3 THE PROJECT

3.1 PROJECT OVERVIEW

Peatland No. 6 is located on Crown land 15 km northeast of Rogersville and it covers 301 ha including 206 ha with over 1 m of peat depth (Maps 2 and 3). Theriault & Hachey, a New Brunswick based company with its headquarter located in Baie-Sainte-Anne, proposes to harvest peat on 176 ha of the 301-ha peatland area. The north-western part of the peatland, including Rosaireville Lake, will remain as conservation area. The bog will be accessed from Weldfield-Collette Road through a 4.07-km access road that will require existing forest road portions to be upgraded and new sections of roadway to be constructed. Standard peat harvesting methods, including drainage, harrowing, and harvesting peat with vacuum harvesters, will be used. Sedimentation ponds will ensure that water released at the outlet of the drainage network meets provincial standard. Harvested peat will not be processed on site, but transported by truck via Weldfield-Collette Road, Highway 11, and Route 117 to the Theriault & Hachey Baie-Sainte-Anne facility for processing (Map 1).

The site will be developed over a 9-year period, expected to start peat harvesting in 2023, with a life expectancy of the operation estimated to be 50 years. At full production, 450,000 bales (340 L) will be produced on average annually with 9 harvesters. These 176 ha are estimated to supply a total volume of 4,590,000 m^3, equivalent to about 14,500,000 bales (340 L) horticultural grade peat that will allow this harvesting operation a lifespan of around 50 years. The site will be restored progressively as harvesting is completed on the different sections. The project will create 23 seasonal jobs at the harvesting site and 19 fulltime jobs at the Baie-Sainte-Anne facilities once the peatland is in full operation.

3.2 PURPOSE AND RATIONALE FOR THE PROJECT

In 2015, following several years of poor harvest, unfavorable exchange rates and changing trends in the industry, Theriault & Hachey entered into a strategic partnership agreement with Les Tourbières Berger Ltée (hereafter "Berger"). Under this agreement Theriault & Hachey transferred its peatlands Nos. 324W and 302A lease rights to Berger. In exchange Theriault & Hachey can continue to harvest peat with the restriction to a base harvest amount of 750,000 bales per year. The agreement allows harvesting an additional 10,000 bales annually from 2015 to 2040, at which time it will be capped at 1,000,000 bales for the remainder of the 40-year term of the agreement. The harvest cap allows for a 25% buffer to compensate for possible subsequent poor harvest seasons.

In the first five years of this partnership the changes of ownership and management resulted in substantial sales growth. This precipitated the need for increasing demands of bulk peat and packaged peat products purchases from various other New Brunswick suppliers. These outside purchases have now reached a level of 33% of the total production.

To ensure the long-term profitability and growth of the business, the amount of peat purchased should be within a range of 20 to 25%, since outside peat is substantially more expensive than in-house production costs. As the company sales grow, Theriault & Hachey must ensure to increase the amount of peat produced in-house, while maintaining the quantity of outside peat supply. Additionally, there is instability and uncertainty with outside peat since it is purchased on the open market.

In March 2018, the Theriault & Hachey processing and packaging plant burned down. It was rapidly replaced by a newly constructed $10M facility that was completed in 2019. It currently operates at approximately 60% of its capacity. Additional volumes of raw peat are required to maximize the Theriault & Hachey investment in this facility.

Not only additional volumes, but good quality peat is required. Theriault & Hachey has been harvesting peat from its former peatlands Nos. 324W and 302A lease areas for decades. As a result, areas available with good quality peat, found in the upper layers of the peatlands, are rapidly declining, with the availability of medium and lower quality peat, found in the lower layers, increasing. Theriault & Hachey needs to gain access to newly to be developed areas with high grade fibric peat allowing it to blend these different types and grades of peat to reduce the effects of this decline, while maintaining and improving the quality requirements of finished products, especially for horticultural growing mix products, and to sustain its own peat resource base.

Developing Peatland No. 6 will allow the company to replace and rebuild its own production capacity and have a better control over its supply. Access for harvesting peat on Peatland No. 6, which will solely be used for the production of value-added horticultural growing mix products, will support continuous growth and viability for Theriault & Hachey in the future. It will help Theriault & Hachey, the leading supplier of New Brunswick peat products to Japan, to maintain this position. It will also strengthen the supply of growing mixes to export and domestic markets, while utilizing and transferring New Brunswick's peat resources to their fullest and increasing the economic growth of the region and the province.

3.3 PROJECT LOCATION

Peatland No. 6 is located in the Local Service District of Gleneg in the county of Northumberland, New Brunswick (Maps 1 and 6). The closest communities are Rosaireville 5 km to the south, St. Margarets 12 km to the northeast and Rogersville 15 km to the southwest. The nearest city is Miramichi located 20 km to the northwest. The site is accessible from Weldfield-Collette Road that links Highway 126 and Highway 11.

The peatland lies in an undeveloped area that is mostly used for forestry. Forest roads provide access to the bog area either from the west through Weldfield-Collette Road and the east via Highway 440.

3.4 PHYSICAL COMPONENTS AND DIMENSIONS OF THE PROJECT

Theriault & Hachey has developed a strong expertise in peatland management and peat processing over the years. Peatland No. 6 project will consist of standard peat operations using the pneumatic method (vacuum harvesting) to harvest the peat. The Project will require the following components (Map 2):

- A 4.07-km access road between Weldfield-Collette Road and the service area.
- 9 harvest sections covering a total of 176 ha.
- A drainage network including 3 outlets with sedimentation ponds.
- A 4-ha service area.
- 2.71 km of bog roads.

The peat will be processed at Theriault & Hachey Baie-Sainte-Anne processing plant.

According to Keys and Henderson (1987), Peatland No. 6 covers 301 ha including 206 ha with over 1 m of peat depth. The project will be restricted to an area of 176 ha that is considered harvestable out of the section with over 1 m of peat. The volume of horticultural grade peat in that area is estimated at 4.5 Mm^3.

Peatland No. 6 is located totally on Crown land. Theriault & Hachey proposes a lease area that covers 351 ha and includes the harvest area, the drainage network and its 3 outlets, and the service area. The northern section of the peatland that comprises Rosaireville Lake is within Candidate Conservation Area No. 0683 and is excluded from the proposed lease (Map 2).

The harvested area will be developed over a 9-year period at a rate of about 20 ha per year. Buffer zones will be left untouched around parcel boundaries, forested areas, undrained ponds and plant borrow zones for restoration.

The proposed drainage network will capture all the water flowing from the harvested fields and infrastructure (bog roads and service area). The water will be directed into sedimentation ponds or over low vegetated land areas in order to filter water before it reaches receiving watercourses.

