Restoration of Brook Trout (Salvelinus fontinalis) Habitat in Baxter Creek

Includes:

Final Report

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Thank you to Tom Brooke from Fleming College (Fish and Wildlife Department) for providing the historic electrofishing and benthic invertebrate data that was used to report on current site conditions and to make recommendations for this restoration plan.

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1.0 INTRODUCTION

Brook Trout (*Salvelinus fontinalis*) are a sought-after game fish and the only native stream-dwelling fish to Ontario (Lanark County Stewardship Council & Watersheds Canada, 2021). Baxter Creek, located in Millbrook, has had Brook Trout reported in it for many years, however their abundance is becoming lower over time. Erosion, past deforestation and the construction of mills have resulted in poor Brook Trout habitat quality in Baxter Creek along Zion Line. This section is just southwest of Millbrook near Millbrook Trails and the Ministry of Natural Resources Fishing and Recreation Area within the Otonabee River tertiary watershed (*Figure 1*) and has great potential to be desirable Brook Trout habitat once these issues are addressed. To do this, a comprehensive restoration guide will be created to include information and instructions on how to create more suitable Brook Trout habitat at this site.

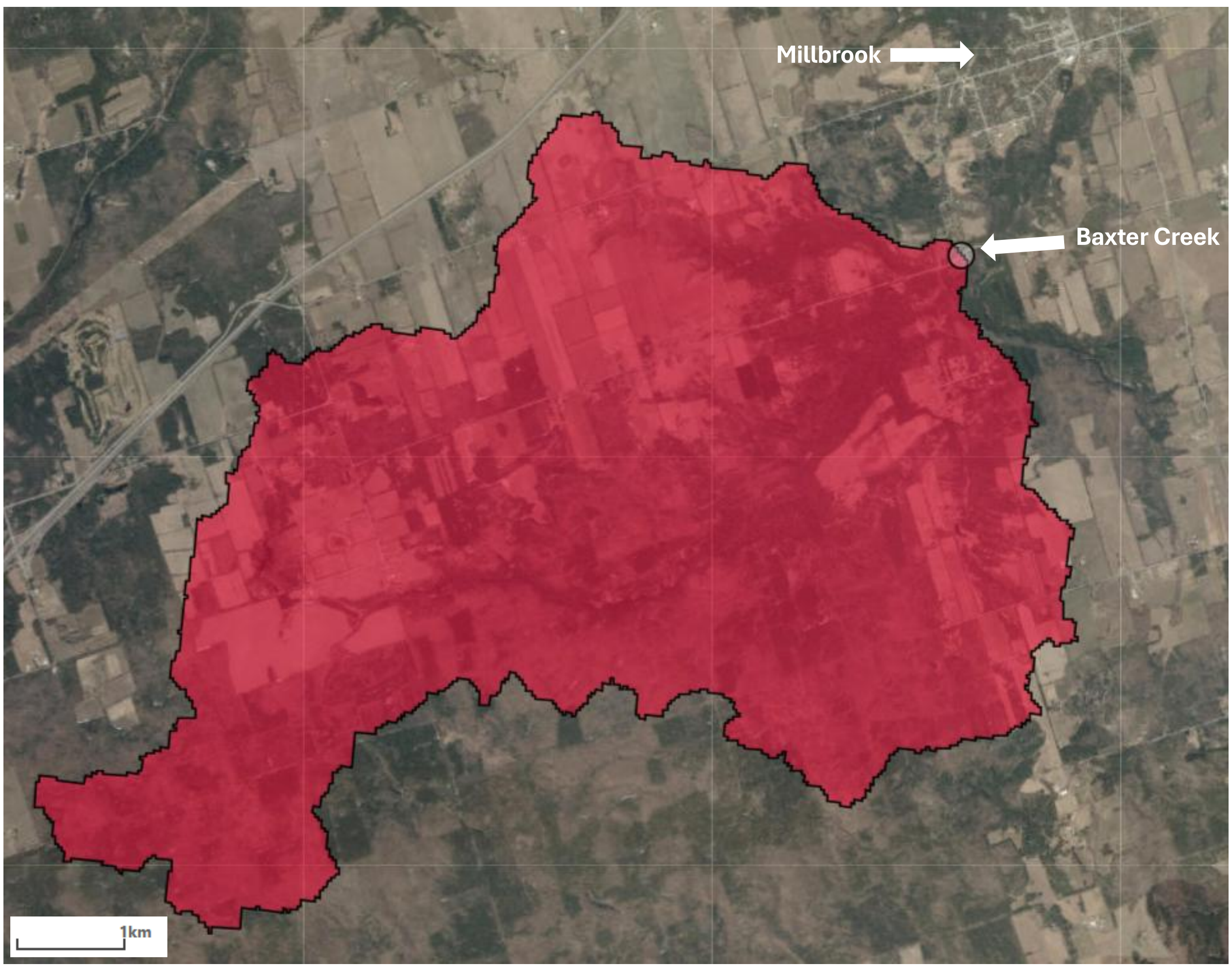

Figure 1. Watershed area of Baxter Creek; Part of the Otonabee River tertiary watershed.

1.1 Baxter Creek

In the 1800s, Baxter Creek played an integral part in the creation of the town of Millbrook (Torgerson, 2020). John Deyell settled in the area around 1820, building his grist and sawmill (originally Deyell's Mill, now Needler's Mill) along the creek to provide the buildings with power (Torgerson, 2020). Others learned of Deyell's settlement and decided to follow suit, setting up nearly 20 different mills along the creek in the 1890s, leading to the growth of the town we now know as Millbrook (Torgerson, 2020). The development of these mills was directly linked to the growth of the town, as it allowed residents to become more self-sufficient and create their own grain, animal feed, and lumber products instead of travelling and purchasing them elsewhere (Torgerson, 2020). A map from 1878 shows a mill dam located at the study site (H. Beldin and Co., 1878), however this dam was removed by 1954 (Ontario Department of Lands and Forests, 1954) leaving a silt-filled lakebed. Currently, this site is frequented by many members of the public for hiking, fishing, and other recreational activities.

Baxter Creek originates from the Oak Ridges Moraine, a kame moraine characterized by sand and gravel soil, abundant groundwater, and natural springs (The Millbrook Times, 2020). Baxter Creek is therefore deemed a cold-water creek (The Millbrook Times, 2020). The highly forested riparian zone in the Oak Ridges Moraine (>90%) maintains cold water in Baxter Creek. Upon leaving the Oak Ridges Moraine Baxter Creek enters a glacial spillway of sand and gravel (Gravenor, 1957) where the gradient is low (0.2% at the study site). Accordingly, the stream bed of Baxter Creek at the study site is much finer, typically consisting of sand, silt, and clay.

1.2 Brook Trout

Baxter Creek is well known and serves as a place of recreation for many residents of Millbrook and the surrounding area. One of the major attractions to Baxter Creek is the novelty of fishing for native Ontarian Brook Trout (*Salvelinus fontinalis*). They are typically olive, brown, or black in colour with a silvery-white belly, light-coloured worm-like markings, and red spots outlined with blue along their sides (Ministry of Natural Resources [MNR], 2023).

Figure 2. Brook Trout (Photo by David Renwald, 2009)

Brook Trout are typically found in streams with cold, clear water, plenty of cover from overhanging branches, logs, or rocks, and that have riffles, pools, and runs present in the channel (MNR, 2023, Department of Fisheries and Oceans Canada [DFO], 1988). They also prefer areas with gravel substrates, well vegetated and stable banks, and they seek out groundwater discharge for spawning (DFO, n.d.: Curry and Noakes, 1995). Brook Trout are very sensitive to their environmental conditions, being considered the fish equivalent to “the canary in the coal mine”, and are currently facing many challenges that are threatening their populations including alterations of stream flow due to urbanization, warming water temperatures, competition from non-native species, and overharvesting (Ontario Streams, 2024a).

1.3 Freshwater Conservation Canada (Millbrook Chapter)

Freshwater Conservation Canada (FCC) was established in 1972 as a registered Canadian charitable organization. It has been working to improve the lives and health of Canadians for over 50 years through their mission to conserve, protect, and restore Canada’s freshwater ecosystems and their cold-water resources for current and future generations. Their work is guided by science and research which is fueled by unending passion put forward by volunteers and professional staff. Many of their current projects include improving freshwater quality, restoring natural stream flows, protecting habitats of native species, reducing erosion, stabilizing riverbanks, and enhancing natural water systems’ resilience to oncoming climate change (FCC, 2025).

