

Hedgerow planting at the Menno-Reesor Restoration Project/Toronto Wildlife Centre and wider applications for hedgerow networks in the Rouge National Urban Park

A Technical Report to the Toronto Region Conservation Authority



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Hedgelaying in the Ontario Landscape

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Summary

1.1. Introduction

- 1.1.1. The Toronto Wildlife Centre (TWC) facility is proposed on an existing farm site which is east of the Rouge River.
- 1.1.2. As part of the habitat restoration work for the site, the Toronto Region Conservation Authority (TRCA) propose to plant a species-rich 'traditionally-managed' hedgerow on raised berms as a feature along the north-east entrance to the Toronto Wildlife Centre. The hedgerow will serve as an attractive and functional addition to the site planting plan and as a reflection of the agricultural culture and history of the Rouge Park Landscape.

1.2. Terminology

- 1.2.1. The term hedgerow, or hedge, can be used interchangeably for many different linear habitat features. This report refers to 'traditional managed' hedgerows. These features are often less than 5m between woody stems at the base and may or not be associated with large isolated trees may. They are best managed on a cycle of cutting and rejuvenation through hedgelaying keep them dense and stock-proof (see Appendix A for further details). They are typical features of the *bocage*-style landscapes which are found predominantly in northern Europe but with examples throughout the world (Appendix D)

1.3. Scope

- 1.3.1. On 30 October 2018 TRCA commissioned Jim Jones, Visiting Scientist with Professor Stephen Quilley's SSHRC project Hedgelaying in the Ontario Landscape (HOL) Project at the Waterloo Institute for Social Innovation and Resilience, to
 - 1.3.1.1. undertake a full review of the Project's Site Plan, Restoration Plan and Grading Plan to provide recommendations on how to incorporate hedgerow features within these plans; and
 - 1.3.1.2. provide detailed prescriptions for hedgerow(s) proposed at the site including a broader landscape analysis of the benefits and monitoring requirements of such features, particularly with reference to the Rouge Urban National Park.

1.4. Rationale

- 1.4.1. The TRCA have been a partner in the HOL project since its inception in 2013. It has already provided technical assistance and plants for two planting locations in its watershed.
- 1.4.2. Through the HOL project the TRCA are cogniscent of the potential traditionally-managed hedgerows to provide a range of ecosystem services and the role of hedgerow management in the form of hedgelaying to provide a range of socio-ecological benefits such as sense of place, connection to nature and stewardship.
- 1.4.3. Maintaining the existing sense of place offered in a farmed landscape such as within the Rouge Watershed is an important consideration of the Menno-Reesor restoration project and the wider Rouge Urban National Park landscape. Hedgerows are important cultural features of farmed landscapes in many societies (Barr and Petit 2001).

1.5. Outcomes

- 1.5.1. The Menno-Reesor site offers an opportunity to demonstrate the benefits that traditionally managed hedgerows bring to a single site and monitor the impacts on the local landscape. A planting guide is given in **Part 1** of this Report.
- 1.5.2. The term 'hedgerow' appears 10 times in the RNUP Management Plan and is most commonly associated with ideas of restoration (9 mentions), farms or farmers (7), connectivity (5) and ecological integrity (4). Hedgerows and their socio-ecological systems could contribute to fulfilling the vision and many of the objectives set by Parks Canada for the Rouge National Urban Park, for example:

Strategy	Role of Hedgerows
Protecting and restore Natural Heritage Values in support of a resilient Park Landscape	Hedgerows could be managed and planted to maintain and restore ecological connectivity and deliver a range of ecosystem service in agricultural landscapes
Sustain a Living Landscape	Hedgelaying and bio-fuel production from hedgerows could contribute to a local economic prosperity
	Opportunities to develop hedgerows as innovative agroforestry systems with indicators of success collected by Citizen Scientists
Achieve success through collaboration	Hedgerow working group formed to oversee the design, planting, monitoring and management of Rouge Park Hedgerow Network

- 1.5.3. Full details can be found in Part 2 and Table 3
- 1.5.4. We propose the creation of a novel *bocage*-style hedgerow landscape designed, created, monitored, maintained and celebrated by local stakeholders using cutting edge stakeholder engagement and citizen science tools This applied research could be a partnership between Parks Canada, TRCA and The University of Waterloo. A full analysis can be found in **Part 2** of this report

Part 1: Toronto Wildlife Centre Hedgerow Planting

1.6. The Site

1.6.1. The site is an existing farm field bordered by Steeles Avenue East to the north, Little’s Road to the east, and Passmore Road to the south. The west property line abuts onto the existing Cedar Brae Golf Course and the Rouge River beyond (Figure 1).

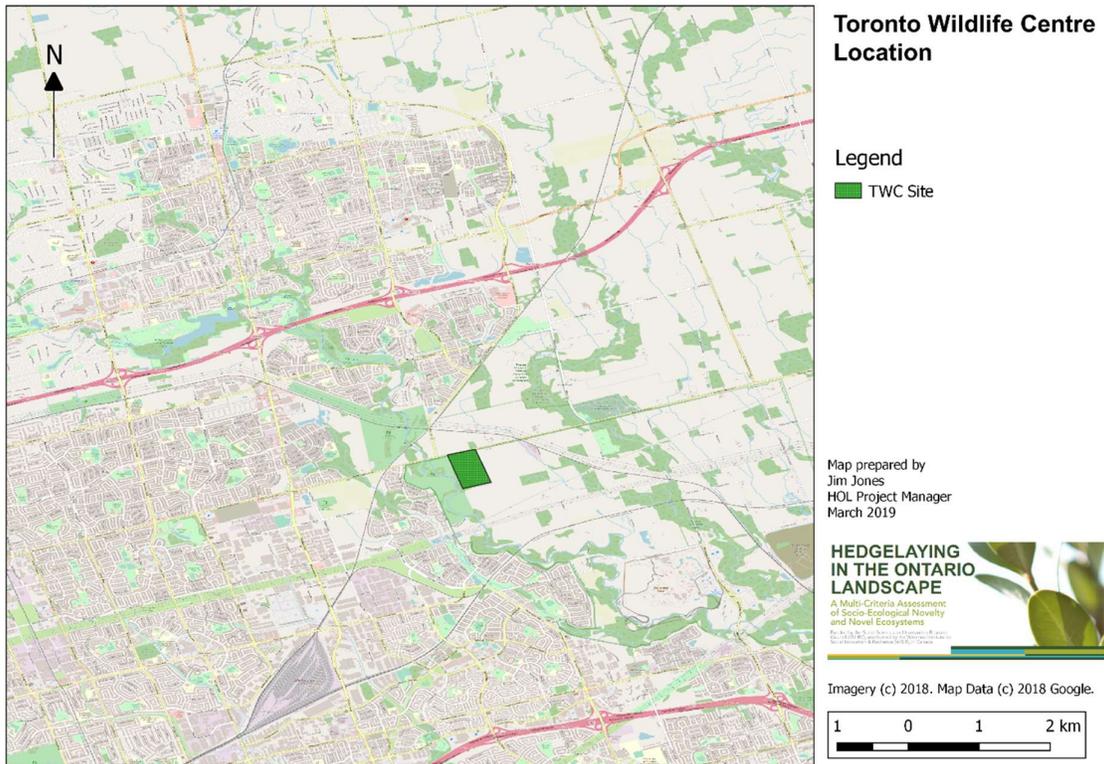


Fig.1: Location of the Toronto Wildlife Centre/ Menno-Reesor Restoration Project site

- 1.6.2. The predominant vegetation community of this site consists of farm fields. The other significant vegetation features of the site are cultural tree plantings around the existing farmhouse, a series of hedgerows located immediately south of the existing buildings and along the boundaries of Little's Road and Passmore Road. (Luk 2014)
- 1.6.3. The Site is situated in the Mixedwood Plains Ecozone, 7E-4 (Toronto) Ecodistrict but within 5.2km of 6E-13 (Oshawa-Coburg) and 4.4km of 6E-7 (Oak Ridges) Ecodistricts. Full descriptions are available in *The Ecosystems of Ontario, Part 1: Ecozones and Ecoregions* (Crins et al. 2009).

1.7. Hedgerow Location

- 1.7.1. A hedgerow is proposed for the north-east corner of the site where Steeles Avenue East meets Little's Road. Currently this area is of flat terrain with scattered shrubs lining Little's Road, corresponding to the Mixed Deciduous Hedgerow of the Arborist and Vegetation Assessment Report (Luk 2014)
- 1.7.2. The TWC Concept Design (TRCA 2018a) (Appendix A) details a series of berms to be constructed at the north-east corner of the site to facilitate drainage. It is proposed that the hedgerow will follow the northern edge of the highest contour of these berms.

