

Nashwaak Watershed Association Inc.

Tree Nursery Management Plan

2015

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Introduction

The Nashwaak Watershed Association Inc. (NWA) is a registered non-profit organization that was founded in 1995. The NWA aims to ensure that the watershed is managed as a healthy ecosystem that balances a variety of economic, recreational, social and landowner interests. In doing so, the NWA has created a native-tree nursery to facilitate on-going community outreach programs. The primary goals of the nursery are to provide the NWA with a consistent annual supply of native tree stock in order to (1) support ongoing floodplain-forest restoration projects within the watershed, and (2) maintain a consistent supply of Acadian tree species available to the public and other watershed organizations. The following management plan was developed to provide a framework for achieving these annual goals, which involves an expansion of the current nursery, as well as a planting schedule projected over a ten-year period, both of which are detailed in this document.

Nursery Location

The NWA nursery is located at 17 Maclean Flat Road, Durham Bridge, New Brunswick (Lat: 46.143510; Long: -66.609553). Although managed by the NWA, the nursery grounds are owned by Sandra Estey (PID 75176636). The nursery grounds occur directly on the Maclean Flat - a low-lying area that is annually flooded by the adjacent Nashwaak River. Although originally covered by Silver Maple floodplain forest, the flats were largely cleared for agriculture in the past, and were subsequently topsoil mined up until approximately 10 years ago. Today the flats are most left as fallow pasture, with the southern portion now managed as the NWA tree nursery.

Nursery Design

The NWA nursery is composed of six separate planting beds. Beds 1 – 4 are for the production of floodplain tree species, whereas bed 5 is for the production of Acadian upland tree species, and is divided into 3 blocks (Figure 1). Bed 6 is for the production of native willow cuttings. Beds 1 - 5 are each 100 x 30 feet (Figure 1) and generally run east – west, whereas bed 6 is 200 x 5 feet and generally runs north – south (Figure 2).

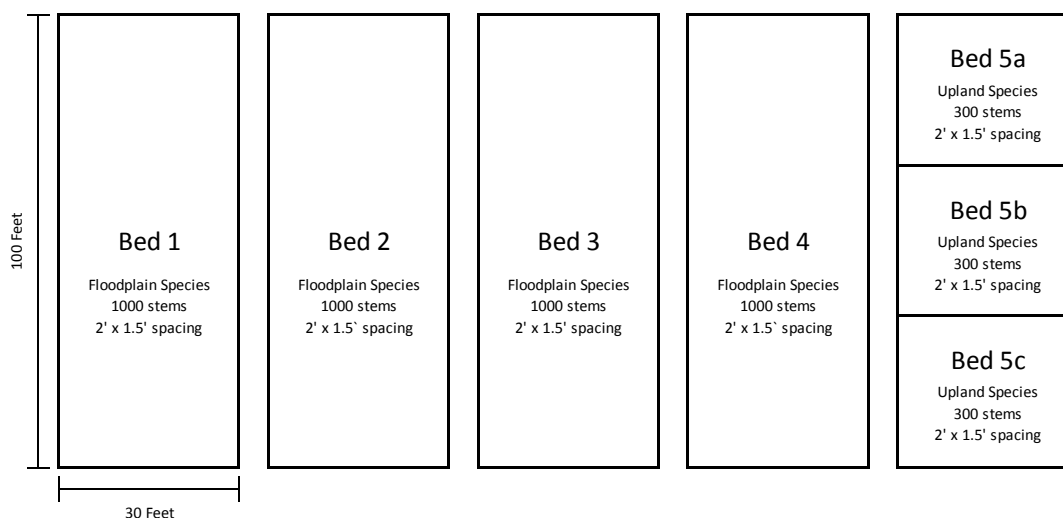


Figure 1. Nursery bed schematic.