The Ontario office of FCC is located in Guelph, Ontario. There are many chapters located across Canada. This report is being completed in partnership with the Millbrook Chapter of FCC.

1.4 Project Goals

Brook Trout abundance at the Zion Line reach of Baxter Creek is largely depressed when compared with upstream reaches. The purpose of this project is to guide habitat restoration at Zion Line in Millbrook to become better suited to support this species. To do this, three major objectives have been put in place:

1. Conduct a literature review to understand the requirements and limiting factors of Brook Trout in Southern Ontario.
2. Assess the current state of Baxter Creek at Zion Line and see how it compares to requirements of Brook Trout.
3. Create a comprehensive and realistic restoration plan that addresses areas of concern to create more suitable habitat for Brook Trout.

2.0 SITE ASSESSMENT OF BAXTER CREEK AT ZION LINE

Baxter Creek at Zion Line has been influenced by human activity for decades via the construction of dams, mills, and the creation of trails throughout the area. The bed of the Old Mill Pond largely contains fine materials (sands, silts, clays), creating an ongoing issue since the 1950s with accumulation of fine sediments (mainly silts) in Baxter Creek and slow vegetation succession throughout the site (Bowlby, 2025, personal communication). Due to this, current conditions at Baxter Creek are not ideal for supporting Brook Trout populations.

2.1 Current Conditions

To assess the current conditions in Baxter Creek, measurements were taken to determine average water chemistry and stream morphology parameters currently present at the site. Measurements were taken on November 19, 2024, so values might differ slightly from summer months (June-August). However, discharge in Baxter Creek on November 19, 2024 was similar to summer base flow (Water Survey of Canada, 2024), and measurements here are representative of Brook Trout habitat.

Figure 3. Map of data collection locations (temperature, electrofishing, benthic invertebrates, water quality, stream morphology) in Baxter Creek at Zion Line.

To gain a better understanding of the current conditions at this site, various field data were collected along a 350m stretch of Baxter Creek (*Figure 3*). Data consisting of water quality parameter and stream morphology measurements was collected along this stretch every 20m in transects across the stream cross-section (indicated with red circles in *Figure 3*). Alongside this, historic benthic invertebrate and electrofishing data from 2022 (light blue circles, *Figure 3*) and temperature data from a logger placed during the year of 2024 (dark blue circle, *Figure 3*) were also provided for this study by Brian Round and Jim Bowlby.

2.1.1 Water Quality & Stream Morphology

The current water chemistry and stream morphology conditions in Baxter Creek at Zion Line are within desirable ranges for Brook Trout populations, which can be seen below:

Table 1. Current stream parameters (measured November 19, 2024) in Baxter Creek at Zion Line compared to the threshold ranges as outlined by Lanark County Stewardship Council & Watersheds Canada, (2021), Blair et al., 2021; & Ralleigh, 1982. Parameters marked with – in "Threshold Ranges" indicate no identified desired condition.

Stream Parameter	Threshold Ranges	Mean Across All Sites
Water Temperature (°C)	0-24	4.8
Water pH	4.0-9.5	7.8
Dissolved Oxygen [DO] (mg/L)	> 5.0	13.2
Conductivity (µS/cm)	< 900	454.9
Total Dissolved Solids [TDS] (ppm)	-	319.5
Stream Velocity (m/s)	0-0.9	0.2
Stream Max Depth (cm)	> 15	60.4
Wetted Width (m)	-	4.8
Bank Width (m)	-	5.4

While these parameters are within ranges, many of these are not the major limiting factors to Brook Trout populations in Southern Ontario, which will be discussed later in *Section 2.2 – Brook Trout Requirements*. However, it is still important to note these values in case there are any changes to them in the future as it allows for more effective monitoring of the system.

2.1.2 Vegetation

Vegetation within the stream (submerged) and along the banks (riparian) were recorded at each of the transects to create a baseline inventory. Currently, the site is dominated by goldenrod (*Solidago spp.*) with some sections of red osier dogwood (*Cornus sericea*) throughout. Some other species noted to be present throughout the site included vetch (*Vicia spp*.), St. John's Wort (*Hypericum spp.*), yarrow (*Achillea millefolium*), asters (*Symphyotrichum spp*.), poa grass, orchard grass (*Dactylis glomerata*, non-native), and reed canary grass (*Phalaris arundinacea,* non-native), among other unidentified species.

2.1.3 Fish

Historic electrofishing data were provided for this project by Tom Brooke from the Fish and Wildlife program at Fleming College. These data were collected from 2017 to 2023, however only the most recent year (2023) of data has been outlined below in *Table 2*.

Table 2. Fish species collected in 2023 via electrofishing. Data provided by Tom Brooke from Fleming College – Fish and Wildlife Department. Ordered by Ministry of Natural Resources Species Code (MNR, 2024a).

MNR Code	Common Name	*Latin Name*	Catch by Number	Percent Composition
078	Brown Trout	*Salmo trutta*	43	21.29%
080	Brook Trout	*Salvelinus fontinalis*	1	0.50%
163	White Sucker	*Catostomus commersonii*	1	0.50%
212	Creek Chub	*Semotilus atromaculatus*	1	0.50%
233	Brown Bullhead	*Ameiurus nebulosus*	1	0.50%
281	Brook Stickleback	*Culaea inconstans*	1	0.50%
313	Pumpkinseed	*Lepomis gibbosus*	1	0.50%
382	Slimy Sculpin	*Cottus cognatus*	147	72.77%
381	Mottled Sculpin	*Cottus bairdii*	6	2.97%

The data show slight changes in the fish community over the years, however the more abundant fish species across all years are Slimy Sculpin and Brown Trout, making up nearly 100% of the fish community across all years (*Table 2*). Brook Trout have been severely lacking in this section of the stream, with electrofishing efforts only finding 6 individuals over the 7 years sampled.

2.1.4 Benthic Invertebrates

Historic benthic invertebrate data were also provided for this project by Tom Brooke from the Fish and Wildlife program at Fleming College. These data were collected from 2017 to 2023, however only the most recent year (2023) of data has been outlined below in *Table 3*.

Table 3. Benthic invertebrate groups (27 taxa) collected in 2023. Data provided by Tom Brooke from Fleming College – Fish and Wildlife Department. Ordered alphabetically by Common Name.

Common Name	Latin Name	Catch by Number	Percent Composition	Functional Feeding Group
Aquatic Earthworm	*Oligochaeta*	1	0.00%	Collector/gatherer
Beetles/Water pennies	*Coleoptera*	28	0.08%	Collector, gatherer, scraper, shredder, predator
Black Flies	*Simuliidae*	7	0.02%	Collector/filterer
Caddisflies	*Trichoptera*	73	0.21%	Collector-filterer, scraper, gatherer, shredder, some families are pradators
Clams/Mussels	*Bivalvia*	16	0.05%	Collector/filterer
Crane Flies	*Tipulidae*	1	0.00%	Shredder/predator
Damselflies	*Zygoptera*	1	0.00%	Predator
Flatworms	*Turbellaria*	1	0.00%	Collector/gatherer
Mayflies	*Ephemeroptera*	96	0.28%	Collector/gatherer EXCLUDING *Heptageniidae* (scrapers)
Miscellaneous Flies	*Misc. Diptera*	6	0.02%	Collector/gatherer, scraper, predator
Mosquito	*Culicidae*	1	0.00%	Filterer
No-see-ums/Biting Midge	*Ceratopogonidae*	5	0.01%	Predator
Non-Biting Midges	*Chironomidae*	46	0.13%	Collector/gatherer
Roundworm	*Nematoda*	2	0.01%	Collector/gatherer
Scuds/Sideswimmers	*Amphipoda*	9	0.03%	Collector/gatherer
Snails/Limpets	*Gastropoda*	11	0.03%	Scraper
Stoneflies	*Plecoptera*	34	0.10%	Shredders, some shredder/scraper, EXCLUDING *Perlidae* (predators)
True Bugs	*Hemiptera*	5	0.01%	Predator
Water Mites	*Hydrachnida*	12	0.03%	Predator

Historic benthic invertebrate data show a change in the community over the years. There appears to be a loss of diversity during the years 2019 and 2020, however more recent years show an increase. Most recently in 2023, *Ephemeroptera, Plecoptera, and Trichoptera* were the most abundant groups, making up over 50% of the overall benthic invertebrate community caught.