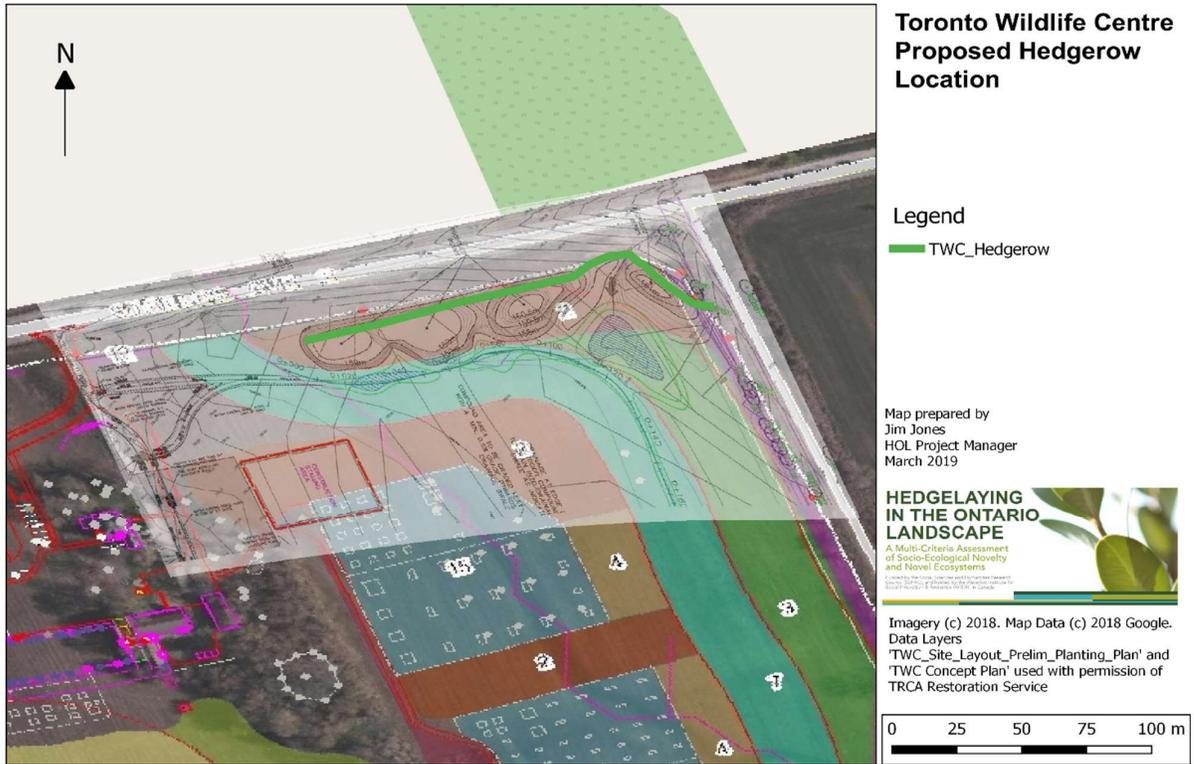


Fig.2: Proposed location for the hedgerow at the Menno-Reesor Site showing the Preliminary Planting Plan areas and the Concept Design Crop (See Appendix A & B).

1.8. Planting

1.8.1. Introduction

- 1.8.1.1. Creating a hedgerow that will develop into a robust living fence that lends itself to management by hedgelaying starts at the planting stage. Close attention to plant species, site preparation and after care are required to insure success.

1.8.2. Location

- 1.8.2.1. The location at the north-east corner of the site will provide a link to the deciduous farm hedgerow already in place along Little Lane (See Fig 2 above).
- 1.8.2.2. The planting of a mixed hardwood forest (Zone 2 on the TWC Preliminary Planting Plan (TRCA 2018b) (Appendix B) is proposed for the berms to the south of the proposed hedgerow.
- 1.8.2.3. In order to prevent over-shading of the hedgerow, a gap of at least the height of the forest should be left between it and the forest plantings. This would be a perfect opportunity to create a pathway between forest and hedge from the TWC car park to Little Road and beyond.

1.8.3. Substrate

- 1.8.3.1. The soil will be fill from site drainage and grading operation and therefore is expected to be easily worked and friable, with good humus and nutrient content.

1.8.4. Species

- 1.8.4.1. Careful consideration should be given to plant species within the hedge. While species diversity is to be desired, attention should be given to building a solid framework that will maximize the delivery of services required by the hedge. For instance, many hedgerows in Europe are predominantly hawthorn (*Crataegus* spp.) which is a thorny shrub ideal for use in hedges where the principle function was a livestock hedge. Hedges designed to maximise the production of useable, straight-grained wood for tool handles are often composed entirely of hazel (*Corylus* spp.) and are more like narrow linear coppice woodlands.

- 1.8.4.2. There is an extant hedgerow along Littles Lane (Zone C on the Arborists report (Luk 2014) which consists of deciduous secondary succession woodland in a north south oriented hedgerow, following the drainage depression at the east and south limits of the subject site. The existing vegetation is sparse along the north end of the hedgerow but becomes increasingly dense and mature towards the south intersection of Little's Road and Passmore Road.
- 1.8.4.3. Hawthorn *Crataegus* spp. is the dominant species (>50%) within this hedgerow which also includes American Elm *Ulmus americana* (9%), and occasionally Manitoba Maple *Acer negundo* Carolina Poplar *Populus x canadensis*, European Buckthorn *Rhamnus cathartica*, Bur Oak *Quercus macrocarpa*, Red Cedar *Juniperus virginiana* Highbush Cranberry *Viburnum trilobum*, White Cedar *Thuja occidentalis*.
- 1.8.4.4. Taking a lead from this collection of species already on site, the proposed hedgerow could also be composed predominantly of hawthorn. Other species in this existing mix with known suitability for hedgerows include are the *Ulmus*, *Populus* and *Viburnum* Species.
- 1.8.4.5. A rule of thumb is to select shrubs that are commonly found in forest understory or as scrubland species, not those that grow rapidly into tall mature trees with thick stems (sycamore/ maples, ash). However, the converse is also true- those species that are very low-growing (less than two metres) and/ or thin/stemmed should not be considered in forming the primary structure of the hedge.
- 1.8.4.6. Essential considerations in choosing hedge plants should be:
 - Site suitability
 - Coppicing response (for management)
 - Complex multi-stemmed growth form
 - Presence of thorns/ spines (optional)
- 1.8.4.7. Hedgerows are true socio-ecological habitat features and consideration should also be given to plants that provide:
 - Food, forage and or material
 - Traditional medicines
 - Cultural and heritage features
 - Fuel source

- 1.8.4.8. Plants in Table 1 were selected for the TWC long list in consultation with experts from the TRCA. Planting of traditionally managed hedgerows in Canada and Ontario is a rare occurrence and there is little data on the suitability of plant selections. One of the purposes of the Hedgelaying in the Ontario Landscape project is to collect evidence of which species make ideal hedgerow components.
- 1.8.4.9. Species are first matched appropriate to moisture and soil regime of specific area of the site with a change to appropriate moisture if planting along a gradient. For hedgelaying purposes choose species that have notable coppicing and massing capabilities; in addition a final height of over two metres is desirable, although fast growing 'tree' species which will shade out others are not. Look towards the natural heritage of the site to help guide the species selection if you have multiple options.
- 1.8.4.10. Plant use by indigenous peoples is also considered. Data on each of the long-list plants is taken from Traditional Plant Foods of Canadian Indigenous Peoples (Kuhnlein and Turner 1991).
- 1.8.4.11. The site is damp overall but has dry areas and full sun. The soil is a mix of sandy clay and the site will be near a road (salt tolerance). High scores in Table 1 hit multiple points (appropriate soils, moisture, function and edible food source, coppicing and massing ability, extra features like thorns) (Stephenson R 2019) .
- 1.8.4.12. Plants with an appropriateness rating of 3-4 will be chosen for the TWC hedge. Choosing a species with a lower rating should be justified (e.g. social-ecological importance).

Table 1: Plant Suitability for Canadian Hedgerows

1 (Oldham, Bakowsky, and Sutherland 1995)

2 (Kuhnlein and Turner 1991)

Appropriateness Rating	Species	Latin Name	Coefficient of Wetness ¹	Sun Tolerance	Salt Tolerance	Traditional and or Indigenous Uses or associations ²
4	Red Osier Dogwood	Cornus stolonifera	-3	Full Sun	low	Fruits, Tobacco, Tea (160)
4	Gray Dogwood	Cornus racemosa	0	Full sun- Partial Shade	low	No mentions
4	Alternate leaved Dogwood	Cornus alternifolia	3	Partial Shade - Shade	low	No data
4	Nannyberry	Viburnum lentago	-1	Full sun- Partial Shade	moderate	Fruits/ Preserves
4	Downy Serviceberry	Amelanchier arborea	3	Full sun- Partial Shade	high	All Amelanchier Serviceberry fruits eaten across range; dried fruits use in liquor; bark used in tea
4	Hawthorn	Crataegus spp	-1	Full sun- Partial Shade	moderate	Most hawthorn fruits are edible. Black hawthorn C.douglasii for medicinal use, fresh or dried and used in cakes;
3	Flowering Raspberry	Rubus odoratus	-2	Full Sun	low	Fruit
3	Common Ninebark	Physocarpus opulifolius	-2	Full Sun	moderate	No data

