Vegetation Guideline 2025

METROLINX

Metrolinx Vegetation Guideline 2025

April 2025

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Land Acknowledgement and Commitment

The Metrolinx Vegetation Guideline is considered a living document that will evolve and develop over time with input and guidance from Indigenous communities.

Metrolinx acknowledges that the lands considered in this Vegetation Guideline are within the traditional lands of the Anishinaabe, the Haudenosaunee and the Huron-Wendat peoples, for whom these lands continue to have great importance.

Treaties between First Nations and governments cover these lands, and the promises contained in these Treaties remain relevant to this day. Metrolinx acknowledges that we are all Treaty people.

Metrolinx is committed to understanding the history of these lands and the continued impacts of colonization and take responsibility for actions to advance reconciliation.

Metrolinx will continue to seek the knowledge, expertise and experience of Indigenous partners and commits to doing business in a manner that is built on a foundation of trust, respect, and collaboration.

Metrolinx commits to ongoing conversations, consultation and learning with Indigenous communities to work towards two-eyed seeing. Metrolinx will continue to work with Indigenous communities on how to minimize or avoid impacts to vegetation and natural heritage features, and increased inclusion in ecological restoration planning, in order to build mutual-respect and influence Metrolinx policies, practices and guidelines.

Indigenous communities are important partners in achieving successful transit projects, including ecological restoration initiatives.

Glossary of Terms

Term	Definition
Adaptation	From a climate perspective, the process of adjustment to actual or expected climate change-related events or trends. Adaptation actions can help to reduce vulnerability and risk associated with climate hazards.
Integrated Arborist Report	A technical report that identifies the location, species, size, and condition of trees, assesses impacts to trees, and describes maintenance strategies and protection measures to be implemented. For Metrolinx Projects, this report captures information beyond a typical arborist report to support implementation of the Mitigation Hierarchy and restoration planning including, but not limited to, identifying Designated Natural Areas and their respective vegetation communities; identifying trees of significance (e.g. bio-culturally significant, Species at Risk); identifying trees suitable for tree end use; and identifying additional mitigation measures to prevent spread of invasive species. All tree surveys and arborist reports generated for Metrolinx Projects should follow **Appendix B** and Metrolinx's Integrated Arborist Report template, which is available upon request.
Arborist	An expert in the care and maintenance of trees, including an arborist qualified by the International Society of Arboriculture (ISA), a consulting arborist registered with the American Society of Consulting Arborists or a registered professional forester.
Ballast	The material which forms the track bed upon which GO rail corridor railroad ties are laid. Ballast is used to bear the load of the railroad ties while helping to facilitate drainage of water and suppress vegetation that might otherwise unsafely impede the track.
Basal Area	Basal area is the common term used to describe the cross-sectional area occupied by tree stems. Stand basal area is defined as the total cross-sectional area of all stems in an ecosystem measured at breast height (1.37 m) and expressed as a unit of land area (m2 /ha).
Baseline Replacement	An approach to vegetation compensation that involves replacement of individual trees at a ratio ranging from 1:1 to 10:1 – this depends on the size of the tree. Trees <30cm DBH are replaced at 1:1 ratio, where trees >30cm DBH should aim to be replaced at 10:1 ratio where possible but not lower than 3:1.
Best Management Practices (BMP)	Professional industry standards that are accepted or prescribed as being correct or most effective by academics and practitioners.
Bio-culturally Significant Species	Species of significance to North American (Turtle Island) Indigenous culture, communities or people, which can be identified by their prevalence in language, cultural practices, spiritual practices, traditions, diet, medicines, material items, histories of a community, and resource acquisition. Such species have intrinsic, symbolic, and/or high-use value and fulfil a psycho-socio-cultural function within a given culture. These species are often embedded within social and ecological systems where they are thought to play critical roles in maintaining cultural or ecological stability at a local level, to be irreplaceable and, therefore, the loss of these species is likely to have a significant effect on cultural integrity and ecological equilibrium.
Boundary Tree	A tree situated with any portion of the trunk growing across both Metrolinx-owned-lands and an existing private or public property.
Butternut	Butternut trees are a native species in southern Ontario, listed as Endangered under the provincial Endangered Species Act. Genetic testing can reveal whether a given tree is a pure southern Ontario butternut or a hybrid with non-native species. Butternuts are categorized based on their apparent resistance to Butternut Canker (Ophiognomonia clavigignenti-juglandacearum) with category 1 trees determined to be least resistant and category 3 trees most resistant and therefore considered important to Butternut conservation and research. Categorization is determined by a Certified Butternut Health Assessor in Ontario.

By-law Compensation and/or Replacement	An approach to off-setting vegetation removals that involves adhering to applicable by-laws or regulations.
By-law + Baseline Replacement	An approach to off-setting vegetation removals that involves adhering to applicable by-laws or regulations in addition to replacement above and beyond the by-law or regulation, if determined necessary based on the Baseline Replacement approach.
By-law + Ecological Replacement	An approach to off-setting vegetation removals that involves adhering to applicable by-laws or regulations in addition to replacement above and beyond the by-law or regulation, if determined necessary based on the Ecological Replacement approach.
Catenary System	An assembly of overhead wires consisting of, as a minimum, a messenger wire, carrying vertical hangers that support a solid contact wire which is the contact interface with operating electric train pantographs, and which supplies power from a central power source to an electrically powered vehicle, such as a train.
Chemical Control	Chemical pesticide or herbicide used to minimize incompatible plant communities while protecting compatible plants from pests, disease, and overgrowth. This form of vegetative control is regarded as an important tool in railway vegetation management, particularly in areas such as track ballast where there are no effective non-chemical control alternatives available.
Compatible Vegetation	Includes vegetation that is not in conflict with rail right-of-way (ROW) and guideways management zones as well as native vegetation in planting or restoration areas.
Compensation	The replacement of a lost/altered natural feature or area and its functions, services, and value within the landscape. This may be achieved through a singular process such as through vegetation replacement by tree quantity following this Guideline or may be a combination of processes including both tree/vegetation replacement and replacement of habitat loss (area-based and/or feature based) which is partially addressed through the Conservation Authority Voluntary Project Review and/or Ministry of Environment, Conservation and Parks (MECP) endangered species instruments.
Conservation Authority (CA)	Local watershed management agency that regulates areas within wetlands and floodplains, delivers services and programs to protect and manage impacts on water and other natural resources in partnership with all levels of government, landowners, and many other organizations. Legislated under the Conservation Authorities Act of 1946 in response to severe flooding and erosion problems.
Conservation Authorities Act (CAA)	Ontario Regulation 41/24, Prohibited Activities, Exemptions and Permits addresses. erosion, flooding, and drought on a watershed basis. The Act prohibits filling within the floodplain and regulates development in and adjacent to wetlands, erosion hazards, waterways and floodplains and is overseen by the Conservation Authority associated with the watershed.
Contact Wire	A solid grooved, bare aerial, overhead electrical conductor of an overhead contact system that is suspended above rail vehicles and which supplies electrically powered vehicles with electrical energy through roof-mounted current collection equipment - pantographs.
Control Threshold	The point at which the abundance of pests, noxious plants, and incompatible vegetation is causing, or is likely to cause, risk indicating that control is necessary or desirable.
Cultural Control	Methods of vegetation management that consider preventative measures or amended ground conditions, including seeding or planting of specific plants, ground covers, soil amendments or mulches to control vegetation growth.
Designated Natural Area(s) (DNA)/(DNAs)	In this document, DNA refers to Natural Heritage Systems made up of natural heritage features, Species at Risk habitat, linkages, and areas intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of native species and ecosystems. These areas may be identified by project studies, resource agencies, Indigenous communities, municipalities, and the government through legislation, policies, or approved management plans (but does not need to be).

Designated Natural Area(s) (DNA)/(DNAs)	In this document, DNA refers to Natural Heritage Systems made up of natural heritage features, Species at Risk habitat, linkages, and areas intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, viable populations of native species and ecosystems. These areas may be identified by project studies, resource agencies, Indigenous communities, municipalities, and the government through legislation, policies, or approved management plans (but does not need to be).
Diameter at Breast Height (DBH)	The diameter of a standing tree, measured at 1.37 m above ground level.
Dissuasive Vegetation	As part of a restoration or landscape plan, native vegetation which is intended to discourage human access, trespassing or trampling e.g. species with thorns.
Emerald Ash Borer (EAB)	An introduced beetle native to northeastern Asia that feeds on ash species and is currently causing significant ecological and economic impacts in forested and urban habitats in North America.
Ecological Replacement	An approach to off-setting vegetation removals that involves replacement of tree units at a ratio representative of their ecosystem functions and services.
Ecological Restoration	Ecological restoration (also simplified as restoration in Guideline) seeks to initiate or accelerate ecosystem recovery following damage, degradation, or destruction. Ecological restoration creates the conditions needed for ecosystem recovery to return a degraded ecosystem to its historic trajectory, not its historic condition. Ecological restoration can be as simple as removing an invasive species or reintroducing a lost species or a lost function (like fire); or as complex as altering landforms, planting native vegetation, improving the hydrology, and reintroducing wildlife.
Ecological/ Ecosystem Function	The natural processes, products, or services that living and non-living environments provide or perform within or between species, ecosystems and landscapes. These may include biological, physical, and socioeconomic interactions.
Ecosystem Services	The benefits to humans and other species provided by nature.
Ecosystem Structure	The living and non-living form and composition of ecosystems that give each system its own definition and function.
Ecological Land Classification (ELC)	The system in place in Ontario for defining ecological units on the basis of bedrock, climate, physiology, and vegetation.
Edge Management	Planning, installation, and monitoring including design considerations, preconstruction and construction measures to mitigate the negative impacts of tree removals and construction in relation to adjacent existing forest. Negative impacts include windthrow, sun scald, loss of habitat. desiccation and increased susceptibility to invasive species. The Tree Preservation Plan and Edge Management Plan shall address mitigation of exposed edges initiated in design, providing mitigation and maintenance for new edges, and installation of supplemental plantings within the existing forest community prior to or within the next growing season in which removal of trees occur.
Elevated Guideway	Sections of track infrastructure that are above-grade, supported by piers and allows for an underpass beneath the guideway structure.
Environmentally Sensitive Features (ESFs, or Sensitive Features)	Including but are not limited to the following: Natural Heritage features (woodlots, natural areas, parks, ravines, linkages etc.), Surface Water and aquatic features (headwater drainage feature, wetland, watercourse, etc.), Significant Wildlife Habitat, Species at Risk (SAR) and/or SAR habitat as well as Lands, structures and/or flora and fauna identified as having significance through Indigenous engagement and Metrolinx's internal Indigenous interest and screening process.

Environmentally Significant Area (ESA)	Natural areas which are particularly significant or sensitive and therefore require additional protection to preserve their environmental qualities and significance.
Endangered Species Act (ESA), 2007	Ontario provincial governmental legislation that provides protection for provincial Species at Risk and their habitat. Protected species are listed on the SARO (species at risk in Ontario) list and classified into one of four levels of risk (Extirpated, Endangered, Threatened, or Special Concern) through science-based assessment via the Committee on the Status of Species at Risk in Ontario (COSSARO); classification is based on best-available science and Indigenous Knowledge including Traditional Ecological/Ethnological Knowledge.
Foliar	A form of herbicide application that involves the use of a manually operated pressurized backpack sprayer or a handgun to spray the foliage of targeted vegetation. Most effectively used when the target vegetation is actively growing.
Geographic Information Systems (GIS)	A system designed to capture, store, visualize, manipulate, analyze, manage, and present spatial or geographical data.
Good Arboricultural Practice	Practices such as tree planting, maintenance and removal performed in accordance with the American National Standards Institute's (ANSI) A300 Tree Care Standards (2023) and best management practices identified by the International Society of Arboriculture.
Hazard Tree	A tree with structural defects likely to cause the failure of all or part of the tree, at risk of causing damage or injury to life or property. The risk level of a hazard tree is assessed and is related to the chance that the tree could potentially strike a target if left untreated.
Healthy Soils	Soil health is closely related to a range of physical, chemical, and biological functions critical for success of restoration plantings. These include adequate water retention and infiltration, soil aeration, nutrient cycling and availability, and diverse and robust soil microorganism communities supporting flora and fauna. A Healthy Soil and Decompaction Plan addressing soil amendments including organics and decompaction, is required for successful long-term restoration.
Hi-Rail Vehicle	A road-rail vehicle which can operate both on rail tracks and a conventional road.
Incompatible Vegetation	Includes vegetation that is in conflict with rail right-of-way (ROW) and guideways management zones and poses an imminent hazard to operations as well as invasive vegetation in planting or restoration areas.
Indigenous Community	The United Nations defines Indigenous communities, peoples and Nations as those with historical continuity with pre-invasion and pre-colonial societies that developed on their territories and consider themselves distinct from other sectors of the societies now prevailing on those territories or parts of them.
Indigenous Knowledge (IK)	Complex of knowledge systems, understandings, skills and philosophies developed by societies with long histories of intimate interaction with their natural surroundings. For Indigenous peoples, IK reflects and informs unique cultures, values, governance, legal systems and fundamental aspects of day-to-day life. This knowledge is integral to a cultural complex that also encompasses language, systems of classification, resource use practices, social interactions, ritual and spirituality. IK is inclusive of Traditional Ecological Knowledge (TEK), also known as Traditional Ethnological Knowledge. IK systems involve living well with, and being in relationship with, the natural world. IK systems build upon the experiences of earlier generations, inform the practice of current generations, and evolve in the context of contemporary society. IK is traditionally passed on verbally and is specific to the Indigenous community from which it originates. IK Holders are the only people who can truly define IK for their communities. When working with IK, the principles of Ownership, Control, Access, and Possession (OCAP) should be observed. IK belongs to the Individual and community who provide it and it is not to be distributed, printed, or made available without permission from the owner.

Infill Rate	The rate, or percent of the total number of trees and shrubs that are planted after initial restoration to replace the stems unable to establish during a given warranty or monitoring period in order to achieve a given success rate. i.e. a 20% infill rate is typical for offsite restoration projects.
Injure or Injury	Any act that will harm a tree's health in any manner, including failure to protect in accordance with respective municipal and regional standards.
Invasive Species	Non-native species that outcompete native species for resources, thus threatening the given ecosystem's biodiversity and ecological integrity.
Integrated Vegetation Management (IVM)	A system, typically involving a stepwise framework for managing and controlling incompatible and compatible vegetation and restoring environments to their natural state.
Landscape Plan	Typically included with construction drawing submissions, capturing on-site drawings and associated notes which directs sustainable design and may include plantings, natural features, streetscaping, public amenities and other public park infrastructure. Landscape plans also can include ecological restoration elements in designated natural areas (DNA).
Lumber Quality Tree	Trees that can potentially be used for lumber or sustainably diverted (reused), identified based on the tree species, size (> 15 cm DBH), and wood quality (lumber quality). Lumber quality trees have a straight trunk at least 3 m long, a minimum DBH of 15 cm, no large branches (greater than 5 cm diameter) and no visible defects.
Migratory Birds Convention Act, 1994 (MBCA)	Trees that can potentially be used for lumber or sustainably diverted (reused), identified based on the tree species, size (> 15 cm DBH), and wood quality (lumber quality). Lumber quality trees have a straight trunk at least 3 m long, a minimum DBH of 15 cm, no large branches (greater than 5 cm diameter) and no visible defects.
Mechanical/ Manual Control	A form of vegetative control used to minimize incompatible vegetation communities and protect plants from pests, disease, and overgrowth. Methods include hand pulling and cutting, weed trimming, mowing, and using brush cutters and chain saws.
Ministry of the Environment, Conservation and Parks (MECP)	The provincial governing body responsible for developing and delivering policies, legislation, regulations, standards, programs and compliance and enforcement tools to protect Ontario's air, land, water, Species at Risk and their habitats.
Metrolinx-ownedlands	All properties purchased fee simple under Metrolinx's jurisdiction, excluding those designated as temporary or permanent easements. Metrolinx acknowledges these "owned" lands have been, and continue to be, home to many Indigenous Peoples including the Anishinaabeg, the Haudenosaunee and the Huron-Wendat peoples. Metrolinx operates on Territories and lands covered by many Treaties that affirm and value the rights of Indigenous communities, Nations and Peoples. Metrolinx acknowledges we are all Treaty people.
Metrolinx Project	Any project undertaken by Metrolinx or for Metrolinx, involving the construction of heavy rail, light rail, bus, subways, stations and related infrastructure works to enable Metrolinx operations. These projects are subject to Metrolinx guiding principles including this Guideline.
Mitigation Measure	Measures taken to reduce, avoid, or offset potential adverse environmental consequences associated with the implementation of a proposed action or an alternative.

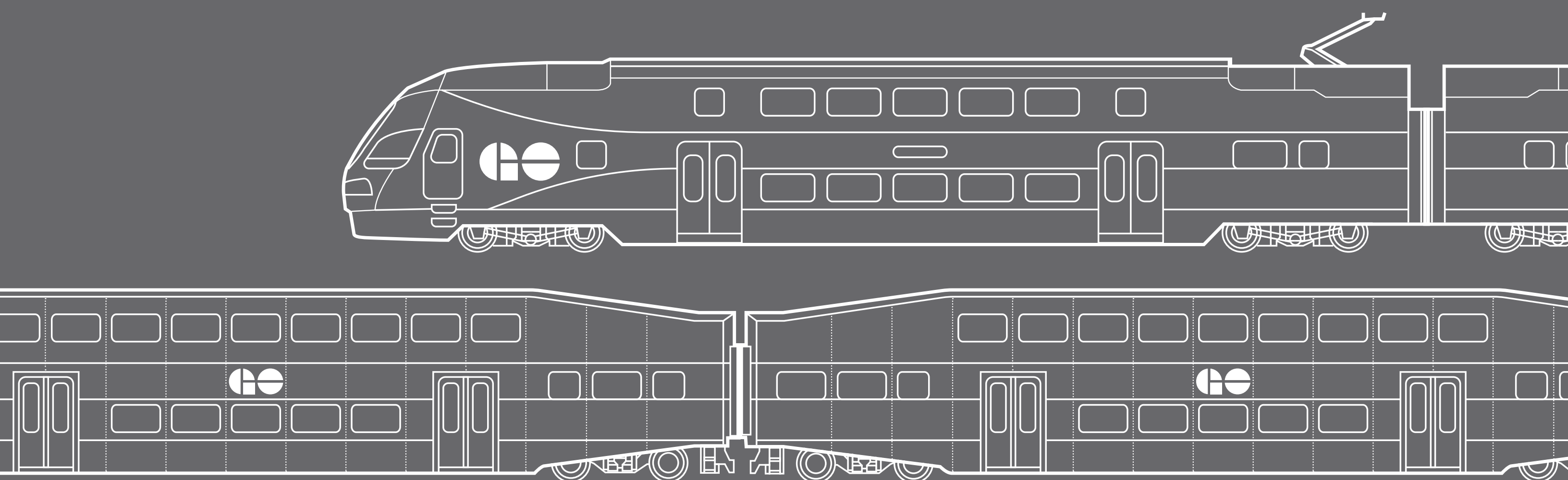
Mitigation Hierarchy	A guiding principle applied to project planning and ecological offsetting programs to reduce environmental impacts. The hierarchy follows an order or priority – avoid, minimize, mitigate, and lastly compensate (through restoration) for environmental impacts.
Ministry of Natural Resources and Forestry (MNRF)	The provincial governing body responsible for sustainably managing Ontario's fish and wildlife resources, Crown lands, forests, water, and other resources.
Multi-stemmed Tree	A tree with two or more stems growing from one rootball that splits below DBH but above ground level. Stems that split below ground level are considered separate trees.
Mycorrhizae	Mycorrhizae are a type of soil fungi that form a symbiotic relationship with plant roots where the fungi help plants access water and nutrients from the soil, while the plants provide the fungi with sugar for energy.
Native Species	A species that is Indigenous to a given region or ecosystem, where its presence in that region is the result of natural evolution and without human intervention.
Natural Environment Mitigation Hierarchy Memorandum (Mitigation Memo)	A memo to be submitted and updated throughout project life cycle, including at each design submission and construction, which documents the implementation of the Mitigation Hierarchy. Mitigation Memo is to be prepared by the Project Technical Advisor (TA) and by Qualified professional(s) including but not limited to Arborist, Landscape Architect, Biologist, Storm Water Engineer, Geotechnical Engineer, Designer, etc. see **Appendix A** for the template.
Natural Heritage Study (Natural Environment Report)	Field studies and a report required for works within or close to (zone of influence) natural features typically referred to as a Natural Environment Report (NER), Natural Heritage Evaluation (NHE), or Environmental Impact Statement (EIS), Natural Heritage Assessment, or Natural Heritage Impact Study. These studies identify natural features, wildlife habitat, and address regulations, and municipal requirement. These reports outline impacts, suggested mitigation, additional studies, commitments and monitoring requirements.
Natural Heritage System	A system made up of 'natural heritage features and areas', linked by natural corridors which are necessary to maintain biological and geological diversity, natural functions, viable populations of native species and ecosystems. These systems can include lands that have been restored and areas with the potential to be restored to a natural state.
Natural wood	Wood material like stumps, trunks, branches, debris from tree and shrub removal, and wood products that are not treated, coated, or glued, etc.
Non-Native Species	A species that has been introduced by human action, either accidentally or deliberately, outside of its natural range.
Noxious Plants	A vegetation species that has been designated by a governing authority as injurious to natural habitats or ecosystems, human health and safety, or agriculture. Can include native, non-native and invasive species.
Nucleation Restoration	Nucleation restoration involves planting small patches (or "nuclei"/ "nodes") of trees, shrubs and/or herbaceous species within a given area identified for restoration to mimic natural succession processes. This restoration method can be implemented alongside other restoration techniques such as soil remediation, creation of habitat features or invasive species management.
Ontario Invasive Plant Council (OIPC)	A multi-sector, non-profit group committed to the collaboration of organizations and citizens to effectively respond to the threat of invasive plants in Ontario. Developed alongside academics and practitioners, the OIPC publishes BMPs (updated on a regular basis) for a growing list of invasive species.