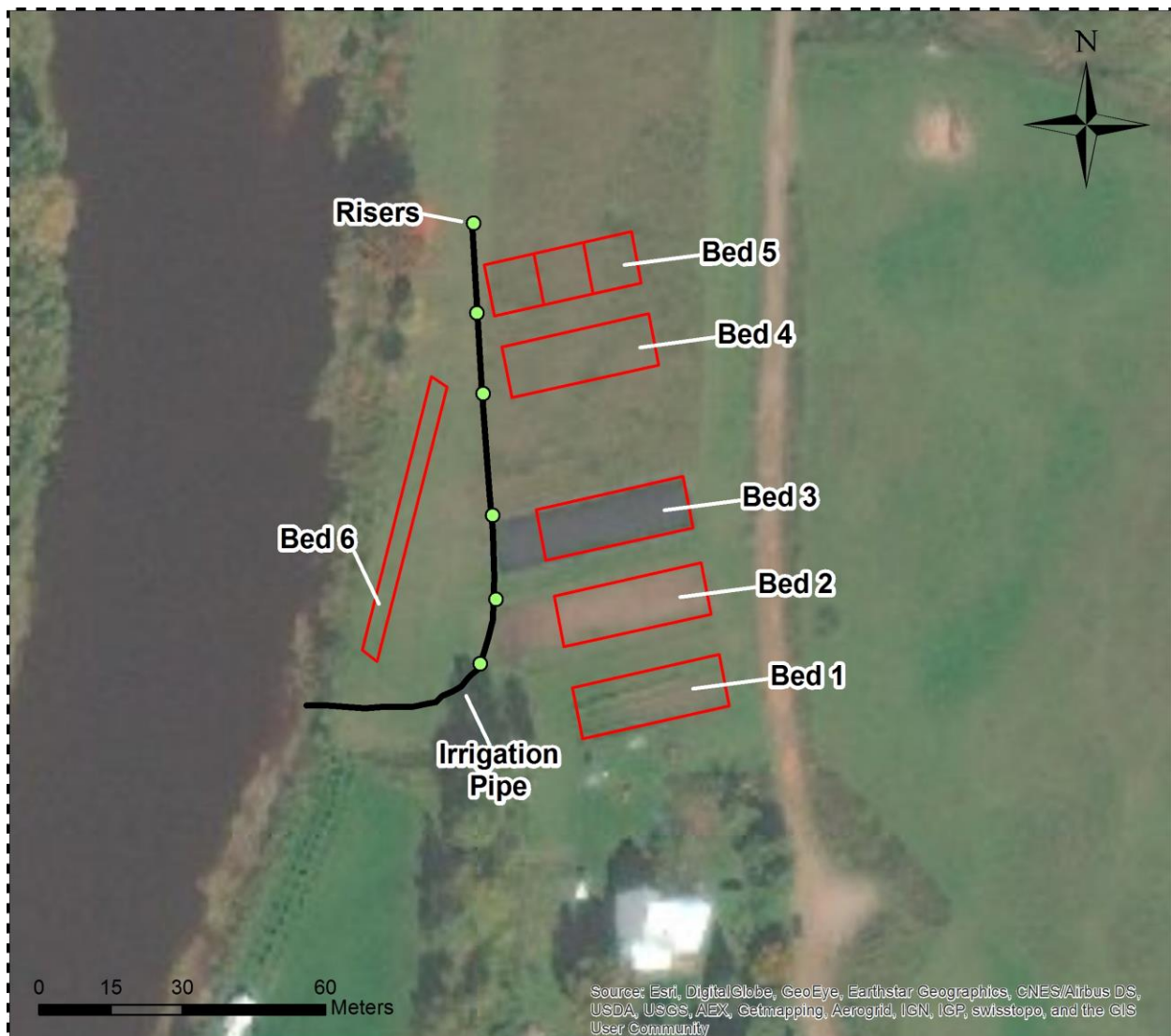


Figure 2. Nursery layout on the Maclean Flat.