Appropriateness Rating	Species	Latin Name	Coefficient of Wetness ¹	Sun Tolerance	Salt Tolerance	Traditional and/or Indigenous Uses or associations ²
3	Common Elderberry	Sambucas canadensis	-2	Full sun-Partial Shade	moderate	Fruit
3	American Hazel	Corylus americana	4	Full sun-Partial Shade	low	Nuts
2	Downy Arrowwood	Viburnum rafinesquianum	-2	Full Shade	moderate	V. dentatum "Wahoo" bark used in traditional medicine
2	Red Chokeberry	Aronia arbutifolia	-5	Full Sun	high	No data
2	Black Chokeberry	Aronia melanocarpa	-3	Full sun-Partial Shade	high	No data
2	Fragrant Sumac	Rhus aromatica	5	Full sun	high	Fruit
1	Winterberry	Ilex verticillata	-4	Full sun-Partial Shade	low	Common Waterberry Leaves; (Tea)
1	Swamp Rose	Rosa palustris; Rosa pisocarpa	-5	Full Sun	low	Fruits (Hips) eaten raw, young leaves and stalks used for tea
1	Meadowsweet	Spiraea alba	-4	Full Sun	moderate	Leaves for tea
1	Speckled Alder	Alnus incana	-5	Full Sun	moderate	No data
1	Willow Species	Salix spp.	-4	Full Sun	moderate	Inner bark eaten in spring. Outer bark for tea; buds, f, young shoots, fruiting capsules and seeds eaten

1.8.5. Site preparation

1.8.5.1. Good preparation of the planting site is essential to support a healthy hedge; in most cases vegetation will need to be removed and the soil broken. The berms will be newly created during the grading process and will not have significant herbaceous veg established. Light site prep can be undertaken if necessary.

1.8.5.2. Depending on the type of plant material available, and soil conditions, the following planting options should be considered:

- Whips (45cm, bare rooted)- T-notch and insert whip directly into well cultivated friable soil;
- Transplants (1+1) will have a bigger root ball so dig a hole and plant directly;
- If soil condition is heavy clay, or root balls are too big to dig individual holes, dig out a trench with an excavator approximately 1 spit (spade depth) deep by 50 cm (19.6 in) wide, removing the soil to the lip; place plants and backfill by hand.

1.8.5.3. Mark out the hedge before planting. Marking out at 1m intervals allows for easier planting of a diverse pattern of shrubs (See section 1.2.6.4 below)

1.8.6. Planting

1.8.6.1. The establishment of a hedgerow which will act as a robust living fence and provide an excellent habitat for wildlife requires a high density of stems. Furthermore, some plants will be lost to natural die-off, and for a hedge which will be laid in 15-30 years the recruitment of a good number of stems to become **pleachers** (laid stems-see Appendix C; Section 4) is required so that the hedgelay is not filling in gaps at a later stage with dead wood.

1.8.6.2. A tried and tested planting plan for a traditional farm/ conservation style hedgerow which will lend itself to most hedgelaying styles is the double-rowed staggered planting with a 45cm (18in) gap between plants and a 40cm (16in) gap between rows. This results in 5 plants per metre (40in) (see Figure 4 below). Details can be found in *Hedging : A Practical Conservation Handbook* (Brooks, Agate, and British Trust for Conservation Volunteers. 1984)

1.8.6.3. Planting plan will follow a traditional conservation/ farmland hedgerow design (Brooks et al. 1984) :

- 1x 50% structural plant; 2x 25% (e.g hawthorn, hazel)

- 10% each of five other species
- 1.8.6.4. Plants should be randomly distributed throughout the hedge. Using the above planting guide, in 1m of hedge there should be
- 5x1 or 2/3 x2 structural plants
 - 5 x 1 other species
- 1.8.6.5. Planting is best in the Fall to allow plants to establish before winter, or in the Spring when the ground has thawed.
- 1.8.7. Hedgerow Trees
- 1.8.7.1. Hedgerow trees are usually planted in the line of the hedgerow or with 1 metre of it at a frequency of approximately 1 per 20 metres. They provide a valuable component of hedgerows in some landscapes. Their species, height, and age add functionality to hedgerows. The hedgerow-hedgerow tree communication provides more value than each does alone.
- 1.8.7.2. Hedgerow trees are more suited to open landscapes where wood lots are small and distant.
- 1.8.7.3. Hedgerow trees are also not suitable if plants below are sensitive to trees or near vulnerable ground-nesting bird populations where they can act as roosting posts for raptors.
- 1.8.7.4. It is not expected that the trees will be planted within the line of the Menno-Reesor hedgerow due to the proximity of tree planting blocks on the site.

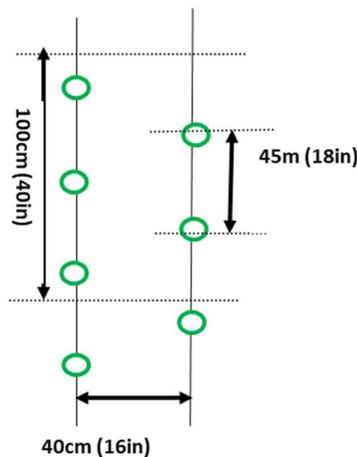


Fig 4: Hedgerow planting layout (after (Brooks et al. 1984))

1.8.8. Immediate Aftercare (0-1 years)

1.8.8.1. To suppress the growth of competitive annual species for the first five years while the hedge is establishing, applying a mulch to the root zone is recommended. Other options which can be used but are not desirable for various environmental reasons include

- plant the hedge through a landscaping cloth; and
- herbicide application.

1.8.8.2. Protecting the hedgerow from a range of herbivores is usually a requirement up to five years, especially in areas where there is dearth of winter forage. To protect against deer herbivory netting or fencing of the hedge would be required. Rabbit guards applied to each plant is also recommended to protect against smaller herbivores.

1.8.8.3. To stimulate root growth and lateral shoots, cut plants to approximately 150cm (6 inches) either just after they have been planted, or in the following Fall (see Figure 5 below)

1.9. Ongoing Management

1.9.1. Long-term management of a hedge aims to keep it in as good condition for as long as possible between rejuvenation cycles. The Hedgerow Management Cycle (Hedgelinek 2012) was developed by the Hedgelinek advisory group and gives an excellent framework for management (See Appendix C).

1.9.2. Although the new hedge managers will need to be adaptive, twelve management principles also recommended by Hedgelinek are worth following (Hedgelinek 2017). The leaflet is reproduced in Appendix D.

1. Consider the Complete Hedge
2. Promote joined-up Hedge Landscapes
3. Create Structural Diversity across the Farm
4. Encourage a Range of Shrubs and Trees
5. Keep the Shrub Layer Dense
6. Allow Shrubs to Flower and Fruit
7. Look after Mature Trees and Encourage New Ones
8. Encourage Out-Growths
9. Encourage Thick Basal Vegetation
10. Encourage Flower-Rich Margins
11. Manage Ditches
12. Keep fertilisers and pesticides away from Hedge Bases and Ditches.

1.10. Hedge trimming

1.10.1. To stimulate root and lateral shoot growth trim the hedge aggressively for the approximately first 5 years, or as required to produce dense, bushy structure:

- In 1st winter, trim to 150cm
- In 2nd-5th winter trim new growth by half
- In 3rd winter trim laterals and leading shoots to an even shape

1.10.2. Trim with a brush hook or loppers.

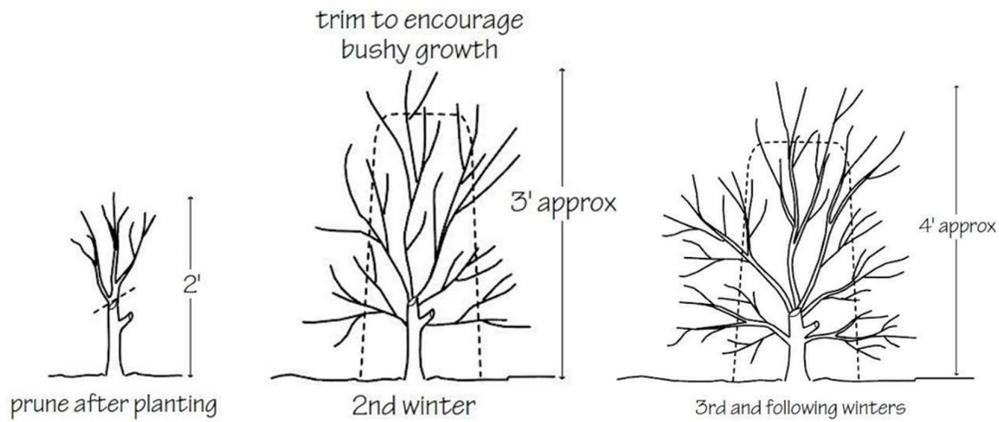


Fig 5: Early pruning diagram (from (Brooks et al. 1984))

- 1.10.3. Once the hedge shape is established begin to allow growth to take place with trimming cycles of approximately 2-3 years. Cutting annually has been shown to be bad for hedge plants, and does not allow the growth of 2nd year wood which produces the most flowers and fruits (Staley et al. 2012)
- 1.10.4. It's very important not to cut at the same height at each cut. Allow an incremental rise of approximately 5cm (2.5 in) each time. Hedge plants cut at the same height will develop a hard callous at the cut line which is prone to infection.
- 1.10.5. For a small length of hedgerow this can be done with a hand-held hedge cutter. For longer lengths tractor mounted circular saws or flail cutters are recommended. Circular saws are far better for the hedgerow but require a second hand to be present for clean-up duties. The advantage of flails is the break-up of hedgerow material into small plants which falls into the hedge bottom.