Brook Trout are opportunistic feeders, meaning they will feed on anything that is easily accessible to them including various drifting benthic invertebrates, other insects, tadpoles, salamanders, and even small fish if available (Tiberti et al., 2016; Ellis, 2022). Drifting invertebrates typically consist of flies (*Diptera*) and certain families of some benthic groups (e.g. *Baetidae* family in mayflies, some families in *Plecoptera* and *Trichoptera*) (Tiberti et al., 2016; Wegscheider et al., 2023). Other invertebrates in mid-stages of life (pupating, emerging from the water surface as adults) can also be considered drifters, however this is only during certain periods of their life cycles (Wegscheider et al., 2023). Mayflies were the most abundant group identified in 2023; however, it is unknown if all mayflies captured are considered drifters. To understand the exact composition of drifting invertebrates at this site, a family-level identification analysis needs to be done.

One request for this report was to include an analysis of the different functional feeding groups that are present at this site. To effectively do this, benthic invertebrates are required to be identified down to family level, which is difficult to do with minimal experience and can be expensive to have the work contracted. Historic data does not reflect this level of identification and will not result in a conclusive analysis for this report.

2.2 Brook Trout Habitat Requirements

Brook Trout have many requirements of their habitat area. The major factors that influence and limit Brook Trout populations in Southern Ontario are within *Table 4*, with the ideal conditions for each parameter being compared to the current creek conditions at Zion Line.

Table 4. Limiting factors of Brook Trout in creeks across Southern Ontario. Green indicates values that are within ideal range, yellow indicates values that are out of ideal range. Sourced from Lanark County Stewardship Council & Watersheds Canada, 2021; J. Bowlby, 2024 [personal communication].

Parameter	Ideal	Baxter Creek @ Zion Line
Water Temperature (°C) (July & August)	11-16	14.2
Food Availability	Benthic invertebrates (benthos)	Abundant benthic community
Instream Cover	≥ 25% (adults), ≥ 15% (juveniles)	Moderate, but not diverse (~25%)
Preferred Habitat Availability	Abundant pool area	Abundant pool area
Spawning Habitat Availability	Groundwater inputs	Not here, but exists upstream

There are five major parameters that limit Brook Trout populations in Southern Ontario, namely water temperature, food availability, shade cover, stream cover, preferred habitat availability, and spawning habitat availability.

Water temperature must be cool to support Brook Trout growth, feeding, and general activity, with ideal ranges for this being recorded between 11-16 °C (Ralleigh, 1982). Bowlby and Roff (1986) found that the best trout habitat in southern Ontario had an average summer temperature of 15.4 C. Baxter Creek at Zion Line had an average water temperature of 14.2 °C in July and August 2024, falling within the ideal range.

Adequate food sources are required to support the growth of Brook Trout, especially *Ephemeroptera*, *Plecoptera*, *Trichoptera*, and *Simuliidae,* drifting invertebrates which are the primary food source of Brook Trout. At this site, there are substantial amounts of drifting invertebrates present, with *Ephemeroptera, Plecoptera, and Trichoptera* being the most captured groups (*Table 3*).

Trees and instream cover may be related to one another. Trees that provide shade also provide roots that stabilize undercut banks and overhead branches that fall, both creating instream cover. Instream covers such as undercut banks, large rocks, logs, or deep sections provide protection from predators and current. This site has few shade trees (0-25%) which provides little to no contribution to log cover. There is instream cover present throughout most of the site, however much of this is provided by undercut banks which are not well stabilized. To stabilize the banks at the site, more plants with various root structures will need to be planted to ensure banks are stabilized and do not collapse into the creek.

Brook Trout require areas of groundwater inputs for spawning and while this is not present in the immediate area of this specific site, there is ample groundwater input in areas upstream which is already largely occupied by Brook Trout. Ideally, if the downstream section is restored to more suitable conditions, this upstream population will eventually move downstream and continue its growth.

2.3 Site Considerations

2.3.1 European Buckthorn

European buckthorn (*Rhamnus cathartica*), a non-native species to Ontario known for its quick cultivation and aggressive growing behaviour (MNR, 2024b), was found at the site. Buckthorn re-seeds itself aggressively and can tolerate a variety of conditions present in this area. Accordingly, it outcompetes native species (MNR, 2024a). Buckthorn can be extremely problematic for these reasons, and it is good to manage these trees and their growth as quickly as possible. However, the trees present at this site have matured, meaning that they will need to be treated using more targeted removal methods. Large trees can be used to eventually replace Buckthorn at the site.

2.3.2 Wild Parsnip

Wild parsnip (*Pastinaca sativa*) plants were observed at the site. It is a non-native, noxious plant known to have foliage that can cause digestive irritation in herbivores and severe burns when in contact with human skin (Tassie & Sherman, 2014). This plant can also form dense stands that can outcompete other plants in the area and reduce biodiversity (Tassie & Sherman, 2014). Management of this plant may be necessary as Baxter Creek is frequented by many for angling, resulting in potentially high traffic in the areas this plant is present. Wild parsnip can also spread quickly in open areas, so early management of this plant will prevent dense stands from forming. Dense stands can prevent the establishment of other species on-site, resulting in lower site diversity. Since only a few of these plants were recorded at the site, mechanical management is possible.

2.3.3 Low Riparian Zone Vegetation Diversity

The riparian zone is the section of land right along the banks of the creek. It serves as a middle-ground between the aquatic ecosystem of the creek itself and the more dry-land ecosystem along the banks. Typically, riparian zones are extremely diverse and host a variety of different plants, however Baxter Creek at Zion Line does not have this. Currently, the most abundant plant on the site is goldenrod (*Solidago spp.*). The resulting low plant diversity offers less resilience to potential pests or disease that may impact the site in the future (Bita-Nicolae & Dhyani, 2025). Vegetation along the riparian zone offers support against erosion in streams by hosting diverse different root systems that hold soil together (Ralleigh, 1982), preventing undercut banks from collapsing. Adding diverse vegetation including trees will also be necessary to ensure the stream is shaded so that water temperatures remain cool and overhanging branches can fall into the stream to provide cover (Stackhouse et al., 2024).

2.3.4 Undercut Banks

Currently, undercut banks at this site are cause for concern due to their instability and potential for collapse into the stream. Nevertheless, undercut banks are prime Brook Trout cover habitat. Currently, the undercuts are small and relatively unproblematic. However, they will need to be considered in the restoration plan to stabilize them and prevent them from collapsing.

Figure 4. An undercut bank in Baxter Creek at Zion Line.

Undercut banks may be eroded further and faster on the outer bends of creeks. This increases sedimentation rates, which can be detrimental to the health of benthic invertebrates (Gupta et al., 2022). Many invertebrates are extremely sensitive to changes in their environment, including changes to sediment, which may influence the benthic community, the main food source of Brook Trout. To prevent erosion, brush bundles may be constructed from branches and twigs and added to areas with undercut banks (Lanark County Stewardship Council, 2021).

To promote bank stabilization, plants with diverse root systems should be planted at the site. This will create a large root system within the bank to prevent soil from eroding further and causing eventual bank collapse into the creek. For example, sun-loving and fast-growing pioneer species (e.g. birch, aspen, poplar) should be planted first to quickly colonize the site. They will provide shade to allow later successional species (white pine, white cedar) to establish easier on the site. Creating this diversity in vegetation throughout the site will not only increase species diversity, but it will also create more intricate and strongly woven root systems that will prevent the creek banks from eroding further (Vannoppen et al., 2017; Watersheds Canada, 2023).

2.3.5 Beavers

Three beaver dams have been observed at this site in the past decade. One dam at the old mill dam crib is still active. This will cause some issues with restoration work because much of the work will consist of replanting the area with various first-stage successional trees (birch, poplar, aspen), many of which are commonly targeted by beavers (Pesaturo, 2018; MNR, 2024b). This will need to be considered both in the preliminary phase when preparing for this restoration project as well as during the implementation of this plan. While beavers have preferences for certain species, they are not necessarily picky. If there are desired trees in the area, beavers will target these first. However, they will also target undesirable species (e.g. ninebark, twinberry, elderberry) if nothing else is available (Pesaturo, 2018; Juhász, 2021).

2.3.6 Interspecific Competition

A potential threat facing Brook Trout is competition from Brown Trout (*Salmo trutta*) and Creek Chub (*Semotilus atromaculatus*). Brown Trout are native to Europe but are now found throughout the Great Lakes and their tributaries across southern Ontario (MNR, 2022).

Figure 5. Brown Trout (Photo by Jiri Bohdal, 2010).