Overhead Contact System (OCS)	The aerial supply system that delivers traction power from traction power substations to the pantographs of Metrolinx electric trains.
Pest/Pest Population	A destructive insect or animal that is harmful to terrestrial or aquatic life forms, human or farm animal health, or interferes with economic activities.
Property Identification Number (PIN)	A provincial electronic identification number for indexing of legal description-based property identification.
Private Lands	Lands that are not owned by a government entity. Private by-laws may apply and works on private property may be authorized under municipal permits.
Proponent	A person who carries out or proposes to carry out an undertaking or is the person having charge, management or control of an undertaking.
Permission to Enter (PTE)	Required permission to enter premises that Metrolinx does not own.
Public Lands	Lands that are under the management of a government entity and other public agencies, such as conservation authorities.
Rail Corridor	The portion of land including and adjacent to tracks owned by the Railway (Metrolinx, Canadian Pacific Railway (CP), Canadian National Railway (CN), etc.). Can be synonymous with the rail Right of Way on which Metrolinx operates.
Raised Guideways	Segments of track infrastructure that are above-grade through support of a retaining wall.
Restoration Planning	Captures the various aspects of planning and preparation for ecological restoration projects that includes restoration accounting, permitting, Indigenous community and stakeholder engagement, location selection that includes a landscape, watershed approach and preparations for restoration implementation, maintenance and monitoring.
Restoration Plan	May include off-site ecological restoration and on-site landscape plans in designated natural areas and includes detailed mapping or drawings and associated instructions/details of required restoration actions and features such as plantings, habitat structures, seeded areas etc.
Road Right of Way (Road ROW)	Land owned by municipalities as opened or unopened road allowances for the purposes of operating a public highway, a public walkway, municipal services or public utilities. A roadway is part of the municipal Right of Way that is improved, designed or ordinarily used for vehicular traffic. For the purposes of this Vegetation Guideline, these are considered public lands.
Shrub	A perennial, woody plant, usually less than 4 meters tall and bushy with several small (typically less than 7.5 cm wide) main stems originating at or near the ground.
Significant Wildlife Habitat	Significant wildlife habitat (SWH) is ecologically important areas in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or natural heritage system.
Soil Decompaction	Actions or a process which loosens compacted soil to create air pockets, gaps, and fissures. This improves the soil's structure, porosity, and permeability, and allows for better water movement and nutrient uptake.

Species at Risk (SAR)	Terrestrial or aquatic plant or wildlife species that have been provincially or federally designated as Endangered, Threatened, Special Concern or Extirpated through species assessments completed by the provincial Committee on the Status of Species at Risk in Ontario (COSSARO), or the federal Committee on the Status of Endangered Wildlife in Canada (COSEWIC). SAR are afforded individual or habitat protection (or both) under the provincial ESA or federal Species at Risk Act (SARA) depending on location of occurrence, and anticipated project impacts.
Species at Risk Act (SARA)	Federal governmental legislation that provides protection for federally designated SAR and their habitat. Species are classified into one of four levels of risk (Extirpated, Endangered, Threatened, or Special Concern) through science-based assessment via the Committee on the Status of Endangered Wildlife in Canada (COSEWIC); classification is based on best-available science and Indigenous Knowledge. Species classified as Threatened or Endangered under Schedule 1 of SARA are afforded protection for individuals and their critical habitat on federal land.
Sustainable/ Sustainability	Meeting the needs of the present without compromising the ability of future generations to meet their own needs through responsible resource use and management, environmental protection measures, and enhancements to quality of life and economy.
Traditional Ecological/Ethnological Knowledge (TEK)	The knowledge base acquired by Indigenous people over many hundreds of years through direct contact with the environment. It includes an intimate and detailed knowledge of plants, animals, and natural phenomena, the development and use of appropriate technologies for hunting, fishing, trapping, agriculture, and forestry and a holistic knowledge, or 'worldview' which parallels the scientific disciplines of ecology (Inglis, 1993, vi). TEK is inclusive of bio-culturally significant and keystone species. TEK rests within the larger body of Indigenous Knowledge systems.
Tree	An assessment of physical characteristics, health, ownership and location of trees within a given project footprint and study area.
Tree end use	Sustainable reuse or repurposing of downed tree material.
Tree Inventory	An assessment of physical characteristics, health, ownership and location of trees within a given project footprint and study area.
Tree Preservation Plan	Drawings that identify trees to be protected, protection limits and protection details as per municipality and Metrolinx requirements. This plan is developed to inform implementation of tree protection for construction and is captured within the Integrated Arborist Report.
Tree Unit	As a method to manage tree compensation equivalencies, 1 (one) tree unit equals to 1 (one) replacement tree or 10 replacement shrubs.
Trunk	The stem or main wooden axis of a tree.
Tree Protection Zone (TPZ)	An area around each tree, typically established based on the DBH of the tree, intended to provide a buffer protecting the tree from potential negative construction impacts including root and soil compaction and mechanical damage and informs where appropriate mitigation must be. The determination of a tree's TPZ may differ between municipalities, as they may provide their own recommendations based on DBH, or canopy dripline.
Toronto and Region Conservation Authority (TRCA)	A registered charity, established under the Conservation Authorities Act and governed by a Board of Directors, with jurisdiction over nine watersheds and their Lake Ontario shorelines.

Vegetation Type/Vegetation Community	A vegetation unit as described by its composition and form and as defined by the Ecological Land Classification System for Southern Ontario.
Vegetation	Plant life, species of plants or flora, inclusive of herbaceous and woody species.
Vulnerability	Sensitivity of a system or component due to exposure to stress or disturbance, such as negative consequences as a result of climate change.

Executive Summary



Executive Summary

This Vegetation Guideline (the Guideline) describes Metrolinx's approach to managing vegetation. This includes planning projects to avoid vegetation impacts to the greatest extent possible; associated Indigenous community and stakeholder consultation and engagement; management of removal/injury of trees as required to accommodate safe construction and operation of Metrolinx projects; sustainable reuse of removed trees; management of invasive species and maintenance of lands throughout the lifecycle of Metrolinx projects. The Guideline is applied to vegetation management within and outside of Metrolinx-owned-lands.

The Guideline is a living document that will evolve over time with input and feedback from Indigenous communities and stakeholders and will incorporate new developments in research and enhancements identified through Metrolinx project implementation. Metrolinx commits to ongoing conversations, consultation and learning with Indigenous communities.

The Guideline outlines the approaches to managing vegetation that allow Metrolinx to provide safe and reliable transit services while also preserving and maintaining the social, economic, and ecological benefits associated with vegetation throughout the life cycle of Metrolinx projects. The Guideline has been updated from the previous version to incorporate input from Indigenous communities and reflect Metrolinx's current transit expansion programs. The Guideline has been developed to provide frameworks for: (1) application of mitigation hierarchy (including evaluation of vegetation removals); (2) vegetation replacement and restoration; (3) vegetation removal and reuse; and (4) integrated vegetation management (IVM). An overview of the phased vegetation management approach provided by the Guideline is illustrated in **Figure 0-1**

Figure 0-1: Metrolinx Vegetation Guideline Process

1. **Application of the Mitigation Hierarchy**
   Evaluation of Environmentally Sensitive Features and Impacts
2. **Vegetation Replacement and Restoration**
   Restoration Planning and Beginning of Phased Implementation
3. **Vegetation Removal and Reuse**
   Implementation of Identified Removals and Reuse Opportunities
4. **Integrated Vegetation Management**
   Invasive Management, Restoration Maintenance and Monitoring

Application of the Mitigation Hierarchy

Metrolinx is committed to prioritizing avoidance, minimization and mitigation of impacts to Environmentally Sensitive Features (ESFs) through the planning and design process as per the Mitigation Hierarchy illustrated in **Figure 0-2**. Where avoidance, minimization and mitigation are not feasible then compensation is implemented as per this Guideline.

Figure 0-2: Mitigation Hierarchy

1. **Avoidance**
   Avoid impacts to Environmentally Sensitive Features to the extent possible
2. **Minimization**
   Where impacts cannot be fully avoided, minimize impacts to Environmentally Sensitive Features
3. **Mitigation**
   Once impacts have been minimized, implement Best Management Practices (BMPs) to reduce impacts and promote recovery of vegetation and Environmentally Sensitive Features adjacent to removals and construction
4. **Compensation**
   Avoid impacts to Environmentally Sensitive Features to the extent possible

The evaluation and implementation of the Mitigation Hierarchy should be documented, in the Natural Environment Mitigation Hierarchy Memorandum (Mitigation Memo), to ensure impacts to ESFs are minimized to the greatest extent possible and to provide justification for ecosystem losses and compensation through ecological restoration (referred to as restoration in the Guideline). A Mitigation Memo shall be submitted and updated throughout the project life cycle, including at each design submission, which documents the implementation of the Mitigation Hierarchy.
Key elements include:

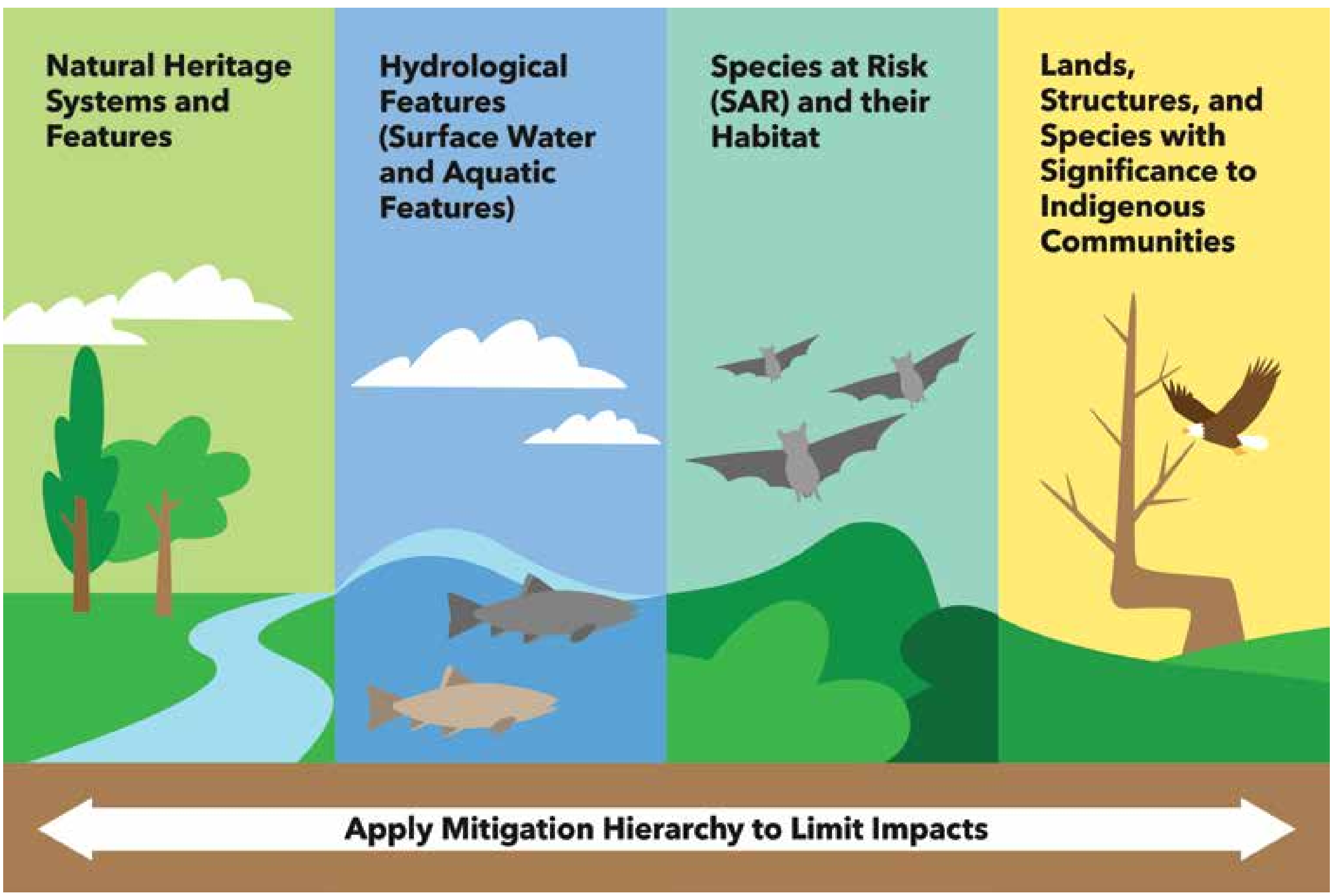
- Identification of ESFs
- Identification of project components that could impact ESFs
- Description of how ESFs were avoided and impacts minimized through proposed project design
- Description of how project impacts will be mitigated
- Analysis of the compensation (through restoration) required for a project given the proposed environmental impacts
- A cost benefit analysis to justify project impacts on the natural environment and related restoration
- An assessment of alternative project designs assessed to avoid/minimize/mitigate project impacts on the environment.

Environmentally Sensitive Features

Environmentally Sensitive Features where the Mitigation Hierarchy should be applied is summarized in **Figure 0-3** and includes, but is not limited to, Designated Natural Areas (DNA) described below:

- Natural Heritage Systems and Features, including individual trees, woodlots, natural areas, parks, ravines and/or linkages
- Hydrological Features (surface water and aquatic features), including watercourses, headwater drainage features, wetlands, vernal pools, etc.
- Species-at-Risk (SAR) and their Habitat, including threatened and endangered species such as Redside Dace, Chimney Swift, SAR bats etc.
- Lands, Structures and Species with Significance to Indigenous communities, including flora and fauna species identified as having significance through engagement with Indigenous communities or through the internal Metrolinx Indigenous interest and screening process.

Figure 0-3. Types of Environmentally Sensitive Features where the Mitigation Hierarchy is Applied



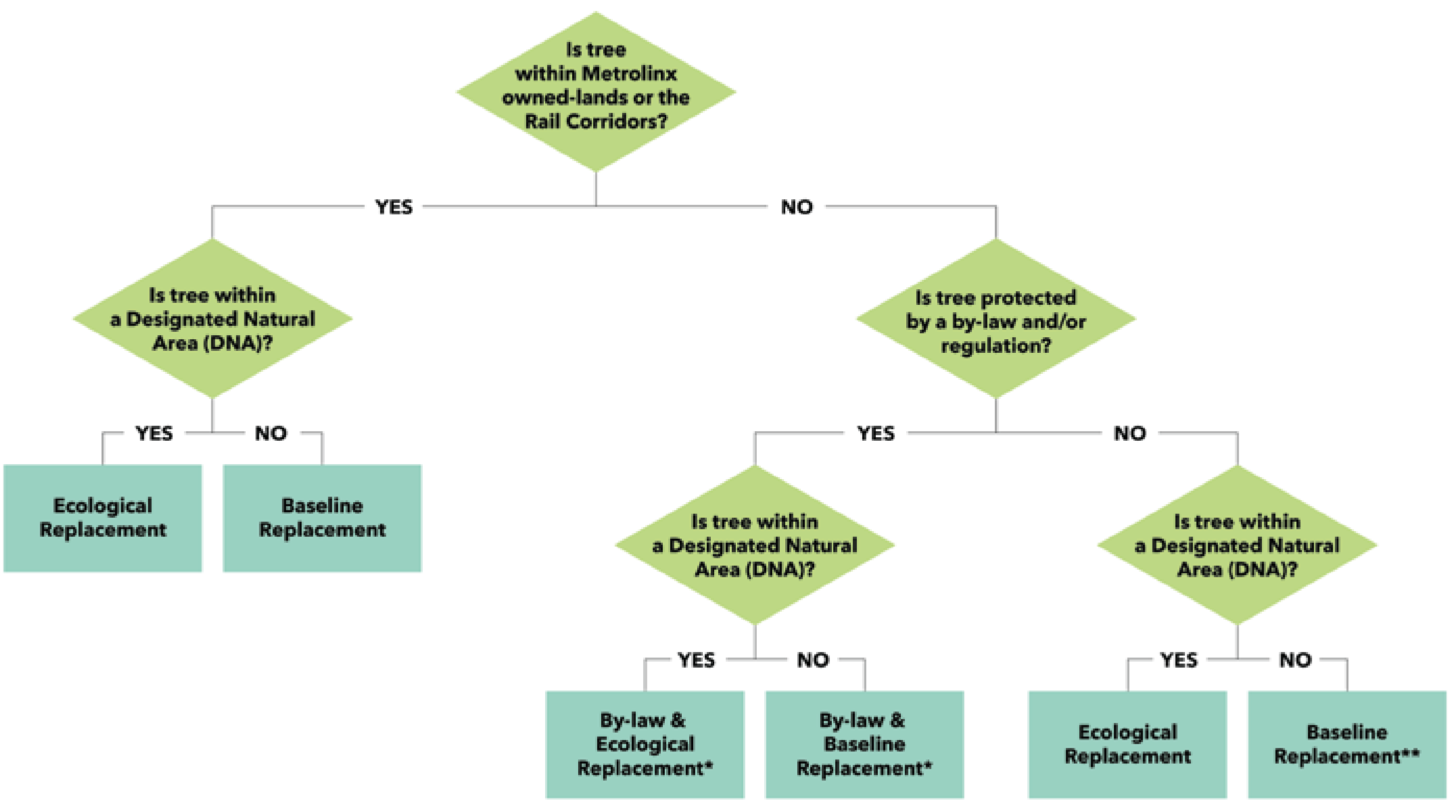
Vegetation Replacement and Restoration

The Guideline includes a vegetation replacement and restoration framework that outlines the approach for determining and implementing replacement and restoration for removal of trees from, and for, Metrolinx projects. It is a landscape science-based approach that at times exceeds the requirements of applicable by-laws and regulations.

The replacement approach is based on the size and location of the tree to be removed including property ownership, applicable by-laws, regulations and impacts to ecological function. The tree replacement quantity will follow one of three approaches: ecological, baseline or by-law, or a combination of these approaches, see **Figure 0-4**. When implementing baseline and/or ecological replacement, 10 shrubs are considered equal to one tree unit.

The vegetation replacement and restoration approach recommended in the Guideline applies to tree removals associated with Metrolinx capital projects only and does not apply to vegetation removal associated with routine operational maintenance work. However, certain principles outlined in the Guideline are integrated in operational and maintenance practices, such as avoiding and minimizing tree removal wherever possible. For example, branch pruning is the preferred approach for addressing trees that pose a risk to safe operations and infrastructure.