Beds 1 – 4: Floodplain Forest Species

In full production, beds 1 - 4 will produce 1,000 trees / year for floodplain-forest restoration projects

Schedule 1	
Species	Stems
Silver Maple	850
White Elm	150

throughout the watershed. The species mix will follow schedule 1 to resemble the natural composition of floodplain forests along the Nashwaak River. Each bed will go through a 4-year cycle, resulting in a bed of three-year trees for outplanting, two beds with 1-year and 2-year trees, respectively, and 1 unplanted bed, each year.

Unplanted beds will be sown with a green manure to replenish soil nutrients, prevent erosion, and control unwanted weeds. Trees will be planted at 2 x 1.5 foot spacing, with the wider spacing running east - west to capture maximum sunlight (see Appendix B for planting bed schematic).

Bed 5: Acadian Upland Species

In full production, the upland species bed will produce 300 trees / year for private sale or donation. The species mix will follow schedule 2, which aims to provide a diversity of native upland Acadian tree species. Bed 5 is divided into 3 blocks, each of which will go through a 3-year cycle, resulting in a block of three-year trees for outplanting, a block of 2-year trees and a block of 1-year trees, each year. Unlike beds 1 - 4, newly planted blocks in bed 5 will require an application of compost rather than green manure, since there is never a fallow block. Trees should be planted at 2 x 1.5 foot spacing.

Schedule 2			
Hardwood Sp. Stems		Conifer Sp. Stems	
Red Oak	50	Eastern Hemlock	25
Red Maple	50	White Pine	25
Sugar Maple	50	Eastern Cedar	50
Butternut	20		
Basswood	30		

Bed 6: Willow Species

Bed 6 will be planted with native willows to provide stem cuttings for riverbank stabilization projects throughout the watershed. The species mix will follow schedule 3 to mimic the species composition typical of alluvial floodplains along the Nashwaak River. Unlike beds 1-5, the willows will remain permanently planted and will be coppiced to produce willow whips for transplant. Willows will be planted at 6 foot spacing to maximise light exposure and growth.

Schedule 3	
Species	Stems
Red-tipped Willow	16
Sandbar Willow	16

Once established, willows can be pruned annually at the end of each growing season (down to ~5 cm from the ground). This will promote multi-stemmed coppicing rather than upward growth.

Irrigation System

An irrigation system has been installed to maintain a water supply to beds 1 – 5 (Figure 2) as needed. A total of 300 feet of buried 2" PVC piping and approximately 300 feet of 5/8" or ¾" hose will be required. The piping runs along the west side of the beds, and hoses will be attached to low-profile risers installed at regular intervals along the pipe. This will allow for a sprinkler-style watering system that can be shifted around depending on the watering needs of each bed. The "source" will be a 2' Honda power water pump that will draw water directly from the Nashwaak River and run through the underground PVC pipe (Figure 3).



Figure 3. Pipeline installation for the irrigation system.

Tree Management

The following sections provide an overview of the annual management activities required to maintain a consistent supply of trees from Schedules 1 - 3. Each year, activities begin in the spring following the last frost. To date, seed stratification and propagation has been completed away from the nursery grounds, as the spring floods inundate the nursery each year. Currently, these activities take place at the residence of Paul McLaughlin and Monique Leblanc [Tel: (506) 450-4943].

Seed collection

With the exception of Silver Maple, Red Maple and White Elm, the required amount of seed for each species should be collected in the autumn prior to planting (see Appendix C for details). In the case where seed is not obtainable, or if germination rates are too low to produce enough tree stock, Appendix D details suppliers where seed and/or nursery stock may be purchased. Generally, the minimum number of seed required annually for each species should be twice the amount scheduled for outplanted. Table 1 provides suggested annual seed required based on Schedules 1 -3 and rates of germination for each species.

Table 1. Annual seed required and average number of seeds per pound
(average seeds / lb from Bonner & Karrfalt, 2008).