1.11. Rejuvenation

- 1.11.1. It is probable that cutting and occasional shaping will keep a hedgerow in good health for 20-60 years. However sooner or later the hedge plants will thicken in the stem, and the hedge will become gappy and lose function. The hedge will require rejuvenation from the base either through coppicing or hedgelaying.
- 1.11.2. Hedgelaying is the preferred option for the maintenance of habitat structure throughout the regrowth period which is desirable for continued stock management but also for wildlife, landscape characters and continuing service provision e.g. soil protection. Further details of hedgelaying are outlined in Appendix C.
- 1.11.3. Coppicing hedgerows can be a useful tool if
 - The hedgerow is old, and shrubs are too large for laying; or
 - Hedgerows are being managed for wood fuel.

Table 2 Hedge Planting & Aftercare Summary Table

Hedge Planting Phase	Details	Year	Details	Report Section
Ground preparation	Remove vegetation	0	50 cm wide strip	1.8.5
	Rotovate and till soil if Necessary			
Planting	Planting Plan	0	Double Row 40cm (16in) apart, Plants 45cm (18in) apart, staggered	1.8.6
	Species Composition	0	e.g 1x 50%, 2x 25% Structural Species (e,g Hawthorn, Hazel) 5x 10% Other Species-3	
Aftercare	Mulching	0-4	Mulch planted strip	1.8.8
	Protection	0-4	Deer fencing and tree guards	
	Trimming	0	Prune trees to 150cm (6in) after planting or following winter after planting	
		1	Prune new growth by 50% in 2nd Winter after planting	
		2	Prune to leading shoots and laterals to shape	
Long-term Management	Trimming	2 to 3	Trim to 2-5cm above previous cut	1.9
	Rejuvenation	15-70	Laying or Coppicing	

Part 2: Bringing the Benefits of Hedgerows to Rouge National Park

2.1. Introduction

- 2.1.1. Hedgerows have a wide range of functional attributes that make them valuable components of many landscapes. The creation of a traditional managed hedgerow at TWC represents an opportunity to explore the opportunities presented by this style of green infrastructure in the Rouge National Urban Park.
- 2.1.2. There is an opportunity in the park through hedgerow planting and management that is integrated, novel and has multiple benefits and is fully consistent with the stated vision of local and regional scale connectivity; engaging and varied experiences; vibrant farming communities; natural beauty; and personal connections.
- 2.1.3. The fullest expression of a hedgerow network within the Rouge Park would be the creation of a *bocage*-style landscape which would engage and delight residents and visitors alike. This landscape would have strong traditional elements but would also be a novel solution to complex issues of land-use trade-offs within the park; designed by the local community, it would also provide connections between diverse cultures and traditions. This landscape could be designed, created, monitored and managed by the Park community.
- 2.1.4. The following sections and Table 3 examine the potential of hedgerows, hedgelaying, rural skills and to help facilitate objectives set out in the Rouge National Urban Park Management Plan (Parks Canada 2019), in particular
 - The Government of Canada's National Conservation Plan
 - 4 Strategies
 - 14 Objectives

2.2. Rouge National Urban Park Overview

- 2.2.1. In 2011, Parks Canada started to work with other governments, Indigenous partners and stakeholders towards the establishment of Rouge National Urban Park. The park’s natural and cultural diversity and urban setting pose opportunities and challenges never before encountered in any other place under Parks Canada’s protection.
- 2.2.2. Since 2011, through four phases, Parks Canada has engaged Indigenous partners, the public, stakeholders, all levels of government and the Toronto and Region Conservation Authority (TRCA). By way of an extensive program of meetings, workshops and discussions early in the engagement process, stakeholders collaboratively developed a series of guiding principles for the park (see page 24). These principles have served as the foundation for development of the park vision (2011), the park concept (2012) and now, the park management plan (2019).
- 2.2.3. In January 2019 the RNUP Management Plan was published. The Plan sets out the context, vision, key strategies and management area concepts for the park.

2.3. Hedgerows in the Rouge National Urban Park

- 2.3.1. The term ‘hedgerow’ appears 10 times in the RNUP Management Plan and is most commonly associated with ideas of restoration (9 mentions), farms or farmers (7), connectivity (5) and ecological integrity (4).



Figure 6: Hedgerows are already associated with a range of features of the RNUP Management Plan

- 2.3.2. A full list of the applications of hedgerows in relation to Management Plan key strategies is given in Table 3. An overview of the main suggestions is given below.

2.4. Ecological Connectivity Science

- 2.4.1. The role of hedgerows in maintaining and restoring connectivity in fragmented landscapes is explored in a number of review papers (Davies and Pullin 2007; Forman and Baudry 1984). Hedgerows are not a 'connectivity panacea' and their use is context and species specific. However, hedgerows have been shown to play a role in supporting movement and dispersal of a range of species. The restoration of hedge networks in Rouge Park could provide an important opportunity to add to the evidence base on connectivity science.

2.5. Hedgerows for Protected Species

- 2.5.1. Hedgerows provide shelter and food for a range of species, many of high conservation status. Additionally they contribute to habitat connectivity at a range of scales, although the effect is dependent on species and is not always positive (Davies and Pullin 2007).
- 2.5.2. The planting of traditionally managed hedgerows in Rouge Park would be an opportunity to monitor the effects on a range of species at different scales, in partnership with local Universities and Conservation Authorities.

2.6. Ecosystem Services

2.6.1. Hedgerows provide a range of ecosystem services including:

- Water quality improvement
- Flood risk reduction
- Soil loss reduction
- Crop water availability
- Crop pest reduction
- Crop pollination improvement
- Shelter provision
- Climate change mitigation
- Urban Air Quality Improvement

2.6.2. The current evidence base for each of these services is reviewed for in a UK context in (Wolton et al. 2014). There is an opportunity to add to this evidence base through hedgerow planting and associated in the Rouge Park.

2.6.3. Services not included above which currently have a poor evidence base including the use of hedgerows as living snow fences and the socio-ecological role of hedgerows.

2.7. Park Management

2.7.1. Hedgerows would also make useful park management features such as living barriers, wayfinding and trail development.

2.8. Socio-Ecology of hedgerows, hedgelaying and hedged landscapes

2.8.1. Despite the association of hedgerows with Europe and particularly England, they exist as a feature of landscapes across the world (J Baudry, Bunce, and Burel 2000a). Their history can be traced back to early inhabitants of the landscape who may have used dead hedges and stick-picket hedges to protect livestock from predators (Müller 2013).

2.8.2. As well as the regulatory services described in 2.5 above, hedgerows are associated with a range of socio-ecological services including sense-of-place, heritage, culture, sustainability and recreation (Jacques Baudry et al. 2000; Baudry and Burel 1984; Burel and Baudry 1995; Oreszczyn and Lane 2000, 2001). Hedgerow landscapes are known as *bocage*, a term that originated in France but has come to represent any landscape with a network of woodlots, hedged lanes, farm houses and ponds (Appendix E).

- 2.8.3. Restoring, maintaining and celebrating hedgerows have been at the heart of a number of citizen-science and community-based projects including Hedgerow for Dormice (Peoples Trust for Endangered Species), Hedgerow Heroes (Surrey Wildlife Trust), The Long Forest Project (Woodland Trust/Keep Wales Tidy); and Tous Eco-citoyens! (see Box 3).
- 2.8.4. The importance of managing hedgerows is discussed in Appendix C. Traditional managed hedgerows are a transitional habitat which require maintenance and rejuvenation for long-term sustainability. The practice of hedgelaying started as a way of maintaining the integrity of a living fence without any gaps and has evolved into a bewildering diversity of styles (Müller 2013) and tools. The social influence of hedgelaying comes in the form of hedgelaying groups and festivals, some of which are international in composition and influence. The National Hedgelaying Championships ('The Nationals') and Maasheggenvlechten in the Netherlands are two such events (see Box 1).
- 2.8.5. There is anecdotal evidence that hedgerows have been used by indigenous people in the Americas. In 1634, William Wood's New England Prospect (quoted in (Riley 2013)) speaking of Native American hunting techniques:

"They corralled the deer in "hedges a mile or two miles long...and made narrower...by degrees, leaving a narrow gap of six foot where they shoot the deer."