Figure 0-4: Vegetation Replacement Approach Flowchart



Vegetation Replacement within Designated Natural Area Lands

Replacement for woody vegetation within a Designated Natural Area (DNA) will reflect the principles of the Toronto and Region Conservation Authority's (TRCA) Guideline for Determining Ecosystem Compensation (June 2023). Ecological replacement involves implementing replacement ratios based on tree size to account for the removed vegetation's ecosystem functions and services. The replacement ratio ranges from 1:1 to 50:1 based on the diameter of the trunk at breast height (DBH, see Section 4.4.3 for more details). Shrub thickets within a DNA can be replaced with 10 shrubs or one tree per 5 linear metres (or per 10 m2) of thicket removed. Dead trees of all sizes will also be replaced at a 1:1 ratio. Ecological replacement ratios based on vegetation type and individual size is summarized in **Table 0-1.**

Vegetation Replacement in Public and Private Lands

Metrolinx's approach to vegetation management is not intended to replace existing tree by-laws but rather complement existing regulations and by-laws to ensure a consistent approach across all municipalities in which Metrolinx constructs/operates, including municipalities where tree by-laws do not exist. Metrolinx adheres to applicable municipal tree by-law requirements, including permit requirements for trees outside of Metrolinx-owned-lands and the rail corridor.

Table 0-1: Summary of Metrolinx Baseline and Ecological Replacement Ratios Based on Vegetation Type and Size

Metrolinx Replacement Type	Vegetation Type	DBH (cm)	Replacement Ratio
Baseline Replacement	Live Tree	10 – 29.9	1:1
	Dead Tree	≥ 30	10:1*
Ecological Replacement	Live Tree	≥ 10	1:1
		1 - 10	1:1
		10.1 – 20	3:1
		20.1 – 30	10:1
		30.1 – 40	15:1
		40.1 – 50	20:1
		50.1 – 60	30:1
		60.1 – 70	40:1
		≥ 70.1	50:1
	Dead Tree	≥ 1	1:1
	Shrub Thicket	N/A	1 tree:10m²

** Where local planting opportunities are limited or not available, a minimum 3:1 replacement ratio must be met for ≥ 30DBH Baseline replacement.*

Vegetation Replacement in Non-Designated Natural Area Lands: Metrolinx-owned-lands & Rail Corridor

The vegetation replacement and restoration approach recommended in the Guideline applies to tree removals associated with Metrolinx capital projects only and does not apply to vegetation removal associated with routine operational maintenance work. However, certain principles outlined in the Guideline are integrated in operational and maintenance practices, such as avoiding and minimizing tree removal wherever possible. For example, branch pruning is the preferred approach for addressing trees that pose a risk to safe operations and infrastructure.

Ecosystem Area Replacement

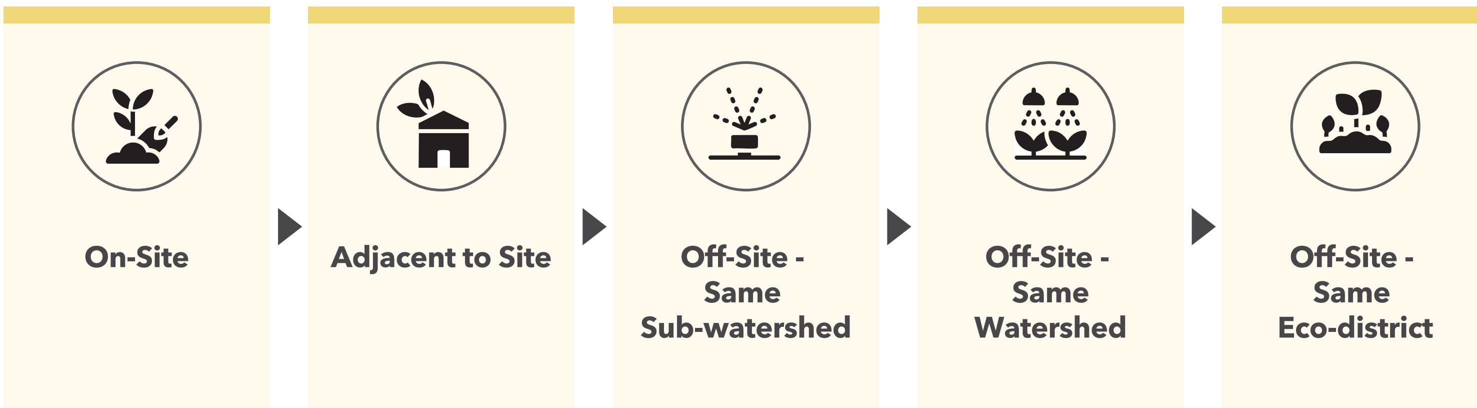
Metrolinx is committed to replacing the permanent loss of habitat within Sensitive Features or DNA such as wetlands, watercourses, and meadows at a 1:1 area-based ratio to the extent possible, likely with off-site restoration. This habitat replacement will be undertaken for areas 0.1 ha or larger in combination with individual tree compensation. In cases where DNA habitat replacement is less than 0.5 ha, it may be combined with another restoration project to streamline implementation where possible.

Area-based compensation may be partially addressed through the Voluntary Project Review (VPR) process (or equivalent process) that Metrolinx is committed to following with Conservation Authorities for works within their regulated lands. Additionally, compensation must comply with the Endangered Species Act, 2007 (ESA, 2007) and applicable regulations administered by the Ministry of Environment, Conservation, and Parks (MECP) authorization process.

Restoration Planning and Implementation

Restoration planning is initiated as vegetation removals are being evaluated. Restoration needs are identified through the amount of vegetation and ESFs losses. The Mitigation Memo provides the rationale for restoration, with the application of the Mitigation Hierarchy as the framework. Restoration location is based on the order shown in **Figure 0-5**. On-site restoration plans are captured in landscape plans included with design submissions. Initiating off-site restoration plan development requires collaboration with organizations capable of implementing ecological restoration as detailed in this Guideline. Indigenous communities are engaged throughout the planning, implementation, and monitoring phases for all types of restoration plans.

Figure 0-5: Restoration Site Selection Order of Priority



Successful restoration, as illustrated in **Figure 0-6**, depends on planning initiated during design, site preparation, implementation, maintenance, monitoring, and should include:

- Identifying existing soil conditions, soil reuse, and amendments as well as mitigation
- Invasive species control and management during construction and in preparation for plantings
- Identification of appropriate native plantings based on existing or historic vegetation communities and site conditions
- Edge mitigation and edge plantings initiated prior to active construction and maintained throughout the project life cycle.

Vegetation Reuse

Metrolinx acknowledges the impact that tree and vegetation removal can have on the landscape when building transit infrastructure. This Guideline outlines methods for mitigating some of these impacts through sustainable and environmentally conscious vegetation reuse initiatives and alternative sustainable vegetation disposal practices including:

- Harvesting opportunities for Indigenous communities; translocating plants within a site or to a nursery
- Collecting seed and plant material for propagation and future restoration
- End-use options for downed woody material
- More details on these initiatives and how they are being implemented are provided in **Section 5.**

Most of the trees removed from Metrolinx projects are chipped on site. The tree end use framework aims to divert removed trees from landfills or chipping and find suitable uses for felled woody materials including, but not limited to, on-site re-use, Indigenous community use, restoration/habitat feature creation, lumber, and art.

Figure 0-6: Successful Restoration Implementation Strategies

Determining the most suitable end use for a tree proposed for removal involves an assessment of its characteristics as described in the Integrated Arborist Report Template. If the tree is determined to be bio-culturally significant or of interest to an Indigenous community, its removal, preparation, and distribution will be determined through engagement on a project-by-project basis. Trees and shrubs that are invasive or growing in areas with dense herbaceous invasive species, are smaller than 10 cm DBH, or are ash trees or oak trees, will be chipped and spread evenly on-site to minimize soil compaction or will serve as organic matter adjacent to the site. For sites where the volume of chipped material generated exceeds on-site capacity (i.e. 10 cm depth in right-of-way ROW), excess material that does not contain invasive species will be transported to an approved off-site waste facility or may be diverted for use off-site or given away. In areas that are pristine, invasive species should be removed and disposed off-site in compliance with Canadian Food Inspection Agency (CFIA) regulations rather than mixed with native sources on-site to reduce the spread of invasive species.

If a tree is non-invasive, larger than 10 cm DBH and not an ash or oak tree, it can be prepared for end use in various forms as requested by the identified partner(s), such as for lumber or habitat creation projects. If a tree is not a lumber quality tree, the tree will be distributed to end use partners in their requested forms as applicable or be chipped. Potential end-users can identify which type of wood product generated they are interested in, i.e., restoration features, tree lumber, or wood chips. Transportation and storage considerations that determine how woody material will be collected, stored, transported, and eventually delivered to the right end users are described in **Section 5.4** and Appendix L of the Guideline.

Integrated Vegetation Management

Integrated Vegetation Management (IVM) is a system, typically involving a stepwise framework for managing and controlling incompatible and compatible vegetation and restoring environments to their natural state. IVM encourages the planting and maintenance of compatible vegetation (i.e., low growing species) and the active identifying of incompatible species for removal (i.e., trees and tall shrubs) along Metrolinx corridors. This approach is considered a proactive, cost-effective, and progressive way to manage vegetation in the rail corridor. The IVM framework presented in the Guideline provides an approach to managing vegetation throughout the project lifecycle, including operations, that:

- Minimizes impact on infrastructure
- Implements practices to diversify and re-establish native plant species and control invasive plant species
- Ensure it is cost-effective.

This IVM approach will apply to rail corridors – including future corridor electrification – elevated/ raised guideways, restoration areas, and other Metrolinx-owned-lands as applicable.

Consistent with Metrolinx's focus on providing safe and reliable service, key management objectives for IVM in a rail corridor, elevated/ raised guideways, restoration areas and on Metrolinx-owned-lands are to:

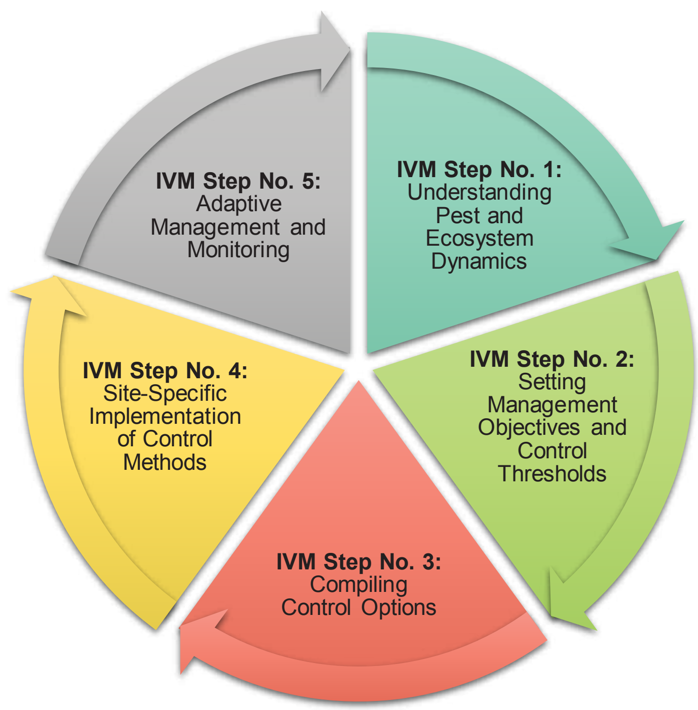
- Prioritize worker and operational safety
- Maintain reliable service by minimizing disruption caused by fallen trees, tree limbs, and debris
- Minimize the spread of invasive species
- Protect rail infrastructure
- Ensure the success of plantings within restoration areas.

Metrolinx's IVM program is presented in five steps and is a cyclical and adaptive framework, as illustrated in **Figure 0-7.**

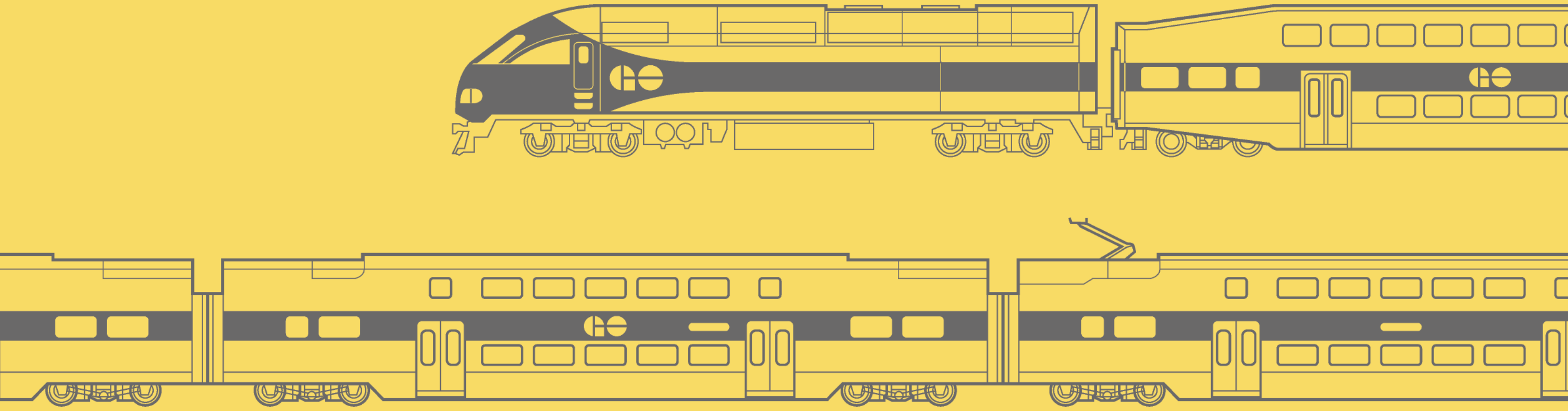
Monitoring, tracking and evaluation to gauge success and inform IVM program improvements is critical. On-site and off-site restoration, electrified corridors, and guideways will require monitoring and evaluation of the IVM process, based on success of plantings, and safety of rail and rapid transit operations. Additional indicators of success will be applied for ecological restoration such as the presence of bio-indicator species. Vegetation monitoring and evaluation will:

- Inform adaptive management needs
- Provide guidance for future work
- Support ongoing improvement to the IVM based on learned experiences
- Allow for IVM to meet new objectives and conditions.

Figure 0-7: The Cyclical Steps of Integrated Vegetation Management



Introduction



1.0 Introduction

Metrolinx was established by the Government of Ontario under the Metrolinx Act (2006) with a mandate to support "a high quality of life, a sustainable environment and a strong, prosperous and competitive economy".

Metrolinx and its partners are delivering on a bold, forward-looking transportation plan to transcend regional borders and foster connections between communities in the Greater Toronto and Hamilton Area (GTHA). The delivery of Metrolinx transit expansion programs will provide significant new travel choices for GTHA residents to meet the needs of a growing region. This will include faster and more efficient service, a wider range of service options, and improved accessibility. The infrastructure work planned under Metrolinx's transit expansion programs (GO Expansion, Rapid Transit and Subway Programs) includes the construction of new tracks, new stations, and improvements to existing stations, grade separations, subway portals and tunneling, and guideways. Additionally, Metrolinx is implementing electrification infrastructure within its expansion programs, converting GO rail services from diesel to electric powered trains.

Vegetation management is an important component within and around Metrolinx Projects. To implement the transit expansion programs (including electrification), large scale vegetation removals are anticipated to ensure that vegetation does not interfere with the safe operation and construction of Metrolinx infrastructure. Vegetation removals completed in a sustainable manner are essential for construction, maintaining infrastructure integrity, and keeping riders and operators safe.

This Guideline has been developed to provide a framework for the application of the Mitigation Hierarchy, vegetation replacement and restoration, vegetation removal and reuse, and integrated vegetation management (IVM), which is summarized in phases in **Figure 1-1**. Together with the Metrolinx Sustainable Design Standard which guides the integration of sustainability principles throughout the design phase of projects, these are important tools that ensure Metrolinx Projects are considering the environmental impacts of transit expansion in a sustainable way.

The Guideline aims to:

- Minimize the environmental impacts of transit service expansion on the natural environment;
- Identify commitments for vegetation and ecosystem replacement across the Metrolinx service area as we build the transit network;
- Manage vegetation on Metrolinx-owned-lands thoughtfully;
- Engage Indigenous communities in restoration and vegetation management; and,
- Maintain a safe and reliable transportation system.

Engagement with Indigenous communities regarding the Metrolinx Vegetation Guideline remains ongoing.

Figure 1-1. Metrolinx Vegetation Guideline Process

PHASE 1
Application of the Mitigation Hierarchy
Evaluation of Environmentally Sensitive Features and Removals/ Impacts

PHASE 2
Vegetation Replacement and Restoration
Restoration Planning and Beginning of Features and Removals/ Impacts

PHASE 3
Vegetation Removal and Reuse
Implementation of Identified Removals and Reuse Opportunities

PHASE 4
Integrated Vegetation Management
Invasive Management, Restoration Maintenance and Monitoring

1.1 Metrolinx Vegetation Guideline Considerations

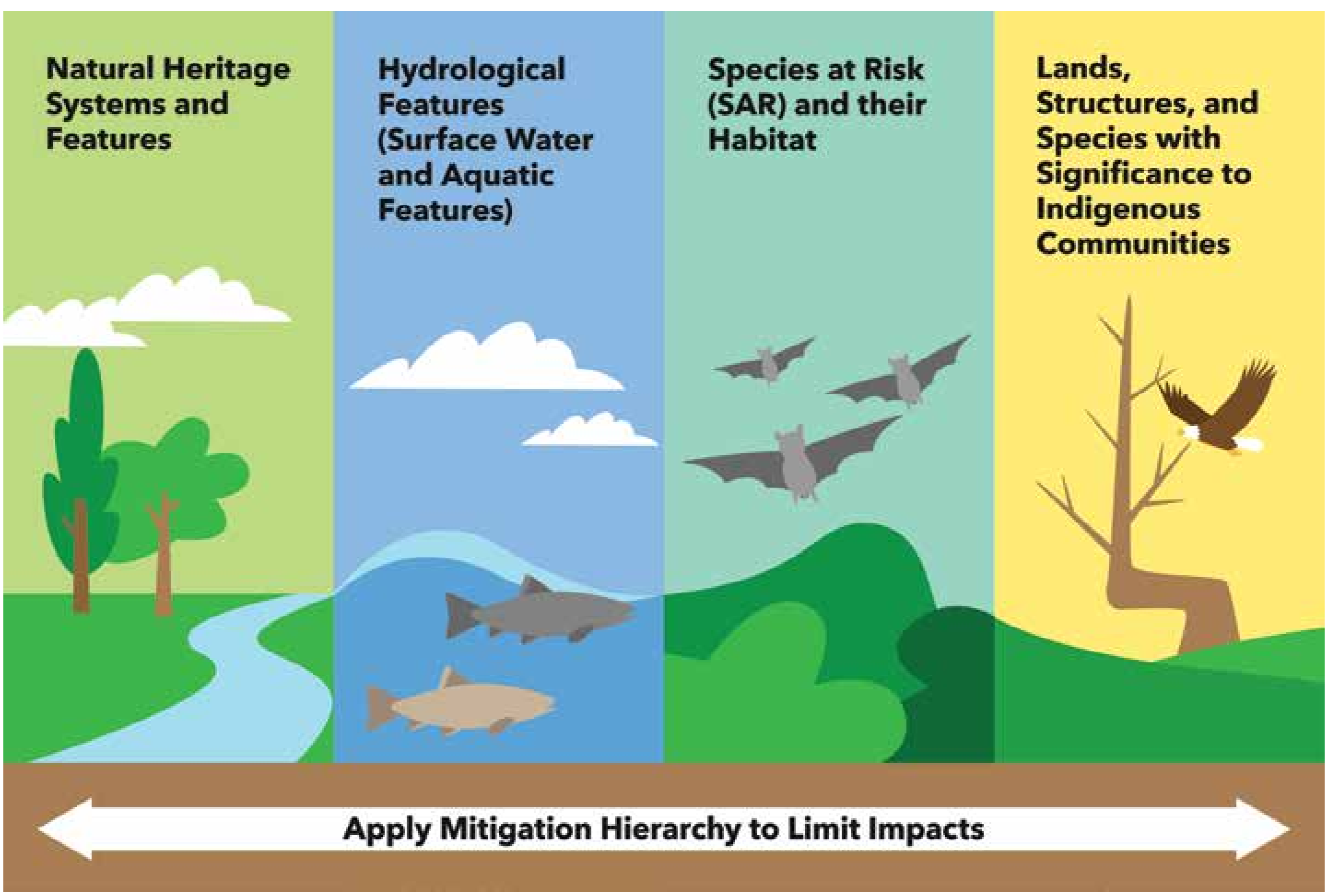
In addition to providing guidance on vegetation management, this Guideline also informs processes to minimize the impact of new and existing infrastructure on ecosystems and look for ways to enhance the health of ecosystems (e.g., species, habitat, biodiversity, etc.). The Guideline will continually adapt from past iterations, by incorporating knowledge gathered from engagement with Indigenous communities and stakeholders impacted by Metrolinx Projects, integrating lessons learned through the implementation of the vegetation replacement and restoration, vegetation reuse, and IVM frameworks herein to establish a forward-thinking industry standard.