Brown Trout may exclude Brook Trout from resting positions with suitable water velocity (Fausch and White, 1981). Log and rock cover that creates suitable resting water velocity is scarce in Baxter Creek at Zion Line, and so Brown Trout are a concern for Brook Trout, here. Creek Chub may outcompete Brook Trout near the stream bottom at temperatures greater than 20°C (Colby et al, 2022). However, the temperature of Baxter Creek rarely exceeds 17°C (FCC, unpublished data), and Creek chub abundance is low at the site (*Table 2*). Accordingly, competition with Creek Chub is not a concern in Baxter Creek at Zion Line.

3.0 RESTORATION PLAN

3.1 Restoration Goals & Sequence

The goal of the restoration plan is to improve the site condition for Book Trout by addressing the identified site considerations including:

1. Removal of shallow rooting and shrubby Buckthorn and subsequent replacement with deeper rooting and taller native trees to improve bank stabilization and stream canopy cover;
2. Increasing riparian plant diversity and bank stabilization by incorporating deeper rooting, native vegetation including species that are undesirable to beavers; and
3. Incorporating cover objects in the stream bed to increase areas of refuge for Brook Trout.

The restoration plan should result in the following outcomes:

- Increased abundance of taller trees and over stream canopy cover
- Increased riparian vegetation diversity and bank stabilization

- Increased invertebrate diversity
- Increased use of the restored downstream site from Brook Trout populations upstream

Restoration should be completed in the order that is presented in the report starting with buckthorn removal, then addressing vegetation diversity on-site, then bank stabilization. Placement of cover objects can occur at any point in the sequence but should be avoided in the fall (September-November) and early spring (February-April) in consideration of spawning and hatching times (Ralleigh, 1982). The time for this restoration is expected to take roughly between 10-15 years to meet all restoration goals (*Figure 6*).

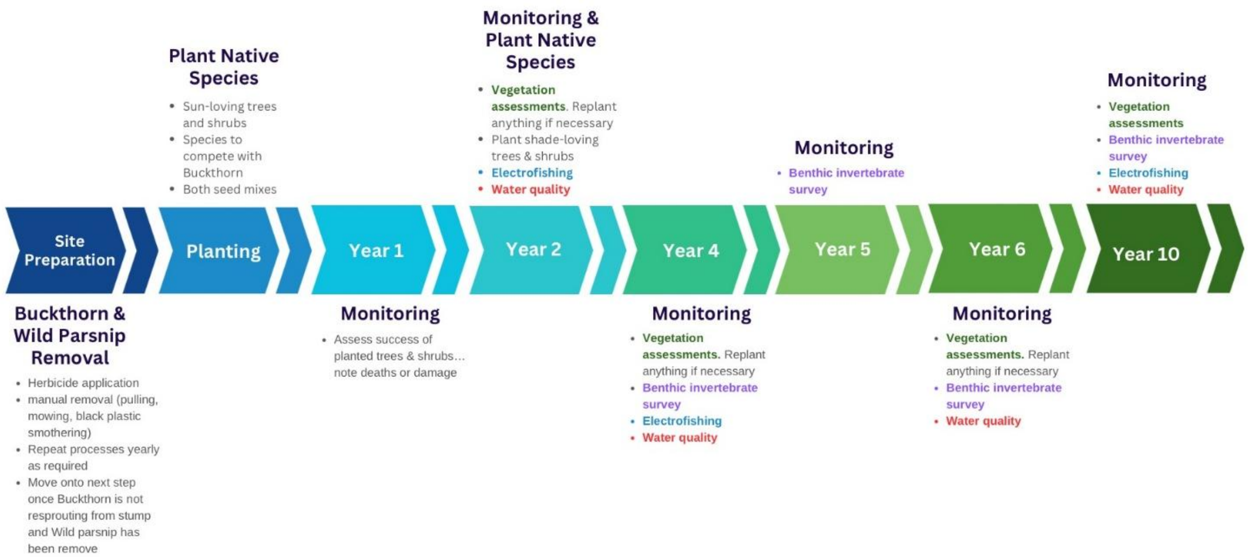

Figure 6. Restoration timeline for Baxter Creek at Zion Line. Note: Site preparation may take multiple years to complete but should be done before starting the other steps of restoration.

Different aspects of the restoration plan will be implemented in specific areas along Baxter Creek (*Figure 7*). Buckthorn removal and replacement with native trees will occur in yellow areas. A bank stabilizing seed mix of native species will be applied in red areas, near the outer banks of the creek. A general diversity plant mix will be used in the larger blue area to increase plant diversity and add canopy cover and resilience.

Figure 7. Proposed restoration plan for Baxter Creek at Zion Line. Blue = general diversity plant mix; Red = bank stabilization plant mix; Yellow = European Buckthorn removal.

3.2 Buckthorn Removal & Replacement with Native Trees

Buckthorn removal will be essential to reduce the spread of this shallow-rooting, shrubby species that does not provide important ecological services such as bank stabilization. As the trees on site are mature, the cut-stump removal method (Van Sloun Larson, 2009) will need to be used.

3.2.1 Cut-Stump Removal Method

Before beginning the removal process, please ensure you have all the correct permits, personal protective equipment (PPE), and materials to complete the task.

When removing Buckthorn, focus attention on the most problematic areas first (e.g. large, dense stands, single trees, trees with large amounts of berries) (Ontario Invasive Plant Council, 2024). In fall (late September through to November), identify all problematic Buckthorn trees that will be removed, as this is when the Buckthorn is most easily identifiable (Van Sloun Larson, 2009). Trees can be marked by tying flagging tape around the base of the tree or to its branches.

For more information about Buckthorn identification, removal (manual and chemical), permit requirements, disposal, and management, please see the *European Buckthorn Best Management Practices* (2024) Technical Document from the Ontario Invasive Plant Council: https://www.ontarioinvasiveplants.ca/wp-content/uploads/2024/09/Buckthorn_Technical_Bulletin_Web_FINAL_2024_09_13.pdf

Buckthorn plants that are small (≤5 cm diameter) can be removed manually via hand in April-May or October-November. This can be done by pulling out the entire plant by hand. If plants are better established, shovels may be used to loosen contact between the soil and roots to make pulling easier. Larger trees (>5 cm diameter) should be removed using the cut-stump herbicide application method between the months of May to October. A chainsaw should be used to cut the Buckthorn down to ground level (or as close to as possible). Immediately following the cut (within 30 minutes), apply herbicide. It is recommended to use Garlon™ RTU (triclopyr active agent) which can be sourced from Corteva Agriscience (https://www.corteva.ca/en/products-and-solutions/crop-protection/garlon-rtu.html#anchor_3) however other herbicides may be used if the herbicide is designated for use on Buckthorn (see here for Garlon RTU label indicating Buckthorn is among the species that can be treated, pg 7). Spray herbicide directly onto the exposed stump and surrounding bark using a large paintbrush or hand-sprayer. Dye may be added to the herbicide to mark treated trees if desired (*Figure 8)*. Ensure you are following directions as outlined in the Garlon RTU Herbicide Label.

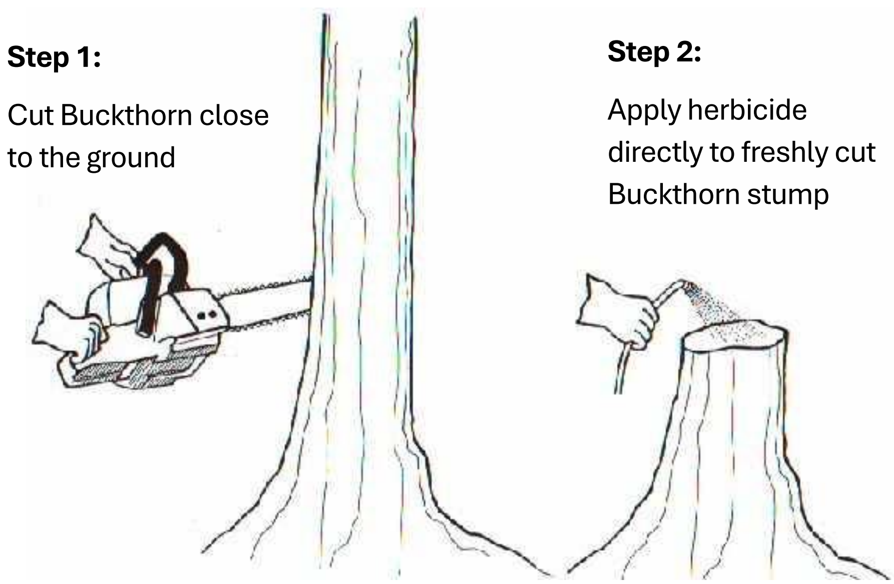

Figure 8. How to perform the cut-stump method of herbicide application on Buckthorn.