Tree Species	Annual Seed Required	Seeds / lb (approximate)
Silver Maple	2000+	1,780
White elm	300+	71,000
Red Oak	150+	105
Red Maple	100+	23,000
Sugar Maple	100+	7,030
Butternut	60+	30
Basswood	100+	5,000
Eastern Hemlock	50+	187,000
White Pine	50+	26,000
Eastern Cedar	100+	346,000

Seed Propagation

After the last frost (ideally in June), seeds can be sorted, cleaned and tested for viability. The process of sorting, cleaning and testing is suggested to take place over no more than 3 days, at which point seeds can be left to air-dry. Once prepared, seeds can be sown in trays of prepared soil and watered daily (Figure 4; Schedule 4). Trays should be watered daily for 2-3 weeks, until germination. Once germinated, seedlings can be transferred into plugs using the same soil mix (Figure 5). An additional 50% of the required number of trees in Schedules 1 and 2 should be transferred to plugs to account for loss.

Schedule 4	
Suggested soil ratio (by volume)	
Manure	10%
Compost	40%
Sand	50%



Figure 4. Example of tray with prepared soil.

Bed Preparation and Planting

In preparation for planting beds 1 - 4, each bed scheduled for planting should be tilled in the spring to scarify the soil and mix in the green manure (see below). For bed 5, blocks scheduled for planting should be given an application of compost before tilling. To date, compost has been donated by the City of Fredericton, Parks & Trees department. The current contact for acquiring compost is Robert Glenwright (**Robert.Glenwright@Fredericton.ca**).

Each spring, unplanted beds will be sown with a commercial green manure and left fallow to increase soil nutrients and limit weed colonization during the growing season. Green manure is broadcast seeded and raked into each bed. Suggested commercial green manures include ryegrass, buckwheat or clover.



Figure 5. Example of seedlings in plugs.

When planting beds, the trayed plugs can be planted based on the spacing provided in Figure 1. It is suggested to use string marked at the appropriate spacing to maintain straight, evenly spaced rows. This will make tilling and cultivating much easier. When planting the beds, it is suggested to keep species together in the planting arrangement for easier access when outplanting. For bed 5, hardwoods can be planted on the northern edge of each block to minimize shading of slower growing conifers. In addition to the willow cuttings directly outplanted for bank stabilization, bed 6 should also provide 100 willow cuttings to be potted annually. Willows can be potted early in spring to provide a full growing season of root growth. They can then be outplanted in the autumn or in the following spring. The species mix can follow Schedule 3.

Nursery Upkeep and Maintenance

Management of the nursery grounds can only happen once flooding subsides, and the soil has been given adequate time to dry. Watering can occur as required throughout the summer, and the irrigation system is to be used in emergencies, in the case where trees may be subject to dehydration in high summer. For general nursery work, the NWA uses a Kubota B2320 tractor, with various attachments, that remain on site at the nursery

Tilling / Cultivating

Tilling and cultivating is required for both bed preparation, as well as ongoing weed management in planted beds. For preparing fresh beds each spring, and tilling under green manure each fall, a 60 in Agric AL 55 tiller attachment (Figure 6) can be used with the Kubota B2320 tractor. Between-row tilling and cultivating can be done using the NWA-owned Husqvarna CRT900 rear-tine (14") hand tiller-cultivator (Figure 7), and/or an Echo hang-held gas cultivator (Figure 8).



Figure 6. Agric AL 55 tiller attachment.



Figure 8. Husqvarna CRT900 Tiller.



Figure 7. Husqvarna CRT900 Tiller.

Cultivating is an ongoing process and should be done whenever possible. Rows should be cultivated once per month, at minimum, to ensure weeds do not begin outcompeting nursery stock. Some hand weeding may also be necessary in areas where the cultivator cannot access (*i.e.* directly adjacent to tree stems).

Mowing

Mowing should also be done as often as possible, with a minimum of four times per summer. Mowing is required throughout the nursery to maintain a field of view, but also to limit the amount of debris from the surrounding fields that catches on nursery stock during flooding events. The entire field on the property should be mowed twice a year, at minimum. The last mowing of the season should occur just before the first frost. Mowing can be accomplished using a loaned Bush hog Model 48 “Squealer” for rough work (Figure 9), and a 48’ finish mower attachment (Figure 10), both of which attach to the Kubota B2320 tractor.



