Nashwaak Watershed Association Inc.

Neil's Flats

Forest Restoration Plan

2015

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Introduction

The Nashwaak Watershed Association Inc. (NWAI) is a registered non-profit organization that was founded in 1995. The NWAI aims to ensure that the Nashwaak watershed is managed as a healthy ecosystem that balances a variety of economic, recreational, social and landowner interests. In doing so, the NWAI has undertaken a series of restoration projects on abandoned farmland along the river. Land cleared up to the riverbank is highly vulnerable to erosion from ice scouring and flooding, and has resulted in a significant loss of land, as well as sedimentation issues within the Nashwaak River.

The following management plan was developed to provide a framework for restoring the Neil's Flats, which were mostly cleared for agriculture in the past. Before land clearing, the flats would have been composed of a Silver Maple dominated floodplain-forest community. Floodplain forests, such as those along the Nashwaak River are, for a variety of reasons, critically important ecosystems. One of main benefits of a healthy floodplain forest is its ability to mitigate flood damage, by absorbing large amounts of water and slowing both the speed and height of floodwaters. A study conducted in the Boston area by the National Wildlife Federation found that Silver Maple floodplain forest was worth $72,000 (US) per hectare, per year, based on flood mitigation alone (Mertl et al. 2015). Kozlowski & Davies (1975) found that, during high summer, a mature Silver Maple can draw up, and subsequently release into the atmosphere, up to 220 litres of water every hour. Additionally, a single Silver Maple can intercept over 11,000 litres of rainfall annually, significantly reducing runoff and soil erosion (Peper et al. 2007).

In addition to flood mitigation and erosion control, these unique forest communities help moderate the temperature of the Nashwaak River by providing shade (Tepley et al. 2004), and decreasing nutrient loads in the river by taking up excess nutrients for growth (Lowrance et al. 1981). Riparian forests, such as those along the Nashwaak, also support a very high diversity of plant and animal species (Naiman et al. 1993), and can harbor up to twice as much biodiversity as nearby upland forests (Gregory et al. 1991). For these reasons, the NWAI has committed to restoring these important forest communities along the Nashwaak River, for the benefit of wildlife and local communities within the watershed.

Property Description

This plan has been developed for two properties on the Neil's Flats, totalling 50.7 hectares (125.3 acres), located along the Nashwaak River in Fredericton, New Brunswick (PID# 01476951 and 01428481). The properties are owned by the City of Fredericton and are almost entirely within a Provincially Significant Wetland (PSW) designation (Figure 1). The City of Fredericton obtained the land in 2013 under the jurisdiction of the Real Estate Department.

Approximately 70% of the property is covered in abandoned fields (Table 1; Figure 2), which are mostly composed of dense grasses and other herbaceous field vegetation. Evidence of the historical forest community exists as fragmented patches of Silver Maple Floodplain Forest, some of which have had wood harvested from them in the recent past. This forest is mostly composed of Silver Maple (*Acer saccharinum*), with White Elm (*Ulmus americana*) scattered throughout. Although the entire flat is flooded each spring, there are a number of backwater wetlands, which contain standing water throughout the year. Around these backwater wetlands are low-lying areas with small, scattered sedge-swales, and these soils remain saturated for much longer than elsewhere in the fields (Figure 3 – Management Zone B) A large beach occurs on the southern tip of the west property, which is accessible by a trail. The 1.8-km trail network on the flats is regularly used by locals to access the river for fishing, swimming and boating. Up until recently, the trails were accessible by vehicle, but the city installed gates in 2015. A significant amount of the riverbank is devoid of any vegetation other than grass, and in these areas, severe erosion has occurred.

Table 1. Land classes and area summary for the Neil's Flats, 2015.