2.9. Sustainability

- 2.9.1. The use of hedgerows as a biofuel resources has been long practiced in Northern Europe, and particularly in France.
- 2.9.2. Hedgelaying is one of the land-based skill that the Ontario Rural Skills Network is focusing on to develop a network of skilled artisans/teachers at farm sites across Ontario, complementing the diversity of business opportunities to strengthen the rural economy and improving the connections between farming and non-farming communities. Supporting services for hedgelaying also include small woodlot management as coppice (hazel/ash) for stakes and binders

BOX 1: The Socio-ecology of Hedgelaying: Styles, Societies, Competition and Festivals

The practice of hedgerow rejuvenation has evolved a myriad of different hedgelaying styles including Midland, South of England and Devon in the UK and *Plaakhag* in the Netherlands. Regional differences are practiced and celebrated by hedgelaying groups through-out Europe. From August to April, hedgelaying is celebrated through a calendar of competitions and festivals. In the UK the most prestigious of these is The National Hedgelaying Championship or simply 'the Nationals' organised by the National Hedgelaying Society whose patron is Prince Charles. Hedgelaying experts compete in competitions for each style to be crowned champion. In the Netherlands *Maasheggenvlechten* has a different offering. Teams of hedgelayers compete, often novices with a couple of workshops under their belt. The event attracts in the region of 9,000 people each year. Both events attract competitors from around the globe.



BOX 2 Hedgelaying in the Ontario Landscape Project

The Hedgelaying in The Ontario Landscape (HOL) project at the University of Waterloo is exploring the connections between rural skills, place-based storytelling and transition at all levels from the individual through community to local government. The project, funded by SSHRC started in 2013, with a visit to the UK in 2015 to explore the world of hedgelaying as guests of the National Hedgelaying Society. In 2016 a series of demonstrations and workshops on local community supported agriculture (CSA) farms in the Greater Toronto Area explored using hedgerows and hedgelaying with reference to broader themes including place-making, collective stewardship, agro-ecology and resilience. The project has from the beginning explored these themes with amongst others the Town of Caledon in order to achieve their incorporation in the Municipal planning process.



Above: Hedgelaying demonstration at the TRCA

Subsequently three pilot plantings at Mount Wolfe Farm, Albion Hills Community Farm, and a private property in Inglewood were undertaken (Ruttonsha n.d.). In 2018 the project has embraced other rural skills and has set up a pilot initiative called the [Ontario Rural Skills Network](#) to connect skilled artisans with community volunteers. This pilot looks to add value to the work of CSA farms by deepening existing shareholders and other community member's connection with their local environment through the learning-by-doing process, offering a transformative gateway to more sustainable and community approaches to living. In 2019 WISIR is seeking grant funding to extend the HOL project, and the ORSN model to other CSA farms in the Ontario Green Belt.

2.10. Rouge Park as a Landscape Laboratory

- 2.10.1. The creation of a hedge network in the Rouge Urban Park would lend itself to these social-ecological structures and would provide a valuable research project consistent with the goals of the Hedgelaying in the Ontario Landscape project at the University of Waterloo.
- 2.10.2. Consider a unique approach to urban landscape planning by integrating the design and implementation of hedgerow landscape-bocage-in areas of Rouge Park. Community groups would design, create, monitor and manage these important corridors, and integrate their own personal stories into the feature using 'Hedge Pledges' (Box 4).
- 2.10.3. Hedgerows can be thought of as a tool in planning novel ecosystems and landscapes. The HOL project is embedded in the idea of novel ecosystems science (Hobbs et al. 2006; Hobbs, Higgs, and Harris 2009) where ecological tools can be used to solve ecological restoration puzzles
- 2.10.4. The HOL project is exploring the social-ecological role that hedgerows and hedgelaying have in fostering sustainable behaviour. The idea of hedgelaying skills as a as an activity with qualities of 'flow' (Cziksentmihalyi 1991; Isham, Gatersleben, and Jackson 2018) and mindfulness suggest they may be useful in a green gym of mental health boosting activity.
- 2.10.5. Parks Canada could drive a new phase of the Hedgelaying In The Ontario Landscape Project by creating a new bocage-style landscape designed and implemented by local stakeholders that would be a first in Novel Ecological landscapes research and contribute to the better understanding of socio-ecological theories such as sense of place, resilience and sustainable landscape science.
- 2.10.6. A long-standing hedgerow research project focusing on agroforestry benefits of hedgerows has been running since 1993 in British Columbia. Details of their work can be found here <http://agroforestry.ubcfarm.ubc.ca/ubc-farm-agroforestry-initiatives/hedgerows/>

BOX 3: Hedgerows and Citizen Science in the Living Landscape

Hedgerows are at the heart of a number of citizen science and community-centred projects including Hedgerows for Dormice (People's Trust for Endangered Species, UK 2009-11); [Hedgerow Heroes](#) (Surrey Wildlife Trust, UK 2017-), [The Long Forest Project](#) (Keep Wales Tidy, UK 2016-19) and [Tous Eco-Citoyens](#) (TEC! France/Belgium 2018-).

Surrey Wildlife Trust's Living Landscapes project Hedgerow Heroes trains volunteers in hedgerow survey techniques using the Standard Hedgerow Condition Assessment Survey (Department for Environmental; Food and Rural Affairs 2007). From this data, management plans are developed for individual farms. Volunteers are also trained in hedgelaying techniques. In 2018, SWT received Heritage Lottery funding for a landscape-level [Hedgerow Heritage](#) project linking volunteers, farmers and community and youth groups in the Surrey Hills Area of Outstanding Natural Beauty.

The data collected by citizen science volunteers will be used as Indicators of sustainable agriculture and include measurements of the integrity of a park hedgerow network including length of continuous hedgerow; biomass; annual yield of wood/ fruit percentage gaps.



Box 4: The Hedgerow Rite (“The Hedge Pledge”)

Emerging from the Hedgelaying in the Ontario Landscape project is a unique experiment in forging new links between people and the landscape rooted in storytelling and ritual traditions common to all cultures and societies.

Taking a hedgerow planting as its beginning the Hedgerow rite recognises that the attending volunteers all came with stories, dreams, hopes and fears that we could imagine as becoming part of the hedge itself. The hedge became a medium for saving and sharing these stories. Jim Jones created poem based on his own experiences and distant Celtic ancestry which he fashioned into a ritual or ‘as-if’ experience to allow the formal recognition and recording of offerings and ‘hedge pledges’ from the planters, most of whom were members and friends of Mount Wolf Farm CSA.

When the hedgerow is laid in 10 years time, hedgerow plants are broken open and the stories explored again. The result is a living connection to the landscape that many cultures and societies have lost.

The poem and short film from the first Hedgerow Rite are available here <https://thehedgerowrite.wordpress.com/> The author hopes to encourage adaptations and uploads from different hedgerow planting projects.



Table 3: The social ecological applications of hedgerow networks in the achievement of objectives and actions In the Rouge National Urban Park Management Plan

Strategies		Objectives		Actions	Role of Hedgerows	Report Section
1	Protect and restore Natural Heritage Values in support of a resilient Park Landscape	1	Protect biodiversity, natural resources and natural processes	Continue to develop and implement a long term integrated ecological restoration and farmland enhancement program	Restoring and maintaining ecological connectivity Ecosystem service delivery in agricultural landscapes	2.4, 2.5, 2.6
				Complete a Multi-Species at Risk Action Plan	Conserving and enhancing protected species	2.5
				Develop guidance for managing ground and surface water resources, floodplains, key landforms such as the Lake Iroquois shoreline and glacial features, and erosion and other hazards in support of resilient natural, cultural and agricultural resources, and visitor facilities and visitor safety	Role of hedgerows in managing regulating service (hydrology)	2.6
		2	Enhance ecological connectivity throughout the park and with	Design and adaptively manage a science- based ecological connectivity strategy to enhance connections between a diversity of natural habitats throughout the park at multiple scales for a wide range of native species (see text box on page 21).	Restoring and maintaining ecological connectivity Ecosystem service delivery in agricultural landscapes	2.4, 2.5, 2.6, 2.7, 2.11

		adjacent natural areas	Encourage external parties to incorporate connectivity improvements in the planning, management and operation of roads, highways, rail lines, hydro corridors and other infrastructure that traverses the park.	The HOL project is exploring the use of hedgerows as alternatives to snow fencing.	2.8 BOX 2
			Support the improvement of ecological connections extending beyond the park	Caledon Town Council has been a partner on the HOL project since 2015 and is co-exploring the use of hedgerows in planning, green infrastructure, and community resilience.	2.8 BOX 2
	3	Encourage people to contribute to the maintenance or restoration of the park's ecological integrity.	Develop an educational program to engage governments, visitors, volunteers, lessees and others in helping to maintain or restore ecological integrity in the park through increased awareness and supportive behaviours and actions.	Ecological connectivity is easily demonstrated by hedgerow corridors (Green network=hedgerows, blue network=rivers). In the UK a variety of Citizen Science based projects focus on hedgerows as an educational tool to foster understanding and stewardship	2.7 BOX 3
			Incorporate ecological integrity messaging into volunteer programs (e.g., park ambassadors, trail leaders), visitor programming (e.g., signage, events), and external relations activities (e.g., offsite programs, web material, park app) to encourage visitors to understand the importance of maintaining or restoring ecological integrity in the park.		