3.5 DEVELOPMENT PLAN

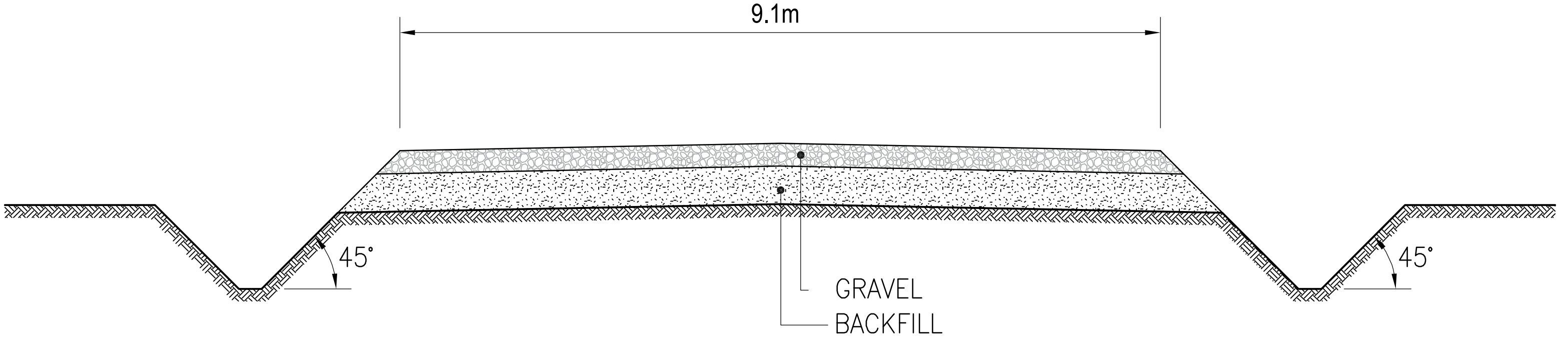
3.5.1 CONSTRUCTION PHASE

ACCESS ROAD

A 4.07-km access road will connect the service area and Peatland No. 6 to Welfield-Collette Road. It will be located entirely on Crown land. The road will use sections of an existing forest road that totalize 2.56 km and that will need to be upgraded. It will require the construction of two sections of 0.89 km and 0.62 km for a total of 1.51 km.

The access road will be constructed at first and will be submitted to a separate permitting process that includes Watercourse and Wetland Alteration permit. It will be upgraded and constructed in compliance with the *Guidelines for roads and watercourse crossings* (Natural Resources, 2004). The road will be 9.1 m wide and bordered by ditches about 5 m wide for a right of way of ±20 m (Figure 3-1). The ditches will have a slope of 45 degrees, and offtake ditches will direct runoff water toward vegetated areas on both sides of the road to avoid direct flow to watercourses. Trees and vegetation will be cleared. The merchantable timber will be offered to the local forestry contractors, and non-merchantable trees will be used for bog road construction. Theriault & Hachey will not remove any quarriable substance from the Crown land to build or upgrade the access road.

The road will cross one watercourse, Vandy Brook, in one of the constructed sections. The crossing will be a galvanized or concrete culvert of appropriate dimensions. It will be placed at the center of the watercourse about 15 cm below the gravel bed, on a 15-30 cm layer of gravel. Appropriate mitigation measures will be implemented to prevent erosion, and to prevent sediment from reaching watercourses.



Theriault & Hachey Peat Moss Peatland No. 6 Project

Figure 3-1
Access Road Cross-section

February 2022

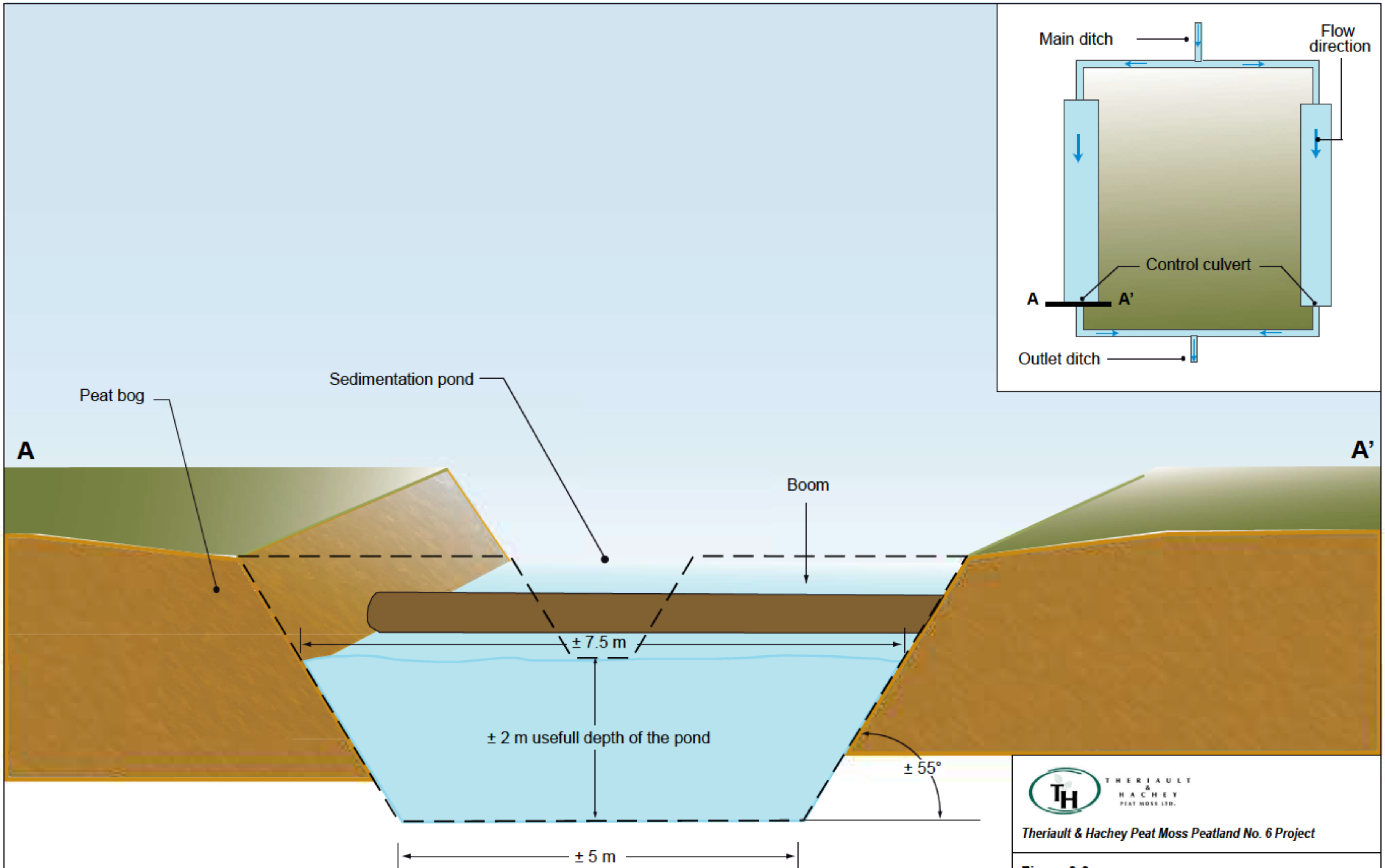
Designed by: F. Quinty
Drawn by: J.-M. Tremblay
Checked by: F. Quinty
File: 211_06686_00_EI_fig3-1_accessroad_wspq_220117.ai

DRAINAGE NETWORK

The drainage network of Peatland No. 6 will comprise main (collector) and secondary ditches, sedimentation ponds, and diffuse overland flow discharge outlets. The sequence of work will start with the construction of sedimentation ponds and overland flow discharge outlets. This will be followed by main ditches, and subsequently, secondary ditches. Sedimentation ponds of adequate size will be constructed to detain water from 3 drainage subnetworks (Thibault, 1998). Outline of the proposed drainage network is displayed on Map 2.

All drainage subnetworks will be equipped with sedimentation ponds at their downstream end that will trap suspended peat particles that could otherwise be released into the environment.

Constructing the sedimentation ponds in the initial stage of construction will ensure that high turbidity waters generated during ditch excavation and field opening are managed adequately. Each subnetwork will discharge to a specific pond or group of ponds. Sedimentation ponds will be located at the downstream periphery of peat fields. Technical characteristics of all ponds will comply with applicable guidelines (Thibault, 1998; Landry & Daigle, 2009). They will have an approximate 7.5 m width and 2 m depth. Figure 3-2 shows a schematic cross-section of a sedimentation pond. The respective length is determined in accordance with the drainage subnetwork area, in order to ensure a retention volume of 25 m^3 per hectare drained, without exceeding 90 m. Required pond volume will also be increased by 20% to take into account the fact that actual pond width decreases with depth since the sides will slope at an angle of approximately 55° (Landry & Daigle, 2009). As such, a pond of 7.5 m x 2 m x 90 m will allow treatment of 45 ha of peatland area. If the drained area exceeds 45 ha, additional sedimentation ponds need to be built in parallel or in a series fashion, depending on the terrain configuration, to guarantee an adequate volume for treatment. Table 3-1 presents the size of each sedimentation pond that will be constructed for Peatland No. 6.