Land Class	Hectares	Acres	Percent
Old Field	35.31	87.26	70
Silver Maple Floodplain Forest	11.58	28.62	23
Backwater Wetland	3.08	7.62	6
Freshwater Beach	0.30	0.74	1
TOTAL:	**50.27**	**124.24**	**100**

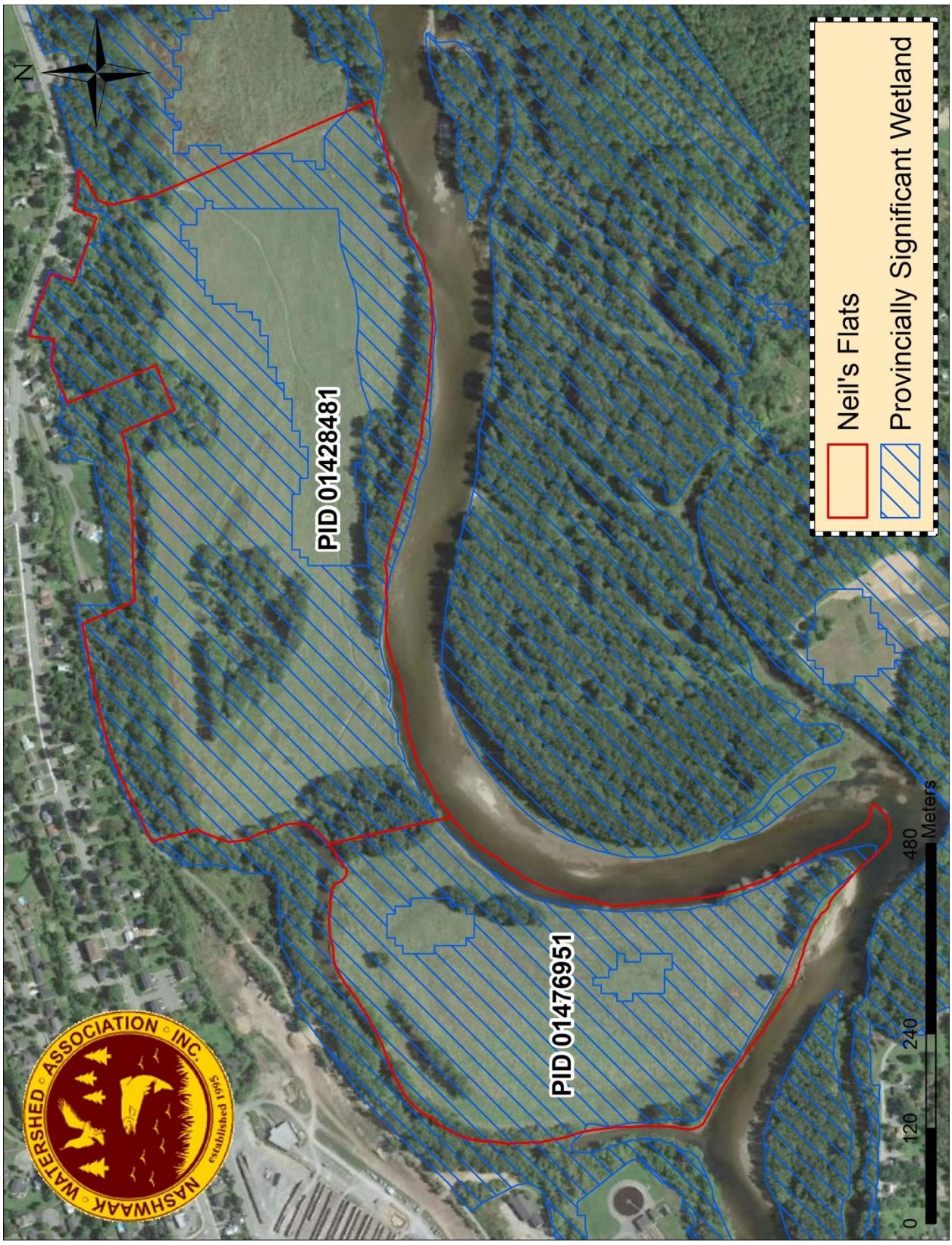

Figure 1: Neil's Flats, 2015.

Figure 2: Land classification for the Neil's Flats restoration project, 2015.