			Involve Indigenous partners in helping to educate the public about park ecology and to incorporate indigenous knowledge in the management of park natural and cultural resources.	There is some documented evidence of hedgerows use in indigenous cultures; additionally, hedgerows can be composed of plants of practical use for a range of traditional uses	2.7.5
			Encourage collaboration with the public, local stakeholders, community groups, Indigenous partners and the farming community in biodiversity conservation, ecosystem inventory, research and monitoring, and habitat restoration and species at risk recovery.		2.7, Box 3
			Work with the park farming community to maintain or restore ecological integrity through improvements to natural habitat, soil and water conservation activities, and in the management of agricultural activities.		2.6 Box 3
		4	Develop a dynamic, adaptive management system based on monitoring that facilitates well-informed decision-making	Collect baseline data and determine the condition and trends of these measures, including ecosystem baseline conditions and information on agricultural and cultural resources.	2.6 Box 3
			Use scientific, Indigenous and community knowledge to support park planning and management.		

				<p>Collaborate in research with Environment and Climate Change Canada and other organizations to:</p> <ul style="list-style-type: none"> -identify climate change vulnerabilities and risks to park resources, the maintenance or restoration of ecological integrity, and visitor experience; and - better understand the extent and magnitude 	Managing regulating services (climate change)	2..6
			<p>Develop near-term climate change mitigation and adaptation best management practices in areas such as:</p> <ul style="list-style-type: none"> - low-carbon park transportation (e.g., electric vehicle charging stations, transit and active transportation access, park shuttle); -carbon sequestration (consider 			
2	Sustain a Living Landscape – Past, Present and Future	5	Build and maintain mutually beneficial working relationships between Parks Canada and Indigenous communities with direct historical and present-day	Actions in collaboration with Indigenous communities:		2.7

			connections to the park			
		6	Provide certainty for farmers in support of a vibrant park farming community	Develop a park-wide agricultural sustainability approach that identifies opportunities for farm diversification and new farming systems, community-based farming, mentoring, incubator farms, marketing, agri-tourism and agricultural contributions to the maintenance or restoration of ecological integrity.	Biofuel production in parts of Northern Europe Hedgelaying and other skills as rural businesses	2.8
			Provide opportunities for connecting people with park agriculture and farmers and provide educational opportunities about the value of near-urban agriculture and how farm practices help to maintain or restore ecological integrity.			2.7. 2.8 BOX 1,2,3
			Work with residential tenants to encourage active engagement in park programming and initiatives (e.g., volunteering, stewardship opportunities).			

		7	Develop and implement sustainable farming systems and practices	Through collaboration and continuing, open dialogue with park farmers, use operational procedures such as farm plans and agricultural best management practices to integrate the maintenance or restoration of ecological integrity with agriculture (see text box below).		2.7 Box 2
				Pursue opportunities for innovative agricultural systems and best management practices research, pilot projects, demonstration projects, and incentives through collaboration with park farmers and farm organizations, universities, colleges and other institutions	Rouge Park as a Living Landscape Laboratory for social-ecological role of hedgerows	2.9
				Incorporate indicators and measures related to agriculture and a vibrant farming community into the Integrated Monitoring Program for the park	Indicators collected by Citizen Scientists on hedgerow network integrity	2.7 BOX 2
		8	Conserve, celebrate and manage the park's cultural resources and traditions	Work to conserve representative structures, cultural landscapes and viewsapes associated with the park's natural, cultural and agricultural heritage.		2.7 Box 2
3	Celebrate Rouge National Urban Park as a National and International	9	Serve as a gateway connecting Canadians to	Implement a strategy to brand Rouge National Urban Park as a protected area of national significance		2.9

	Gateway to Discovering Canada's Environment and Heritage		nature, culture and agriculture	Introduce and promote Parks Canada national signature activities, events and programs in the GTA (e.g., Xplorer);to use the park as a model to showcase Parks Canada initiatives; and promote opportunities available at other national protected heritage places. Offer an enhanced range of group programming to diverse communities, with a particular focus on connecting youth, newcomers to Canada and families.		2.9 Box 3
				Work with local hospitals and municipal community services departments to provide 'Mood Walks' and other programs that enhance the social, mental and physical well-being of at-risk youth.		2.9
		10	Promote the rouge as Canada's premiere "learn-to" park	Expand the park's "learn-to" offer to encompass a range of learning opportunities (e.g., hiking, fishing, paddling, farming, gardening).		2.7 Box 2
				Work with youth and educational organizations to facilitate group learning for diverse communities of all ages in the park, including tying park experiences into school curricula and continuing education opportunities for teachers.		2.7 Box 2

				Present cultural activities such as art events, seasonal celebrations, group picnicking and citizenship ceremonies.	The Hedge Pledge	Box 3
				Develop a hierarchy of park entry points to provide a sense of arrival to the park, as follows:	See "A New Bocage"	
		11	Develop a range of infrastructure and supporting services to facilitate memorable experiences in the park's rich landscapes and features	Seek commercial uses that provide services and educational opportunities for park visitors (e.g., 'cottage industry' type operations such as bed and breakfasts, farm stays, artisan studios and cafés).	As well as the coppicing of hedgerows for wood fuel, management by hedgelaying is associated with several sustainable landscape businesses which could provide employment for land-based workers. The management of some small woodlands in coppice rotations is needed to provide hedgelayers with stakes and binders (usually hazel). Coppice woodland can also be managed for other woodland products such a locally made charcoal and tool handles	
4	Achieve Success through Collaboration	12	Foster strong, transparent, inclusive and responsive governance	working groups to engage partners, stakeholders and community residents in the implementation of the management plan. (A working group may provide input on a continuing basis, or be program- or project-specific with a defined duration and scope of work.)	A hedgerow working group would be formed to oversee the design, planting, monitoring and management of the Rouge Hedgerow Network.	2.9

		13	Facilitate opportunities for volunteering, research and innovation that benefit the park and strengthen community involvement	Promote volunteering in the following priority areas: park stewardship, ecological restoration, and visitor experience and outreach.		Box 2
				Create an "adopt-a-trail" program with volunteer trail captains and teams assigned to all park areas to help prevent and remove litter, act as park ambassadors and assist with minor trail maintenance.	The Hedge Pledge ritual could help foster intimate relationship with hedgerows as park features.	Box 3
				Promote the park as a centre of research and innovation that generates applied, implementable and replicable results relevant to the park.		2.9
				Continue to work with academic institutions such as the University of Toronto Scarborough and Centennial College on programs of mutual interest. Use research to develop demographic knowledge to better understand and serve park visitors and outreach audiences.		
				Pursue collaborative pilot and demonstration projects with outside parties and agricultural lessees that generate new knowledge that benefits the park and beyond.		

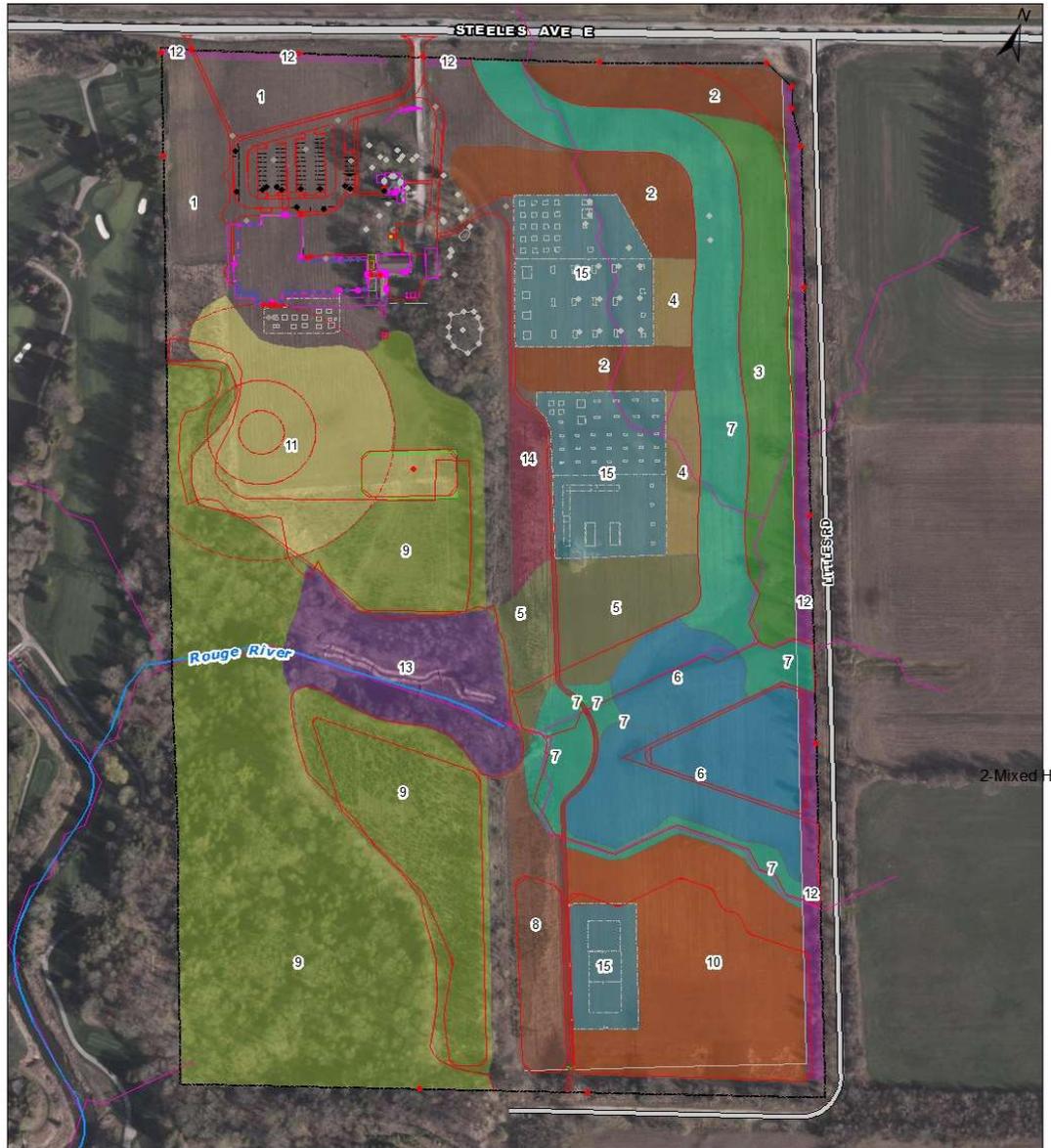
		14	Collaborate with partners and stakeholders in park operations, access, infrastructure and planning	Planning Coordination		2.9 Box 2
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Appendix A: TWC Preliminary Planting Plan