Theriault & Hachey Peat Moss Peatland No. 6 Project

Figure 3-2
Schematic Cross-section of a Sedimentation Pond

February 2022

Designed by: F. Quinty
Drawn by: J.-M. Tremblay
Checked by: F. Quinty
File: 211_06686_00_EI_fig3-2_sedpond_wspq_220117.ai

Sedimentation ponds will be equipped with a web membrane destined to filter out coarser floating particles. The design of the sedimentation ponds will also include a closure mechanism to prevent water exit from each pond during maintenance. Where possible, discharge of water from the sedimentation ponds will take place in the form of a diffuse overland flow through the vegetation of the surrounding wetland 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). Water discharged at the outlets will mostly flow in a semi-radial, diverging fashion through the acrotelm[1] in a direction opposite to the harvesting areas. During snowmelt or intense rainfall events, discharge outflow will increase, thus inducing runoff over terrain surface. The progressive lateral spread of runoff will ensure that flow remains diffuse and transforms into subsurface flow through acrotelm some distance from the release point (outlet). The lateral spread will also result in a significant reduction of the velocity of flow. Once discharged, water will be available for evapotranspiration and further infiltration toward deeper portions of the peat deposits. Consequently, no significant surface runoff originating from the peatland should reach neighbouring streams, which are all located more than 30 m away, and generally more than hundreds of metres away from a discharge point. No significant modification of the hydrology and hydrological regime of the local streams is expected as a consequence of drainage water discharge.

Main (collector) ditches will run along the downstream edges of harvest areas to collect water from the secondary ditches and channel it toward sedimentation ponds of the corresponding subnetwork. They will be dug with an excavator that will unload the excavated peat over nearby harvest fields or over the surface bordering the ditch along segments that do not run next to any harvest field.

Excavated peat will be spread over the fields, where it may then be harvested or used for access road construction, depending on its grade. Excavated mineral material will be used to stabilize sedimentation pond banks, construct access roads or piled up for future use at the decommissioning phase. No fill will, however, be directly deposited over peat, to prevent mixing of the two and alteration of the peat fields. Main ditches will have a rectangular shape and a depth and width of respectively 2 m and 1.5 m.

Secondary ditches will be constructed parallel to each other and ±25 m apart, and run along each peat field. The secondary ditches will be dug with a V-ditcher pulled by a tractor, to a depth of approximately 1.5 m on current land surface. Width will reach 1.5 m at the ditch's crest, and walls will be sloped at an angle of about 65°. The use of a V-ditcher allows excavated peat to be directly spread over adjacent harvest fields. Two to three V-ditcher passes within the same ditch are required to obtain the desired depth and width.

[1] The acrotelm is the upper layer of a peat bog where the water table fluctuates. The catotelm is the underlying layer which is permanently saturated.

Table 3-1 Sedimentation Ponds Specification for Each Drainage Subnetwork

DRAINAGE SUBNETWORK Sedimentation Pond No. (see Map 2)	HARVEST AREA	DRAINED AREA (ha)	EFFECTIVE REQUIRED RETENTION VOLUME (m^3)	ACTUAL POND VOLUME - ADJUSTED 20% (m^3)	THEORETICAL LENGTH IF 1 POND (m)	ADJUSTED POND LENGTH ACCORDING TO THE NUMBER OF PONDS (m)	NUMBER OF PONDS REQUIRED (-)	POND WIDTH (m)	POND LENGHT (m)	LENGTH/ WIDTH RATIO (-)
1	1, 2 and 9	61.5	1,538	1,845	123	62	2	7.5	62	8.2
2	7 and 8	44	1,100	1,320	88	88	1	7.5	88	11.7
3	3, 4, 5 and 6	71	1,775	2,130	142	71	2	7.5	71	9.5

BOG ROADS

Internal bog roads include the roads that link the service area to peat harvest areas and will be used by equipment required to complete project activities (Map 2). Bog roads may be built on mineral material that could be present between the service area and the peat harvest areas. Within the peatland, construction of bog roads on organic soil will be completed using a base layer of non-commercial timber or woody debris collected during site preparation. In some cases, bog roads may require a layer of mineral material or gravel. In these cases, geotextile will be installed under the mineral material or gravel to prevent mixing with peat.

In the peat harvest area, the bog roads will be widened to allow temporary stockpiling of the harvested peat along bog roads before it is transferred to the service area. The bog roads and bordering stockpiling areas will be made of woody material removed during field preparation. No mineral material will be used.

PEAT FIELD PREPARATION

Peat field preparation consists of tree removal and dome-shaped contouring of peat fields to facilitate drainage. All merchantable timber will be offered to the licensee contractor for the area. All non-merchantable timber and shrubs will be mulched, and the debris used for bog road construction and to fill depressions in the peatland.

A profiler is used to create the dome-shaped peat field profiles by scraping and moving peat from the edges toward the center of fields. This dome-shaped profile allows adequate drainage and favors peat drying.

SERVICE AREA

The Project requires a service area of approximately 4 ha. It will be located on the west side of the peatland at the end of the access road (Map 2). The exact location and shape of the service area will be determined based on local conditions. Trees and vegetation will be cleared. The merchantable timber will be offered to the licensee contractor for the area, and non-merchantable trees will be used for bog road construction. If necessary, gravel or sand will be added. The site will be graded to ensure proper drainage.

A preliminary layout of the service area is presented in Figure 3-3. The service area will consist of a peat storage area of approximately 120 m x 50 m; a 100 m x 30 m parking area for harvesting equipment; a 25 m x 20 m parking area for employees; a service area for fuel storage and refuelling; a 12 m x 6 m service garage; and a 15 m x 3 m building that will house an office and employee facilities. Power will be provided by a generator.

A surface well will be installed to provide water. If the water meets the *Canadian Drinking Water Quality Guidelines*, it will be used as a source of potable water. Otherwise, Theriault & Hachey will supply bottled water to the employees. An appropriately designed septic / sewage system will be installed on site to service the facilities. This system will be installed by a licensed contractor and will be maintained and pumped out as required by an authorized local contractor.

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 Canadian Council of the Ministers of the Environment (CCME, 2015). Other petroleum products will be stored in a designated area, as described above.

A water reservoir, 15 m wide x 45 m long x 5 m deep, surrounded by an earthen berm will be constructed to serve as a source of water for fire prevention / fighting purposes.