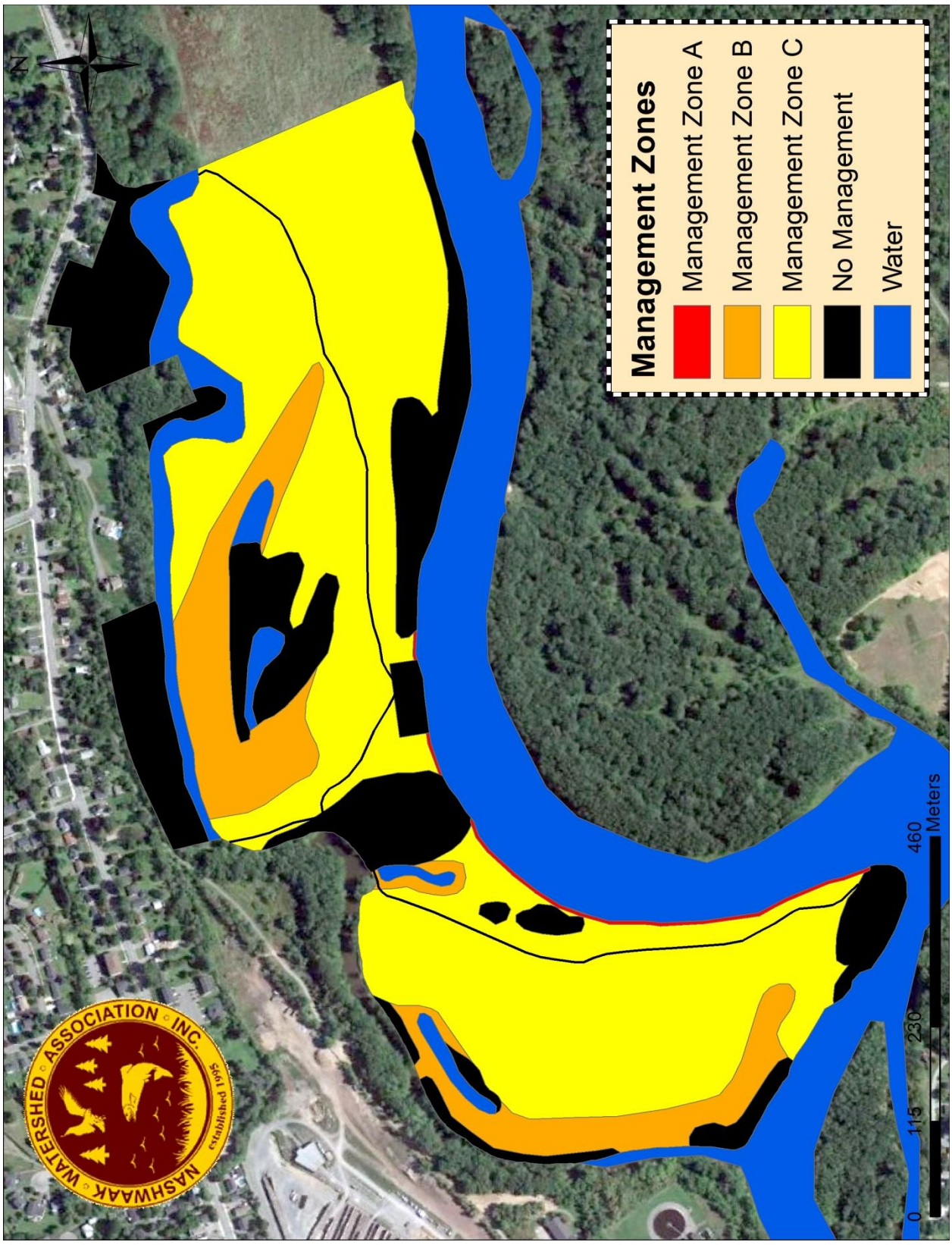

Figure 3: Management zones for the Neil's Flats restoration project, 2015.

