the upper portion of the peat deposits. The residual peat layer that will remain in place after the end of operations will remain saturated, and a superficial water table will be maintained in the harvest areas. Progressive restoration will induce a rise of this water table, as the ditches are blocked, and areas of open water are created. It is expected that the residual impact will be low.

Operations of petroleum products transfer and handling will be executed away from any watercourse and with dedicated equipment aimed at adequately preventing and managing any spill. If an accidental spill occurs outside of these areas, the execution of emergency response procedures would ensure that it is confined adequately and swiftly (Appendix I). Appropriate cleaning and remediation measures will then further mitigate the associated negative impacts. Consequently, no chemical or hazardous product will be released to the surrounding environment.

5.1.3 FLORA

IMPACT

Peat field preparation involves the clearing of trees and peatland vegetation from harvest areas and bog roads that result in an important impact at the site level. Peatland No. 6 is a typical bog of the region 2B *sensu* Keys and Henderson (1987) regarding plant communities that are dominated by open ombrotrophic vegetation. These habitats and plant communities are not threatened by the project locally or regionally since they are also present at the bog margin and in conservation areas, as well as in other peatlands in the area. Consequently, no loss of exceptional habitat is expected. Part of these plants will be used as donor material for the restoration of closed fields. None of the three rare species found in Peatland No. 6 are listed under provincial or federal Species at Risk (SAR) legislation (Table 4-4). Cloudberry was found in an area that will not be developed and be kept for conservation. That species should not be impacted by the project. Russet Cottongrass was found at the southern margin of the peatland near the limit of the area that will be developed. It is not known if that population will be affected or not, but that species was also recently found in other peatlands of the coastal region (WSP, 2016) and a recent change of the status of that species suggests that it is secure as it is also the case for Cloudberry (see Section 4.2.1). The White Fringed Orchid was observed close to bog pools in the central area of the peatland that will be developed, and it will disappear.

MITIGATION MEASURES

The reclamation plan described in Section 3.5.5 represents the main mitigation measure regarding flora, plant communities and habitat. The long-term goal of the reclamation plan is to restore wetland ecosystems currently present in the area. It includes three options that are Sphagnum Revegetation, Forest Habitat and Open Water, which address specific conditions anticipated at the cessation of peat harvesting. In the short term, specific objectives of the three reclamation options are to re-establish a plant cover and to restore the hydrological regime. Meeting these two objectives should eliminate most impacts of peat harvesting on flora and vegetation.

In all cases, the reclamation plan will lead to the re-establishment of peatland plant communities as well as the habitat diversity that already exists locally:

- Sphagnum Revegetation corresponds to typical peatland plant communities such as open areas.
- Forest habitats are found at the bog margin.
- Open Water should lead to the creation of bog ponds that are numerous in the peatland. Bog ponds are characterized by floating mats and specific plant communities, and are considered as biodiversity hot spots.

Methods used for Sphagnum Revegetation and Forest Habitat have been applied for years in New Brunswick, and they return a high success rate. Recent research demonstrated that the Moss Layer Transfer Technique ensures the re-establishment of bog plant communities and more than 80% of peatland species within ten years (Poulin *et al.*, 2013; Hugron *et al*., 2020). Tree plantation in areas unsuitable for Sphagnum Revegetation will create forest stands that may evolve toward laggs that are transitional habitats between peatland and upland and that contribute to conserving peatland integrity. In the case of pond creation, approaches are being developed and it is expected that successful restoration methods for bog ponds will be available at time of reclamation and will improve the ecological value of created ponds. The best available techniques will be applied at time of reclamation works.

Theriault & Hachey will rehabilitate peat fields within three years following cessation of peat harvesting when possible. Such progressive reclamation will accelerate the return of peatland plant communities and habitat.

Conservation areas and buffer zones will also be preserved within and around the peatland. A total of 125 ha will remain at their natural state that includes zones protected by Theriault & Hachey and CCA No. 0683, borrow areas, and areas that will not be developed at the margin of the bog. CCA No. 0683 comprises a large peatland area around Rosaireville Lake that will be protected by Theriault & Hachey even if the CCA does not receive its conservation status.