The Guideline aims to support the following goals:

- Integrate requirements into Metrolinx procurement practices to manage and mitigate impacts of new and existing infrastructure on existing ecosystems.

  Reduce the amount of vegetation removals and loss of ESFs and mitigate potential impacts through implementation of the Mitigation Hierarchy: avoiding vegetation and/or natural heritage removals, minimization of impacts followed by mitigation and compensation through vegetation, and natural feature replacement as a last resort, see **Figure 1-2.**
- Identify and implement opportunities to support and enhance conservation of biodiversity (i.e., habitat and species) to meet or exceed applicable legislation and guidelines, and to align with climate resilience goals.
- Identify opportunities to enhance existing ecosystems to meet or exceed applicable legislation and guidelines and to align with climate resilience goals. This includes but is not limited to consideration of southern Ontario native and pollinator species.
- Where possible, replant native vegetation on Metrolinx owned land to minimize negative impacts of vegetation removal in communities. This includes exploring opportunities to plant in local communities impacted by removals through tree giveaways and developing partnerships with local community groups to ensure that the local tree canopy and natural heritage system are maintained.

Figure 1-2. Types of Environmentally Sensitive Features where the Mitigation Hierarchy is Applied



1.2 Indigenous Communities Engagement

Engagement with Indigenous communities will support the ongoing improvement, development, and implementation of the Guideline. This engagement will enrich all components within the vegetation removal evaluation, replacement and restoration, reuse, and IVM frameworks.

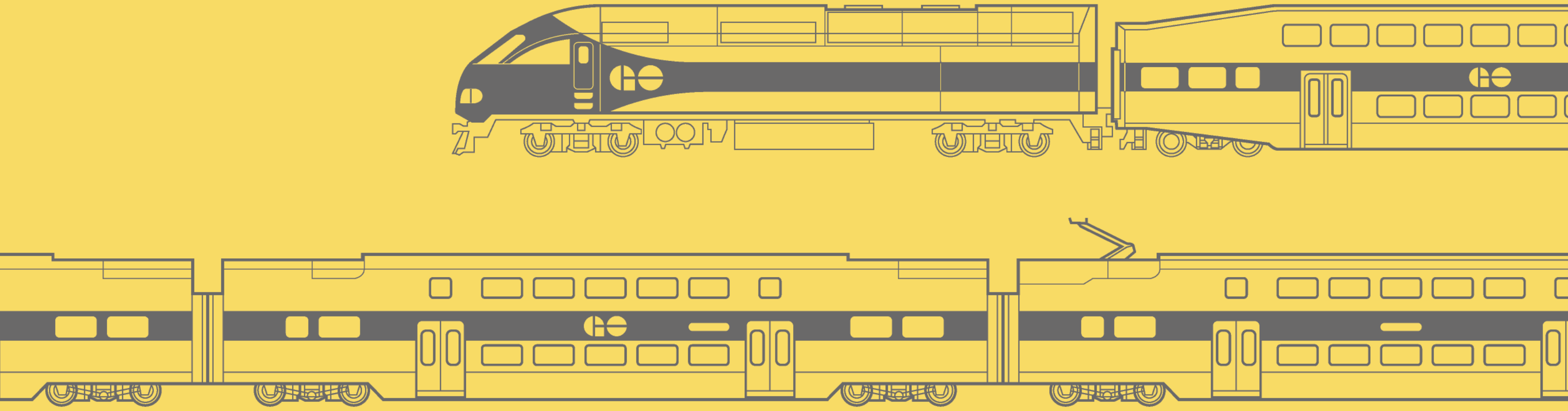
The previous iterations of the Guideline have been largely prepared without consultation with Indigenous communities. The 2025 version includes feedback and guidance from Indigenous communities as the Guideline inches closer to two-eyed-seeing. This process will take time as Metrolinx continues to learn and develop processes to support this. Metrolinx is committed to undertaking meaningful engagement with Indigenous communities to ensure the frameworks within the Guideline capture their interests, Indigenous Knowledge (IK) and Traditional Ecological Knowledge (TEK) regarding vegetation removals, replacement, restoration, reuse, and IVM as applicable.

Metrolinx recognizes that IK and TEK often identifies values and significance to natural features and landscapes not captured in the values and methodologies of western culture (i.e., the use of 'invasive species' may hold a different meaning between Indigenous and western beliefs). The Guideline has been revised to reflect opportunities for IK and TEK inclusion and these considerations are identified, where possible, directly throughout the document.

When working with IK and TEK, the principles of Ownership, Control, Access, and Possession (OCAP) should be observed. IK/TEK belongs to the Individual and community who provide it and it is not to be distributed, printed, or made available without permission from the owner.

NOTE: Engagement with Indigenous communities should always precede engagements with non-Indigenous groups or entities.

Background



2.0 Background

The Vegetation Guideline was first drafted in 2020 to guide Capital Projects and Operations for the GO Rail Expansion Program. As part of the GO Rail Expansion Program, it was identified that appropriate replacement for the removal of vegetation would need to be implemented.

The Initial Business Case (IBC) for the Metrolinx Vegetation Policy Framework (now referred to as the Vegetation Guideline) was originally developed to address vegetation removals through replacement and restoration for the GO Rail Expansion Program that could be transferrable to future Metrolinx Projects. In 2020, the Vegetation Guideline was first published with multiple workshops with municipalities and conservation authorities. In 2022, The Guideline was updated to include all Metrolinx Projects and committed to Indigenous community engagement. In 2023, Vegetation Guideline workshops began with Indigenous communities with Aboriginal and Treaty Rights in the Metrolinx service area. This 2024 update is a result of these workshops. Future workshops may result in additional updates as needed.

The Guideline is considered a living document, and has undergone revisions to incorporate lessons learned, climate resilience considerations, as well as guidance from Indigenous communities and stakeholders including, but not limited to, community groups, elected officials, municipal staff, conservation authorities, and affected property owners. Moving forward, Metrolinx will continue to consult and engage with Indigenous communities on the Guideline.

The TRCA's Guideline for Determining Ecosystem Compensation (June 2023) (herein referred to as the TRCA ecosystem compensation guideline) was a guiding document for the Guideline and will continue to inform the approach to ecosystem management. The TRCA ecosystem compensation guideline presents an approach for replacing natural features lost through development and/or infrastructure under circumstances where impacts cannot be avoided. It recognizes ecosystem compensation as a tool to help ensure that the critical ecosystem functions and services lost through development and infrastructure are restored. It provides guidance on how to determine the total amount of compensation required to replace lost or altered ecosystems in a repeatable and transparent manner. It promotes strategic and effective implementation of compensation restoration and attempts to provide a standard and consistent approach informed by science and decades of experience in the application of natural heritage planning and ecological restoration. Finally, it is intended to set standards to ensure that compensation projects are adequately financed and successfully implemented for the long term.

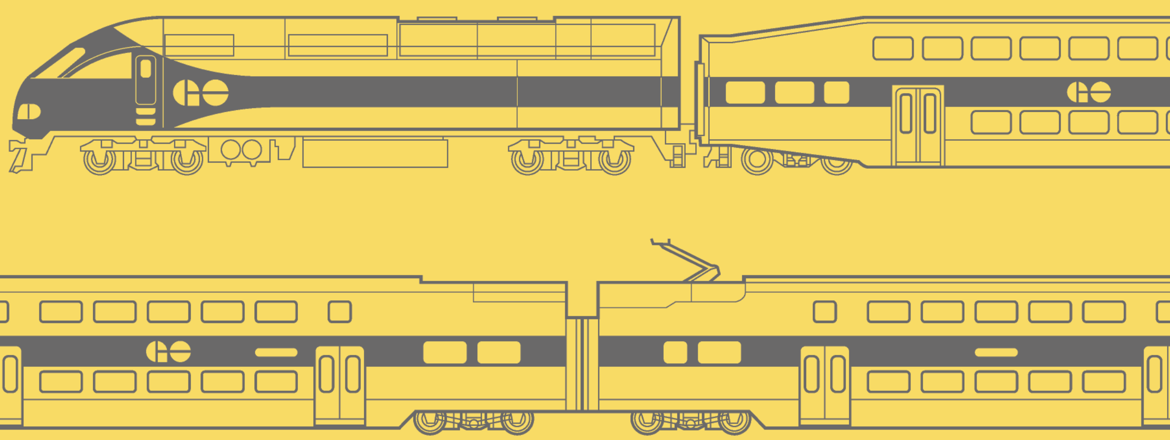
The TRCA ecosystem compensation guideline promotes the use of the Mitigation Hierarchy before vegetation removals are considered. The Mitigation Hierarchy is a guiding principle commonly applied to ecological offsetting programs which calls for the avoidance of impacts first, then minimization, followed by mitigation, with compensation as a final option following vegetation removals. Compensation can be defined as the creation or restoration of habitat to offset the loss that could not be avoided, minimized, or mitigated.

The TRCA ecosystem compensation guideline outlines two main approaches to compensation, which are often used in tandem: (1) replicating ecosystem structure, and (2) replicating the land base. Replicating the land base, however, involves securing or acquiring land, which will not be done as part of Metrolinx's approach to vegetation compensation. Thus, replicating the land base is not suitable and only the replicating ecosystem structure approach has been carried forward for consideration in developing the Guideline.

The TRCA ecosystem compensation guideline acknowledges that compensation requirements for the loss of vegetation may be met under existing by-laws or authorization under the Endangered Species Act (ESA), 2007. The TRCA ecosystem compensation guideline was originally published in 2018 and it was updated based on a review of the early application successes and challenges. A summary of updates includes:

- Minor updates to the approach to land base compensation.
- Updated replacement ratio for treed ecosystems. These include a more graduated ratio progression and elimination of the highest ratio for woodlands/forests.
- Monitoring requirements have been modified to include monitoring of the restored sites at the 10-year mark.
- Greater ratios for the compensation of marshes.
- Implementing Low Impact Development or habitat enhancements (e.g., invasive species management) as compensation actions.
- Exploring methods of calculating offsetting ratios that consider multiple ecosystem service.

Application of the Mitigation Hierarchy



3.0 Application of the Mitigation Hierarchy

Metrolinx acknowledges that the loss of vegetation and ESFs can result in the loss of ecosystem services, habitat, amenity value, privacy, and canopy cover in an area, and therefore prioritizes the Mitigation Hierarchy for each of its projects. The Mitigation Hierarchy calls for avoidance, minimization, implementing mitigation measures, prior to considering removals with compensation through vegetation replacement/restoration, as illustrated in **Figure 3-1**.

Figure 3-1: Mitigation hierarchy

1 Avoidance
Avoid impacts to Environmentally Sensitive Features to the extent possible

2 Minimization
Where impacts cannot be fully avoided, minimize impacts to Environmentally Sensitive Features

3 Mitigation
Once impacts have been minimized, implement Best Management Practices (BMPs) to reduce impacts and promote recovery of vegetation and Environmentally Sensitive Features adjacent to removals and construction

4 Compensation
Where impacts cannot be avoided, on-site and off-site restoration will be completed to offset vegetation removals and habitat loss

Documentation of Mitigation Hierarchy implementation will be completed through a Natural Environment Mitigation Hierarchy Memorandum (Mitigation Memo) **(Appendix A)** prepared at each phase of a project's life cycle. The Mitigation Memo documents alternatives assessed to avoid, minimize, and mitigate impacts in each stage of the project life cycle beginning with Initial Business Case planning through EA/TRPAP, detailed design construction and monitoring. As detailed design progresses, design modifications that reduce/eliminate impacts are documented. See **Appendix A** for the Mitigation Memo Template.

Vegetation removals are anticipated for the development of most transit infrastructure projects. Metrolinx focuses on the reduction of vegetation removals and impacts through project design and identification of mitigation techniques prior to construction. In situations where vegetation removal or impacts to Sensitive Features are considered unavoidable during a project's life-cycle (including construction and maintenance phases), removals and subsequent compensation through replacement will be required. This approach is consistent with the Mitigation Hierarchy: avoidance of impacts, then minimization followed by mitigation. Compensation through replacement is the least desirable option.

The following subsections outline the methodologies to identify potential impacts to vegetation and Sensitive Features, assess where avoidance and minimization can be implemented, and identify appropriate mitigation measures for the protection of vegetation and Sensitive Features. The final step of the Mitigation Hierarchy, compensation through replacement, is described in **Section 4.**

3.1 Avoidance and Minimization of Removals and Impacts

3.1.1 Identification of Vegetation Removals

Robust data collection is a key step in the assessment and application of the Mitigation Hierarchy. Furthermore, the evaluation of vegetation removals, replacement and restoration, and reuse frameworks provided in the Guideline are also dependent on the accurate vegetation information collected for Metrolinx Projects.

Metrolinx anticipates that vegetation removals will be required throughout a project's life-cycle due to construction and operation activities or for safety and maintenance purposes. To ensure the minimal number of vegetation is removed for the delivery of a Metrolinx Project, a tree inventory and assessment is required to be completed by an Arborist prior to any tree or vegetation removals; with support from a qualified professional (e.g. ecologist). The results of the tree inventory and assessment are documented in an Integrated Arborist Report, which is further detailed below. Re-assessments of the Integrated Arborist Report should be completed during each subsequent phase of the Project to determine whether additional mitigation measures or design changes could minimize the number of vegetation removals. Efforts to avoid or minimize impacts to vegetation can continue throughout early works and construction, such as when Arborists and the project contractor are field fitting designs and have the option to continue to reduce vegetation removals. This assessment is to be documented in a Mitigation Memo. When weighing design options, Metrolinx will prioritize reducing removals and impacts within DNA(s) and other naturalized areas and parks, avoid Species at Risk (SAR) and SAR habitat, bio-culturally significant species and other significant trees, and transplant suitable trees and/or plants wherever possible.

Metrolinx provides data collection requirements for the Integrated Arborist Report (including requirements for the Tree Preservation Plan) in **Appendix B** of the Guideline. **Appendix B** also provides details on the resources and natural heritage studies that should be reviewed to delineate a DNA prior to site surveys and tree inventories. Information within the Integrated Arborist Report shall include data such as tree species, diameter at breast height (DBH) in cm, health/structural condition, tree location and identification of lumber quality trees, trees of significance (e.g., bio-culturally significant and/or SAR trees), and DNA within the Project footprint and appropriate buffer area.

A Tree Protection Plan shall also be prepared, illustrating the Project's footprint, tree locations, associated Tree Protection Zones (TPZs), and recommended actions (remove, injure, transplant/relocate, and protect/retain) based on design. Additionally, the Integrated Arborist Report will provide tree protection measures to mitigate for the impacts of construction on retainable trees, mitigation to prevent spread of invasive species, and other criteria to support implementation of the mitigation hierarchy and restoration planning. Potential opportunities for vegetation harvesting, relocation, archiving and seed collection to be implemented prior to removals, and suitability for tree end use may also be identified within the Integrated Arborist Report.

All tree data collected on behalf of Metrolinx should be provided to Metrolinx within tree inventory table spreadsheets and locations captured in the associated geographic information system (GIS) data as outlined in **Appendix B**. Metrolinx has developed an Integrated Arborist Report template to be used for Metrolinx Projects that adheres to the requirements of the Guideline; this template is available upon request. Tracking of tree inventory data as well as the implementation of vegetation removals throughout construction is not only required to understand a Project's impacts and progress, but to inform and coordinate with adjacent Projects and contracts to avoid potential duplication of work and unnecessary vegetation removals. Generally, Metrolinx Projects track progress on vegetation removals and implementation of tree protection measures monthly.

Identification of vegetation other than trees, and within DNA, other than shrubs, is captured in a natural heritage study (also referred to as a Natural Environment Report) and subsequent study and/or reporting as warranted. The natural heritage study shall include an assessment of the study area ecosystems including Ecological Land Classification for Southern Ontario (ELC) assessment per ecosite, which includes an inventory of herbaceous and woody species on site and soil coring wherever possible. These details on environmental site conditions support application of the Mitigation Hierarchy such as avoiding the removal of rare or significant ecosystems or herbaceous species.

As appropriate, Integrated Arborist Reports and natural heritage studies shall be shared with Indigenous communities and stakeholders when available or as design progresses for review and comment. If concerns are identified, the design is reviewed and modified to avoid/reduce impacts where feasible. Instances where vegetation removals cannot be avoided are often due to the works being linear infrastructure. Prior to the implementation of vegetation removals, seed collection, vegetation rescue/reuse and/or ceremonies will be undertaken with Indigenous communities when identified as desired through the consultation process. Vegetation reuse, such as the distribution of lumber quality trees and other requested forms, to Indigenous communities will occur after removals when identified as desired in the consultation process.

3.1.2 Identification of Natural Environment Impacts

Natural environment impacts are identified and addressed through a natural heritage study (also referred to as a Natural Environment Report) and subsequent study and/or reporting as warranted. A natural heritage study is typically carried out as part of an Environmental Assessment in accordance with the Transit and Rail Project Assessment Process (TRPAP) for most transit capital projects. The TRPAP is defined by Ontario Regulation (O.Reg.) 231/08 under the provincial Environmental Assessment Act (as amended) and includes consulting on the assessment of the potential environmental effects of the Project and associated mitigation. The Environmental Project Report (EPR; which documents the TRPAP) reviews the need and provides justification for the Project, documents the existing conditions (e.g., herbaceous plant list) and constraints and details the potential environmental impacts and provides recommendations for addressing these impacts through further study, mitigation, and monitoring. Existing conditions are documented, potential impacts identified, and impact avoidance, minimization, mitigation, and monitoring are recommended and addressed where feasible during design and construction as commitments and obligations.

This environmental assessment and natural heritage study (also referred to as a Natural Environment Report) typically identifies DNAs/ESFs and addresses matters of provincial interest relative to the natural environment, including, but not limited to:

- Parks, conservation reserves or protected areas;
- Endangered, Threatened or Species of Special Concern (SCC) and their habitat;
- Wetland, woodland, significant wildlife habitat (SWH), habitat for wildlife, or other natural heritage area (e.g., prairie);
- Areas of natural or scientific interest (ANSI; earth or life science);
- Direct and indirect fish and fish habitat including but not limited to streams, creeks, rivers or lakes;
- An area or region of surface water, groundwater, or other important hydrological features; and,
- Areas that may be affected by a known or suspected on- or off-site source of contamination such as a spill, a gasoline outlet, an open or closed landfill site, etc.

In addition to regulatory requirements the natural heritage study is to identify all Sensitive Features that may be impacted by the project. Therefore, the natural heritage study supports restoration planning where appropriate and is also an opportunity to identify plant rescue, reuse and seed collection opportunities that can be conducted in collaboration with Indigenous communities.

Information from the natural heritage study is used to inform the development of the Mitigation Memo. The Mitigation Memo will document all Sensitive Features on site for a project (e.g., wetlands and watercourse crossings) and identify how project impacts to each Sensitive Feature will be avoided, minimized and/or mitigated throughout design stages. Where impacts could not be fully avoided, minimized, or mitigated, the compensation for the Sensitive Feature impact/loss through restoration shall be identified. The Mitigation Memo shall be updated throughout the project life cycle including within each design update as impacts are re-assessed.

Analysis of impacts to ESFs in the Mitigation Memo will also consider impacts to ecological function to be mitigated and/or compensated for through applicable regulations, identified environmental commitments, and in some cases the permitting processes.

While the Guideline primarily focuses on vegetation replacement, Metrolinx recognizes the value of other natural features and habitathe larger landscape (e.g., riparian habitat, wetlands, forests). It is therefore critical to ensure that any permanent damages, losses and/or function of these natural systems as a result of the vegetation removals (as illustrated in **Figure 3-2** below) or other ecosystems be addressed by replicating/restoring area-based habitat such that habitat loss/damage is limited to the extent possible.