Branches of Buckthorn that were cut down will still have viable seeds. To prevent the spread and germination of these seeds, put removed branches into black plastic bags and leave in direct sunlight for 1-3 weeks (solarize). After the branches are solarized, they may be disposed of via municipal compost programs or by sending them to landfill (Ontario Invasive Plant Council, 2024).

Monitoring should be completed in subsequent years, as Buckthorn can resprout from stumps. Assessments should be conducted annually for at least **3 consecutive years** to monitor the success of Buckthorn removal. Revisit the treated Buckthorn. If Buckthorn is regrowing (resprouting from cut stump), repeat cut-stump herbicide application procedure on the new growth and old stump the following year (***do not apply herbicide treatments more than once***

per year). If monitoring indicates that the herbicide application was unsuccessful after 2 years, application of another herbicide could be attempted (glyphosate active agent as base). Do not remove stumps from the ground when chemical control is complete. Pre-established Buckthorn roots help to hold soil together, preventing erosion and bank collapse.

When removing Buckthorn manually, wear proper protective equipment (e.g. thick gloves, long sleeves, long pants, eye protection). When applying herbicide, wear appropriate protective equipment as outlined by the Material Safety Data Sheet.

3.2.2 Replanting Native Species

After Buckthorn removal, native trees can be planted in the vicinity of the remaining Buckthorn stumps.

Plants can be sourced from various local plant nurseries such as:

- Peterborough Landscape Supply (Peterborough, Ont.)
- Grow Wild! Native Plant Nursery (Omemee, Ont.)
- GreenUP Ecology Park Native Plant Nursery (Peterborough, Ont.)

To plant native species, some equipment will be necessary, including:

- Shovels
- Hand trowels
- Gardening gloves
- Extra soil
- Fertilizer (recommended to use a standard NPK mix for best results)
- Watering cans (water can be used from Baxter Creek for easy watering)
- Fibre mats (coconut fibre mats ideal for beaver deterrent, used to protect newly planted saplings)
- Gardening knives (optional, but helpful to remove thick roots)
- Gardening knee pads (optional, but helpful to make planting more comfortable)

Some other considerations when planting are weather conditions and personal safety. Wear long pants and comfortable footwear. Bring a hat and sunglasses to protect yourself from the sun. Wear sunscreen and bug spray to protect from sunburn and insect bites. Bring a water bottle and ensure you are keeping hydrated as you plant.

Buckthorn replacement species have been selected based on their ability to compete with the already established Buckthorn root system and their lack of desirability to beavers. For each species, planting instructions (timing, spacing, hole depth) are provided (*Table 5*).

Table 5. Native trees and shrub species to be planted to re-establish areas with Buckthorn. Yellow highlight = beaver deterring species. Information collected from Gardenia.net (2025), Farmer (2021), Prairie Moon Nursery (2025), Sears (2023), & McKay Nursery Company (2025).

Common Name	Latin Name	Planting Season	Planting Sequence; Sun/Shae	How to Apply/ Planting Density	When to Expect Presence On-Site
Common Ninebark	*Physocarpus opulifolius*	Anytime from spring (April) to early fall (October)	First; full sun	- Sapling - 3-6 ft apart - Hole twice as wide & deep as root ball	Immediately
Twinberry	*Lonicera involucrata*	Spring or fall	Second; sun – partial shade	- Seed or cutting - 6-10 ft apart - Hole twice as wide & deep as root ball	Immediately
Nannyberry	*Viburnum lentago*	March, May-November If planting bare root, plant in fall	Second; partial sun	- Sapling - 8-12 ft apart - hole twice as wide and deep as root ball	Immediately
[Northern] Spicebush	*Lindera benzoin*	Harvest berries in late summer or fall (turn red), sow immediately after harvest Will germinate in spring the following year	Later; medium shade	- Seeds or saplings - 8-12 ft apart	Immediately
Red Osier Dogwood	*Cornus sericea*	Spring. Take cutting and plant before buds start to open	First; full sun	- Twig cuttings (healthy, young shoots, 6-9 in) - 8-12 ft apart - stick deep into ground (covering 2 nodes) with at least one bud aboveground	Immediately

Species in *Table 5* were selected because of their root systems that can compete with established Buckthorn roots. A mix of sun-loving species and shade-loving species were chosen to ensure that native plants will continue to compete with Buckthorn throughout the stages of ecosystem succession. Sun-loving species will be planted first and after these are established, shade-loving species will be planted. The Buckthorn stands on-site are close to the creek bank's edge, so species were also selected based on their ability to prevent erosion and stabilize undercut banks. For example, red osier dogwood (*Cornus sericea*) and common ninebark (*Physocarpus opulifolius*) were selected because of their shallow but very fibrous root systems, which will directly compete with Buckthorn roots while still offering bank stability. Native grasses and forbs with deeper root systems will also be planted across the site (including near Buckthorn stands) to prevent erosion and offer deeper bank stability.

3.2.2.1 Protection Against Beavers

Some species in *Table 5* were selected based on their preference by beavers. In areas away from Buckthorn stands, species that are liked by beavers should be planted to attract attention away from where other trees to compete with Buckthorn will be planted. In these Buckthorn stands, disliked species (e.g. twinberry, common ninebark) will be planted to further deter beavers from the area, allowing newly planted trees to establish. The goal is to provide preferred species further from these vulnerable sections to prevent the added stress of beaver grazing on the newly planted trees meant to compete with Buckthorn.

Saplings that are planted on the site can be surrounded by coconut fibre mats or other exclusion devices (e.g. fencing) to prevent damage. Chicken wire can replace these mats once the saplings are larger and sturdier (MNR, 2024b). Another consideration will be controlling water levels due to damming to prevent inundation of newly planted vegetation. Beaver deceivers are a water control device that allows beavers to continue building dams on-site, while still allowing water through via a large ADS pipe that acts as a safety valve/drain (Lee, 2016). In some cases, beavers will chew through ADS piping. In these cases, replace ADS piping with 8-10" PVC piping. For an example of a beaver deceiver, see *Figure 9*.

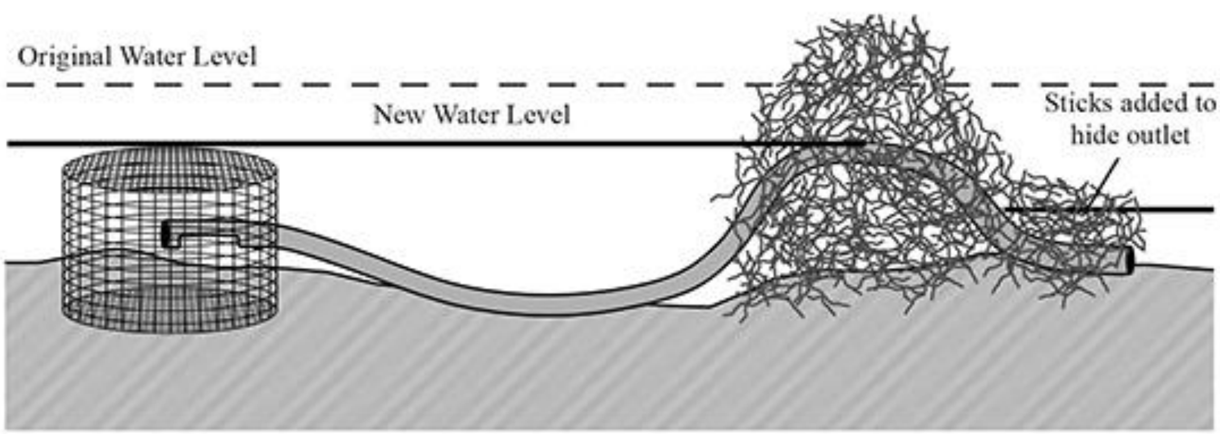

Figure 9. Beaver Deceiver diagram. (Ebbeka, 2013).