These natural areas include diverse habitats such as open bogs, forested wetlands, ponds and laggs. The areas that will remain untouched will ensure the presence of the different habitats all along the project and will serve as a source of seeds and propagules that will help the revegetation process.

Based on the anticipated initial impact and the proposed mitigation measures, it is estimated that the residual impact of the project on vegetation and rare plant species will be low.

5.1.4 TERRESTRIAL WILDLIFE

IMPACT

Peat field preparation will disturb wildlife and result in a loss of habitat and disturbance of mammals, birds and herpetofauna at the site level. Since the habitat types that will be affected are well represented in other peatlands locally, there will be no loss of exceptional habitat and the impact can be considered as a temporary contraction of habitat during the lifespan of peat harvesting operation estimated at 50 years. Undeveloped areas, including the CCA No. 0683, will serve as refugee for wildlife and favor the return of wildlife species following reclamation as do natural bog remnants at the periphery of harvested areas (Mazerolle *et al.*, 2001). The conservation of two large water bodies will maintain habitat for aquatic species (including insects) and bird species that use ponds for staging on an occasional basis. The passage of migratory bird species in spring and fall corresponds to periods of low intensity of harvesting operation. Consequently, the potential impact on these species and habitats should be low.

The impact will be temporary because the site will be reclaimed following peat harvesting. Reclamation usually begins by fields located at the margin of a peatland where peat is shallower as it is the case for Peatland No. 6. These reclaimed fields will progressively increase available habitat that can be colonized by wildlife living in adjacent natural areas and buffer zones.

The selected mitigation measures will facilitate the reclamation of lost habitat. The surrounding natural and protected areas such as the Black River conservation area, 14 km east of Peatland No. 6, and the Kouchibouguac National Park located to the east of the Black River conservation area, ensure the maintenance of large areas of wetlands for wildlife in the region. Their presence will facilitate recolonization of the site after reclamation.

SPECIAL STATUS SPECIES

Seven wildlife species with a legal protection status were identified within a radius of 5 km from the center of Peatland No. 6 by the ACCDC. None of these species counts ombrotrophic peatlands among its preferred habitats. They are all avian species of which only two, the Olive-sided Flycatcher and the Canada Warbler, can frequent wetlands. These two bird species can use open areas such as open bog, but they prefer forested habitats with openings or disturbed forest with a dense layer of shrubs or regeneration for the Olive-sided Flycatcher, and mixed conifer and deciduous forest often near water for the Canada Warbler.

During the bird surveys completed by WSP, the only SAR species observed near Peatland No. 6, or within a 400 m radius from the survey points, was the Olive-sided Flycatcher. The species was observed at a station located on the access road to the west of Peatland No. 6 (Appendix G). Its singing was heard at a distance of approximately 120 m from the station. The habitat surrounding the station is predominately mid-aged coniferous forest, with a dense understory, a habitat deemed unsuitable for the Olive-sided Flycatcher which prefers transitional and semi-open habitats for nesting. During the plant survey, two Common Nighthawks were also seen flying 500 m east of the project boundary, and another Common Nighthawk was heard near the southern border of the project.

Considering the habitat preference of the Olive-sided Flycatcher, the development of Peatland No. 6 will not have a direct effect on the habitat of these species and the impact should be negligible.

MITIGATION MEASURES

The implementation of the reclamation plan represents the main mitigation measure in regard to wildlife. The return of typical bog plant communities and ponds will restore wildlife habitats that are used by mammals, birds and herpetofauna on an occasional basis. The conservation of about 125 ha of bog habitat within the limits of Peatland No. 6 includes open water areas that can be used by many bird species. The peatland lies in a region that is largely undeveloped and the presence of natural peatlands and other wetlands in the surrounding area is sufficient to maintain the wildlife population locally, which will subsequently recolonize the peatlands during the reclamation process.