This type of area-based compensation is partially addressed through the review process that Metrolinx is committed to following with Conservation Authorities and the SAR Overall Benefit Permit review process under the ESA, 2007 administered by the MECP. However, Metrolinx is committing to replacing the permanent loss of habitat or natural heritage as a result of Metrolinx Capital Projects within DNAs or ESFs at a 1:1 area-based ratio for areas lost as small as 0.1 ha, to the extent possible regardless of MECP or Conservation Authority requirements. This habitat replacement will be undertaken through a combined approach with the individual tree replacement as outlined in this Guideline.

In cases where a habitat replacement is less than 0.5 ha it could be combined with another restoration project to streamline implementation.

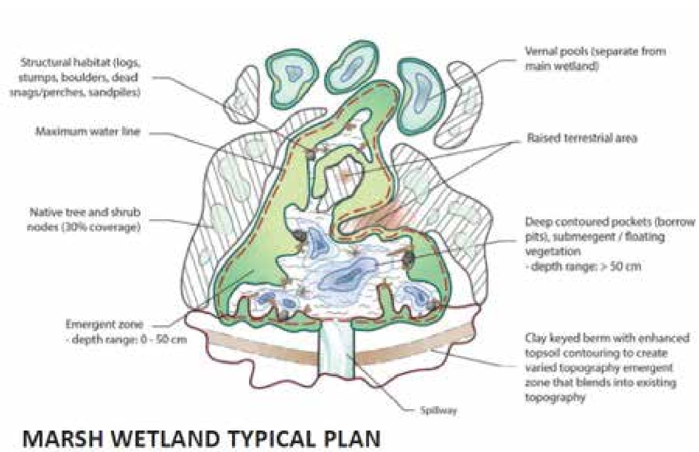
The temporary and permanent loss of DNA or ESFs (e.g., watercourse, forest, wetland, meadow) is to be identified and included in the Mitigation Memo to ensure that best efforts are made to avoid and minimize impacts where possible.

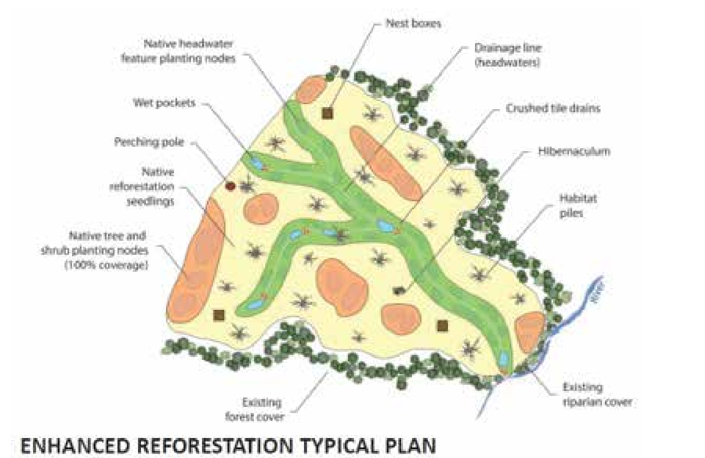
This includes a cost benefit analysis to include the cost of replacing ecosystems (inclusive of associated monitoring and engagement). Temporary loss of habitat will be replaced where the impacts are occurring as part of the on-site restoration. Unavoidable permanent loss should be included as part of the restoration process outlined within this Guideline for off-site restoration (replaced at 1:1 area-based ratio). In cases where a project does not have a DNA outlined (most likely due to the project's age) an assessment should be completed to document which ELCs noted in the Natural Environment Report, or similar report, are considered DNA and a note to file should be logged.

Natural heritage and habitat replacement will be undertaken through a combined approach with the individual tree replacement as outlined in this Guideline where appropriate. For example, a project that has a tree replacement requirement of 5000 tree units and also requires area-based habitat replacement of 1 ha of forest, 0.5 ha of savannah and 0.5 ha of meadow, if the Project is planting 3000 trees and 3000 shrubs (total of 3300 tree unit equivalent) to meet the area-based habitat replacement requirement, then a total of 3300 tree units would count towards the project's required 5000 tree unit replacement. Therefore, a remainder of 1700 additional tree units will be required to be planted elsewhere.

Area-based compensation required through Conservation Authorities, MECP and/or DFO (Department of Fisheries and Oceans) will be delivered separately from the replacement outlined in the Guideline.

Figure 3-2: Typical Plans from TRCA Guideline for Determining Ecosystem Compensation (2023)





3.1.3 Metrolinx Project Design

Direct impacts to natural heritage, tree, and vegetation communities within a project footprint can be avoided, minimized, or mitigated during the design phase of a project. Examples include adjusting the placement of infrastructure, re-sizing infrastructure to avoid Sensitive Features, and relocating temporary and permanent easements to less densely vegetated areas where feasible. During the construction planning phase, adjusting laydown areas, material storage locations, and grading limits are facets to be examined to avoid, minimize, or mitigate impacts.

Generally, trees that are situated within or immediately adjacent to the proposed Project footprint, or trees that pose a hazard risk to targets (i.e., infrastructure or people) are identified for removal or injury (i.e., branch or root pruning). However, Metrolinx is committed to considering and implementing alternatives to tree removals where the circumstances are favourable (i.e., identifying trees for relocation/transplanting opportunities).

Efforts such as those described above to apply the Mitigation Hierarchy should be captured in the associated Mitigation Memo.

3.1.4 Retention of Dead/Snag Trees

It is important for future planning that dead trees are identified within the Integrated Arborist Report and illustrated within the Tree Preservation Plan as they have a high potential to become hazard trees. However, Metrolinx also recognizes the role dead standing trees provide within ecosystems for various wildlife species and their life cycles. Metrolinx is committed to retaining dead trees if they are not located within the project design footprint and do not pose a risk to health and safety, private property or infrastructure. Should the condition of the dead standing tree change, the Project team should reevaluate the actions.opportunities).

Efforts such as those described above to apply the Mitigation Hierarchy should be captured in the associated Mitigation Memo.

3.1.5 Confirmatory Site Inspections

A site inspection, including a certified Arborist, is recommended to be completed prior to finalizing Arborist Reports which include a vegetation removal plan, in order to verify vegetation removal data and plans. In addition to verification of the tree inventory, the following information should be collected:

- The presence and location of existing debris piles not part of the vegetation removal program;
- Areas where the use of hi-rail equipment will be or is likely to be required;
- The need and potential locations for temporary access points to support vegetation removal activities;
- The condition of existing fence and locations where fence replacement may be required;
- The need for utility protection around trees;
- An assessment of hazard trees, as detailed in Appendix B, to determine what action(s) can be taken on the tree; and,
- If vegetation inventory is carried out at an earlier date, confirmation of the presence, condition, and proposed action on trees.

3.1.6 Arborist Report Re-assessment

It should be noted that if more than two (2) years elapses between tree and vegetation inventory and tree and vegetation removals, tree sapling size may have increased or new trees may have emerged, thus necessitating more removals and/or pruning than originally captured in the inventory. The addition of any vegetation that has grown into new size thresholds per the Guideline should be documented, therefore:

- For tree removals requiring permits:
  - Where Arborist Reports are over two (2) years (or other time frame as per the applicable municipality requirements) the applicable tree data and associated Arborist Report should be re-assessed. Municipalities typically require up to date data on injuries (roots or canopy) for applicable trees as health will have to be assessed and size is required for permitting.
- For tree removals that do not require permits:
  - Where Arborist Reports are between 2-5 years, then the Metrolinx Project team will determine the best approach to update report and tree data (e.g., re-assess trees/shrubs in DNA or, re-assess sample areas and apply growth factors to tree species ensuring the growth assumptions used does not lead to a decrease in replacement versus re-doing the survey.) The selected strategy should be discussed with applicable Indigenous communities. Additionally, areas must be surveyed to ensure potentially sensitive species/SAR are documented.
  - Where Arborist Reports are over 5 years, re-assessment is required to ensure tree data and associated Arborist Report(s) is up to date and new trees are captured.

Indigenous communities may be invited to monitor tree inventory field work, as appropriate and interested, to identify features and bio-culturally significant species or other significant IK related to the ecosite and Project.

3.2 Mitigation Measures

Mitigation measures are important to continue to reduce impacts to vegetation and natural heritage and thereby apply the Mitigation Hierarchy. These measures should be described in applicable environmental management plans and referenced in the applicable Mitigation Memo. Industry standards and best management practices (BMPs) for environmental hazard mitigation may include various mitigations, but the Guideline will only cover those associated with arboriculture in **Section 3.2.1**, edge management in **Section 3.2.2**, and invasive species BMPs in Section 5 and Section 6.

Metrolinx requires that an Arborist be retained during tree removal operations to ensure that standardized arboricultural techniques are employed, prior to and during the proposed work activities, and to confirm the need to remove or protect additional trees and vegetation in proximity to the Project footprint. Additionally, it may be required that an Arborist return at the conclusion of construction to assess the health of trees that were protected during construction and identify opportunities for mitigation should any trees display signs of stress (e.g., falling limbs, declining health, etc.).

It can be assumed that tree health will decline with injuries, therefore trees will be retained and protected wherever possible, in addition to any municipal requirements. Where tree injuries exceed 30% of the crown or root zone, the injury will be considered as a removal with respect to compensation, though all efforts should be made to retain and support recovery of the tree. If trees are not an immediate hazard to people, private property, infrastructure or rail operations the tree will be retained but compensated for as removal due to recognition of gradual decline. These assessments are completed by an Arborist and re-assessed during each phase of design to determine whether additional mitigation measures or project design options may reduce impacts to vegetation. Further information relating to the details of a tree inventory and Integrated Arborist Report are found in **Appendix B**.

3.2.1 Arboriculture Best Management Practices

Metrolinx will adhere to the arboriculture BMPs and mitigation requirements of the local municipality, where applicable, where tree removals and construction work is taking place. Mitigation measures and BMPs that should be followed for all Metrolinx Projects are provided in **Appendix C.** These requirements and recommendations may vary between municipalities; however, several arboricultural BMPs that are typically recommended in Arborist Reports can be found in The Arborists' Certification Study Guide (Lilly, 2010), City of Toronto's Guidelines for Completion of an Arborist Report (2011), and Tree Protection Policy and Specifications for Construction Near Trees (2016) and include mitigation for the following:

- Tree Protection Fencing
- Branch and Root Pruning
- Tree Relocation/ Transplanting
- Excavation and Grade Changes
- Structural Soils/ Soil Cells
- Soil Decompaction **(Appendix D)**

Timing of Vegetation Clearing: Vegetation removals will be limited to the specified activity areas and shall not commence until required permits and approvals, and documentation/memo are obtained. Removals may be restricted by bat roosting and/or maternity periods dependent on whether the vegetation communities identified on-site are suitable habitat for bats or breeding birds. Clearing vegetation outside of the breeding bird season (breeding bird season is generally April 1 to August 31 in southern Ontario <u>but can include shoulder months, especially in complex habitats)</u> is recommended to reduce potential impacts to migratory birds and avoid contravention of the Migratory Birds Convention Act (1994). Metrolinx schedules vegetation removals to occur outside of the breeding bird season wherever possible. However, if removals must occur during this period, the bird nest avoidance mitigation measures provided in **Appendix E** will be followed. If SAR or suitable SAR habitat is identified on-site, timing restrictions associated with those species will also be adhered to.

3.2.2 Edge Communities and Edge Management

Edge communities refer to the boundary between two land cover types (e.g. the meeting between a forest and meadow). Edge communities can occur naturally where there are changes in soil characteristics or natural disturbances; however, most edge communities are created by human activities, often by urban development where tree removals occur (NCSU, 2019).

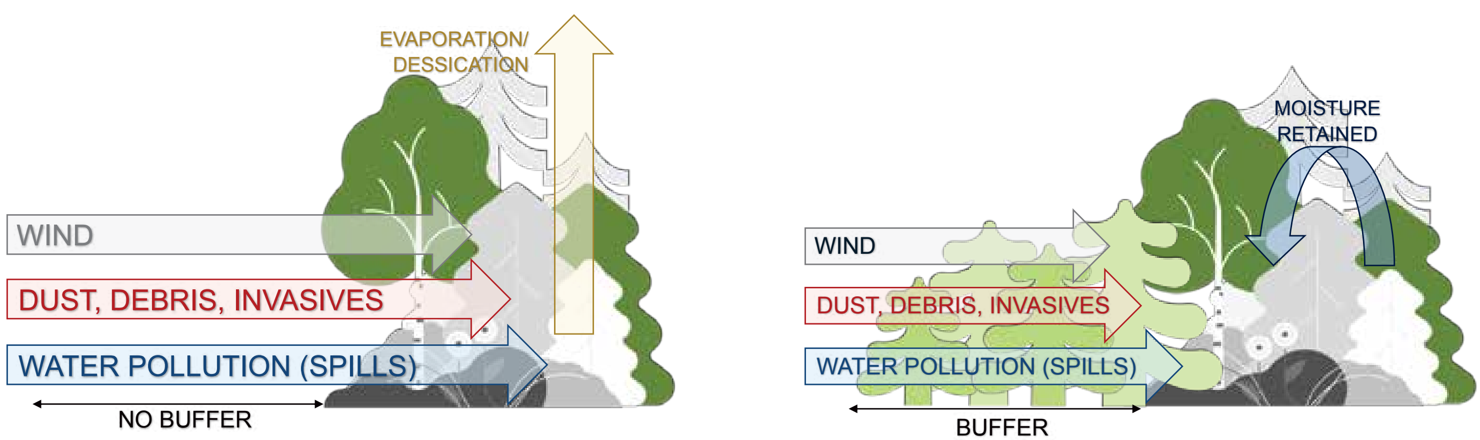
The removal of vegetation along the existing edge of a treed feature that results in the exposure of a new forest edge has several negative impacts along the forest borders and within the forest interior. The new edge changes the microclimate, exposing interior forest to increased light, wind, and sun resulting in decreased soil moisture and soil compaction as well as increasing the potential spread of aggressive non-native plant species, as illustrated in **Figure 3-3**. Trees and vegetation along newly formed edges are ill-equipped to cope with the sudden change in microclimate since they grew and developed within forest interiors. Such trees are at greater risk of falling due to conditions to which they are not adapted (e.g., changes in drainage and soil characteristics, increased snow loading, and increased wind exposure).

It's generally recognized that forest interior habitat starts at least 100 metres from the edge of the forest. Edge habitat includes the part of a forest next to open habitats like meadows and farm fields or human-created breaks like roads and development. The forest interior is less windy as the trees along the edge act as windbreaks. This leads to less non-native plant seeds getting blown in, like garlic mustard. The dense shrubs and trees along the edge protect the interior forest from sunlight and desiccation resulting in the interior forest being cooler and shadier. This makes it more damp compared to the edge. This is vital to maintain pools of water that wildlife need to live in including aquatic insects. The edge also protects the interior from which makes it easier for animals to avoid predators, attract a mate, and use sound to navigate.

The most effective buffer to mitigate edge effects is a dense planting that with multiple layers from the ground to the canopy including herbaceous vegetation, shrubs and fast-growing small trees and conifers. This layering assists in:

- blocking artificial light and noise;
- slowing down, spreading out, and filtering water runoff;
- reducing dust particles reaching pristine forest; and,
- making it more difficult for invasive species to reach interior habitats.

Figure 3-: Illustration of wind, dust, debris and water pollution penetration into a wooded area where there is no naturalized buffer (top) and where there is a naturalized buffer (bottom). Based on King Township: https://www.king.ca/naturalizedbuffer



The implementation of edge management techniques, including the preparation of a Forest Edge Management Plan and plantings **(Appendix F)**, is intended to help mitigate negative impacts to forested communities. Dense plantings of appropriate native trees, shrubs, and ground flora shall be undertaken in the spring prior to removals or as soon as possible following vegetation removals to provide a protective buffer. Plantings may also be installed when construction works are proposed within 10 meters of an existing Sensitive Feature. Drainage patterns adjacent to newly created edges should be maintained to avoid changes in soil moisture. This is especially important around wetland areas and forest communities with substrates that depend on increased moisture capacity. Ensuring surface water flows and ground water contributions remain unchanged during construction and post construction is critical to ensure ecological function. Proper erosion and sediment controls, tree protection, mulching, watering of individual trees and forest edges and monitoring will assist in minimizing construction impacts to forest and Sensitive Feature edges.

Edge management is also included in the IVM Plan **(see Section 6)** to prevent the spread of noxious, invasive and/or non-native plant species from colonizing disturbed edges. Details on the Forest Edge Management Plan and edge planting requirements is found in **Appendix F.**

Plant species to be planted within and adjacent to newly exposed edges will consist of hardy native species that have been identified within existing forest communities, or native plant species that are suitable during initial stages of restoration such as those suited to higher light conditions. Implementing hardy native plantings within newly exposed edges will minimize the areas available for invasive and/or non-native disturbance-tolerant species and mitigate their spread. As tree and shrub species grow and reduce light conditions, the planted ground flora species requiring higher light conditions will be at a competitive disadvantage and more suitable species already established within the remaining and undisturbed forests will slowly re-establish.

Other aspects of edge mitigation may apply when working in and around Sensitive Features and should be outlined in the Forest Edge Management Plan. This includes any wetland water balance commitments, enhanced Erosion and Sediment Controls and monitoring, timing of works in relation to wildlife lifecycle processes, and mitigation for compaction.

3.3 Compensation Through Restoration

As a final component within the Mitigation Hierarchy, compensation can be rationalized for ecosystem or vegetation losses or impacts through the Mitigation Memo and delivered through replanting and ecological restoration. This is further described in **Section 4.**

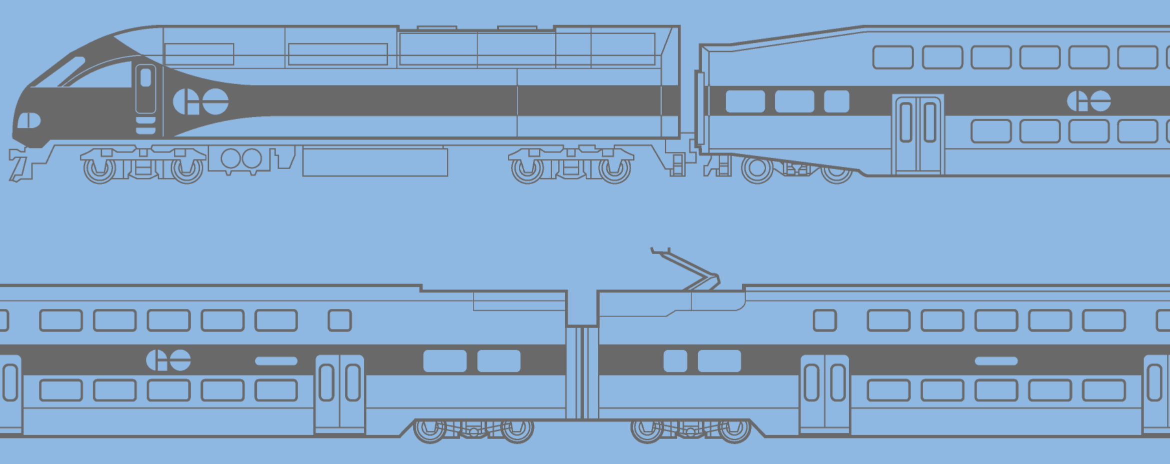
3.4 Engagement and Consultation

Engagement and consultation – particularly with Indigenous communities – is important for thorough application of the Mitigation Hierarchy. This means that engagement is ongoing and has many touchpoints to ensure that feedback is incorporated appropriately and informs efforts to avoid, minimize, and mitigate impacts to vegetation and the natural environment, and compensate through restoration. The Indigenous engagement and consultation process through the circulation of applicable reports, plans, and documents related to the Guideline (e.g. Natural Environment Reports, Integrated Arborist Reports, Restoration Plans and etc.) is summarized in a flowchart in **Appendix G.** Data collected during the tree inventory and assessment is encouraged to be circulated to Indigenous communities, private landowners, and other stakeholders to assist in identifying heritage, marker or memorial trees, Sensitive Features, or SAR that Metrolinx can avoid where feasible. Where SAR are confirmed (e.g., Butternut, Black Ash), additional permitting requirements under the ESA are necessary if removals are unavoidable. Associated compensation must meet permit conditions and may include SAR tree relocation/transplantation, seed collection, archiving (Butternut only), replacement and restoration requirements, a payment to the SAR Conservation Fund, or additional studies or considerations following conversations with MECP and Indigenous communities. Further guidance on Butternut restoration can be found in **Section 4.5.1.2.**

Additionally, direct consultation with Indigenous communities prior to vegetation removal activities can identify bio-culturally significant species that have the potential to be retained through design adjustments or additional mitigation techniques.