Figure 9. NWA1 Mower attachment.



Figure 10. Finish mower attachment.

Reference Material

Bonner, F.T. & Karrfelt R.P. (2008). The Woody Plant Seed Manual. Agriculture Handbook 727. U.S. Department of Agriculture, Forest Service. Online: http://www.nsl.fs.fed.us/nsl_wpsm.html

Burns, Russell M., and Barbara H. Honkala, tech, coords. (1990). Silvics of North America: 1. Conifers; 2. Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. vol.2, 877 p. Online: http://www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm

Hinds, H. R. (2000). Flora of New Brunswick. 2nd ed. Fredericton, N.B: Primrose Press.

Hoag, C. (2007). How to plant willows and cottonwoods for riparian restoration. USDA-Natural Resources Conservation Service. TN Plant Materials No. 23.

OMNR (Ontario Ministry of Natural Resources). (1995). Restoring shorelines with willows. Land Owner Resource Centre. Extension Notes.

von Althen, F.W. (1990). Hardwood planting on abandoned farmland in Southern Ontario: Revised Guide. Forestry Canada, Ontario Region, Sault Ste. Marie, Ontario. 77 p.

Appendix A: Ten-Year Management Schedule

2015 Activity Schedule

Complete?

- 1) Salvage or dispose of all trees from beds 1 – 2 ☐
- 2) Apply compost to beds 4, 5 and 6 ☐
- 3) Till all 6 beds ☐
- 4) Sow green manure on beds 1 -5..... ☐
- 5) Setup irrigation system ☐
- 6) Plant bed 6 ☐
- 7) Pot 100 willows ☐
- 8) Till under green manure in Autumn ☐
- 9) Mow field..... ☐

2016 Activity Schedule

Complete?

- 1) Clear debris from beds ☐
- 2) Till beds 1 - 5 ☐
- 3) Plant beds 1 and 5a ☐
- 4) Sow green manure on beds 2 - 4..... ☐
- 5) Pot 100 willows..... ☐
- 6) Weeding and mowing mid-summer..... ☐
- 7) Till under green manure in Autumn ☐
- 8) Coppice bed 6 ☐
- 9) Mow field..... ☐

2017 Activity Schedule

Complete?

- 1) Clear debris from beds ☐
- 2) Till beds 2 – 4 and 5b..... ☐
- 3) Plant beds 2 and 5b..... ☐
- 4) Sow green manure on beds 3 – 4 ☐
- 5) Pot 100 willows..... ☐
- 6) Weeding and mowing mid-summer..... ☐
- 7) Till under green manure in Autumn ☐
- 8) Coppice bed 6 ☐
- 9) Mow field..... ☐

2018 Activity Schedule

Complete?

- 1) Clear debris from beds ☐
- 2) Till beds 3, 4 and 5c ☐
- 3) Plant beds 3 and 5c ☐
- 4) Sow green manure on bed 4 ☐
- 5) Pot 100 willows ☐
- 6) Weeding and mowing mid-summer ☐
- 7) Till under green manure in Autumn ☐
- 8) Coppice bed 6 ☐
- 9) Mow field ☐
- 10) Outplant bed 1 and 5a ☐

2019 Activity Schedule

Complete?

- 1) Clear debris from beds ☐
- 2) Apply compost to bed 5a ☐
- 3) Till beds 1, 4 and 5a ☐
- 4) Plant beds 4 and 5a ☐
- 5) Sow green manure on bed 1 ☐
- 6) Pot 100 willows ☐
- 7) Weeding and mowing mid-summer ☐
- 8) Till under green manure in Autumn ☐
- 9) Coppice bed 6 ☐
- 10) Mow field ☐
- 11) Outplant beds 2 and 5b ☐

2020 Activity Schedule

Complete?