Theriault & Hachey will abide by the Migratory Birds Convention Act (MBCA) and the Fish and Wildlife Act that protect most bird species in Canada. Under Section 6 of the Migratory Birds Regulation, no person shall hunt, disturb, destroy or take a nest or egg of a migratory bird, or be in possession of a live migratory bird, or its carcass, skin, nest or egg. Development operations will be conducted outside the nesting season (Mid-April to late August) as much as possible to limit impacts on bird species. If activities involving vegetation clearing must be performed outside that period, a nest survey will be performed by an ornithologist, or other qualified professionals, in order to identify any active nests that may exist in the work area. Further protection measures for wildlife are presented in the Environmental Protection Plan (Appendix I).

Based on the anticipated initial impact and the proposed mitigation measures, it is estimated that the impact of the project on wildlife and rare wildlife species will be low.

Any observation of special status wildlife species will be reported to the DELG.

5.1.5 AQUATIC WILDLIFE

IMPACT

Evaluating the impacts of peat harvesting on watercourses located downstream is essential to the implementation of adequate mitigation measures. Although few studies exist to support that claim, peat harvesting can lead to a temporary decrease of fish abundance in downstream watercourses during and shortly after harvesting operations (Clément *et al*., 2009). The main source of impact to aquatic wildlife comes from peat particles that are released into the environment either to the atmosphere or water. These emissions may have an influence on the water quality downstream of Peatland No. 6. Peatland drainage ditches are known to deliver suspended sediments downstream, despite the use of sedimentation basins (Clément *et al.*, 2009; St-Hilaire *et al.*¸ 2006). Peat harvesting operations can also influence water quality by inducing higher concentration of total organic carbon and phosphorus, and by favoring acidification. Moreover, suspended solids can be a vehicle for many contaminants as well as heavy metals deposited in the environment, and they can potentially alter physical and chemical characteristics (Ouellet *et al*., 2006). Bioaccumulation of some metals, such as mercury, has been associated with dissolved organic carbon which could be related to the discharge of dissolved organic matter from bogs into the watershed (French *et al*., 1999). However, studies conducted in the Richibucto River area (New Brunswick) concluded that although an elevated level of mercury is present in peat particles, bioaccumulation of mercury in the aquatic biota does not necessarily occur (Surette *et al*., 2002). The increase in suspended solids, sediments and other elements may have several impacts for the aquatic biota, but there are few studies on the impacts of peat harvesting on aquatic organisms (Kreutzweiser *et al*. 2013).

It was not deemed necessary by the DELG to do fish surveys due to the lack of watercourses in Peatland No. 6 and the surrounding area.

MITIGATION MEASURES

Three sets of sedimentation ponds will be established at the outlet of the drainage network (Table 3-1). Discharge of water from the sedimentation ponds will take place in the form of a diffuse overland flow through the vegetation of the surrounding peatland surfaces, thus creating an additional filtration process to the sedimentation system. Diffuse overland flow is a very efficient method for filtering drainage waters before they reach a receiving stream (Thibault, 1998). Moreover, drainage water outlets will also be more than 50 m away from any watercourse (> 1,000 m in the case of Black River). This will allow for the suspended sediments and other peat particles and elements resulting from peat harvesting to settle down or dilute before reaching receiving watercourses. Peat harvesting will also be limited in the presence of strong winds and stockpiles will be covered with tarps to limit the emission of peat particles into the air which can be transported toward watercourses. Thus, the effect on the fish habitat downstream and other aquatic wildlife should be mitigated.

Considering the mitigation measures, the peat harvesting project should not affect the quality of surface water or that of receiving watercourses. The impact of the project on fish habitat downstream is expected to be negligible.

5.1.6 AIR QUALITY

IMPACT

Peat harvesting can be a source of airborne particles and may raise some concerns. Harrowing, vacuum harvesting, handling and transportation operations can all potentially result in the emission of peat particles into the air. The wind can transport these particles in the surrounding area where they will deposit and represent a nuisance, and affect human health and activities. Vegetation, wildlife and watercourses can also be affected by peat particle deposition.

The use of tractors and other vehicles is also a source of pollutants that can affect global air quality and represent a nuisance, locally, for nearby residents.

The remoteness of Peatland No. 6 limits the potential impact of airborne particles on the population. There is no settlement in a radius of 2 km from Peatland No. 6 in any direction. The dominant south wind during the harvest season will transport particle emissions to the north over an area that has no human settlement in a radius of 2 km.