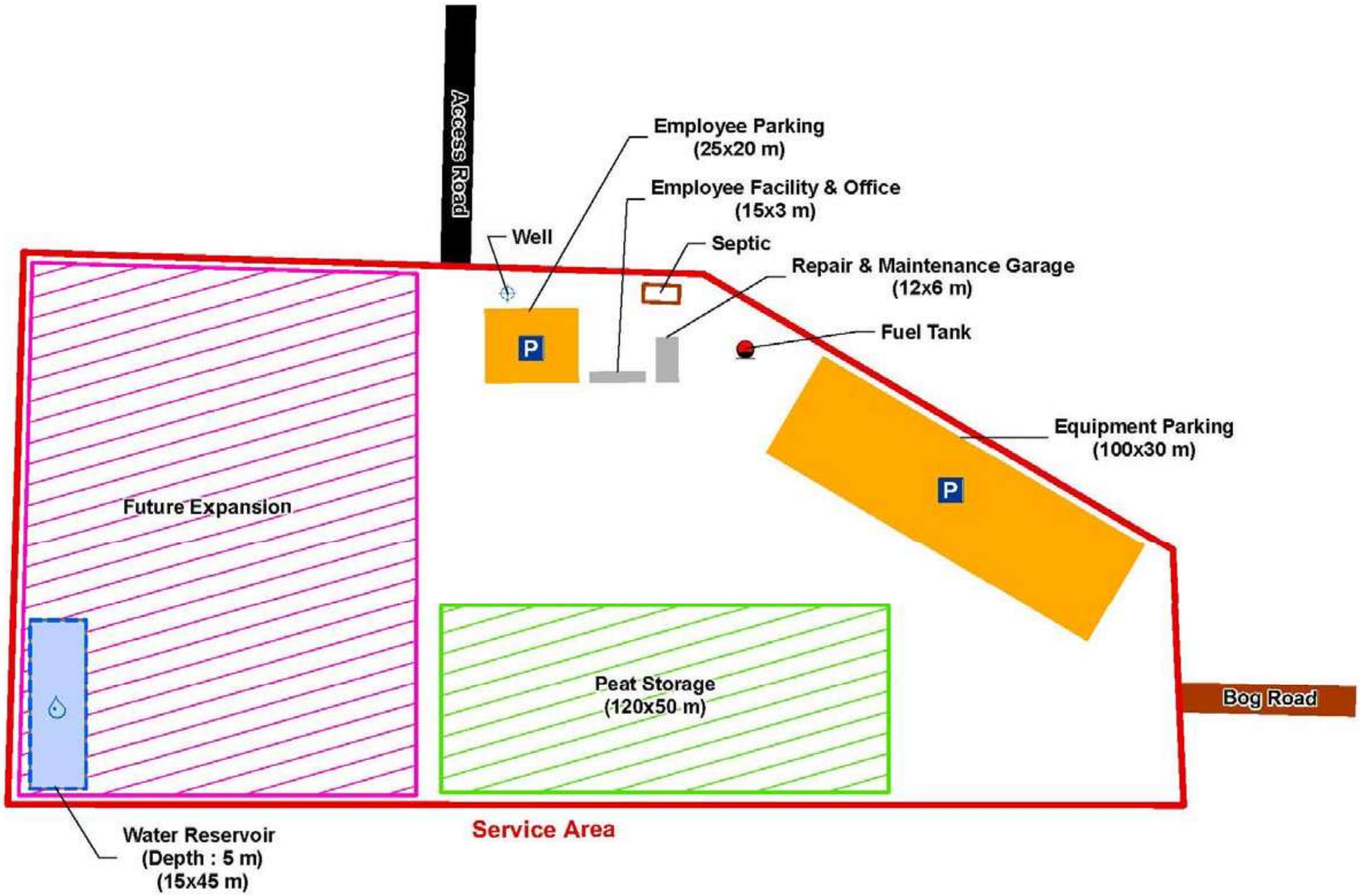


Figure 3-3 Preliminary Layout of the Service Area

3.5.2 OPERATION PHASE

The operation phase involves harrowing, harvesting, stockpiling, peat transportation, drainage, and maintenance.

HARROWING

Peat fields are first harrowed to a depth of approximately 15 cm using tooth rakes attached to tractors. This operation decompresses the undisturbed compacted peat and breaks it up into small chunks. Before harvesting can start, fields are again harrowed with other types of rakes to loosen up 2 to 4 cm of peat for drying.

HARVESTING

Harvesting may occur between April and November but is generally more frequent between June and September. Weather conditions represent the major constraint since peat must be harvested when it is dry. Harvesting operations will take place from sunrise to sunset, 7 days a week under appropriate weather peat conditions. It stops during rainfall and can start again after a period of two to three days after harrowing and when surface peat reaches the desired moisture content of 45-55%. The expected annual depth rate of harvesting is around 7 cm of peat which represents 700 m^3/ha. Once dry, the peat is collected using a method referred to as pneumatic harvesting, which alternates with harrowing. Theriault & Hachey will use standard two-headed vacuum harvesters equipped with dust collection systems installed underneath the harvester. Harvesters typically go up and down a field and dump the harvested peat into stockpiles along the bog road.

Harvesting and harrowing operations alternate all along the harvesting season.

STOCKPILING

As mentioned above, vacuum harvesters typically travel up and down a field and dump the harvested peat into stockpiles along the bog road. A front-end loader is used to stockpile this harvested peat into larger piles. It is also used to load peat from these field stockpiles into large trailers, which are then hauled to the stockpiling area within the service area. To maintain the quantity and quality of the harvested peat, the stockpiles are covered with large plastic tarps. This procedure prevents loss of peat by wind action or soaking by heavy rain. Covering the stockpiles also reduces the risk of peat particles being transported in the drainage network and/or outside the developed area.

TRANSPORTATION

There will be no on-site peat processing. Peat will be transported in bulk to the Theriault & Hachey Baie-Sainte-Anne processing plant using a highway tractor and tarp-covered, enclosed 16 m walking floor (self-unloading) trailer. Trucks will head north on Weldfield-Collette Road for 15.7 km, southeast on Highway 11 for 8 km, northeast on Highway 117 for 31 km, and south on Eel River Road and Chemin Thériault-Haché for another 5.6 km to reach the Baie-Sainte-Anne facilities (Map 1).

Peat will generally be transported daily. The number of shipments will vary, depending on the requirements of the Baie-Sainte-Anne processing plant. It is expected that 8 daily shipments will travel from Peatland No. 6 to the processing plant at full production (176 ha) based on a volume equivalent to 400 bales (340 L) per truck load over a six-month period 5 days per week. A larger number of shipments may be necessary during high demand periods. According to the development plan, the volume of harvested peat will diminish as parts of the peatland are depleted. Consequently, the number of shipments per year will decrease with time (see Section 3.5.4 and Table 3-3).

MAINTENANCE

In order to maintain a constant depth and effective drainage, accumulated debris in field and main ditches will be removed as needed. Maintenance will also be performed prior to closing the peatland for winter.

Peat field maintenance will include reshaping the dome-shaped fields using a leveler. Branches, roots, and other wood debris on the field surfaces will be collected with a special rake, hauled off and used for bog road maintenance. These operations will be conducted yearly, preferably in the fall after the harvesting season and prior to winter. However, any of these operations can be carried out when necessary.

SITE ACCESS CONTROL

Access to the site will be controlled by a gate at the entrance of the access road. The gate will be locked after work hours. Keys will be available to the local forestry district office to permit access to the site in the event of a forest fire, or other situations where access is required.

3.5.3 WATER MANAGEMENT DURING CONSTRUCTION AND OPERATION

PEAT DEPOSIT DRAINAGE

Water collected by the ditch network during construction will mostly originate from natural storage within peat porosity. Water will drain from the various fields in a progressive way, as the bottom of ditches is brought deeper and, consequently, as the local water table is gradually lowered. The occasional surface runoff will also reach the ditches following rainfall once secondary ditches are constructed.

A minor component of water inflow to the ditches will also occur as direct rainfall over their surface. In areas where a ditch will intersect a pond, stagnant water will also be drained (see next section). Drainage water and surface runoff collected from secondary ditches will flow gravitationally toward the main ditches and end up at the downstream end of the subnetwork.

Water will enter and slowly flow through the sedimentation ponds. Discharge of water will occur at the outlet of the ponds toward the infiltration areas.