3.3 Wild Parsnip Removal & Monitoring

Wild parsnip removal is recommended due to the heavy use of the area by humans. It is important to note that the presence of Wild parsnip will not cause any detrimental effects to the quality of habitat being restored for Brook Trout, however it is a safety concern for humans using the site (e.g. for recreation, angling, etc.). Wild parsnip can be managed mechanically on-site, either by digging (for small infestations) or by mowing (larger infestations). For digging, the best time to remove the plant is in the spring when soil is moist and it's easy to dig roots out (Ontario Invading Species Awareness Program [OISAP], 2021). It is important to remove the entire taproot, or as much as possible when removing by digging, as the plant might resprout if a large portion of the taproot remains. Mowing may also be done immediately following peak blooming, but before seeds set in the late summer or early fall (OISAP, 2021). Mowed plants will likely resprout the first couple of times it is mowed, but repeated mowing should eventually kill the plant. Black plastic (tarps, garbage bags, etc.) can be placed following digging or mowing and left for at least one season to smother any roots and new growth. Once the black plastic is removed, the area can be replanted to rehabilitate the soil and add desirable species (OISAP, 2021).

Monitoring efforts to ensure Wild parsnip has been removed can be done at the same time as other vegetation assessments and will be completed using a presence/absence survey. If Wild parsnip is identified at the site, the location will be noted (using a handheld GPS unit or manually identified on a map) and removal efforts can be repeated the following season using the same methods as outlined above.

For more information about Wild parsnip removal, permit requirements, disposal, and management, please see the *Wild Parsnip Best Management Practices* (2024) Technical Document from the Ontario Invasive Plant Council: https://www.ontarioinvasiveplants.ca/wp-content/uploads/2024/02/OIPC_BMP_WildParsnip_Feb182014_FINAL2_1.pdf

3.4 Seeding Native Species

Revegetating the site with native species will be key in meeting restoration goals. Two primary plant mixes will need to be used to reach the desired outcomes of the restoration plan: a bank stabilizing plant mix to prevent creek bank erosion and collapse, and a general diversity plant mix to increase vegetation diversity. Replanting will be completed on a schedule, with pioneer species being planted first and later successional species being planted later once other plants have established. Pioneer species should be planted in the first year of revegetation efforts, then 2-3 years should pass before planting later successional species to ensure adequate site conditions are present.

Species being planted via seedlings/saplings will require spacing between other species and other man-made objects. These spacing requirements will ensure replanted species can properly grow. Seedlings or saplings will need to be transported and planted by hand.

Species being planted via seed (e.g. grasses and forbs) can be mixed for easier seed broadcasting. For replanting, the seeding rate used should be roughly 25 kg/ha (20 lbs/acre), meaning 25 kg of seed mix should be distributed relatively evenly across 1 hectare of the site. When seeding areas with established vegetation that might be patchy, you can seed more in bare areas and less in established areas. Avoid seeding in areas of dense established vegetation because new seeds will not get good seed-soil contact and will be outcompeted by larger plants for resources (sunlight, nutrients, water, etc.). Seeding by hand (hand broadcasting) will be the most effective method of revegetating at this site due to the terrain and established vegetation.

3.4.1 Bank Stabilizing Mix

The bank stabilizing plant mix consists of species that have diverse root structures (deep/shallow, fibrous/taproot) to stabilize the creek banks and prevent erosion/collapse. This mix will be focused on the outer banks of the stream where undercut banks are most prevalent. All seeding and planting should be completed by hand. Species included in this mix are outlined in *Table 6, Table 7,* and *Table 8*.

Table 6. Native tree and shrub species to be planted as part of the bank stabilizing mix. Information collected from Gardenia.net (2025), Loughrey (n.d.), Ferguson Tree Nursery (2019), & Vermont Willow Nursery (2020).

Common Name	Latin Name	Planting Season	Planting Sequence; Sun/Shae	How to Apply/ Planting Density	When to Expect Presence On-Site
Buttonbush	*Cephalanthus occidentalis*	Spring or fall	First; full sun	- Sapling - 4-12 ft apart Hole twice as wide and deep as root ball	Immediately
Eastern White Cedar	*Thuja occidentalis*	Early spring (gives full season to mature and strengthen) or fall (cooler days are less stressful to plants)	Later; shade tolerant	- Sapling - 10-12 ft apart - hole twice as wide and deep as root ball	Immediately
White Pine	*Pinus strobus*	Spring	Later; shade tolerant	- Sapling - 6-8 ft apart - hole twice as wide and deep as root ball	Immediately
Willow** e.g. American /Pussy Willow	*Salix spp.* *Salix discolor*	Spring. Take cuttings and plant before buds start to open	First; full sun On bank	- Twig cuttings - 10-20 ft apart to get mature trees - push into soil 6-8 in. deep	Immediately

**any *Salix* species EXCLUDING weeping (*Salix babylonica*), bay-leaf/laurel (*Salix pentandra*), crack/brittle (*Salix X fragilis*), and white/golden (*Salix alba*).

Table 7. Native grasses to be planted as part of the bank stabilizing mix. Information collected from Gardenia.net (2025), Stevens et al. (2006), Lloyd-Reilley (2010), Favorite & Moore (2002), & North Carolina Plant Toolbox (n.d.)

Common Name	Latin Name	Planting Season	Planting Sequence; Sun/Shae	How to Apply/ Planting Density	When to Expect Presence On-Site
Broad-leaf Cattail	*Typha latifolia*	Late fall (October-November), ideally after first rains and before any heavy flooding	First; full sun or partial shade	- seedlings/root divisions (taken from mature stands) - 48”-84” apart	1 year after planting
Canada Wild Rye	*Elymus canadensis*	Late fall (October-November)	Later; shade-tolerant but can also thrive in full sun	- Seeds - sow ¼ in deep	1 year after planting
Giant Bur-reed	*Sparganium eurycarpum*	Late fall (October-November)	First; prefers full sun but can tolerate some shade	- Seeds	2 years after planting
Threeway Sedge	*Dulichium arundinaceum*	Late fall (October-November)	Second; partial sun to partial shade	- Seeds	1-2 years after planting

Table 8. Native forb/wildflower species to be planted as part of the bank stabilizing mix. Information collected from OPN Seed (2025).

Common Name	Latin Name	Planting Season	Planting Sequence; Sun/Shae	How to Apply/ Planting Density	When to Expect Presence On-Site
Swamp Milkweed	*Asclepias incarnata*	Sow seeds 4-8 weeks before last frost (for cold stratification)	First; full sun	- Seeds - Do not need to be covered	1-2 years after planting
Cardinal Flower	*Lobelia cardinalis*	Sow seeds outdoors in late fall	Later; part-sun to full shade	- Seeds - lightly rake over after seeding to incorporate into soil	1-2 years after planting

3.4.2 General Diversity Mix

The general diversity plant mix consists of many species that will be well adapted to the conditions of the site. This mix will increase plant diversity presence on-site to increase resilience and provide diverse habitat space for surrounding wildlife. All seeding and planting should be completed by hand. Species included in this mix are outlined in *Table 9, Table 10,* and *Table 11*.

Table 9. Native tree and shrub species to be planted as part of the general diversity mix. Information collected from Gardenia.net (2025).

Common Name	**Latin Name**	**Planting Season**	**Planting Sequence; Sun/Shae**	**How to Apply/ Planting Density**	**When to Expect Presence On-Site**
Shrubby Cinquefoil	*Dasiphora fruticose*	Spring Softwood cuttings early summer	First; full sun	- Sapling, cuttings - 4-5 ft apart - hole 1.5 times wide and deep than root ball	Immediately
Trembling Aspen	*Populus tremuloides*	Early spring	First; full sun, fast-growing Plant further away from banks	- Sapling - 20-30 ft apart; - Hole twice as wide and deep as root ball	Immediately
White/Paper Birch	*Betula papyrifera*	Spring or fall	First; sun-loving, fast-growing Plant further away from banks	- Sapling - 20-30 ft apart - hole twice as wide and deep as root ball	Immediately

Table 10. Native grasses to be planted as part of the general diversity mix. Information collected from Gardenia.net (2025) & OSC Seeds (2025).

Common Name	Latin Name	Planting Season	Planting Sequence; Sun/Shae	How to Apply/ Planting Density	When to Expect Presence On-Site
Carex Sedge** (e.g. knotsheath/retrorse, brown fox, golden, etc.)	*Carex spp.* *Carex retrorsa* *Carex vulpinoidea* *Carex aurea*	Fall (October-November)	First; full sun-partial shade	- Seeds - Prepare site beforehand (other plant removal, loosen soil to 1" depth with rake or other equipment) - very close to water	1-2 years after planting
Woolgrass	*Scirpus cyperinus*	Fall (October-November)	First; prefers full sun but moderately shade tolerant	- Seeds - Prepare site beforehand (other plant removal, loosen soil to 1" depth with rake or other equipment)	1 year after planting

**Any *Carex spp*. EXCLUDING *Carex spicata, Carex torta, Carex willdenowii, Carex mesochorea, Carex muricata, Carex aestivalis,* and *Carex membranacea*.