MITIGATION MEASURES

The Canadian peat industry is aware of the potential impact of peat particle emissions and has developed measures that limit these emissions. Theriault & Hachey intends to apply the following measures to mitigate the impact of peat particles on air quality:

- Use of vacuum harvesters with equipment to reduce dust emission during the peat extraction. Most vacuum harvesters that are going to be used in this project are modified and the exhaust discharges air downward instead of upward thus reducing peat dust quantities that can be dispersed and reach the surroundings.
- Limit vehicle speed especially on access roads.
- Transportation of peat into tarp-covered trailers.
- Orientation of peat stockpiles in such a way to reduce their exposition to wind.
- Cover peat stockpiles with tarps.
- Limit peat harvesting and handling in windy conditions.
- Proper equipment maintenance.
- Where existing, leaving in place a treed buffer zone at least 50 m wide as a wind break to trap airborne peat particles.
- Not leaving in the field, after October 31, peat stockpiles that are not covered or do not have a crust.
- Re-establishing the vegetation cover as proposed in the reclamation plan (Section 3.5.5).

Theriault & Hachey has established management practices to limit emission of airborne peat particles and to prevent risk of fire. Wind speed is being monitored through Environment Canada website. If the wind gusts to more than 45 km/h, vacuum harvesting and harrowing should be suspended until the speed of wind drops below 35 km/h. If the wind speed is 50 km/h or higher, all peatland operations (vacuum harvesting, harrowing, loading and transport) should be suspended until the speed of wind drops below 35 km/h. These thresholds may be raised or lowered according to site conditions such as peat substrate humidity. For instance, constant 40 km winds increase the risk of fire and peat particle emissions following a dry period while 70 km winds are safe after a series of rainy days.

Given the absence of settlement in a radius of 2 km from the site, the wind direction in regard to settlements and the proposed mitigation measures, it is considered that the impact to off-site receptors should be minimal and localized.

5.1.7 OTHER IMPACTS

SOIL QUALITY

Peat harvesting developments have an impact on soils since the main activity consists in collecting the soil. Peatland soils are not comparable to mineral soils since they are made of more or less decomposed plant remnants, and they can regenerate over time. Nonetheless, peat harvesting has a limited impact on soil quality because a 50 cm layer of peat will be left in place at the cessation of activities. The remaining peat usually has bog chemical and physical properties that will help recreate bog conditions and allow the re-establishment of peatland plant communities (Gonzalez and Rochefort, 2014). The return of peatland vegetation will ensure the return of soil properties including carbon sequestration (Waddington *et al.*, 2010; Strack and Zuback, 2013; Nugent *et al*., 2018).

STORAGE AND HANDLING OF FUELS

Other potential impacts on soil quality arise almost exclusively from leakage or spills of petroleum products related to the use of mechanized equipment for peat harvesting. Peat harvesting does not involve the use of other chemical products. If a spill occurs, it will affect a limited area, especially because dry peat soils have the potential to absorb hydrocarbons rapidly, which prevents contaminants from spreading and potentially reaching watercourses. Furthermore, the only place that will be used for fuel storage is the service area.

Theriault & Hachey is in possession of a NB Petroleum Storage Tank Licence No. 7501 for the fuel tanks. Diesel fuel will be stored in a 9,090 L dual wall steel aboveground storage tank (AST), which will comply with CAN/ULC S601 standards. It will be installed near the equipment storage area, on a 20 cm thick concrete platform surrounded by 15 cm posts spaced every 60 cm. A portable double walled diesel fuel tank with a capacity of 2,420 L will also be on site. This tank will be equipped with an electric pump with a capacity of 90 L/min. Gasoline will be stored in 20 L portable containers and placed in a designated area, which will be chosen to create the least possible impact on the local environment. Installation, operation and maintenance of AST will follow the *Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products* of the CCME (2015). Other petroleum products will be stored in a designated area, as described above.

To prevent and limit the impacts of potential spills, contingency plans were elaborated in the EPP (Appendix I).