The ditch network will be subdivided into a series of subnetworks. The outlet of each subnetwork will not drain more than 100 ha of harvest fields (Map 2, Table 3-1).

It is important to emphasize that ditch construction within the peatland will be carried out progressively. A maximum of 22 ha of peatland will be open to harvest within a given natural watershed, during a single year. Field opening will be executed in a number of successive phases, during a working season, as each secondary ditch requires between two and three V-ditcher passes in order to be completed. Each of these passes are executed a few weeks apart. Peat field drainage will thus take place in an incremental fashion as ditches bordering any given field will be deepened. The various fields subdivided through ditching will gradually drain during the following months, until the water table reaches a new state of equilibrium. Most of the drainage process of a peat field will take place within a year. As such, the residual flow of drainage water will be marginal upon initiation of a subsequent ditching season in a different area. Consequently, an annual contribution of drainage water to the global runoff in the various watersheds will be very low, in addition to being spread over several years of fields opening.

PONDS DRAINAGE

Ponds found in Peatland No. 6 are located where the peat cover is the thickest and surface topography is the flattest. As such, ponds are predominantly found in the central portion of the peatland, primarily within the Black River natural watershed.

The portion of peatland located in the Black River natural watershed displays a significant density and coverage of ponds over its extent. Pond coverage nevertheless represents less than 6% of the total area of peatland of Black River natural watershed. They essentially occur as large ponds, with no apparent pattern in their spatial distribution. Their shape varies greatly and is usually irregular. There are approximately 30 ponds with individual surface area greater than 50 m², but no greater than 2,700 m², located in harvest areas 1, 2, 3, 4, and 9. It would not be possible to develop the structured network of fields and ditches required for peat harvesting in these sectors without draining the ponds present. Attempts to by-pass the ponds would result in a very complex drainage network in this portion of peatland, which would, in turn, translate into less-than-optimal production conditions. Another alternative to pond drainage would be to subtract the pond areas from extraction. This would result in the loss of significant volume of extractable peat, given the number of ponds present in the area, as well as their irregular shape[2].

Very few ponds exist in harvest area located in Bay du Vin River natural watershed. When present, these standing water bodies occur as small ponds, distributed scarcely and randomly. In the portion of peatland located in Bay du Vin River watershed, there are approximately 10 small ponds, all located within harvest areas 3[3] and 5, with individual surface area less than 244 m². These ponds represent 2.45% of the total peatland area and will be drained during field openings. Global impact of pond drainage in this harvest areas will thus be negligible.

ESTIMATION OF TEMPORAL EVOLUTION OF DRAINAGE DISCHARGE

Peat fields will be drained by ditching and induced water table lowering in a progressive fashion. It is estimated that a maximum of 22 ha of peatland will be drained annually in a given natural watershed until development reaches its full extension.

Excavation of each secondary ditch will proceed in two to three cutting phases until target depth is reached. The time span between each cutting phase may reach several weeks to allow sufficient drainage of any given field, as well as to enable the execution of other surface preparation operations.

The anticipated drainage discharge during a ditching season has been evaluated using a conservative approach, assuming that complete excavation of each ditch will be executed in two phases. Additionally, the estimate was based on the year of greatest expected expansion when 22 ha will likely be ditched in a single watershed (22 ha per year in 2028 and 2029).

It is hypothesized that execution of each cutting phase will proceed at a rate of 1,380 m of secondary ditches per day (3 ditches of 460 m average length per ditch). This is based on high productivity ditching rates in optimal conditions from similar projects. It is supposed that ditching is carried out five days a week, with two-days interruption on weekends. Each cutting phase is assumed to take place over 6.5 days, which is the time theoretically required for covering 22 ha in ideal conditions based on assumptions described above. The second phase will be initiated three weeks after the initiation of the first phase and executed according to the same schedule as the first phase.

---

2 Data for natural ponds are obtained from GeoNB, New Brunswick Hydrographic Network (NBHN): http://www.snb.ca/geonb1/e/DC/NBHN.asp.

3 This harvest area is divided between Black River and Bay du Vin River natural watersheds.

This approach has the benefit of maximizing the peak drainage discharge that may be recorded during ditch network construction. One must note, however, that actual duration of the operations could deviate from this estimate, and possibly spread over a longer period. Possibly, the first cutting phase will be initiated at the beginning of the year (January) and the second phase will be proceeding in spring at the same year.

The assumption is made that the first V-ditcher pass will remove the slice of peat within depth interval 0-0.91 m, while the second will remove the 0.91-1.53 m deep slice.

Drainage discharge was estimated by separating the vertical profile of each peat field in two layers to represent the two stages of secondary ditch excavation. Drainage of each layer was considered independently from the other, and a three-week delay was defined between drainage initiation in two contiguous layers. The delay represents a conservative assessment of the time span required for dewatering and surface profiling between the two stages.

Drainage discharge in the first stages of each ditch excavation phase was calculated using the exact solution method of Polubarinova-Kochina (1962), which evaluates the outflow to a fully penetrating channel during the drawdown. Drainage discharge for the later stages was calculated using the Boussinesq (1904) exact solution method. The transition point between the early and late stages of drainage was established using the hydrograph separation approach proposed by Brutsaert and Nieber (1977). The hydraulic properties of the peat were based on the stratigraphic and humification characteristics described by Keys and Henderson (1987) as well as data computed by Carrier (2003) in various peatlands of New Brunswick, Price (1996) and Price *et al*. (2003). The detail for hydraulic properties defined for each peat layer is given in Table 3-2.

Table 3-2 Hydraulic Properties Defined for Each Layer of Peat

	LAYER 1 0-0.91 m	LAYER 2 0.91-1.53 m
Hydraulic conductivity (m/s)	6.3E-06	2.5E-06
Peat specific yield (-)	0.250	0.150

Geometric and spatial characteristics of the secondary ditches presented in sub-section 2 of Section 3.5.1 were used in the drainage discharge calculations.

The peak drainage discharge during the construction of the peatland ditch network was estimated to be 808 m³/day for a given watershed. This value is equivalent to a rainfall event with an intensity of 0.15 mm/h over a 22-ha area during a 24 h period with no infiltration, interception or storage loss (complete contribution of rainfall to surface runoff). The drainage peak discharge occurs on the fifth day of the first cutting phase since a thicker slice of peat with a higher specific yield is ditched during the first phase. A second drainage peak appears 3 weeks later at the fifth day of second phase. Drainage discharge during the second cutting phase remains between 452 and 617 m³/day. A sustained decrease in drainage discharge is observed following the end of the second phase, which corresponds to completion of ditching in the area under consideration. A residual drainage discharge of about 27 m³/day is observed after 365 days, a little more than 3% of the peak discharge value estimated.

Figure 3-4 presents the evolution of drainage discharge during and after ditch network construction, in an area of peatland covering 22 ha.