Management Overview

Management Goal: Restore Floodplain Forest community
Objective 1: Prevent Riverbank Erosion and Sedimentation
Objective 2: Restore Floodplain Forest Species Composition / Structure

The management actions described in the following section are designed to achieve objectives 1 and 2 through active restoration from old-field to a Silver Maple floodplain forest community. In the short-term, emphasis should be placed on establishing willows along the eroded riverbanks to slow the rate of erosion. It should be noted that willow plantings may need to be replaced annually along sections of riverbank that are lost due to ice scouring. However, it is believed that the collective effort will slow the rate of erosion significantly, providing a larger window of opportunity for planted trees to establish and hold soil.

Where the two access roads meet, a small rectangular patch has been set aside for no restoration. This area is frequently used by locals for swimming and fishing. If the surrounding area is restored, it is believed to be enough to hold the riverbank in place.

All restoration actions are divided into three management zones, which are detailed below.

Management Zone A: Willow Planting

Management Zone A is 0.25 hectares (0.62 acres) in size, and is designated for planting willow cuttings to stabilize the riverbank. Willow planting should occur within a 4-metre swath of land running along the river meander, where no trees are established (Figure 3).

Site Preparation

To prepare the site for willow plantings, herbaceous **field vegetation should be mowed** in the autumn prior to planting. This will allow for planting early in the spring when the soil is saturated and machinery cannot access the flats. In high, eroded areas, sloughing banks may need to be sloped to a shallower grade for plantings to be successful (Figure 4). This will depend on the extent of ice scour each year a planting takes place.

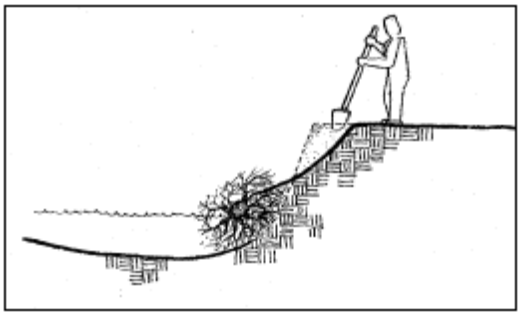

Figure 4. Creating a shallower slope on a sloughing bank (from Hoag & Fritt 2007).

Planting Stock Preparation

Two species of willow are recommended for planting: **Red-tipped Willow (*Salix eriocephala*) and Sandbar Willow (*Salix exigua*),** both of which grow naturally along the Nashwaak River and are commonly used for restoration purposes. Willow cuttings must be collected when they are

dormant (Hoag 2007), so it is best to **collect cuttings in late fall, winter or very early spring**. Cuttings should be a **minimum of 2-cm wide at the base**, but larger cuttings tend to work better than smaller ones (Polster 2013). Cuttings should be as long as possible when harvested, and can be cut-to-length when planted. All twigs and **branches should be trimmed,** and several inches off the top of the stem should be removed (Hoag 2007). This will redirect energy to lateral branching and root development when planted. **Cuttings should be cut at a 45° angle** at the base for ease of planting, and to mark the bottom to ensure cuttings are not planted upside-down. They can be bundled for ease of transport, and stored in plastic in a dark, moist and cold environment, such as a snowbank (Hoag 2007). Seven to ten days before planting in the spring, **soak cuttings in water**. The cuttings should be entirely covered, and to keep them well oxygenated, water should be replaced every 2 days (Zonge et al. 1997).

Planting

Willows can be planted as soon as the ground has thawed in the spring (Zonge et al. 1997). Since the water will be high, multiple plantings may need to occur throughout the spring to plant up to the low-water mark. It is suggested to plant in a random fashion **approximately 0.75 – 1 metre apart** in staggered rows (Hoag & Fripp 2002; OMNR 1995). This should equate to roughly 5 rows and an estimated **3,625 willow cuttings** to complete Management Zone A at this spacing. On eroded slopes, use a denser spacing (0.5 metres apart), and plant stems both vertically and diagonally into the soil (Polster 2013).

Cuttings can be cut to length as needed, but should be **at least 60cm long** (Polster 2013). As the prepared cuttings will be sharpened at the base, they can be pushed into the soil with heavy gloves, or hammered into the ground using a rubber mallet. One of the most important aspects of planting willows is ensuring the **base of the stem reaches the low-water table** (Zonge et al. 2009). On high, eroded banks, this will require large and long stems (> 3m). In these areas, a piece of rebar can be used as a dibble to create a pilot hole (Polster 2013). Regardless of size, all cuttings should be **buried at least ¾ of their length** (Polster 2013). Once inserted into the ground, **tamp the soil around the cutting**. Any air pockets will kill new-forming roots.