- 1) Clear debris from beds ☐
- 2) Apply compost to bed 5b ☐
- 3) Till beds 1, 2 and 5b ☐
- 4) Plant beds 1 and 5b ☐
- 5) Sow green manure on bed 2 ☐
- 6) Pot 100 willows ☐
- 7) Weeding and mowing mid-summer ☐
- 8) Till under green manure in Autumn ☐
- 9) Coppice bed 6 ☐
- 10) Mow field ☐
- 11) Outplant beds 3 and 5c ☐

2021 Activity Schedule

Complete?

- 1) Clear debris from beds..... ☐
- 2) Apply compost to 5c ☐
- 3) Till beds 2, 3 and 5c..... ☐
- 4) Plant beds 2 and 5c ☐
- 5) Sow green manure on bed 3 ☐
- 6) Pot 100 willows..... ☐
- 7) Weeding and mowing mid-summer..... ☐
- 8) Till under green manure in Autumn ☐
- 9) Coppice bed 6 ☐
- 10) Mow field..... ☐
- 11) Outplant beds 4 and 5a..... ☐

2022 Activity Schedule

Complete?

- 1) Clear debris from beds..... ☐
- 2) Apply compost to 5a ☐
- 3) Till beds 3, 4 and 5a ☐
- 4) Plant beds 3 and 5a..... ☐
- 5) Sow green manure on bed 4 ☐
- 6) Pot 100 willows..... ☐
- 7) Weeding and mowing mid-summer..... ☐
- 8) Till under green manure in Autumn ☐
- 9) Coppice bed 6 ☐
- 10) Mow field..... ☐
- 11) Outplant beds 1 and 5b..... ☐

2023 Activity Schedule

Complete?

- 1) Clear debris from beds..... ☐
- 2) Apply compost to 5b ☐
- 3) Till beds 1, 4 and 5b ☐
- 4) Plant beds 4 and 5b..... ☐
- 5) Sow green manure on bed 1 ☐
- 6) Pot 100 willows..... ☐
- 7) Weeding and mowing mid-summer..... ☐
- 8) Till under green manure in Autumn ☐
- 9) Coppice bed 6 ☐
- 10) Mow field..... ☐
- 11) Outplant beds 2 and 5c ☐

2024 Activity Schedule

Complete?

- 1) Clear debris from beds ☐
- 2) Apply compost to 5c..... ☐
- 3) Till beds 1, 2 and 5c ☐
- 4) Plant beds 1 and 5c ☐
- 5) Sow green manure on bed 2 ☐
- 6) Pot 100 willows ☐
- 7) Weeding and mowing mid-summer ☐
- 8) Till under green manure in Autumn ☐
- 9) Coppice bed 6..... ☐
- 10) Mow field ☐
- 11) Outplant beds 3 and 5a ☐