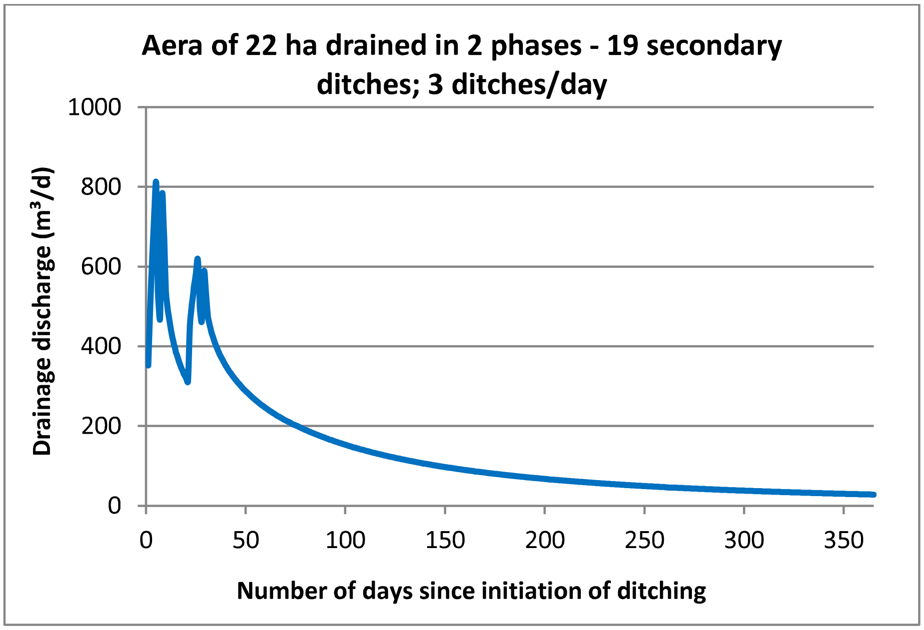


Figure 3-4 Expected Peatland Drainage Discharge During a Ditching Season

DRAINAGE WATER QUALITY

It is expected that water associated with peat and pond drainage will display a chemical quality typical of that observed in water of undeveloped peatlands. It will thus be acidic, with a relatively low metal content. In contrast, the chemical signature of water originating from surface runoff and discharged at the subnetwork outlets will be similar to that of rainwater and snowmelt, given its short residence time in the peatland. Discharge associated with the resurgence of infiltrated rainfall/snowmelt water in the ditch network will likely exhibit hybrid chemical characteristics and be influenced by both rainfall/snowmelt water quality and the chemical characteristics of peat. Ion content and conductivity of discharge generated by resurgent water will be low, and acidity will be moderate.

In addition, when runoff occurs on a snow-free surface, suspended solids in the form of peat particles will generally be mobilized and transported by the runoff. However, it is expected that suspended solids content in discharge associated with the resurgence of infiltrated rainfall/snowmelt water will be low, as peat particle mobility will be restricted to water flow within the ditches.

Runoff water discharge at the sedimentation ponds or at diffuse overland flow outlets will have variable suspended solids content, depending on the intensity of runoff, antecedent climatic conditions, moisture condition of the peat field surface at the start of the runoff event, and field activities being conducted (*e.g.*, maintenance ditching).

While none of the watercourses located downstream from the bog has been classified under the *Water Classification Regulation*, the fact that no discharge of peatland water will take place in any of these streams rules out the possibility of significant stream water quality alteration as a result of the development of Peatland No. 6.

WATER FLOW AND DISCHARGE DURING CONSTRUCTION AND OPERATION

Rainfall and snowmelt events will generate surface runoff when the infiltration capacity of the surface has been exceeded. Surface runoff from each field will flow toward the secondary ditches, where it will be collected by the drainage network.

Surface runoff collection by the drainage network may take place during ditching, in response to episodes of runoff-generating rainfall. In such cases, water discharge at the network outlets will originate from both drainage and runoff.

During harvesting, water discharge at the outlets will essentially come from runoff generation induced by precipitation. A secondary component of water discharge at the outlet will originate from the resurgence of rainfall/snowmelt from the peat fields and into the ditch network, after infiltration and porous-medium flow through peat.

Due to the time required for runoff from distant parts of the watershed to reach a given outlet ("concentration time"), the peak discharge will occur in phase with or slightly lagging, episodes of rainfall or snowmelt. The timing of the discharge will also depend upon the duration and intensity of the precipitation events, as well as the antecedent climatic conditions and moisture condition of the peat field surface at the start of the runoff event. The discharge rate will be low to moderate, although it may be elevated during episodes of intense surface runoff. Phases of elevated discharge rates will generally have a short duration. The volume of water discharge associated with surface runoff will be proportional to the precipitation recorded and inversely proportional to the magnitude of infiltration and evaporation.

The timing of water discharge associated with the resurgence of infiltrated rainfall/snowmelt in the ditch network will be delayed with respect to the infiltration episode(s). This delay might span from a few hours to numerous weeks, depending upon antecedent moisture conditions of peat and upon the distance between the location of infiltration and the ditch where resurgence occurs. Water stemming from infiltration and resurgence will thus discharge at the outlets following a proportional time delay. Due to the moderate permeability of drained peat, flow through peat, and subsequent discharge to the ditches will occur at a relatively low rate. For this reason, discharge rate at the network outlets will be low. Volumes of water discharge associated with infiltrated rainfall/snowmelt resurgence will be proportional to the magnitude of infiltration and inversely proportional to the magnitude of evaporation, as well as the volumes of rainfall and snowmelt.

3.5.4 DEVELOPMENT SCHEDULE

The development schedule for Peatland No. 6 was designed based on the following assumptions:

— Harvestable peatland area with a peat depth of 1 m and over = 176 ha.

— Harvesting rate = 7 cm/yr.

— Annual yield of 2,500 bales[4] per hectare.

— Loss of 50 cm of surface peat, due to subsidence of the surface peat following drainage.

— A 50 cm layer of peat left in place following harvesting.

Development of Peatland No. 6 will take place over 9 years. The first 20 ha field preparation will begin by the middle / end of 2022 by clearing and field drainage construction of harvest area 1 (Map 2). That should allow vacuum peat harvesting of about 17,000 m^3 or 50,000 bales on the initial 20 ha as early as summer 2023. The other sectors will be developed in the following years until the entire harvest area is open (176 ha). The annual production will increase until it reaches nearly 450,000 bales once the harvest area is fully developed. Table 3-3 presents annual and cumulative production areas, peat production volume, and closed areas over the project lifetime.

The 176 ha are estimated to supply a total volume of 4,500,000 m^3, equivalent to about 14,500,000 bales (340 L) horticultural grade peat that will allow this harvesting operation a lifespan of around 50 years.

4 One (1) bale = 0.17 m^3 (6 cubic feet), containing 0.34 m^3 of peat compressed 2:1.

Table 3-3 Peatland No. 6 Development Schedule

YEAR	PRODUC-TION AREA (HA)	CLOSED AREA (HA)	CUMULATIVE CLOSED AREA (HA)	PEAT PRODUCTION (M^3)	PEAT PRODUCTION (340 L BALE)	CUMULATIVE PEAT PRODUCTION (M^3)	CUMULATIVE PEAT PRODUCTION (340 L BALE)	TRUCK LOADS	TRUCK /D
2023	20			17,000	50,000	17,000	50,000	125	1
2024	40			34,000	100,000	51,000	150,000	250	2
2025	57			48,450	142,500	99,450	292,500	356	3
2026	77			65,450	192,500	164,900	485,000	481	4
2027	94			79,900	235,000	244,800	720,000	588	5
2028	110	1	1	93,204	274,128	338,004	994,128	685	5
2029	132		1	111,904	329,128	449,907	1,323,256	823	6
2030	154		1	130,604	384,128	580,511	1,707,384	960	7
2031	175		1	148,454	436,628	728,964	2,144,012	1,092	8
2032	175		1	148,454	436,628	877,418	2,580,640	1,092	8
2033	166	9	10	140,911	414,444	1,018,329	2,995,084	1,036	8
2034	166		10	140,911	414,444	1,159,240	3,409,528	1,036	8
2035	166		10	140,911	414,444	1,300,151	3,823,973	1,036	8
2036	166		10	140,911	414,444	1,441,062	4,238,417	1,036	8
2037	166		10	140,911	414,444	1,581,973	4,652,861	1,036	8
2038	156	10	20	132,697	390,287	1,714,670	5,043,148	976	8
2039	156		20	132,697	390,287	1,847,368	5,433,435	976	8
2040	156		20	132,697	390,287	1,980,065	5,823,721	976	8
2041	156		20	132,697	390,287	2,112,763	6,214,008	976	8
2042	156		20	132,697	390,287	2,245,460	6,604,295	976	8
2043	145	11	31	123,021	361,827	2,368,482	6,966,122	905	7
2044	145		31	123,021	361,827	2,491,503	7,327,950	905	7
2045	145		31	123,021	361,827	2,614,524	7,689,777	905	7
2046	145		31	123,021	361,827	2,737,546	8,051,605	905	7
2047	145		31	123,021	361,827	2,860,567	8,413,432	905	7
2048	132	12	44	112,459	330,761	2,973,026	8,744,194	827	6
2049	132		44	112,459	330,761	3,085,485	9,074,955	827	6
2050	132		44	112,459	330,761	3,197,944	9,405,716	827	6
2051	132		44	112,459	330,761	3,310,402	9,736,477	827	6
2052	132		44	112,459	330,761	3,422,861	10,067,239	827	6
2053	118	14	58	100,420	295,352	3,523,281	10,362,591	738	6
2054	118		58	100,420	295,352	3,623,700	10,657,942	738	6
2055	118		58	100,420	295,352	3,724,120	10,953,294	738	6
2056	118		58	100,420	295,352	3,824,540	11,248,646	738	6
2057	118		58	100,420	295,352	3,924,959	11,543,998	738	6
2058	100	18	76	85,197	250,580	4,010,156	11,794,578	626	5
2059	100		76	85,197	250,580	4,095,354	12,045,158	626	5
2060	100		76	85,197	250,580	4,180,551	12,295,738	626	5
2061	100		76	85,197	250,580	4,265,748	12,546,318	626	5