Maintenance

After stems have hardened off in autumn, it is recommended to prune roughly half of the planted stems. Pruning back to 5-cm above the ground will encourage coppicing and root growth the following year (OMNR 1997). In this way, half the stems will provide a living buffer against ice scouring, and the other half will better prevent erosion in the following spring. Any cut stems > 2-cm at the base can be used for planting in the following year.

Management Zone B: Sensitive Area

Management Zone B is 6.21 hectares (15.34 acres) in size and is considered ecologically sensitive. This zone buffers the backwater wetlands and other low-lying areas that have saturated soils for most of the year. For these reasons, care should be taken if machinery is to be used in this zone – both to minimize soil disturbance in wet areas, and to keep from destroying any shrubs and trees that have colonized around the backwater wetlands. For these reasons, the site preparation guidelines are specific to zone B, but all other restoration activities follow the same as zone C.

Site Preparation

Due to the PSW designation, site preparation is restricted to activities that do not result in soil disturbance. Heavy machinery is also not recommended in this zone unless soils are completely dry. To prepare the site, **field vegetation should be removed** prior to planting. In areas where machinery cannot access, vegetation can be cleared using a thinning saw, or string-trimmer with a blade attachment. Grasses should be cut low to the ground, and care should be taken not to cut any shrubs or trees around the perimeter of the wetlands. Where a mounted post-hole auger cannot be used due to wet soils, holes can be dug manually, with attention paid to **removing the sod layer** around the planting hole.

Planting

See Management Zone C.

Maintenance

See Management Zone C.

Management Zone C: Old Field

Management Zone C is 28.53 hectares (70.50 acres) in size and is composed of old-field that is not considered sensitive. Restoration will be similar to Management Zone B, except for the recommended use of machinery to prepare the site for planting.

Site Preparation

Due to the PSW designation, site preparation is restricted to activities that do not result in soil disturbance. To prepare the site, **field vegetation should be bush-hogged** prior to planting. This can only be done once soils have been given adequate time to dry in spring. Although care should be taken to avoid any trees that have naturally colonized the old-field, any grasses and shrubs should be removed to prevent competition with planted trees. The most efficient way of

preparing holes for planting is to use a mounted post-hole auger (von Althen 1990), which breaks the sod layer and allows for more efficient planting.

Planting

Planting should be completed in late spring once flooding has subsided and the soil has begun to dry. Species mix should ideally follow the composition in Table 2. Planting stock should be a **minimum of 30-cm in height**, but preferably 50-cm or greater (von Althen 1990).

Table 2. Required number of trees for restoration of Management Zones B and C.

Species	Species Composition	Total trees for Zone B	Total trees for Zone C	Total Trees
Silver Maple	85%	13,196	60,626	73,822
White Elm	15%	2,329	10,699	13,028
Total:	100%	15,525	71,325	**86,850**

The planting density for Management Zones B and C should equate to a **2 x 2-m spacing** (2,500 stems / ha). This density will create competition between individual stems, encouraging upward growth rather than sprouting of multiple stems (von Althen 1985). Dense plantings also facilitate rapid canopy closure, which helps to suppress field vegetation. It is suggested not to plant in obvious rows, but instead plant in irregular spacing to mimic a natural forest. Care should be taken to ensure the **root ball is below the sod layer**. Compost can be added to each hole to encourage initial growth, and the **soil should be tamped firmly** around each tree to ensure no air pockets occur in the hole. It is generally suggested to start along the east boundary of the flats and plant towards the river over subsequent years.

Maintenance

Since soil cannot be disturbed, it is extremely important that all field vegetation be **mowed as often as possible** for three or more years after planting (von Althen 1990). This not only controls competition, but also discourages rodents from nesting in the grass, as they will girdle young trees. Once established, Silver Maples are prolific sprouters, so it may be desirable to **prune any sprouting stems** once the trees have hardened off. Although labour intensive, pruning will focus energy into height growth and root growth, and promote healthy trees with good form (von Althen 1990).