Legend

Drainage Line 2.5ha	8-Black Walnut
Watercourse	9-Mixed Infill
1-Front North West Entrance	10-Mixed White Pine Forest
2-Mixed Hardwood Forest	11-Meadow
3-Poplar/Birch Forest	12-Mixed Carolinian
4-Shrub Thicket	13-Cedar Ravine
5-Lowland Cedar Forest	14-Orchard/Fruit Trees
6-Lowland Hardwood Forest	15-Pens
7-Lowland Shrub	

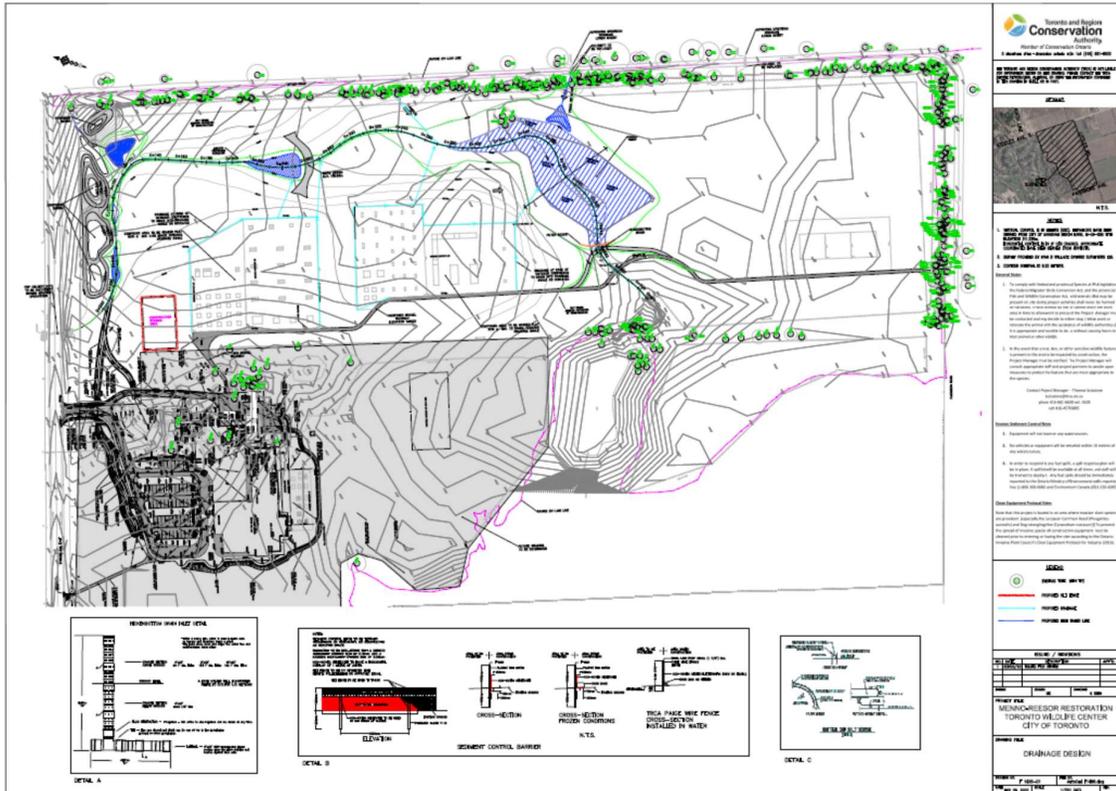
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 The data used to create this map was compiled from a variety of sources and dates. The T.R.C.A. takes no responsibility for errors or omissions in the data and retains right to make changes and corrections at anytime without notice. For further information about the data on this map, please contact the T.R.C.A. Restoration and Infrastructure Division. (416) 607-2600
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Toronto Wildlife Centre Preliminary Planting Plan



Appendix B: Rouge Park Concept Design



Appendix C: 'Traditional Managed' Hedgerows

1. What are 'Traditional Managed' Hedgerows'?

- 1.1. The terms fencerow and hedgerow are often confusing and loosely applied. The dictionary definition of a fencerow is 'an uncultivated strip of land on each side of and below a fence, but is commonly used to describe without a fence as 'a narrow linear strip of trees that defines a laneway or boundary between fields or properties' (Durham Municipal By-Law 31/2012). A hedgerow can describe a range of linear features. In the UK it has a technical definition of 'any boundary line of trees or shrubs over 20m (67ft) long and less than 5m (16ft) wide at the base' (Hedgeline/DEFRA).
- 1.2. A major difference between fencerows and hedgerows is that the latter are usually managed, and the former is not; however the type and timing of management for both can vary enormously!



Fig 6: An annually trimmed shrubby hedgerow

2. The Origins of Hedgerows

- 2.1. It's thought hedgerows, or hedges, have arisen from the use by early humans of thorny plants for corralling livestock using 'dead hedges' or stick picket fences (Müller 2013). Similar structures such as the thorny acacia *enkang* used by the Masai to protect their village are still in use today (Adams, N. pers comm.) With the advent of agriculture, clearance of woodland created fields with tree and shrub boundaries that were managed to create livestock-proof 'living fences'.
- 2.2. Hedgerows have been actively planted since the times of the Roman Empire but reached their peak in Britain during the enclosure acts of the 1700s when an estimated 200,000 miles of mostly hawthorn (*Crataegus* species) hedgerows were planted.
- 2.3. Although the closed landscapes of the Atlantic fringe, termed 'bocage' are often considered as the core of hedgerow distribution, there are many other regions, not only in Europe, but also elsewhere in the world with equally dense networks (J Baudry et al. 2000a)

3. Planting and Management

- 3.1. A hedgerow may take 7-10 years to establish, depending on the species composition, but with good management they are more robust than a fence and bring additional benefits.
- 3.2. Like fencerows, hedgerows arise naturally along fences and other linear features but are more often planted. They can be single species but are more useful with a diversity of plants.
- 3.3. To provide a dense hedge with opportunities for nesting and many stems for laying in the future, planting is usually in a double line, spaced 45cm (18in) apart, with plants in a staggered pattern at 40cm (16in) centres, giving five plants per metre (Brooks et al. 1984).
- 3.4. Hedgerows are composed of living shrubs which will grow and need management so there is a balance which needs to be found between allowing shrubs to grow and keeping the hedge from becoming a line of trees, developing gaps and eventually disappearing. Hedgerows can be cut to slow their growth, but annual cutting can limit flower production and the development of fruits, berries and seeds. Annual cutting also stresses and eventually kill plants.
- 3.5. Cutting every two to three years and increasing the cut height by a few inches every time can maintain the health of the hedge. As a hedgerow grows, the shrubs will thicken and become gappy at the base, so at some point it will be necessary to rejuvenate the hedge. The hedge could be coppiced (felled), however, with shrubs removed it cannot function as a fence.

3.6. Hedgeline have produced the Hedgerow Management Cycle which is a helpful guide for intervention in a growing hedgerow (see Table 4 below). The Complete Hedge Good Management Guide also provides good information and 'Top 12 Management Principles' (Appendix D).