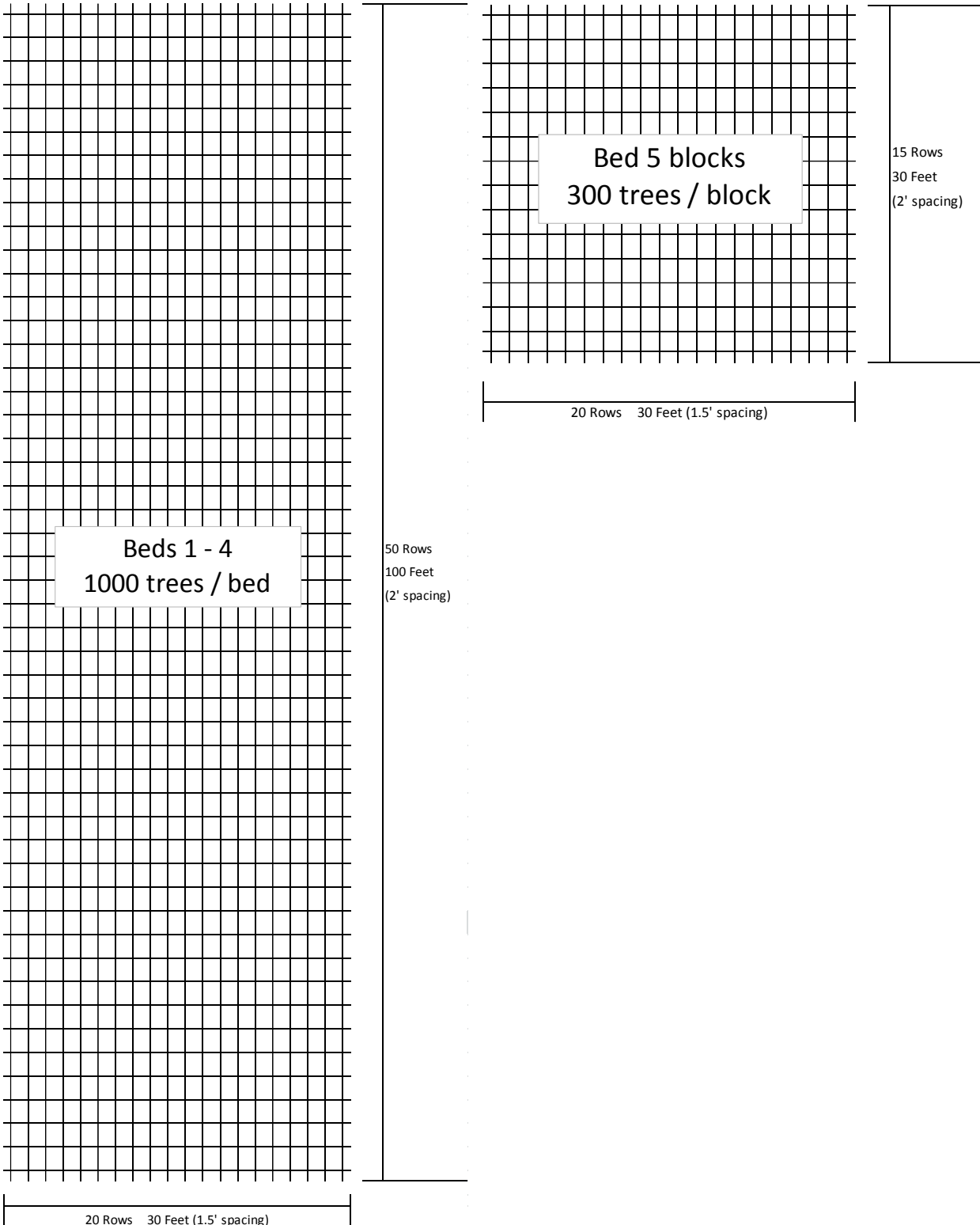
2025 Activity Schedule

Complete?

- 1) Clear debris from beds..... ☐
- 2) Apply compost to 5a ☐
- 3) Till beds 2, 3 and 5a ☐
- 4) Plant beds 2 and 5a..... ☐
- 5) Sow green manure on bed 3 ☐
- 6) Pot 100 willows..... ☐
- 7) Weeding and mowing mid-summer..... ☐
- 8) Till under green manure in Autumn ☐
- 9) Coppice bed 6 ☐
- 10) Mow field..... ☐
- 11) Outplant beds 4 and 5b..... ☐

Appendix B: Bed Planting Schematic

(A planted tree is represented wherever two lines cross)



Appendix C: Species seed production, germination, viability and outplanting suggestions

Silver Maple (*Acer saccharinum*)

Silver maple seeds ripen early in the spring and seed fall is generally complete by early June. Seeds do not require stratification, and can be germinated immediately after maturation. Germination is best on moist mineral soil with high organic matter content. Germination rates are typically very high, and a success rate of >95% is not uncommon. Outplanting is most successful on trees greater than 50 cm in height (von Althen, 1990).

White Elm (*Ulmus americana*)

White elm seeds mature in spring and seed fall is usually complete by mid-June. Seeds do not require stratification and can be germinated immediately after ripening. Germination is best on moist mineral soil. Germination rates are typically >60%. Seedlings are often ready to be outplanted after 1 year of growth.