Engagement and consultation with Indigenous communities should always precede engagements with non-Indigenous groups or entities.

Vegetation Replacement and Restoration



4.1 Vegetation Replacement and Restoration

Where vegetation removals and/or impacts to Sensitive Features are unavoidable through project design or implementation techniques prior to construction, Metrolinx is committed to compensating by replicating ecosystem structure.

Compensation for vegetation removals is the last step of the Mitigation Hierarchy and is only considered when avoidance, minimization, and mitigation measures have been applied to the greatest extent reasonable for project design. Reductions or additions to proposed tree removals are to be documented as the design progresses to allow for necessary adaptations of the vegetation replacement plantings plans/drawings.

Providing replacement for tree removals occurring on Metrolinx-owned-lands, the rail corridor, on both publicly owned (e.g., municipal and Conservation Authority), and privately-owned lands is also consistent with Metrolinx's goal to minimize impacts on ecosystems and ecosystem services. The vegetation replacement and restoration framework outlined below is intended to guide replacement and restoration work for unavoidable natural heritage impacts as part of Metrolinx Projects.

Ecosystem or habitat losses due to Metrolinx Capital Projects' unavoidable impacts within DNAs is described in **Section 3.1.2** and should be documented in the associated natural heritage studies and Mitigation Memo. Metrolinx is committing to replacing the permanent loss of habitat due to the result of Capital Projects impacts at a 1:1 area-based ratio for areas larger than 0.1 ha, to the extent possible, regardless of MECP or Conservation Authority requirements. This ecosystem or habitat replacement will be undertaken through a combined approach with the individual tree replacement as outlined in this Guideline. In cases where a habitat replacement is less than 0.5 ha, it should be combined with another restoration project to streamline implementation. Details on Metrolinx ecological restoration approach is captured in **Section 4.4** and **Appendix H.**

Environmental legislation and regulations should be reviewed early in project planning to ensure information regarding replacement and/or compensation is accurate and utilized to obtain permits and approvals. Applicable regulations may include but are not limited to: Municipal by-laws, Conservation Authority approvals, ESA, 2007 permits/authorization and DFO approvals.

Of note, the replacement approach recommended in the Guideline applies to tree removals and area loss of Sensitive Features associated with Metrolinx Capital Projects only and does not apply to vegetation removal associated with routine operational maintenance work on Metrolinx-owned-lands and rail corridor to ensure safe railway operations and sightlines. However, certain principles outlined in the Guideline are integrated in operational and maintenance practices such as avoiding tree removal wherever possible, with pruning being a preferred approach where trees are posing a risk to safe operations and infrastructure.

4.1.1 Individual Tree and Basal Area Approach

TRCA's ecosystem compensation guideline recommends several aspects that should be considered for the implementation of ecosystem replacement and restoration projects. This includes calculating the basal area of the ecosystem or inventorying the individual trees that will be impacted.

Basal area is a standard forestry measurement used to describe the cross-sectional area occupied by tree stems. It can be calculated by conducting a tree tally or prism sweep within any given vegetation type classified in accordance with the Ecological Land Classification for Southern Ontario (ELC) system. Alternatively, an individual tree approach, where each tree is inventoried individually, can be applied.

Since the majority of Metrolinx Projects are linear infrastructure where removal of trees and vegetation required to support these Projects are typically limited to narrow portions and/or edges of treed ecosystems, the individual tree approach is more suited to Metrolinx needs. An outline of the basal area approach was included within a previous iteration of the Guideline and remains a valid industry approach for establishing ecosystem restoration replacement ratios; however, after being used on a small number of Metrolinx Projects it proved difficult to consistently track within the larger internal database among Projects and has since been removed. This iteration of the Guideline solely outlines the individual tree approach to maintain consistency of tree inventory methodology for future Metrolinx Projects and only a few select in-flight projects are continuing with the basal area method.

4.2 Vegetation Replacement and Restoration Framework

The vegetation replacement and restoration framework provides a process for tracking tree removals and replacement/restoration required for the GO Expansion, Rapid Transit, and Subway Programs. The framework can also be applied to future tree removals within and outside of Metrolinx owned lands and rail corridors. The framework exceeds what is required by Metrolinx to meet regulations and environmental assessment commitments. Moreover, the framework allows for meaningful engagement with Indigenous communities and stakeholders to support success collaboration, and restoration and incorporate feedback on a project-by-project basis. **Figure 4-1** below provides an example of vegetation restoration in action.

The Guideline identifies four replacement approaches to be used for vegetation removals that are based on tree replacement ratios largely determined by property ownership, by-laws/regulations, and project location with respect to ecological functioning. Planning, collaboration and implementation of replacement through on- and off-site restoration plans shall occur in parallel with identification and implementation of removals respectively.

These vegetation replacement approaches include:

- Baseline Replacement;
- Ecological Replacement;
- By-law + Baseline Replacement; and,
- By-law + Ecological Replacement.

The Baseline Replacement approach includes replacement of individual trees outside of DNA such as street trees and ranges from 1:1 to 10:1.

The Ecological Replacement approach requires off-setting vegetation removals that involves replacement of tree units within DNA at a ratio representative of their ecosystem functions and services. This can range from 1:1 to 50:1.

The by-law Replacement approach will vary dependant on the requirements of the applicable by-laws or regulations.

A combined approach to off-setting vegetation removals involves adhering to applicable by-laws or regulations in addition to replacement above and beyond the by-law or regulation, where determined necessary, based on the Ecological or Baseline Replacement approach.

Figure 4-1: Off-site Vegetation Restoration Planting at North Maple Regional Park

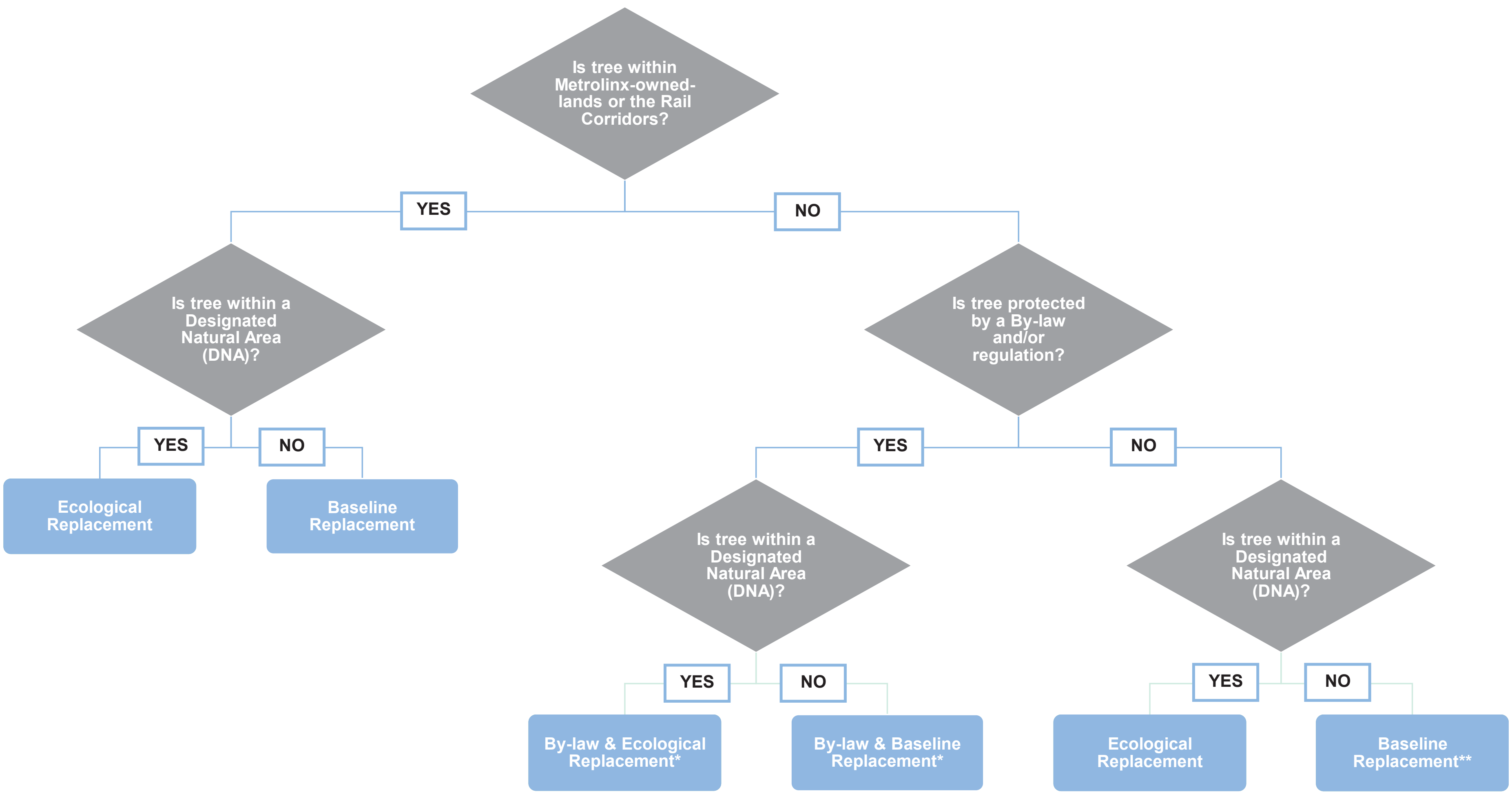
Table 4-1 provides a summary of the replacement approach based on the location of each tree. Further details about replacement approaches and associated replacement ratios are provided in **Section 4.4.** An illustrative flowchart for determining the vegetation replacement approach is shown in **Figure 4-2.**

DNAs include natural heritage systems, which are made up of natural heritage features and areas, linkages intended to provide connectivity between natural areas and features, and support of natural processes. DNAs are necessary to maintain biological and geological diversity, natural functions, viable populations of native species, and ecosystems. **Figure 4-3** below provides an example of DNA mapping utilized by Metrolinx to identify these areas along rail corridors (note the extent of the DNA in this example does not fully include all wetlands, ravines and natural features as it is outside the projects study area.)

Table 4-1: Replacement Approach Based on Tree Location

Location	Applicable Bylaw with Compensation Approach	Within a Designated Natural Area	Replacement Approach
Metrolinx-owned-lands & rail corridors	No	No	Baseline Replacement
Metrolinx-owned-lands & rail corridors	No	Yes	Ecological Replacement
Public/Private Land	Yes	No	By-law + Baseline Replacement
Public/Private Land	Yes	Yes	By-law + Ecological Replacement
Public/Private Land	No	Yes	Ecological Replacement
Public/Private Land	No	No	Baseline Replacement

Figure 4-2: Vegetation Replacement Approach Flowchart



* Baseline and Ecological Replacement is applied if replacement is greater than by-law replacement requirement
** Baseline Replacement is applied to public/ private lands where trees (e.g. smaller trees) are not protected by by-laws

Figure 4-3: Example of a Map Displaying Designated Natural Areas

DNAs include those identified by resource agencies, municipalities, the government, Indigenous communities, and/or the public through legislation, policies, or approved management plans. Site-specific natural heritage studies also support identification of DNAs, including Sensitive Features and linkages that support wildlife connectivity and life-cycle phases such as spawning, rearing, nesting, or overwintering. Details on how DNA mapping is carried out is provided in **Appendix B**. Mapping of DNAs will be captured with the natural heritage evaluation (e.g. Natural Environment Report) and Integrated Arborist Reports or made available upon request. Metrolinx is committed to sharing natural heritage studies and Integrated Arborist Reports with Indigenous communities for input to ensure that the identified DNA sufficiently captures areas of potential ecological significance and incorporates IK and TEK as appropriate.

4.3 Determining Replacement Approach

4.3.1 Metrolinx-owned-lands and Rail Corridor

Metrolinx, as a Crown Agency, is not subject to municipal permits and approvals. This includes replacement requirements for tree removals within Metrolinx-owned-lands and the rail corridor. All removed trees within Metrolinx-owned-lands and the rail corridor will be replaced using either an ecological (all trees and shrub thickets) or baseline approach (10 cm or greater DBH). Determination of replacement ratios is discussed in **Section 4.4.**

4.3.2 Public/Private Lands

Replacement and/or compensation for removed trees within public and private lands (including those on the boundary between Metrolinx-owned-lands and/or public or private lands), lands used for construction access and laydown, and temporary or permanent easements, will follow the requirements of applicable by-laws and regulations. Removed trees that are not subject to by-laws/regulations will be replaced at the appropriate baseline or ecological replacement ratio as discussed in **Section 4.4.1.** Where trees are subject to by-law replacement requirements a combined approach may be required as per **Section 4.4.2** and **Section 4.4.4.**

4.3.2.1 Compensation and/or Replacement on Public Lands

By-law compensation and/or replacement for vegetation removals on public lands may include provision of cash in lieu to municipalities based on tree by-law removal and compensation requirements. If this approach is followed, the compensated municipality is responsible for the use of funds that may be used in the replacement and maintenance of trees, parks and/or natural heritage systems within the municipality's boundaries.

In cases where there are no applicable by-laws or regulations, Metrolinx will consult with the landowner (i.e., municipality) regarding the need to remove trees and will arrange for tree removal and replacement. Tree replacements will follow either the ecological or baseline compensation approach dependent on their location, as presented in **Table 4-1** and **Figure 4-2** of the Guideline.

4.3.2.2 Compensation and/or Replacement on Private Lands

Metrolinx will work directly with property owners to address the loss of trees on private lands. For private tree removals, Metrolinx will consult with the property owner regarding permission to enter the property and identifying trees to be removed.

In cases where the tree is subject to by-laws or regulations, Metrolinx will initiate the permitting process, submit the permit application to the municipality, remove trees once necessary permits have been received. Metrolinx will work with the property owner to develop a restoration plan that meets the by-law requirements (and additional ecological or baseline compensation requirements, if applicable) on the property where removals are to occur.

In cases where there are no applicable by-laws or regulations, Metrolinx will work with the property owner to develop a restoration plan consistent with either the baseline or ecological restoration approach, to be determined based on the location of the trees as presented in **Section 4.4.**

If additional tree replacements are required (based on by-law, ecological or baseline compensation requirements as applicable) beyond what the property owner agrees to plant on their property, Metrolinx will incorporate those replacements elsewhere in the Project's restoration plan.

4.4 Determining Replacement Ratios

4.4.1 Baseline Replacement

Where the baseline replacement approach is to be followed, trees greater or equal to 10 cm and smaller than 30 cm DBH will be replaced at a 1:1 ratio. Trees measuring 30 cm DBH or greater will be replaced at 10:1 ratio, subject to availability of land within the same sub-watershed and municipality for planting opportunities. Where these planting opportunities are limited or not available, a minimum 3:1 replacement ratio must be met. Dead trees equal to or greater than 10 cm DBH will be replaced at a 1:1 ratio. Baseline replacement is summarized in **Table 4-2** below.

When available planting opportunities are not sufficient to meet the baseline and/or ecological replacement ratios, the planting infill rate will be increased to 50% (standard is 20%). Planting infill rate refers to the percentage of plantings which will be replaced (or infilled) if they do not survive within the agreed upon establishment and stewardship period. For example, if 100 plants are planted and experience a 20% die-off (20 plants), 20% would be replanted (20 plants) as per standard, this would represent a 20% infill planting rate.

Table 4-2: Baseline Replacement Ratios based on Vegetation Type and Size

Vegetation Type	DBH (cm)	Replacement Ratio
Live Tree	10-29.9	1:1
	≥30	10:1*
Dead Tree	≥10	1:1

Where local planting opportunities are limited or not available, a minimum 3:1 replacement ratio must be met.

4.4.2 By-law and Baseline Replacement

Where the by-law compensation approach is to be followed, the replacement ratio for removed trees will be determined based on the requirements of the applicable by-law/regulation. Applicable by-laws should be reviewed at the time of implementation to ensure up-to-date information regarding compensation and/or replacement is utilized. If the applicable baseline replacement ratio from the Guideline exceeds the by-law/regulation requirement, additional replacement plantings will be required during restoration to meet the baseline ratio.

4.4.3 Ecological Replacement

Replacement for the removal of any tree located within a DNA will be based on the ratio determined following the ecological compensation approach. **Table 4-3** below outlines the ecological replacement ratios required based on removed individual tree diameter. Shrub thickets removed within a DNA will be replaced at a ratio of one (1) tree per 5 m of linear shrub thicket or 10 m2 shrub thicket removed.

Removed dead trees of all sizes will be replaced at a 1:1 ratio while also allowing felled logs to naturally decay on-site where conditions and rail corridor safety allow.

Table 4 -3: Ecological Replacement Ratios based on Vegetation Type and Size

Vegetation Type	DBH (cm)	Replacement Ratio
Live Tree	1 - 10	1:1
	10.1 – 20	3:1
	20.1 – 30	10:1
	30.1 – 40	15:1
	40.1 – 50	20:1
	50.1 – 60	30:1
	60.1 – 70	40:1
	70.1+	50:1
Dead Tree	≥ 1	1:1
Shrub Thicket	N/A	1 tree:10m2

4.4.4 By-law and Ecological Replacement

Any removed tree that is subject to a by-law or regulation will be compensated for in compliance with the applicable by-law or regulation. For trees and shrubs that are subject to a by-law or regulation and located within a DNA, additional replacement may be provided when ecological replacement is greater than by-law/regulation requirements. For example, one (1) 25 cm DBH tree removed from public property within a Ravine and Natural Features Protection Area (RNFP) in the City of Toronto would be determined to have a 10:1 replacement ratio based on ecological replacement and a 3:1 replacement ratio based on the RNFP by-law. Based on this replacement approach, the City of Toronto would be provided with compensation and/or replacement plantings to meet the 3:1 replacement ratio required under the RNFP By-law, and Metrolinx would additionally implement the remaining seven (7) tree plantings to meet the ecological replacement requirement of 10 total trees planted.

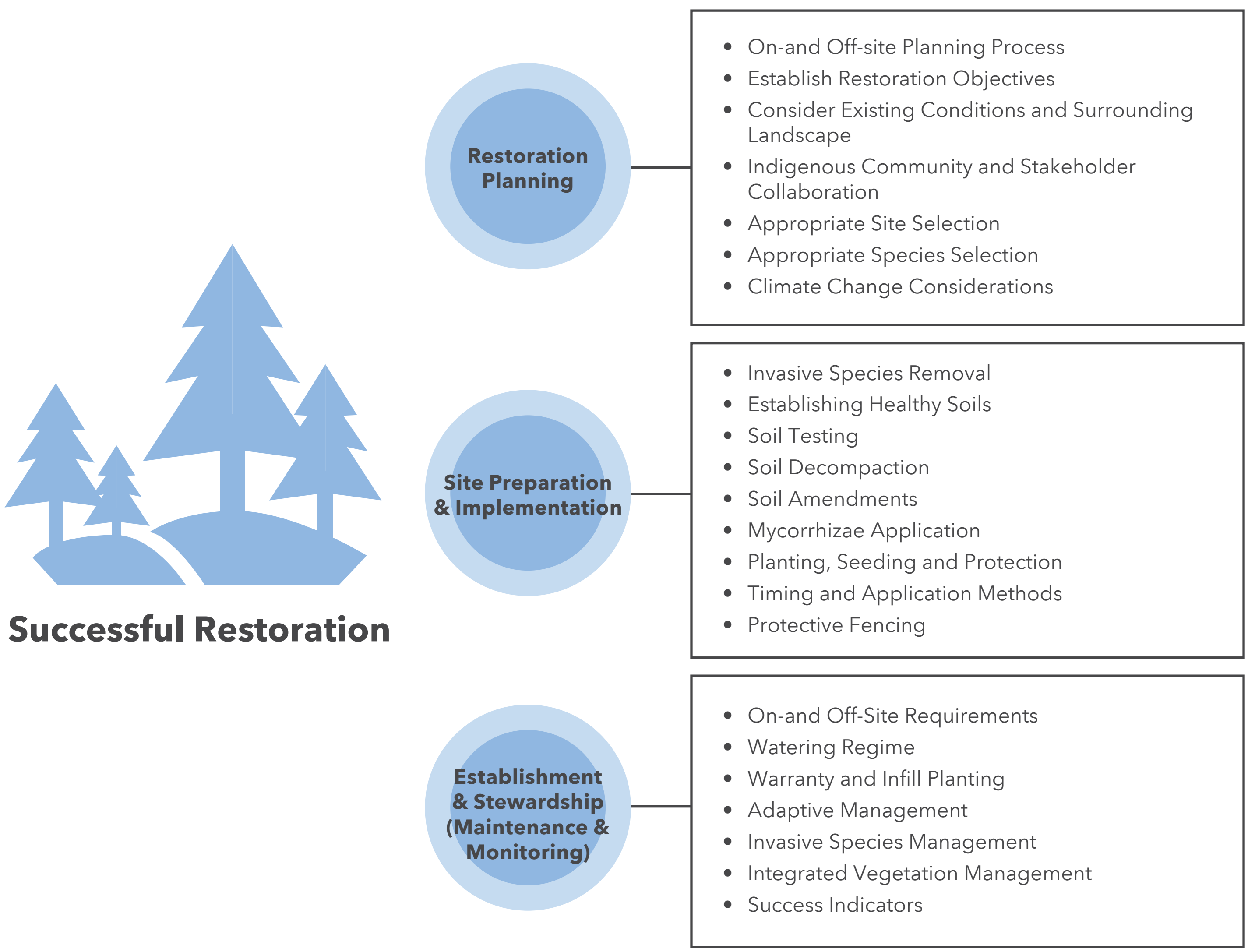
4.5 Successful Restoration

The following subsections provide an outline of the components needed to implement restoration, to satisfy the Guideline's replacement requirements and meet the Guideline's goal in supporting and enhancing ecosystems. The intent is not to just meet replacement requirements through tree and shrub planting, but to set up the plantings for success through proper planning, site preparation, and establishing a maintenance and monitoring program that allows for adaptive management, as summarized in **Figure 4-4**. These subsections provide considerations and other implementation strategies that are key for successful restoration undertaken both on-site post Project completion and off-site to offset impacts that could not be restored on-site.