WORKER HEALTH AND SAFETY

Exposure to peat dust and the risk of work-related accidents are the main source of potential impacts on workers' health and safety. Theriault & Hachey intends to implement mitigation measures currently applied at its Baie-Sainte-Anne facility to reduce the likelihood of potential impacts, which includes dust control measures and use of tractors with air-conditioned cabs to reduce workers' exposure to peat dust. Appropriate safety equipment and training are also provided for workers. Theriault & Hachey adopted a safety policy and developed a complete Workplace Health and Safety Program in compliance WorkSafe NB requirements. Safety manuals are available at each workplace.

The site manager will keep records of all incidents and implement appropriate prevention measures. Hygiene and safety policy is applied at all time and in case of emergency.

CLIMATE

Peatlands play a role in global climate by sequestering large amounts of carbon in the form of plant debris that constitute the peat and that contribute to reducing the greenhouse effect (Chapman, 2002). It is estimated that peat accumulates at a rate less than 1 mm/y thus storing 68 $g/m^2/y$ of carbon (Rydin and Jeglum, 2006). At this rate, carbon sequestration in a single bog is negligible, but it becomes significant considering that peatlands cover 113 million hectares in Canada (Daigle and Gautreau-Daigle, 2001).

As of 2017, 31,675 ha corresponding to 0.03% of the total peatland area had been used by the Canadian peat industry, and a significant proportion of this area had been restored by the moss layer transfer technique (Canadian Sphagnum Peat Moss Association, 2017). At a local scale, the impact of the proposed project will be mitigated by the reclamation plan, which will resume carbon storage as peat (Sphagnum Revegetation) and wood (Forest Habitat). Research has shown that peatlands start sequestering carbon 12 to 14 years after Sphagnum restoration work thus re-establishing the carbon sink function (Nugent *et al.*, 2018). Moreover, the harvested peat may be used for tree production, since every year over 150,000,000 tree seedlings that contribute to Canada's reforestation efforts are grown in peat substrate. Hence, no significant impact is expected on global climate.

Theriault & Hachey is aware of the importance of climate change and that machinery is a source of greenhouse gas emission. It will ensure proper maintenance of equipment and implement best available measures and management practices that can lower its carbon footprint from this source.

Peatlands also influence microclimate conditions in two ways. Peatland vegetation determines the albedo and is responsible for evapotranspiration, two processes resulting in localized cooling effect (Rydin and Jeglum, 2006). Second, the typical hummock-hollow microtopography induces a non-uniform snow distribution. The resulting snow patches that remain longer in the spring also contribute to cooler temperatures locally. In turn, the microclimate influences the functions of the whole ecosystem that rely on the plant-hydrology equilibrium. The disappearance of trees and vegetation creates bare peat surfaces where diurnal temperature fluctuations increase. Wind speed may also become higher. Such change is site-specific and does not have repercussions outside the developed area. Re-establishment of peatland vegetation, tree cover and overall bog conditions following progressive reclamation will return harvested sites to pre-development conditions regarding microclimate and the residual impact is considered to be negligible.

ARCHAEOLOGY

Although no archaeological sites are reported for the project footprint (Appendix H) and no impact is expected, any worker who discovers archaeological object, paleontological object, burial object or human remains will notify the site manager at once, who will report the discovery to the Archaeological Services as soon as possible, stating the nature, location (GPS) and date of the discovery, and will also provide pictures of the discovery and its surroundings. In the case that peat is present, organic material will also be preserved with the archaeological resource. All work in progress within a perimeter of 15 m around the location of the discovery will stop at once until further instructions from the Archaeological Services. The site manager may extend the protection perimeter depending on the importance of the discovery.

FIRE

Drying caused by the drainage and surface preparation of the fields increases surface peat flammability. The contact between dry peat and hot parts (engine exhaust) of machinery that is used for peat harvesting and other operations may initiate fires whose proportion may vary widely according to prevailing wind speed and direction.

Hence, fire represents a risk for the peat resource and Theriault & Hachey will apply to the site area a series of measures aimed at reducing the risk of fire and controlling peat fires; that includes (Appendix I):

- Presence of a mobile water tank in the fields.
- Most harvesting equipment equipped with an extinguisher and portable water tank.
- Workers trained for firefighting.
- Close monitoring of harvesting operations in dry and windy conditions.
- Stopping of harvesting operations in extreme conditions.