Eastern Hemlock (*Tsuga canadensis*)

Eastern hemlock cones ripen fully by mid-October, and can be collected at this time. Seeds require cold stratification and germinate the following spring. The optimum seedbed for germination is a warm (15°C), moist mineral soil with high organic matter content. Deep rooting systems are common on well-drained soil, so care should be taken to minimize root stress when outplanting.

Eastern White Pine (*Pinus strobus*)

Eastern white pine cones ripen in summer (August – September) of their second year, and seeds are typically dispersed within 1 month of ripening. Seeds require stratification slightly above freezing to germinate, and do so best on moist mineral soil.

Eastern White Cedar (*Thuja occidentalis*)

Eastern white cedar cones typically ripen in late summer and seed dissemination begins in September. Seeds require stratification over the winter and germinate the following spring. High temperatures are required for germination, which can result in delayed germination until July or August. A warm, moist seedbed is ideal for germination and seedling establishment, preferably on mineral soil with high organic matter content.

Red Oak (*Quercus rubra*)

Red oak seeds mature in fall and require stratification over the winter before germinating the following spring. Germination is best when acorns are buried in mineral soil and covered with a thin layer of organic matter. Both acorns and seedlings are highly susceptible to drying out in early spring. During outplanting, care should be taken to minimize root damage as seedlings develop a vigorous

taproot upon germinating. Outplanting is most successful on trees greater than 50 cm in height (von Althen, 1990).

Red Maple (*Acer rubrum*)

Red maple seeds ripen in early spring before leaves are fully developed. Seeds can be collected and sowed immediately after ripening as red maple has very few germination requirements. A seedbed of moist mineral soil is best for germination.

Sugar Maple (*Acer saccharum*)

Sugar maple seeds ripen in autumn, and can be collected approximately 2 weeks before the leaves begin to fall. Sugar maple seeds require moist stratification over the winter, and prefer temperatures slightly above freezing to germinate. Outplanting is most successful on trees greater than 30 cm in height (von Althen, 1990).

Butternut (*Juglans cinerea*)

Butternuts ripen in September – October and will remain on the tree until after leaf fall. Early seed collection is recommended as butternuts are highly prized by squirrels and other wildlife. Seeds require cold stratification to overcome dormancy, and will germinate the following spring. Seedlings will establish a tap root followed by a deep and widespread root network, so care should be taken to minimize root stress during outplanting. Outplanting is most successful on trees greater than 30 cm in height (von Althen, 1990).

Basswood (*Tilia americana*)

Seeds ripen in September – October and can be collected at this time. Basswood seeds require extended dormancy in nature, but this can be overcome by early harvesting (September) and immediately sowing the harvested seeds. Seeds are ready for harvest once they turn brown, but before they dry and harden. Basswood seedlings can form a taproot up to 20 cm in length during their first year's growth. Outplantings have been successful on abandoned farmland that received site preparation and weed control.

Red-tipped Willow (*Salix eriocephala*) Sandbar Willow (*Salix exigua*)

Both willow species are native to New Brunswick and are commonly used for riparian restoration (Hoag, 2007; OMNR, 1995). They are best propagated from cuttings. Plant willow cuttings as early as possible in spring to maximise root growth for erosion control. Nursery stock can be cut at the base of the stem (5 cm above ground) each spring to promote shoot growth (also called whips). The cut stems can be outplanted directly.

Appendix D: Seed and Nursery Stock Suppliers

Scott's Nursery - <http://scotts-nursery.ca/>

Scott & Stewart - <http://www.scottandstewart.com/nursery.html>

T & D Native Tree Nursery – 1503 Forties Road, New Ross, NS; (902) 689-2737

Springvale Nurseries - <http://springvalenurseries.com/>

Cornhill Nursery - <http://www.cornhillnursery.com/>

Pineneedle Nursery - <http://www.pineneedleplants.ca/>