The strategies highlighted in **Figure 4-4** and detailed in the following subsections should be included in the landscape plan, restoration plan, or other contract documents as applicable. The landscape plan should also take into consideration construction phasing and identify which areas can be planted and restored in each phase of construction, with the aim of replanting areas as soon as possible.

Refer to **Appendix G** for a flowchart illustrating each replacement approach. General principles and additional details for implementing the Metrolinx replacement and ecological restoration are provided in

Figure 4-4. Successful Restoration Implementation Strategies



4.5.1 Restoration Planning

Ecological restoration planning begins with an understanding of vegetation and natural heritage removals and related replacement requirements. These are critical needs which landscape and restoration plans should describe and guide the implementation of. Planning for appropriate restoration will also include consideration of removal site characteristics such as the species removed, and the ELC vegetation community type impacted. Collaboration with Indigenous communities and stakeholders on restoration begins with discussing proposed removals and their associated replacement requirements.

Development of landscape or restoration plans is the key element of restoration planning. Landscape and restoration plans will be informed by ecological and nucleation restoration approaches, aiming to enhance existing environments with the objective of create a diverse, and resilient ecosystem in the long term. Although the replacement ratios in the Guideline are calculated in terms of quantity of trees to be planted, it is essential to include a variety of species in different canopy layers when implementing restoration planting, following proper ecological and nucleation restoration principles. Landscape and restoration plans should include design drawings or GIS spatial data to provide a complete visual perspective. Additionally, planting species selection must be native to Southern Ontario and should prioritize bio-culturally significant species as much as possible.

To allow for diverse plant selection that meets the calculated number of tree replacements, Metrolinx considers 10 individual shrubs planted as equal to one tree unit planted during restoration (10:1). Although the carbon sequestration potential of trees and shrubs are not equal, the 10:1 equivalency is used to support biodiversity and replanting goals. Shrubs are primarily planted in areas where Metrolinx may not be able to plant trees or in conjunction with trees as they establish more quickly, provide edge management mitigation, and provide ecological function for different species.

Ecological restoration projects may include, but are not limited to:

- Re-naturalization of human areas,
- Infilling existing natural areas with plantings,
- Habitat enhancement or creation,
- Urban Parks enhancement through plantings, and,
- Invasive Species Management for re-establishment of native species.

4.5.1.1 On-site Restoration Planning

Planning for on-site restoration should be initiated and finalized in parallel with the Tree Inventory Plan and/ or Integrated Arborist Report and be captured in the associated Project landscape or restoration plan. Landscape plans are typically included with construction drawing submissions. They capture drawings, specifications, and associated instructions/notes. The associated instructions/notes directs sustainable design and can include plantings, seeding, natural/habitat features, streetscaping, public amenities, and other public park infrastructure. Landscape plans may also include ecological restoration elements within DNAs where applicable. Restoration plans are like landscape plans and typically include coarser planting details and more specifics on habitat features and monitoring. Landscape plans are preferred for smaller, urban scales where anthropogenic features are prioritized versus when wildlife habitat is the priority. The landscape or restoration plan should be shared with Indigenous communities and stakeholders for review as the plans progress through design.

At the TRPAP and/or 10% detailed design stage, a high-level landscape or restoration plan should be prepared. The high-level landscape or restoration plan would include, at minimum, a proposed native species list for tree canopy, shrub layer, herbaceous ground cover seed mix, and habitat creation, based on Ecological Land Classification (ELC) vegetation community type impacted where applicable. Recognizing, the target ELC for a given restoration project may not reflect the impacted ecosystem as Metrolinx aims to enhance the natural environment where the impact location may be degraded. A high-level figure with areas to be impacted and areas that may be replanted is recommended. The figure should focus on replanting in any impacted DNA, including ecosystem linkages within the rail corridor to maintain ecological connectivity within the landscape. Although there are limitations to planting within the rail corridor due to safety and operational requirements, strategic replanting in the rail corridor as a cultural control method can serve a dual purpose: decrease maintenance related to incompatible and invasive vegetation during operations, while also re-establishing greenspace with native plants. This control method as well as its limitations are further discussed in **Section 6.**

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restoration with natural heritage feature area-based habitat replacement, such that the overall physical extent and function of the natural system is not reduced. Considering this, nucleation restoration – planting in patches/nuclei in-order to support natural succession processes is a good strategy to support restoring natural ecological function.

Recommendations and considerations for successful restoration of natural heritage features are described further in **Appendix H.**

At the 30% and/or 60% detailed design stage, an updated on-site landscape or restoration plan should be prepared. At this design stage, the landscape or restoration plans should expand on the locations and preliminary quantities of plant species identified in the first iteration of the plans and incorporate initial input received from Indigenous communities and stakeholders, where possible. The landscape or restoration plans will include notes regarding planting and maintenance. The notes may include, but are not limited to, appropriate soil testing, soil decompaction and amendment planning, edge management mitigation, a pruning plan, invasive species management, and other maintenance plans. The Integrated Arborist Report and associated landscape or restoration plans will be further refined as the design progresses to the 90% and 100% stages. The plans should incorporate changes and input through ongoing collaboration with Indigenous communities and stakeholders.

Wherever possible, such as in areas where new plantings will be unaffected by project construction such as along property boundaries or areas adjacent to the Project, on-site restoration shall be implemented before vegetation removals occur. The remaining restoration elements shall be completed following the phased approach as identified in the landscape or restoration plans.

4.5.1.4 Indigenous Community and Stakeholder Collaboration

On-site and off-site restoration planning will involve a number of collaborators dependant on where the vegetation removals are located and where potential replacement planting and restoration is located.

Collaborators may include, but not limited to:

- Indigenous communities,
- Local municipality or regional government,
- Local community groups,
- Local Conservation Authorities,
- Conservation organizations (e.g., Forest Gene Conservation Association),
- Academic Institutions,
- Provincial ministries or agencies (e.g., MECP), and,
- Project stakeholders.

Often the local Conservation Authority or municipalities are in a good position to provide restoration opportunities as they have land available for planting in the same sub-watershed or watershed and they may be able to provide site-specific information on appropriate planting conditions and species recommendations.

Metrolinx is committed to exploring opportunities to partner with Indigenous communities, as well as local Conservation Authorities and municipalities, as applicable, to ensure off-site plantings are installed as close to the removal location as possible with preference to stay within the same sub-watershed or watershed.

Restoration planning at Metrolinx strives to include IK and TEK, as well as western science. Indigenous communities will be included in restoration planning and are important partners in achieving successful restoration. Elements for consideration in restoration include but are not limited to bio-culturally significant plant species and future harvesting potential. Conversations on restoration planning with Indigenous communities are intended to be iterative and undertaken in parallel with conversations about associated project impacts for which restoration activities are intended to compensate. Discussions are intended to cover, at minimum, restoration project location (when off-site), habitat features, planting species, restoration maintenance, and monitoring.

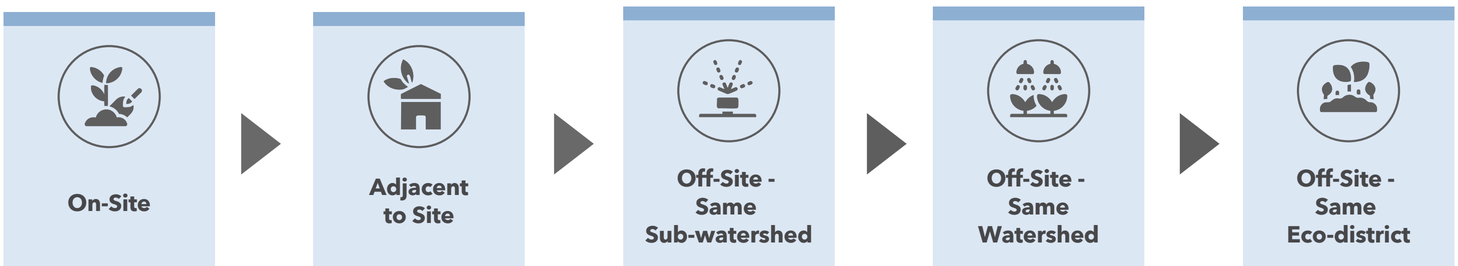
Following conversations with Indigenous communities on restoration planning, Metrolinx will look to prioritize a more holistic approach and continually integrate two-eyed seeing in restoration planning. A holistic approach does not consider differing species in a hierarchy but rather consider all equal and significant.

4.5.1.5 Appropriate Site Selection

The priority for restoration is to plant as much vegetation and as close to the removal or impact location as possible, ideally on the same Project site. Where restoration cannot take place on-site (e.g., due to space constraints) or adjacent to site, off-site locations will be identified through collaboration with Indigenous communities and stakeholders. Off-site location order of priority is shown in **Figure 4-5**, where the next preference after on-site or adjacent to site, is to undertake restoration within the same sub-watershed, watershed, or within the same eco-district. Replacement plantings should take place on lands secured for conservation in perpetuity (e.g., lands managed by Conservation Authorities). This could also include lands with restrictive covenants or conservation land easements.

It is important to site selection that the opportunity for Indigenous communities harvesting is available and protected.

Figure 4-5. Restoration Site Selection Order of Priority



4.5.1.6 Appropriate Species Selection

Species selection may differ based on the type of site and purpose of planting. For example, species selected for streetscape or the rail corridor should be more tolerant to urban and maintenance pressures, such as salt, pruning, foot traffic, etc. Whereas naturalized plantings within DNA or for habitat creation will have different considerations and should be informed by the impacted ELC vegetation community type and native species that were removed by the Project. Landscape and restoration plans species lists can be further refined in collaboration with Indigenous communities and stakeholder input. Although different sites may have varying considerations, it is important to prioritize native species and bio-culturally significant species to the extent possible in both urban and naturalized areas. Metrolinx strives to plant 100% native species in both on-site and off-site landscaping or restoration. This includes avoiding the use of cultivars or hybrids, unless required by the applicable municipality or if it is shown that site conditions are too degraded that only a cultivar or hybrid would survive.

The considerations used for species selection based on site type are summarized in **Figure 4-6** below. Plant species that are recommended for planting and recommended seed mixes are provided in **Appendix I** and **Appendix J**, respectively.

Street, Park, ROW or Landscaping

- 100% Native+
- Salt-tolerant
- Pollinator species
- Tolerant to pruning
- Consider Sun Availability
- Full Sun, Partial Sun or Shade
- Consider Soil conditions and moisture regime
- Soil remediation may be needed
- Tolerant to Foot Traffic
- Fast Growing/Low Maintenance along Property Boundaries
- Dissuasive Vegetation for Prevention of trespassing and graffiti

Designated Natural Area

- 100% Native
- Reflect Vegetation Community impacted
- Species typically found within same ELC
- Consider Soil conditions and moisture regime
- Soil remediation may be needed
- Edge Plantings
- Includes Berry/Nut Bearing and/or Pollinator species
- Retain Dead Trees and allow felled trees to decay naturally on-site where possible

Habitat Creation

- 100% Native
- Species should support multiple life cycle functions
  - e.g. for Bats: Plan should have both woodlands for roosting and riparian/wetland/meadow habitat to promote foraging
- Consider Soil conditions and moisture regime
- Soil remediation or amendments may be needed (e.g., for Butternut plantings)

Opportunity to incorporate IK/ TEK and Bio-culturally Significant Species

+ Subject to municipal requirements

Native shrubs, vines and trees with thorns (i.e., dissuasive vegetation) may be considered in combination with fencing to deter trespassers or those unaware from entering rail corridors. This is helpful for safety considerations. These same species may be used along noise walls or retaining walls to prevent access for graffiti or vandalism. See Appendix I for a list of species that may be planted in areas with potential to dissuade access.

These vegetation replacement approaches include:

- Baseline Replacement;
- Ecological Replacement;
- By-law + Baseline Replacement; and,
- By-law + Ecological Replacement.

The Baseline Replacement approach includes replacement of individual trees outside of DNA such as street trees and ranges from 1:1 to 10:1.

The Ecological Replacement approach requires off-setting vegetation removals that involves replacement of tree units within DNA at a ratio representative of their ecosystem functions and services. This can range from 1:1 to 50:1.

The by-law Replacement approach will vary dependant on the requirements of the applicable by-laws or regulations.

A combined approach to off-setting vegetation removals involves adhering to applicable by-laws or regulations in addition to replacement above and beyond the by-law or regulation, where determined necessary, based on the Ecological or Baseline Replacement approach.

4.5.1.7 Sustainability and Climate Change Considerations

4.5.1.7.1 Green Infrastructure and Vegetation Management

Green Infrastructure can be defined as technologies that support infrastructure challenges and achieve social, economic, environmental, and climate resilience objectives in communities and urban environments by leveraging natural assets and nature-based solutions. Green infrastructure approaches commonly include strategies to address common challenges in the built environment such as urban heat island, air quality, stormwater management, erosion control, or shading.

Vegetation is an important type of green infrastructure, since trees and plantings are nature-based solutions to mitigating the impact of climate change. Resilient approaches to vegetation management will support optimized operation, maintenance, and recovery of rail corridors and reduce vulnerability to extreme weather events and future climate conditions. Not only does vegetation absorb atmospheric carbon, site-appropriate planting can reduce potential impacts from extreme weather events and support resilient ecosystems.

4.5.1.7.2 Climate Resilience and Biodiversity

Climate change is a key driver for biodiversity loss, alongside other factors such as land use changes, pollution, and invasive species. However, inversely, protecting and enhancing biodiversity is an important strategy for increasing the climate resilience of a system. Ecosystems with higher species diversity are likely to be more resilient to shocks and stressors. For example, some species of trees are more susceptible to certain pests (such as Emerald Ash Borer [EAB]). A diverse ecosystem can recover more effectively from disturbances such as pests, invasive species, extreme storms, or temperature and moisture variability. Therefore, to enhance the climate resilience of replacement plantings, each project should consider species diversity as a mechanism for increasing climate resilience.

Future climate conditions will result in increased frequency of intense wind, rain, and ice storms which are expected to cause structural damage to forests. Droughts will likely become longer and more frequent, and plants will experience more heat stress. Warming winters may result in the northward expansion of species or diseases that are currently constrained by temperature. These events coupled with changing conditions may favour the spread of invasive species and pest outbreaks. Management plans that address restoration and vegetation should address climate change adaptation.

The Guideline presents BMPs intended to control invasive species and to promote native species plantings in support of sustainability goals including biodiversity. Native species tend to be better adapted to regional weather conditions, although the impact of the changing climate should be considered. Native trees and plants that have historically thrived in certain regions may become stressed when exposed to increasingly extreme conditions, and vulnerable to highly adaptable invasive species from other climate zones. Restoration planning should consider resilience of plant species selected to the projected future climate conditions in the region, including higher summer temperatures, colder winter temperatures, increasing drought conditions, higher intensity and frequency windstorms, and increasing likelihood of freezing rain.

Assisted migration, the human-assisted movement of a species informed by the projected changes to climate and habitat suitability in an area, could potentially decrease risk of species extinction and improve habitat resilience as the climate changes. Assisted migration can be performed at three different levels that range from the movement of populations of a species within their current range (e.g., Carolinian species) to moving species adjacent to, or far outside, their current range. This is distinguished as assisted population migration, assisted range expansion, and assisted long-distance migration, respectively (Ste-Marie et al., 2011). However, the application of assisted migration of plant species should be thoughtfully considered prior to implementation as each type comes with varying levels of risk of success as well as the risk of potentially replacing the local populations of a species already present in the area. Thus, a balanced approach to implementing assisted migration into restoration planning, that prioritizes the preservation of locally adapted populations, rare species, and habitat types should be employed.

Several organizations such as Environment and Climate Change Canada (ECCC), Natural Resources Canada's Canadian Forest Service, and Ontario's Ministry of Natural Resources and Forestry (MNRF) have developed a collection of climate change adaptation tools and related resources that should be considered in the development of both on- and off-site restoration plans and implementation to increase resilience and long-term survivability of the restoration project. These tools and resources include, but are not limited to:

- Climate data and modeling providing projections of temperature, precipitation, changes in growing season length, frost days and other variables;
- Interactive maps and web applications that depict:
    - Canada's tree species vulnerability to climate change;
    - Projected species-specific plant hardiness changes;
    - Determining suitable seed sources for future climate scenarios;
    - Projected movement of forest insects, diseases and pathogens; and
    - other climate change factors impacting forest systems; and
- The Ontario Tree Seed Transfer Policy (MNRF, 2020) that provides guidance on climate-based seed sourcing and transfer within Ontario.

Implementation of climate change considerations in restoration planning will depend on location, habitat type, and is project specific. Recommendations on the inclusion and use of the above tools and resources is provided in **Appendix H.**

4.5.2 Site Preparation and Implementation

4.5.2.1 Invasive Species Removal

Invasive species can significantly hinder ecological restoration goals by out-competing with native vegetation that is planted or seeded. Site preparation is essential to ensure there are not any invasive species at the site of restoration and invasive species management should begin one season prior to restoration plantings at a minimum. For optimal results, three years of invasive species removal and management ahead of restoration plantings should be undertaken. Details on what invasive species management can look like is described in **Section 6** and **Appendix K.**

4.5.2.2 Establishing Healthy Soils

Prior to planting in all resto ration areas, it is essential to verify that soils can support the long-term success of vegetation being planted. This begins with an assessment of reuse and storage. Topsoil and subsoils are to be amended and de-compacted focusing on a combination of physical, biological, and chemical properties to ensure optimal growth for imported topsoil and sufficient growth for in situ soils, summarized in **Figure 4-7**. See **Appendix D** for details.

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Figure 4-7: Soil Health Parameters from Soil Health 101 Vineland Research and Innovation Centre (2023)

Key Soil Health Properties

Common Soil Health Parameters

Physical	Biological	Chemical
Texture	Soil organic matter	pH
Bulk Density	Particulate Organic Matter	Electrical conductivity
Porosity	Mineral Associated Organic Matter	Macro and Micro Nutrients
Aggregate Stability	Active Carbon	Heavy Metals
Penetration Resistance	Soil Respiration	
Available water capacity	Potentially mineralizable nitrogen	
Saturated Hydraulic Conductivity	Root pathogen pressure assessment	
Infiltration		

Poor drainage and lack of organic matter are the most common problems in urban soils, particularly those subjected to construction activities due to soil compaction. To correct soil compaction, soil amendments and decompaction techniques shall be executed (e.g., tubular radish). Typical decompaction tools such as rototillers or subsoilers can be used when there are no existing infrastructure/trees on the site, and used for edge plantings and decompaction. Otherwise, soil compaction is best managed through avoidance, which includes protecting future planting sites during construction by using the appropriate mitigation (i.e., horizontal tree hoarding).