Extreme conditions can be defined as a combination of three parameters that are favorable to fires. For instance, a prolonged warm and dry period combined with constant 40 km winds increase the risk of fire and its spreading. Temperature, precipitations and wind speed will be monitored through Environment Canada website.

NOISE

The noise generated by machinery and the diverse operations may potentially affect nearby residents. The conservation of treed buffer zones between the developed peatlands and nearest settlements should limit the impact of noise. Moreover, truck drivers are asked not to use Jacob brakes and harvesting operations will be restricted to the 7 am to 9 pm period. Considering the absence of settlements within a 2 km radius, the impact of noise is insignificant.

ROAD TRAFFIC

The development of Peatland No. 6 will increase traffic on public roads, especially on the roads used to transport harvested peat to the Theriault & Hachey Baie-Sainte-Anne facility for processing, namely Weldfield-Collette Road, Highway 11 and Route 117. The number of transports of peat harvested at Peatland No. 6 is estimated at 1,100 per year at full production that represents 8 transports per day, five days a week over a 6-month period (Table 3-3). The addition of 8 transports per day should not have a significant impact on current road traffic especially for Highway 11 and Route 117.

Increased traffic may have an impact on Weldfield-Collette Road and the management of that road may have an impact on the project. That road is a designated highway with a prescribed maximum Gross Vehicle Weight (GVW) of 43,500 kg. According to the Department of Transportation and Infrastructure (D. Matchett, personal communication) the gravel section of this road normally closes each spring due to breakup generally from mid-March through to early June. This situation should not affect Theriault & Hachey as peat truck loads do not exceed the maximum GVW. Since peat harvesting begins in May, peat shipment to Baie-Sainte-Anne may wait a few weeks until the road is open. Road traffic should still be increased due to workers moving on and off site.

5.2 CUMULATIVE IMPACT

Consideration of cumulative environmental effects is an essential component of any environmental impact assessment. Impacts from other human activities may combine and result in higher impact values than would otherwise be expected from an individual project. It is necessary to identify and put in place, from the initial phase of the project, all the mitigation measures to limit and avoid any potential effect on the environment. Cumulative environmental effects can be defined as changes to the environment as a result of an action combined with other past, present and future human actions. Human actions include both events, actions as well as projects and activities of an anthropogenic nature (Hegmann *et al*., 1999). This definition suggests that any effect linked to a given project may interfere, in time or in space, with the effects of another past, current or future project and thus generate additional direct or indirect consequences on the one or other of the components of the environment. A cumulative effects assessment can help to see the impacts of a project to a regional scale, instead of just considering the local effects of a project. Human activities in the area around Peatland No. 6 are restricted to forest management (logging) and peat harvesting.

PEATLAND FOOTPRINT

The development of Peatland No. 6 will add to two other harvested peatlands (peatlands Nos. 4 and 5) located in the area within a 10 km radius. Peatlands targeted by the peat industry consist of large peatlands and few of them remain in the region. Nonetheless, many smaller peatlands that present no interest should stay at their natural state around peatlands Nos. 4, 5 and 6, ensuring the preservation of bog habitats.

At a larger scale, the development of Peatland No. 6 is one of many peat harvesting projects in the Kouchibouguac Ecodistrict. Taking all these projects into consideration, peat harvesting lead to a regional decrease of peatland habitat. The presence of extensive peatlands in Kouchibouguac National Park and Black River PNA ensures the protection of these habitats. In New Brunswick, peat harvesting is considered the main activity impacting peatland. Peatlands in New Brunswick covers approximately 140,000 ha, 7% of which (10,000 ha) have already been mined for horticultural peat and 1,200 ha have been restored or reclaimed (E. Prystupa, personal communication). The development of Peatland No. 6 will further increase the regional footprint on peatland albeit temporarily since the site will be reclaimed once peat harvesting is completed.