Table 11. Native forb/wildflower species to be planted as part of the general diversity mix. Information collected from The Vermont Wildflower Farm (2025).

Common Name	Latin Name	Planting Season	Planting Sequence; Sun/Shae	How to Apply/ Planting Density	When to Expect Presence On-Site
Jewelweed/ Touch-Me-Not	*Impatiens capensis*	Spring or fall *Better success if cold stratified for 1-2 months before sowing in Spring	Second; partial shade	- Seeds - do not need to be covered	1 year after planting
Spotted Joe-Pye Weed	*Eutrochium maculatum*	Fall (October-November)	First; sun-loving	- Seeds	1-2 years after planting

Figure 10 is an example of a replanting map that may be followed in the first year of revegetation efforts. Tree spacing and grouping will be species dependent.

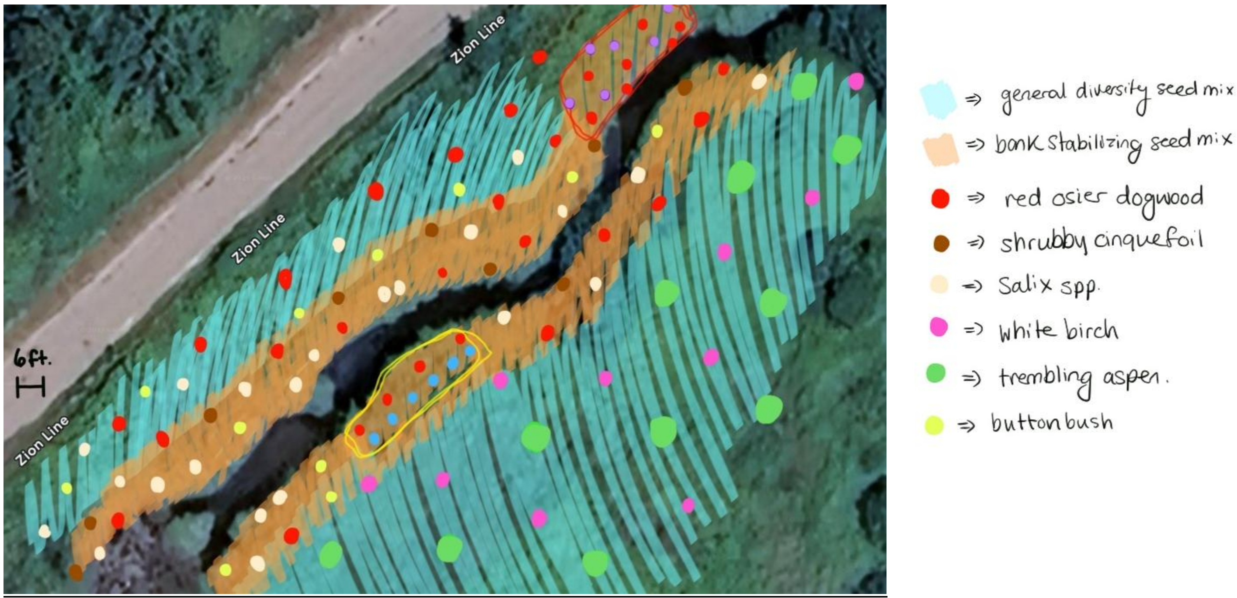

Figure 10. Replanting plan for the first year of revegetation efforts. All trees/shrubs are sun-loving species and will be the first species to be planted on the site. 6 ft is marked on the side of the left side of the map to provide context for plant spacing.

In the first year of replanting native trees and shrubs, sun-loving species will be planted first. Once these species are established, shade-loving species can be planted under the new canopy. Planting patterns for shade-loving species can be done similarly to what is outlined in *Figure 10*.

3.4.3 Monitoring & Contingency

For revegetation efforts to be deemed successful, the following values of vegetation cover should be established:

- 50-75% canopy cover of large (diameter-at-breast-height (DBH) >2.5 cm), established trees and shrubs
  - For smaller trees, (DBH <2.5 cm), ~50% cover of saplings
- 25-50% cover of grasses;
- 25-50% cover of forbs;
- ~50% cover of bank stabilizing species

These values will ensure diversity across the site, while also ensuring adequate cover of bank stabilizing species is present at the site. Aiming for these cover ranges will ensure site resilience to pests/disease and stabilize banks to keep undercut banks intact.

Presence of planted species should be apparent within 1-2 years of the initial planting, with later successional species being planted after this time frame. This will allow all species to have adequate time to establish on site. Vegetation assessments should be done in Year 2 (to assess pioneer species), Year 4 (to assess later successional species), Year 6 (to assess both), and Year 10 to assess overall revegetation success. At these times, notes should be taken of any damage (e.g. from insects, wildlife, humans, etc.) to established vegetation and any species that are missing from the site.

To ensure the success of the revegetation efforts, presence/absence surveys should be conducted to monitor the overall effectiveness of planting efforts and assess any damage to new growth. For each seeded/planted area of approximately 100 m^2 (10 m by 10 m) one 1 m x 1 m quadrat can be used to assess presence/absence of herbaceous species, while a 3 m x 3 m can be used to assess shrub growth. Within each quadrat, the number and name of the species present should be recorded (*Figure 11*; College of Natural Resources, n.d.). The list of species present should be compared to the seeded species. Any species that did not establish could be reseeded or planted. Those that are established but do not occupy a large area could also be reseeded or planted. An estimate of total cover should also be made for each plot (*Figure 12*). If total cover is below the recommended values identified above, reseeding is recommended.

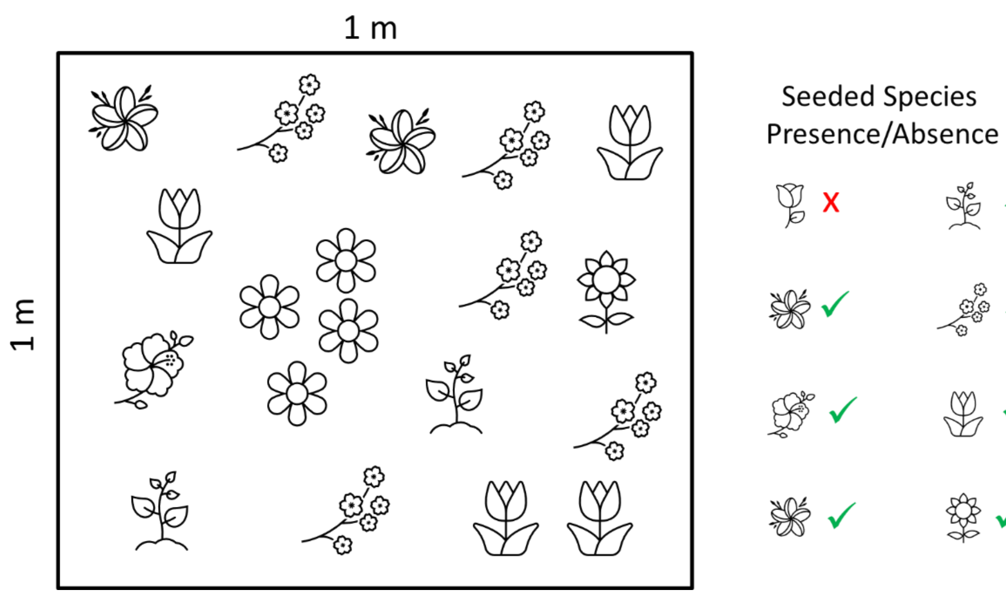

Figure 11. Determining species' presence and absence and comparing them to the list of seeded species. In this example, only one species did not establish from the seed mix. A couple of other species only have one individual established. These species could be reseeded.

Figure 12. Visual representation of determination of percent cover. In the photo to the right, the area of the 1 m x 1 m plot, covered by the shrub, is indicated by the red area and estimated to be approximately 50%. Total cover by vegetation would be 100% as bare ground cannot be seen.