YEAR	PRODUCTION AREA (HA)	CLOSED AREA (HA)	CUMULATIVE CLOSED AREA (HA)	PEAT PRODUCTION (M^3)	PEAT PRODUCTION (340 L BALE)	CUMULATIVE PEAT PRODUCTION (M^3)	CUMULATIVE PEAT PRODUCTION (340 L BALE)	TRUCK LOADS	26 WEEKS	TRUCK /D
2062	100		76	85,197	250,580	4,350,945	12,796,898	626	130	5
2063	75	25	101	63,960	188,118	4,414,905	12,985,016	470	130	4
2064	75		101	63,960	188,118	4,478,865	13,173,134	470	130	4
2065	75		101	63,960	188,118	4,542,826	13,361,252	470	130	4
2066	75		101	63,960	188,118	4,606,786	13,549,370	470	130	4
2067	75		101	63,960	188,118	4,670,746	13,737,488	470	130	4
2068	56	19	120	47,403	139,421	4,718,149	13,876,908	349	130	3
2069	56		120	47,403	139,421	4,765,552	14,016,329	349	130	3
2070	56		120	47,403	139,421	4,812,955	14,155,750	349	130	3
2071	56		120	47,403	139,421	4,860,358	14,295,171	349	130	3
2072	56		120	47,403	139,421	4,907,761	14,434,591	349	130	3
2073	39	17	137	32,806	96,489	4,940,567	14,531,080	241	130	2

In order to estimate the areas and volumes of peat that will be harvested, data from Keys and Anderson (1987) were used to create a digital elevation model (Map 3). Given the above assumptions, it has been determined that approximately 4.9 Mm^3 of horticultural peat could be extracted over a 50-year period, taking into account the expected 50 cm of subsidence of the peat that takes following drainage. Periodic re-evaluation of the economic feasibility of the Project or other conditions could lead to a different lifespan. Over this 50-year period, it is estimated that 14.5 million bales of peat will be produced.

3.5.5 DECOMMISSIONING PLAN

Theriault & Hachey is aware of its environmental obligations and is dedicated to complying with all requirements of the DELG and DNRED, including implementing responsible management procedures to mitigate potential impacts and reclaim peatlands at cessation of harvesting activities. As required by the New Brunswick *Peat Mining Policy* (Government of New Brunswick, 2021), Theriault & Hachey will restore or reclaim former harvested sites based on options offered by most recent science and approved by the DERD and DELG including:

- Sphagnum Revegetation.
- Forest Habitat.
- Open Water.

Other options, such as small berry cultivation, are possible, but they do not achieve the re-establishment of functional wetland ecosystems and may not be economically viable (PERG, 2009). Reclamation will then involve the three main options although Theriault & Hachey favors Sphagnum Revegetation where conditions are suitable. The best available methods at the time of reclamation work will be applied. At this point, this comprises methods developed by the Peatland Ecology Research Group (PERG) for rewetting (Landry and Rochefort, 2012), re-establishing peatland vegetation (Quinty and Rochefort, 2003) and planting tree species (Hugron *et al.*, 2013). The reclamation plan should favor the option that has the best chance of success according to anticipated conditions at the cessation of peat harvesting. A detailed reclamation plan that will address peat field restoration and reclamation as well as infrastructure decommissioning will be submitted as a separate document.

SPHAGNUM REVEGETATION

The goal of Sphagnum Revegetation is to return peat harvested areas back to functional peat-accumulating peatland ecosystems. In the short term, the specific objectives comprise raising the water table and establishing peatland plant communities dominated by Sphagnum mosses. Meeting these two objectives should initiate a process leading to the return of a functioning peatland.

A method referred to as the Moss Layer Transfer Technique (MLTT) was developed with the help of the Canadian peat industry (Quinty and Rochefort, 2003; Quinty *et al*., 2020a). Sphagnum Revegetation is best suited when a layer of peat of at least 50 cm deep is left, and ombrotrophic conditions are present, that is a pH < 5.5 and corrected electric conductivity < 250 µs/cm (Andersen *et al.*, 2011). Such conditions can be created in abandoned fields where drainage can be blocked without affecting peat roads or nearby fields that are still being harvested. Management, adequate rewetting and donor sites with targeted plant communities are among the main drivers of success for this option (Gonzalez and Rochefort, 2014).

This approach consists of shredding the top living vegetation layer in undisturbed peatland areas called donor sites (Quinty *et al*., 2019). This plant material is spread over abandoned peat fields and covered by straw mulch that helps creating appropriate growing conditions for peatland species (Quinty *et al.*, 2020b). Light phosphorus-rich fertilizer is added to speed up plant establishment. Secondary and main ditches are blocked or filled to raise the water table and restore the hydrological regime (Quinty *et al.*, 2020c). Site-specific field preparation, such as berm construction, is also required to favor uniform wet soil conditions. Plant material is commonly collected from donor sites such as new peat fields being developed, or from shallow peat areas adjacent to peat fields. It is important to note that vegetation can recover rapidly on borrow areas after plants are collected (Guêné-Nanchen *et al.*, 2019). Some donor sites were used up to three times at an interval of about five years.

The MLTT leads in a majority of cases to the progressive return of peatland functions. For instance, recent research showed that a complete plant community including more than 80 % of a reference site species can establish within ten years (Poulin *et al.*, 2013; Hugron *et al*., 2020) and that the acrotelm may rebuild in 17 years, thus reducing water level fluctuations (McCarter and Price, 2013; Lucchese, *et al.*, 2010). Carbon storage, an important function of peatlands, returned after 14 years and earlier at some sites (Waddington *et al.*, 2010; Strack and Zuback, 2013; Nugent *et al*., 2018).

Theriault & Hachey proposes to apply Sphagnum Revegetation where conditions will be appropriate to favor successful reclamation.