HYDROGEOLOGICAL PROCESSES

Expansion of the drainage network and opening of new peat fields in Black River and Bay du Vin watersheds will induce further modifications to local surface and subsurface flow systems. The modifications anticipated with the proposed development project will mostly take place in zones located up gradient, or upstream, from the receiving streams or water bodies. The presence of an intact buffer zone between altered areas and their receiving watercourses, as well as the implementation of complementary mitigation measures, will essentially preserve the natural hydrological and hydrogeological processes taking place near or in these watercourses, following initial peat fields drainage. Negligible change to existing watersheds, and sedimentation ponds and diffuse overland flow for managing water discharge will lessen cumulative impacts associated with the proposed development project.

For the most part, anticipated hydrological impact of the proposed development will be limited in time and prevalent during initial field drainage. Since harvest field openings will be carried out in a progressive fashion, this impact will be moderate, and will mostly affect areas located at the peatland periphery. As mentioned previously, no significant impact is expected on the quality of surface or groundwater, as a consequence of the proposed project. Implementation of the mitigation measures presented in Section 5 will prevent quality degradation of the receiving waters. Consequently, peat harvesting operations in Peatland No. 6 will not have a significant incremental effect on eventual modifications to local water quality that could have occurred as a result of other developments.

FLORA AND FAUNA

No cumulative impacts on vegetation are anticipated since the plant communities that will be lost during peat mining will still be present in the conservation areas and other natural peatlands near Peatland No. 6. The presence of conservation areas and peatlands Nos. 1056 and 1057, both located within a 2 km radius (Map 5), will help maintaining a pool of diverse habitats for plants and wildlife. No cumulative impact is expected on rare plant species since no legally protected species are found on Peatland No. 6.

Cumulative impacts on wildlife are expected to be insignificant considering that a pool of peatland habitats present locally, including bog ponds, will remain untouched and that wildlife species use peatlands on a punctual basis. No wildlife species is restricted to this ecosystem. Moreover, of all animals, birds are considered among the best suited to adapt to spatial modifications to their habitat.

OTHERS

The main impacts of peat harvesting on air quality result from dust generation during the operation phase that may affect human activities, vegetation and water quality. The implementation of mitigation measures should maintain the potential cumulative effects to a low intensity. It is considered that the impact on air quality should not cumulate to that of the two other harvested peatlands located in the area given the distance of over 5 km between Peatland No. 6 and these sites.

Increased traffic represents a potential impact for public safety and quality of life for residents that has the possibility of generating cumulative impacts. It is estimated that the project will result in an increase of 8 transports per day, 5 days a week for 6 months, but the traffic caused by Sun Gro Horticulture Canada Ltd. peatlands Nos. 4 and 5 is not known and that impact cannot be quantified.

The cumulative impact on other components such as microclimate, fire, noise, soils and human health are expected to be negligible, mainly due to the seasonal nature of these impacts.

5.3 REVERSIBILITY OF IMPACTS

The proposed development project for Peatland No. 6 should not result in significant irreversible impacts on the environment after the implementation of the mitigation measures. The reclamation plan described in Section 3.5.5 represents the main mitigation measures to be implemented and is the principal factor that limits the impact of peat harvesting to a low value.

The goal of the reclamation plan is to restore harvested sites back to functional wetland ecosystems. Research has shown that a peatland vegetation cover can re-establish itself over the entire surface of a harvested peatland and the carbon storage function be restored within 12 to 14 years of the application of the Moss Layer Transfer Technique for Sphagnum regeneration (Poulin *et al.*, 2013; Waddington *et al.*, 2010; Strack and Zuback, 2013; Nugent *et al*., 2018). Hydrological conditions also recover within about 17 years (McCarter and Price, 2013; Lucchese, *et al.*, 2010). Consequently, the development of Peatland No. 6 should not result in irreversible impacts provided that appropriate mitigation measures are applied.

5.4 MONITORING PROGRAM

Theriault & Hachey proposes to develop a monitoring program that will meet the DELG requirements that will be detailed in the Approval to Operate. The monitoring program will include the collection and analysis of water samples from the outlets of sedimentation ponds on a regular basis or after a significant windy or rainy event. Samples will be analysed for total suspended solid (TSS) by a certified laboratory that operates in accordance with recognized standards for quality management systems. The monitoring program also includes the inspection of the ditches and sedimentation ponds. The monitoring and maintenance of these sediment control structures are described in Section 2.3.6 of the EPP (Appendix I).