Future Management

The NWAI may see benefit in doing additional restorative forest management in the future to enhance wildlife habitat, improve the conservation value of the land, and quicken the development towards a mature floodplain forest. Below are two suggested management

options: enrichment planting and crop-tree release, both of which can be implemented opportunistically if the NWAI sees benefit in doing so.

Enrichment Planting

As planted stock grows and begins to compete with one another, individuals will begin to die, leaving small gaps in the canopy. It may be of interest to do enrichment plantings in these canopy gaps using other floodplain species to enhance wildlife habitat, and increase the conservation value of the land by supporting rare and at-risk tree species. Enrichment plantings would be most effective during early forest development, since most floodplain species cannot survive under the shade of a forest when young. However, if done strategically with crop-tree release (see below), planting in canopy gaps throughout forest development can result in the successful establishment of other tree species.

Four potential species are identified for optional enrichment planting (Table 3). Although White Elm (*Ulmus americana*) is already part of the species mix, it should be expected that many will die due to the Dutch Elm disease. However, resistant strains are becoming available, and in the future, it is expected that a resistant variety from the genetic stock of the St. John River watershed will be available. If / when this occurs, emphasis should be placed on restoring this species.

Table 3. An optional species mix for enrichment plantings on the Marysville Flats, 2015.

Species	Species Composition
White Elm	30%
Butternut	30%
Red Ash	20%
Bur Oak	20%
Total:	100%

Butternut (*Juglans cinerea*) is native to the floodplains of the Nashwaak River and is an endangered species in Canada (COSEWIC 2003). One of the main threats to Butternut is the Butternut Canker – an exotic fungal disease that has infected all known populations. Although there has been preliminary success in locating and breeding resistant trees (Schlarbaum et al. 1997), it does not appear that resistant genetic stock is commercially available. The NWAI may want to look into surveying the watershed for Butternut and collecting seed from any trees that appear to be resistant.

Both Red Ash (*Fraxinus pennsylvanica*) and Bur Oak (*Quercus macrocarpa*) are floodplain species that have limited distribution, and are considered species of conservation concern in New Brunswick (Powell & Beardmore 2002). Both species reach their far northern limit here (Burns & Honkala 1990), and as such are not abundant. However, if seed can be acquired from the St. John River watershed, both would make excellent additions to the species mix.

Crop Tree Release

Once the average diameter of planted trees reaches 10-cm or greater (Randall & Herring 2012), the NWAI may want to implement a crop-tree release using the crown-touch method. This method removes adjacent trees that touch the crowns of selected crop-trees (Nyland 1996; Figure 5). It is recommended to aim for 50 – 120 crop trees per hectare (Perkey et al. 1990). The selection can favor rare tree species from enrichment plantings, and Silver Maples that have good form and vigour. It has been shown that Silver Maple can triple their wood volume in the 10 years that follow a release (Larson, 1968), which will quicken the development towards a mature forest. Other benefits include reducing crowding, and improving the health and seed production of crop trees.

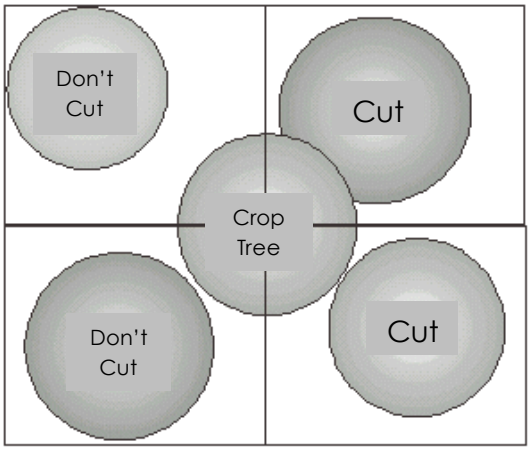

Figure 5. Crop-tree release.

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