1	Heavily over-trimmed with many gaps and sparse stems, their bases gnarled or rotting. May be invaded by elder, sycamore or other invasive species.
	ACTION Coppice and re-plant gaps. Grub out or poison invasive species.
2	Over-trimmed, infrequent stems too far apart to be 'let up' for laying, perhaps evidence of laying in the past. Hard knuckle at trim line, shrubs developing mushroom shaped growth form.
	ACTION Coppice and re-plant gaps.
3	Over-trimmed, frequent stems. Stems still healthy but require more height. Hard knuckle may be starting to form at trim line.
	ACTION Allow incremental height gain at each cut or 'let up' up for laying.
4	Recently layed, coppiced, or planted hedgerow.
	ACTION Trim lightly for first few years, then cut on a two or preferably three or more year rotation, allowing height to increase a little each time.
5	Healthy, dense, hedgerow with frequent stems and more than 2m in height.
	ACTION Trim on a two or preferably a three or more year rotation. Raise cutting height if hard knuckle forming at trim line.
6	a) Hedgerow more than 3m high and trimmed on rotation. b) May also be non-intervention hedge, having intentionally been left un-trimmed for several years.
	ACTION a) Enter hedge into non-intervention period. b) Re-shape with circular saw then return to rotational trimming or non-intervention period.
7	Hedgerow with frequent healthy stems more than 4m high.
	ACTION Lay or reduce height and width with circular saw blade. Would also respond well to coppicing.
8	Mature tall hedgerow with spreading tops. Stems still healthy (although they may be infrequent) but too large (more than 18cm in diameter) for laying.
	ACTION Either reduce in height and width with circular saw blade or coppice and re-plant gaps if necessary.
9	Over-mature hedgerow with tops dying back, collapse possible. Perhaps becoming dominated by tree species such as oak, ash or sycamore.
	ACTION Coppice, retaining a few selected healthy trees, and plant up gaps.
10	Hedge developed into line of trees.
	ACTION Manage as a line of trees, if necessary undertake selective thinning. If shrubs still exist beneath trees raise height of tree canopy to allow in more light.

Remember a hedgerow cannot be kept at one score on the scale indefinitely. A hedgerow at point 4 on the scale would, if trimmed continuously at the same height, eventually decline to point 1. Alternatively, if not managed at all it would progress over time to point 8 or beyond.

Table 4: The Hedgerow Management Cycle

4. Hedgelaying

- 4.1. The practice of hedgelaying has evolved to rejuvenate a hedge while still maintaining a stock-proof structure. Hedgelaying is a catch-all term used to describe the rejuvenation of a hedge from the base by cutting and 'laying-over' of the shrub.
- 4.2. The roots of hedgelaying are contentious, but it is hard not to imagine the an early use of scrub in 'dead hedges' for defensive boundaries similar to the Masai Enkang described in section 2.1 above. The first written reference to hedgelaying was by Julius Ceaser in 57 BC (Maclean 2006; Müller 2013; Wright 2016)., however there are suggestions of a Bronze Age hedge at Fengate in England. The history of hedgelaying is covered from a European perspective is covered by (Maclean 2006; Müller 2013; Wright 2016).
- 4.3. There are many different styles of Hedgelaying throughout the world, with at least 16 styles in the UK alone. In some styles wooden stakes are positioned at intervals along the hedge and long 'binders' are woven in across the top to give the hedge strength. This
- 4.4. The evolution of hedgelaying may have been driven by its practical applications, but the resulting diversity of styles and their contribution to a 'sense-of-place' or place attachment (Low and Altman 1992) has emerged as property of hedgerow networks.

Table 5: Hedgelaying Styles of Europe (Except from the UK National Hedgelaying Society Website www.hedgelaying.org)

	
<p>Midland ©NHLS</p>	<p>Welsh Border ©NHLS</p>
	
<p>South of England ©NHLS</p>	<p>Yorkshire ©NHLS</p>
	
<p>Devon Style ©NHLS</p>	<p>Plaakhaag (Netherlands)-©JJones</p>

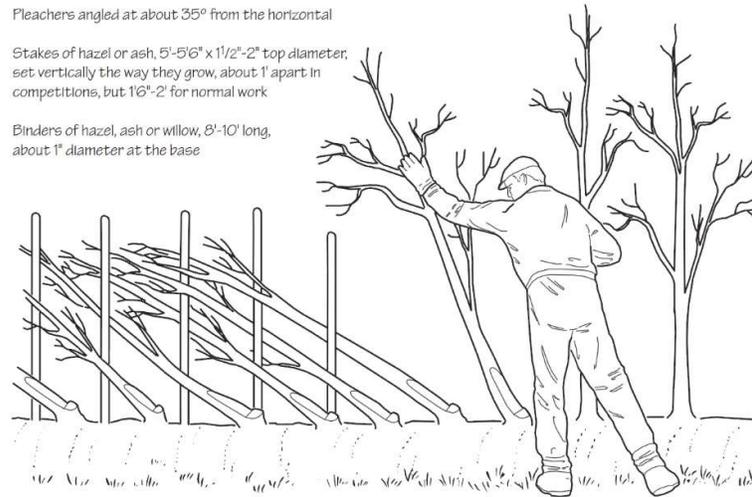


Fig 7: Hedgelaying basics from (Brooks et al. 1984)

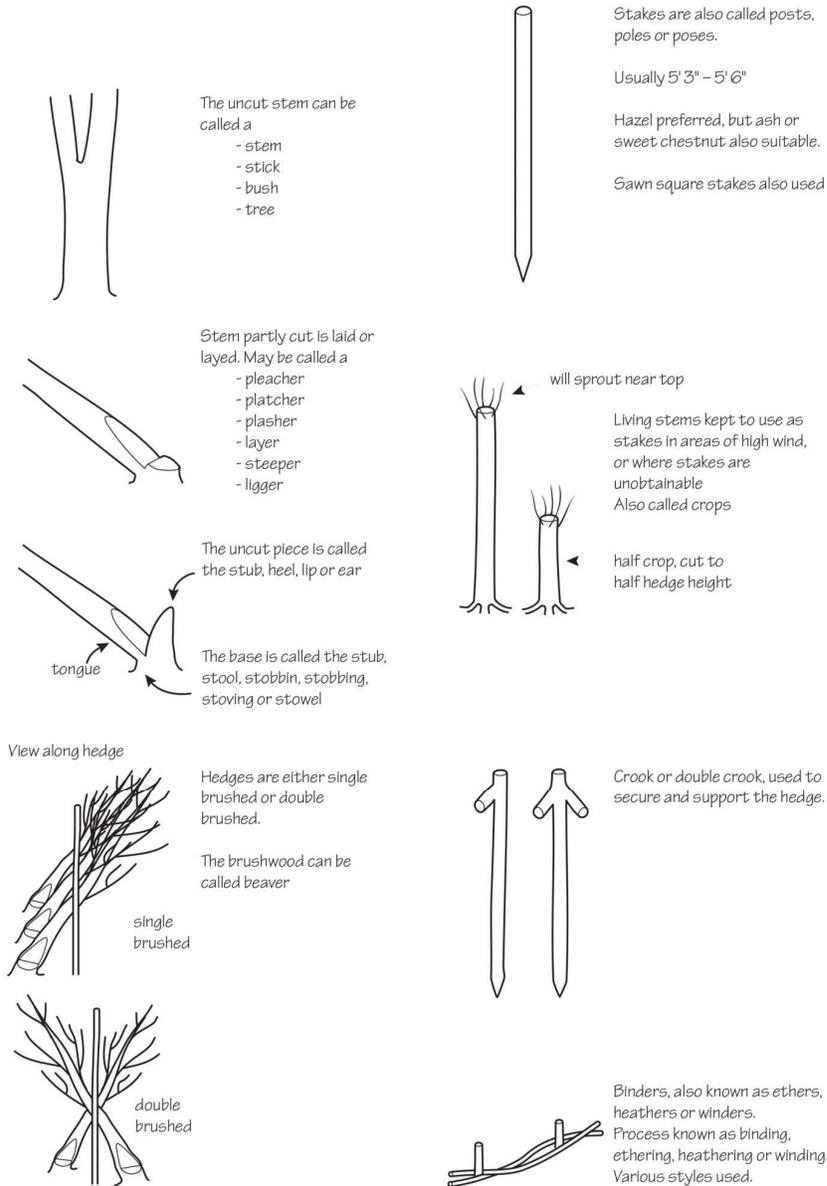


Fig 7: Some hedgelaying terms from (Brooks et al. 1984)

Appendix D: Hedgelink Complete Good Hedge Management Guide

Appendix E: The Bocage Landscape

Geographers use the word 'bocage' to mean a landscape where hedgerows are characteristic features. It is often used as a synonym for 'hedgerow network landscape', which is inelegant (J Baudry, Bunce, and Burel 2000b).

Bocage landscapes are most extensively described in Britain and France but less detailed studies describe the bocage landscapes of Galicia (north-west Spain), Jutland (western Denmark), northern Spain, Italy, Switzerland, Belgium and Germany. Shelterbelts are present in some parts of Poland and Ukraine. While studies on hedgerows outside of Europe are scarce they can be found in Africa, Ecuador and Bolivia (J Baudry, Bunce, and Burel 2000b). Studies of hedgerow networks which could also be termed bocage are found in Canada (De Blois, Domon, and Bouchard 2002; Schmucki et al. 2002) and the US (Forman and Baudry 1984; Sutton 1992)



Fig 1: A Bocage Landscape By Matthieu Debailleu¹

¹ <http://aascalys.free.fr>, CC BY-SA 3.0,
<https://commons.wikimedia.org/w/index.php?curid=630054>