FOREST HABITAT

The goal of Forested Habitat reclamation is to turn harvested peat fields into forested wetland habitats comparable to what already exists in the region, especially in poorly drained areas often found at peatland margins. In the short term, the objective is to plant tree seedlings and promote spontaneous colonization by other plant species to start a process leading to a forest habitat. The goal of Forest Habitat differs from that of a commercial tree plantation, although specific objectives may be similar. Tree density is lower, and growth and yield may not reach the commercial standard in a peatland environment due to adverse conditions such as a high water table and nutrient poor conditions.

Tree plantation is a valuable reclamation option in various situations (Hugron *et al.*, 2013). Tree plantations around harvested areas located at the peatland margin may contribute to the formation of laggs that are transitional zones between peatlands and uplands. Forest Habitat may also be the favored option for progressive reclamation of fields that can hardly be rewetted because they are surrounded by areas being harvested. Moreover, trees could be planted along access roads where the soil may remain drier and serve as windbreaks.

In practice, Forest Habitat reclamation consists of planting tree seedlings and favoring spontaneous colonization by vegetation to start a process that will lead to forested wetlands. The two species most commonly planted on abandoned peatlands are Black Spruce (*Picea mariana*) and Tamarack (*Larix laricina*), but other tree and shrub species can also be planted. It is strongly suggested to plant more than one species to obtain a higher biodiversity and to prevent plantation die out due to disease or other problems that can affect one species. However, Black Spruce will be favored in drier areas and Tamarack in wetter and more minerotrophic nutrient rich conditions. According to the current tree planting method in harvested bogs, seedlings are planted at a density of 1,200/ha, which corresponds to a spacing of 3 meters between plants, and they are fertilized. Seedlings are planted in such patterns that will mimic natural forest, instead of being planted in line like a tree plantation. Other plant species, such as birch and ericaceous shrubs, should establish themselves spontaneously and increase biodiversity (Poulin *et al.*, 2005). Planted trees should speed up that process by providing sheltered sites. With time, ditches will get clogged, and the water level will rise slowly, leading to forested wetland conditions.

Forest habitat will be favored in areas where conditions are not optimal for Sphagnum Revegetation such as where there is less than 50 cm of peat left, in dry conditions or zones influenced by minerotrophic conditions (Hugron *et al.*, 2013).

It is expected that such situations will be present toward the peatland margin closer to nutrient rich habitats and where peat is shallow and along access roads bordered by operational drainage ditches.

OPEN WATER

Peatland No. 6 is characterized by a large number of open water bodies. Except for the two large lakes that will be protected, there are a few medium size ponds (20-25 m across) that concentrate in a depression between the two peat domes and on top of the north dome, and many small ponds (< 10 m across) mainly on the south dome.

The reclamation will include the creation of open water bodies. The *Peatland Restoration Guide* offers guidance for pond creation (Quinty and Rochefort, 2003). Ponds may be created by excavating shallow depressions. The excavated peat is spread around the pond and mounds may be created to favor species that prefer drier conditions. Ponds usually have small dimensions (< 100 m^2) and a curved-irregular shoreline. Usually, created ponds occupy a restricted area within reclaimed peatlands as it is technically difficult and costly to excavate large ponds. The major problem is to dispose of the excavated peat. One strategy is to create ponds in existing depressions where water accumulates naturally among Sphagnum Revegetation and Forest Habitat areas thus reducing the need to excavate. Some ditches may also be left as open water bodies.

Open water bodies improve the ecological value of restored wetlands because bog ponds are considered hotspots of natural peatland biodiversity (Fontaine *et al.*, 2007). They provide habitat for ecologically valuable plants species, invertebrates and insects, and they can be used by birds and wildlife.

It was shown that created bog ponds are rapidly colonized by amphibians and certain insects, and that vegetation requires more time to become established (Mazzerolle *et al.*, 2006).

DEPTH OF PEAT LEFT ON SITE

A peat layer of 50 cm will be left on site as much as possible to maintain bog conditions and favor the restoration process. Nevertheless, given the uneven mineral deposit under the peat and the pneumatic method that requires long flat peat fields, it is not possible to leave a regular peat layer, and 50 cm represents an average. It is also possible that a shallow layer of the peat be left on some sectors to benefit from the presence of high-quality peat almost to the bottom of the deposit, as it is allowed by the Peat Mining Policy.

SIZE AND LOCATION OF PROTECTED PEATLAND AND USED FOR RESTORATION

Theriault & Hachey has designated two zones covering 53.5 ha to the north of the peatland that will be protected for conservation purposes (Map 2). The largest zone (46.5 ha) comprises Rosaireville Lake, a buffer zone, and a large peatland area that extends north of the lake. A large portion of this conservation area is also part of Candidate Conservation Area (CCA) No. 0683 that may enhance the level of conservation. The second zone covers 7 ha and includes a large unnamed lake, a buffer zone and the peatland area between the lake and uplands to the north.

Five potential donor sites have been identified based on existing vegetation data (Airphoto Analysis Associates Consultants Limited, 1975). They are located around the harvest area and they are 1.3 to 5.5 ha in size for a total area of 17.74 ha (Map 2). The donor sites will have to be validated by a field investigation.

Extended areas with less than 1 m of peat depth and mostly located at the margin of Peatland No. 6 will also be left untouched.

REHABILITATION PLAN FOR DRAINAGE DITCHES AND INFRASTRUCTURE

Secondary ditches will be filled with peat or left open to create open water. Main ditches will be blocked or filled in such a way as to ensure proper conditions for Sphagnum restoration, tree planting, open water bodies, or any other reclamation options. Some sections of ditches may not be filled and may therefore become open water bodies. Main ditches will be filled, or their sides graded to make sure they do not represent a safety hazard for humans and wildlife.

Access roads will be left in place and will be compensated for. They will provide access for post-decommissioning monitoring purposes and for use by other eventual land users, especially for bird and wildlife watchers and hunters.

DETAILS OF PAST RESTORATION AND RECLAMATION INITIATIVES

In the past, Theriault & Hachey allocated efforts to reclaim closed peat fields at peatlands No. 324W and No. 302 in accordance with the Peat Mining Policy. As of 2021, 13.7 ha have been restored as Sphagnum Revegetation and 40.9 ha have been planted with trees (Forest Habitat) for a total of 54.6 ha (Table 3-4). Reclamation as Forest Habitat splits between Peatland No. 324W with 18.2 ha and Peatland No. 302A with 22.7 ha. The Sphagnum Revegetation is located exclusively on Peatland No. 302A and it includes a 11.3-ha section that restored naturally.

Under the agreement with Berger who acquired its former leases, Theriault & Hachey will reclaim 34.9 ha as Forest Habitat in 2022 and 2022, at which time restoration obligations will be completed by Theriault & Hachey and taken over by Berger.

Table 3-4 Theriault & Hachey Reclamation Past Reclamation Works on Peatlands Nos. 324W and 302A

YEAR	SPHAGNUM REVEGETATION (HA)	FOREST HABITAT (HA)
2000	11.3	-
2006	-	18.2
2010	2.4	2.4
2017	-	22.7
2022 (planned)	-	34.9
Total	13.7	78.2

Theriault & Hachey also experimentally created two ponds in 2006 within a Forest Habitat area. They were shallow (< 1 m) and about 20 m across. Pictures taken in 2021 show that the ponds have been successfully colonized by wetland species and seem to harbour a diversity of species (Figure 3-5).

Figure 3-5 Pond at Theriault & Hachey Peatland No. 324W at Creation in 2006 (left) and 15 Years Later in 2021 (right)

DECOMMISSIONING SCHEDULE

When possible, Theriault & Hachey will implement appropriate reclamation options ±3 years after peat harvesting stops on peat fields or sections of fields, provided that it does not interfere with its operations. At this point it is not possible to develop a decommissioning schedule more precise than the development schedule (Table 3-3). Such a schedule will be prepared and updated periodically.