Assessments should be made to measure the survival and success (trunk diameter and height) of trees (pre-established and newly planted) on site. This should be done to ensure trees are effectively growing on site. Trunk diameter measurements can be taken using a standard DBH measuring tape approximately 1.3 m up the trunk from the ground, and height can be measured using a clinometer. Clinometers are all calibrated differently, so ensure you follow the instructions provided for the specific tool you are using. Assessments can be completed on a schedule of 1 year post restoration (to note any dead saplings), 2 years post restoration (to assess any replanted saplings), 5 years post restoration, and 10 years post restoration. Any sapling death or reasons for concern (e.g. foliar death, insect damage, trunk damage, etc.) should be noted during the assessment. If specific species have not succeeded

For larger trees (DBH >2.5 cm), canopy cover should be measured every 5 years to track changes over time (Sabatini, 2021). These assessments can be made using a densiometer. Canopy cover can be estimated by counting the number of marked squares on the densiometer that are filled with tree canopy (Trimble, 2021). Each densiometer has its own correction factor, so ensure that you are following instructions with your specific model.

For identifying vegetation at the site, refer to the planting list for species that are expected to be present as well as external guides for identification guidance. Some helpful resources include:

- *Plants of Southern Ontario* (2014) by Richard Dickinson published by Lone Pine Publishing
- *Native Plants of the Northeast: A Guide for Gardening and Conservation* (2005) by Donald J. Leopold published by Timber Press Publishing
- Phone application *Ontario Wildflowers* (available on Apple and Android products)

- Phone application *iNaturalist* (available on Apple and Android products) and available online at https://www.inaturalist.org/
- Some species (grasses, forbs) may be listed in *Wetland Plants of Ontario* (1997) by Steven Newmaster, Alan Harris, and Linda Kershaw published by Lone Pine Publishing

If revegetation is found to be unsuccessful for planted trees (e.g. plants are not present at the desired abundance or plants are not present at all), replanting will be necessary. To replant, follow the same steps as outlined in *Section 3.4 – Seeding Native Species*, however it is recommended use rakes to loosen the soil before distributing seeds to increase seed-soil contact and increase establishment rates. The next season, if some species have still not established on site, make note of those that were not successful and remove from future planting efforts. If some species are still unsuccessful at the site after the second planting, remove species from planting mixes if future revegetation efforts become necessary.

3.5 Other Additions

3.5.1 Cover Objects

Cover objects, typically large rocks, logs, or undercut banks, are an important aspect of Brook Trout habitat to provide protection from predators. Currently, there are few large cover objects present aside from undercut banks. Stabilizing these banks will be key in creating some cover within the stream, however it is ideal to have diverse cover available. Objects (logs, branches, large rocks) found around the site can be placed into the stream as cover. These objects can be placed anywhere throughout the stream, but it is recommended to distribute them across the site relatively equally to provide ample cover throughout the site. Over time, large branches or sticks will fall into the stream following revegetation efforts, adding more naturally placed cover objects into the stream.

3.5.2 Brush Bundles

Brush bundles are made by tying together many sticks or branches together to form dense bundles. These bundles are then placed along the outer bends of the stream to prevent erosion. Brush bundles can be created following the instructions outlined by Lanark County Stewardship Council (2021) (pg. 23) found here.

Brush bundles will need to be secured to the sides of the creek, which can be done using wooden stakes. Use a mallet to hit stakes into the creek bed where brush bundles will be placed. After stakes securely in the creek bed, place brush bundles between the stakes and the creek bank and tie them to the stakes using twine to secure them into place. See *Figure 13* for a diagram of how brush bundles would be placed along the creek bank.

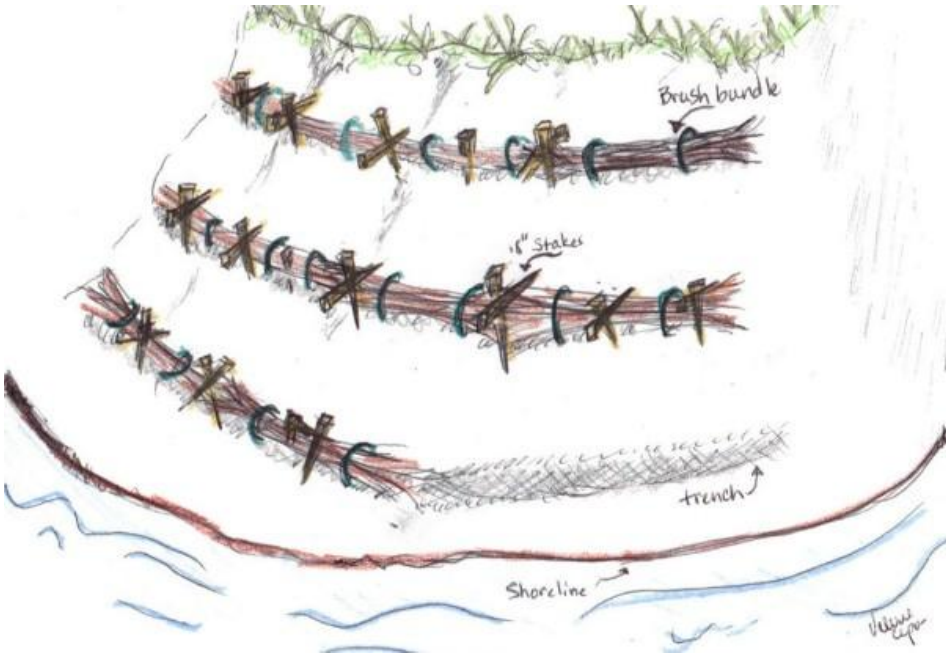

Figure 13. Brush bundles used in a stream for erosion control. Brush bundles are placed between stakes and creek bank. Twine is wrapped around both the brush bundles and the stakes to keep everything in place.

3.6 Stream Health Monitoring

Monitoring will be key to ensure this restoration is successful. Monitoring should include vegetation surveys (outlined in *Section 3.4.3 Monitoring & Contingency (Seeding Native Species)*, electrofishing surveys, benthic invertebrate surveys, and water quality assessments. All surveys are recommended to be completed at their respective sites outlined earlier in *Figure 3*.

3.6.1 Fish

The key measure of success for this project will be to ensure that Brook Trout are in fact using the new habitat area. Rapid assessment electrofishing (Jones and Stockwell, 1995) should be used to assess the fish community. By conducting electrofishing samples, the success of the restoration efforts can be quantified by the number of Brook Trout that are currently using the site. Electrofishing should be completed in Year 2, Year 4, and Year 10 of restoration. If restoration efforts are successful, an increase in the number of Brook Trout collected at this site during electrofishing events is expected.

3.6.2 Benthic Invertebrates & Water Quality

To ensure that restoration practices have not altered microhabitats available to benthic invertebrates (a key food source for Brook Trout), regular samples will need to be collected to assess the overall community structure throughout the restoration process. The most accessible method of doing this is by following standard OBBN protocols, however it may be desirable to collect samples in accordance with the Canadian Aquatic Biomonitoring Network protocols to gain more in-depth information about the site and its benthic inhabitants. The level of identification of OBBN is inadequate for understanding potential diet and growth of Brook Trout and for understanding the ecological function within the benthic community. Brook Trout feed primarily on drifting invertebrates. Ecological function and members of the drifting community can usually be determined with identification of insects to the family taxonomic level which we recommend. After riparian planting has been completed (Year 4), benthic invertebrates should be collected for three (3) consecutive years to establish baseline data (Jones et al., 2007) (Year 4, Year 5, Year 6). After this, benthic invertebrates may be collected whenever necessary/desired. Water quality will also be assessed during these surveys

3.6.3 Water Quality & Erosion

Water quality assessments should be completed to ensure that the values are in the required ranges for Brook Trout. Assessments can be made using multi-probe meters (e.g. OAKTON meters, YSI meters, etc.) to complete surveys efficiently. Water quality should be assessed during Year 2, Year 4, Year 6, and Year 10. Stream morphology measurements (wetted width, bank full width, depth, stream velocity) should also be taken during water quality assessments. Wetted width and bank full width measurements can be used to track changes in erosion over time at the site to ensure the revegetation and brush bundles are preventing further erosion of the banks. Measurements can be taken along the cross-section of the stream at the sites outlined in *Figure 3* using a 30 m transect tape (to measure widths), a meter stick (to measure depth), and a flowmeter (e.g. a Pygmy meter or a digital meter [SWOFFER]) (to measure stream velocity).

4.0 SUMMARY & CLOSING

After implementing this restoration plan, it is expected that this site will become excellent Brook Trout habitat by stabilizing undercut banks and preventing further erosion, promoting plant diversity on-site, and adding instream cover objects. Completing monitoring during the times suggested will be key in ensuring this site is on track to meet restoration goals and continue to thrive into the future. The creation of suitable habitat in this downstream section of Baxter Creek will help to support existing Brook Trout populations and allow them to thrive in this area for generations to come.

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