Soils are to be amended with organic matter. Doing so will improve water infiltration, increase water-holding capacity, improve soil aeration, and increase the activity of soil organisms responsible for creating and maintaining soil structure. Soil pH and nutrient balance deficiencies may be addressed through soil tests and foliage analysis. While different species have different requirements, a soil pH range of 6-6.5 is generally favourable for most trees. A balance of nitrogen, phosphorus, and potassium is essential for most vegetation, followed by some balance of secondary nutrients.

Soil decompaction and application of amendments will be applied to depths of 1 metre in areas with restoration plantings. Each site will require its own site-specific Soil Amendment and Decompaction Plan that is based on municipal requirements, regulations and vegetation needs to ensure long term success. The below is a list of minimum requirements to be included in the Soil Amendment and Decompaction Plan.

A. Vegetation species specific requirements for restoration success
B. On-site Soil Management
   i. Soil storage and reuse methods
   ii. Soil Mitigation for on/adjacent to site soils
C. Soil sampling to determine amendments needed
   i. Requirements for existing soils for restoration
   ii. Identification of existing soils conditions
   iii. Assessment of results that do not meet optimal/ sufficient criteria
   iv. Requirements for Imported Soils/Compost for Restoration
D. Soil compaction prevention and decompaction
   i. Compaction prevention methods
   ii. Identification of soil decompaction depths
   iii. Methodology for decompaction
E. Application of Soil amendments – description and methodology
   i. Mycorrhizae application
   ii. Organic Material
   iii. Other amendments
F. Verification of Healthy Soils prior to Planting

Additional details regarding healthy soils, decompaction, and amendment requirements that shall be followed for Metrolinx Projects are provided in **Appendix D.**

4.5.2.3 Planting, Seed Application and Protection

Planting and seed application should follow BMPs and standards to ensure that plant survival is optimized. This includes the following parameters and additional details provided in **Appendix H:**

- Planting should take place in spring (after ground thaw) or fall (before first frost) ensuring that the root ball is covered by soil and not above ground level.
- Plant species selection needs to be aligned with site conditions, particularly considering the species' moisture level and sun/shade tolerance.
- Watering and mulch to provide plantings with needed moisture and nutrients, which support establishment.
- Plantings should be protected from herbivores (e.g., rodent guards or deer fence) or trampling (e.g., perimeter fencing) depending on location pressures.
- Plantings should include native seeding considerate of appropriate soil and sun contact, with consideration for soil and erosion control.
- Cover crops are important to support native seedings and invasive species management, which species selected to not out-compete native seeded species.
- Terraseeding™ is the preferred method of seeding as it includes a growing medium that has a lower risk of introducing invasive or weedy species to site. Please refer to the TRCA

4.5.2.3.1 Restoration and Planting Strategies

Restoration and planting strategies can vary depending on restoration goals and site conditions, the following are examples of active restoration methods which could inform planting composition.

Nucleation

Nucleation restoration is a strategy for accelerating natural succession by planting early successional species in clusters, rather than the whole site. This strategy enhances forest recovery and relies on natural species dispersal which will support high native biodiversity. This strategy is commonly used by Metrolinx as it is cost effective and supports adjacent ecosystem expansion as well.

Plantation

This planting approach is desirable where maximizing plant stems in limited space is an important restoration objective. This leaves no spaces between plantings for natural infill or subsequent additional plantings, or – beneficially – invasive species infestations. Therefore, locations with invasive species pressure may integrate a plantation style restoration into their plan strategically in sites where invasive species pressures are higher.

Miyawaki

The essential principle of the Miyawaki method is planting species that would occur naturally in that area and that work together to create a diverse, multi-layered forest community. This creates a resilient and thriving forest ecosystem with species that complement each other. This strategy requires planting seedlings at very high densities to mimic a natural regeneration process.

Infilling

In-fill planting is beneficial where existing environments have gaps. Infilling planting therefore serves to increase plant density and biodiversity. This method is desirable in forests/thickets where gaps are pre-existing or a result of anthropogenic factors. It should be noted that some ecosystems such as savannahs are distinguished by having openings that support savannah native species and processes – therefore in-filling such ecosystems should be avoided and given scrutiny as to restoration and local ecology objectives.

Co-planting with conifers

Another forest restoration technique that can increase planting success is planting a desired composition of species interspersed with coniferous trees with the intent of gradually thinning the conifer trees as they establish to allow the desired species composition to thrive. Conifer species (softwoods) are particularly beneficial for their fast growth rate (when generally compared to deciduous, hardwood trees), which allows them to be excellent companion trees in the early stages of restoration for several reasons. The benefits of co-planting with ecologically compatible conifer species during establishment is to accelerate tree growth, act as weed suppressants, reduce windthrow, improve spacing between stems, produce shade during early growth stages, accelerate canopy closure, and generally promote good establishment of restoration plantings.

Species-specific restoration

Species-specific restoration is often desirable when there have been species specific losses or impacts due to Metrolinx Projects, such as to species at risk. In these cases, specific habitats will be created, installed, and monitored to off-set losses and impacts to a specific species. Examples include: (1) species at risk bat nesting or roosting habitat structure creation within an existing ecosystem which supports the intended species, and (2) butternut tree plantings that may also include butternut specific soil amendments, companion plantings, and butternut specific maintenance.

Invasive species management

Invasive species management may be implemented in sites inundated with invasive species to prepare a site for native plantings or as the major goal of restoration. For example, restoring a monoculture of European Common Reed into a native wetland community. Regardless of restoration objectives, where there are invasive species on or immediately adjacent to a restoration site, invasive species management is important to restoration and should be implemented as part of any maintenance and monitoring plan. Additional information regarding invasive species management is described in Section 6 and **Appendix K.**

4.5.3 Establishment and Stewardship Period (Maintenance and Monitoring)

Maintenance, monitoring, reporting, and warranty requirements are critical components of the establishment and stewardship period and are dependent on the restoration location (on-site vs. off-site) and habitat type. These requirements are summarized below and further described in **Appendix H.**

4.5.3.1 On-Site Maintenance and Monitoring

A five-year establishment and stewardship period with a maintenance and monitoring program should be provided for plantings completed as part of on-site restoration including any temporary easements. The maintenance and monitoring program should include the following as well as additional considerations identified in **Appendix H**:

- Watering regime for at least the first two (2) years;
- Maintenance and repairs for protective fencing;
- Conducted as per the applicable municipalities' requirements;
- Annual or biennial monitoring and reporting for plant survival, health and recommendations for adaptive management (e.g., determining if additional soil amendment is needed);
- Wildlife surveys for naturalized restoration areas;
- Removal and management of weeds, incompatible vegetation, invasive plant species, and noxious plant as per the Integrated Vegetation Management Plan, see **Section 6**; and
- Replacement or infill plantings to replace die-off.

The party or parties responsible for restoration maintenance, monitoring, and warranty should be identified early in the project life cycle. Depending on site handover requirements or the warranty length identified in the project agreement, a separate contractor may be retained to complete the final years of maintenance and monitoring beyond the warranty required by the contractor that undertook the planting.

4.5.3.2 Off-Site Maintenance and Monitoring

Off-site restoration must include a 10-year establishment and stewardship period with a maintenance and monitoring program, where monitoring and reporting is conducted with at least five (5) events over the 10-year period (e.g., years 1, 3, 5, 7 and 10) and a monitoring event in the 1st or 2nd and 10th year is required. Monitoring event details are to be agreed upon and approved with Metrolinx and includes reporting. Maintenance for off-site restoration includes many of the same elements as on-site such as watering, fencing repairs, and invasive species management. In place of a warranty on plantings, off-site restoration must have allocated budget to support infill planting ranging from 20% to 50% **(see Appendix H).**

Additional surveys to assess various indicators of restoration success should be incorporated as part of the monitoring program to evaluate success beyond plant survival. This includes biological surveys that are appropriate for the habitat type prior to planting/restoration and throughout the monitoring program to judge changes in biodiversity and presence of bio-indicator species.

4.5.3.3 Success Indicators

Using multiple success indicators is important to evaluate if compensation is meeting restoration objectives and identify if adaptive management is needed to support a more biodiverse, sustaining ecosystem with healthy ecological function.

When assessing restoration plant survival, Metrolinx considers a survival rate of 80% a success. The survival of plantings is to be assessed every monitoring event and identified in the reporting. If infill plantings are identified to be required due to <80% survival, the infill plantings will be undertaken in the next growing season.

Beyond plant survival, restoration sites should be assessed to determine use by fauna regardless of being associated with a species at risk restoration project. Restoration monitoring should include documenting presence of target bio-indicator species groups. A bio-indicator species group can not only demonstrate that wildlife is returning to the location but can also indicate the level of biodiversity and whether different life-cycle functions are supported for a variety of species.

Successful restoration sites should demonstrate resiliency to invasive species, climate change, and natural and urban disturbances. Other indicators of successful plantings can include assessing growth and evidence that species can reproduce (i.e., seed production). Monitoring events will include assessment of invasive species on site and subsequent action to support successful restoration. This will be documented and provided to Metrolinx.

Further action to support successful restoration will be assessed using scientific methods, data from each monitoring event, and in discussion with Indigenous communities and stakeholders. Additional success indicators will be identified and evaluated as Metrolinx continues to learn more and improve ecological restoration with collaborators.

4.6 Procurement Approach

Given the wide variety of Metrolinx undertakings, a one-size-fits-all procurement approach for ecological restoration work will not meet the unique needs of each Project. For example, a Project with minimal vegetation removals may be able to carry out replacement planting within the Project location itself through the construction contract, while Projects with large scale vegetation removals and natural heritage losses may not have the option of implementing replacement restoration within or close to the Project location. Therefore, a more involved procurement process may be necessary. Metrolinx often collaborates with Conservation Authorities, municipalities and Indigenous communities to enhance the local natural heritage system through restoration planning. The local Conservation Authority or municipality may have land available for off-site restoration in the same sub-watershed or watershed. Indigenous communities have knowledge and value systems beyond western science to support restoration success.

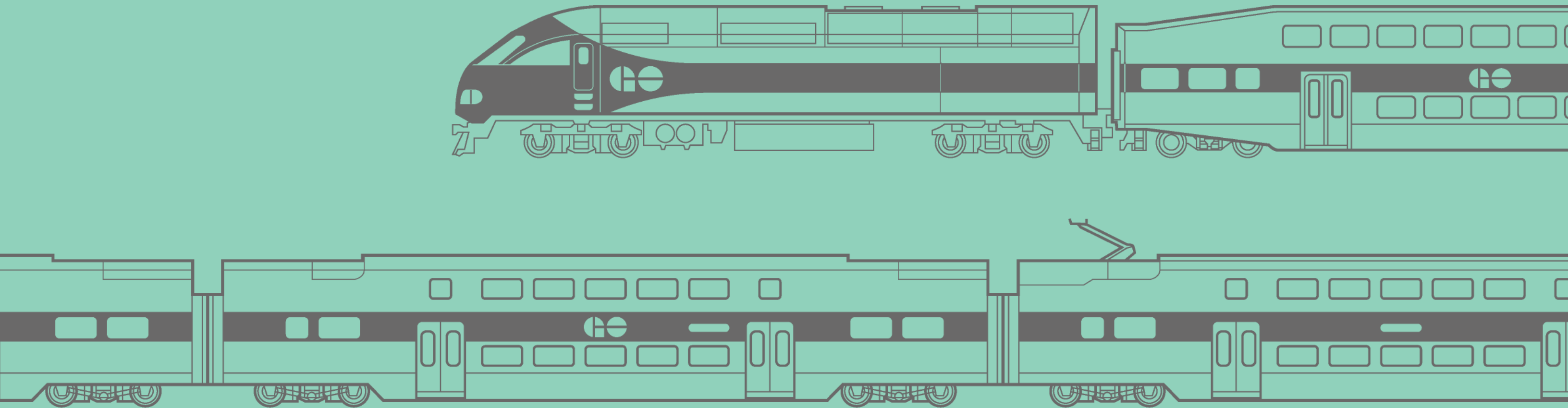
Each Project should develop their own procurement model that works best to meet the principles of the Guideline while respecting the circumstances of the Project. Pre-planning work should include consideration of the potential procurement model and ensure that sufficient budget and resources are allocated, and an effective implementation framework is in place for the restoration work.

The projected cost of restoration and cash-in-lieu will be determined on a project-by-project basis, based on the number and location of vegetation and/or natural heritage features removed, and the associated ratios for ecological, baseline and/or by-law replacement. The Project team will be responsible for allocating the necessary budget needed to implement restoration.

Projected restoration costs should be calculated utilizing a combination of the market price of the total number of replacement trees (e.g., cost of a 60 mm wire basket caliper tree at time of tree removal) and natural heritage features needed, and other budget items related to site preparation, installation, maintenance, and monitoring as identified in **Appendix H.**

Engagement with Indigenous communities is needed to further determine procurement and partnership opportunities related to elements of restoration.

Vegetation Reuse



5.0 Vegetation Reuse

Metrolinx acknowledges the impact that tree and vegetation removal can have on the landscape when building transit infrastructure. To that end, Metrolinx is committed to mitigating some of these impacts by undertaking sustainable and environmentally conscious vegetation reuse initiatives that provide effective diversion options and go beyond typical practices.

This section outlines vegetation reuse opportunities for plant materials being impacted by Metrolinx Projects. The options provided herein support sustainable alternative vegetation disposal practices including harvesting opportunities for Indigenous communities; translocating plants within a site or to a nursery; collecting seed and plant material for propagation and future restoration; and end use options for downed woody material.

5.1 Vegetation Harvesting

Metrolinx seeks to support harvesting of vegetation, particularly by Indigenous communities who are engaged on Metrolinx Projects or restoration projects. Natural environment study field visits often include invitation to Indigenous communities to participate, which is an excellent opportunity to begin to understand harvesting potential and importance of a Project site. Understanding existing harvesting opportunities on-site is further supported with a natural heritage study (also referred to as a Natural Environment Report) and Integrated Arborist Report or Arborist Report where applicable, which identify vegetation communities and plant species present. Where harvesting requests are identified, Metrolinx will facilitate harvesting activities where appropriate and if Project schedules and safety requirements permits. Specific harvesting needs and/or details by Indigenous communities may not be shared with Metrolinx as this information may be considered confidential and sensitive.

Understanding the importance of harvesting to Indigenous communities, Metrolinx seeks to support this practice. Within the context of the Guideline, this is done through prioritizing the planting of bio-culturally significant species and ensuring restoration sites are accessible for harvesting by Indigenous communities and peoples.

5.2 Vegetation Relocation (Transplantation)

Vegetation relocation (also referred to as vegetation transplantation or vegetation rescue) is the practice of moving a plant or plant material from the site where it is expected to be impacted to a safe location to allow it to continue to grow and proliferate. This can mean translocation to a different, unaffected part of the same site, which is often the preferred action; translocation off-site; or relocation to a nursery where the plants will be cared for and eventually used in restoration initiatives. In any scenario, sufficient time must be allocated to planning and preparing the resources required for this work.

The process is initiated by identifying qualified partners who review the relevant Arborist Report or Integrated Arborist Report and NER. The review would include tree and vegetation plant lists, associated mapping of project impact areas and property limits, and to review and identify plant material that may be suitable for translocation. While these documents can provide a good background on the plants that may be suitable for relocation, much of the assessment must be performed in the field where a better understanding of the site conditions and plant material can be gathered. Field visits are undertaken during the appropriate times of year where plants can be identified and marked for immediate relocation to alternative location (including in the Project area) or transportation to a nursery partner. Alternatively, and especially for spring ephemeral species, the plants can be marked and/or mapped to be collected later when the plants are dormant and can be more successfully transplanted.

Where plants are relocated within the same site, the newly planted locations should be documented, and monitoring and maintenance efforts should be considered to ensure the plants' survival over time. Relocating plants can be very stressful and the survival rates can be low, especially for sensitive species. They require an abundance of watering and maintenance to ensure their survival over the long term. Often, larger plants with more mature root systems will not survive relocation, in which case alternatives such as cuttings and grafting can be considered for propagation in a nursery. These plants can eventually be used in restoration of the site in which it was collected or used in other Metrolinx restoration projects to maintain the genetic material of the vegetation as close to the parent material as possible. This is thought to lead to greater survivability and adaptation of the plant species in the natural landscape.

5.3 Seed Collection and Archiving

Seed collection is a multi-step, multi-year process that often requires extensive planning, foresight, and resourcing to be successful. The timelines required for forecasting and collecting seed varies by species, and they each have different collection and processing requirements. Which is why it is crucial to be aware of the flowering, forecasting and collecting times for every species of interest. For instance, some species may have an optimal collection window of just two weeks of the year, while others can be collected over many months. Timing is critical to effective seed collection. The more time available for planning prior to tree and vegetation removal, the better the collection results will likely be.

Accurate timing alone is not enough to guarantee a successful yield. Many species do not produce a good seed crop annually. The time between optimal crop yields is called periodicity or masting and can differ from species to species by a length of one to 10 years. This is another reason why early planning is important in successful seed collection.

Seed collection planning starts with identifying collection partners who have demonstrated knowledge and experience with seed collection of vegetation native to southern Ontario and nursery partners that will process and store the seeds based on the forecasted quantities. Seed collection knowledge can be acquired through certification from Forest Gene Conservation Association (FGCA, or similar body) or acquired through IK. The professional seed collector then reviews relevant documentation including the applicable Arborist Report, NER, tree and vegetation plant lists and associated mapping. The professional seed collector provides a list of potential collection species to be agreed upon in advance and an estimate of the number of days required to complete forecasting of the areas identified for seed collection.

Forecasting should be completed at the appropriate time of year for the species and may require multiple site visits. Considerations should be made for access and safety requirements, depending on the collection location. Forecasting work may include opportunistic seed collection sampling during site visits. During these sites visits, recommendations for collection, processing and storage of future material collected based on forecasted quantities and anticipated timelines can be provided.

Seed collection should take place per the species-specific timelines and agreed upon quantities based on the forecasting results, to the extent possible. This can occur between May to January. Collected seed should then be transported and processed in an appropriate facility according to the species' individual requirements and stored for an agreed upon duration of time. A final report summarizing the results of seed collection efforts and quantities collected should be submitted, along with recommendations for storage and plant propagation by a nursery partner which is to be identified ahead of time.

The collected seed will then be propagated and grown to be used in Metrolinx Projects, with a preference for planting as close to the collection site as possible. This will ensure the native genetic material of the plants are maintained close to their natural parent material, which is thought to produce more successful restoration results than plants with genetic material sourced from elsewhere in southern Ontario. Any remaining propagated plants can be stored in an appropriate facility and used in other Metrolinx Projects as needed.

5.4 Tree End Use

Metrolinx's current direction to is to prioritize diversion and distribution of suitable removed trees to interested end users including Indigenous communities, Conservation Authorities, restoration practitioners and other community partners where possible. This section provides guidance on identifying bio-culturally significant trees for Indigenous communities, determining the appropriate end use option for each removed tree, identifying tree end use partners, and the logistical implementation of the tree end use framework.

The tree end use framework aims to:

- Satisfy safety requirements;
- Promote the integrity of a healthy ecosystem;
- Prioritize diversion to Indigenous communities;
- Minimize or eliminate vegetative debris from entering the landfill; and,
- Maximize the repurposing of downed trees to the extent possible.

The determination of tree end use considers:

- Indigenous community interest;
- Tree species;
- Tree size and form;
- Suitability for habitat creation;
- Limits for on-site storage and transportation off-site; and
- On-site availability for use of chipped material.

Figure 5-1 provides a summary of the step-by-step process for determining tree end use described further in the subsections below.
While trees of all sizes have intrinsic value, Metrolinx does not place monetary value on trees or removals and does not condone any such valuation by our affiliates. Additionally, the recommendations in this section related to tree end use and lumber quality are based on western values and do not represent IK or TEK.

5.4.1 Bio-culturally Significant Trees

Bio-culturally significant trees can be tree species or individual trees that hold significance or cultural value to Indigenous communities. Metrolinx will share Arborist Reports with Indigenous communities well in advance of tree removal to identify any interest in reuse. Indigenous community's review of NERs can also include feedback on trees of significance for reuse. With feedback of which trees Indigenous communities have an interest in receiving for end, planning can begin to support this request. Of importance, Indigenous community requests maybe be specific to tree species, processing, environmental inspections, and delivery.

5.4.2 Trees not to be Reused

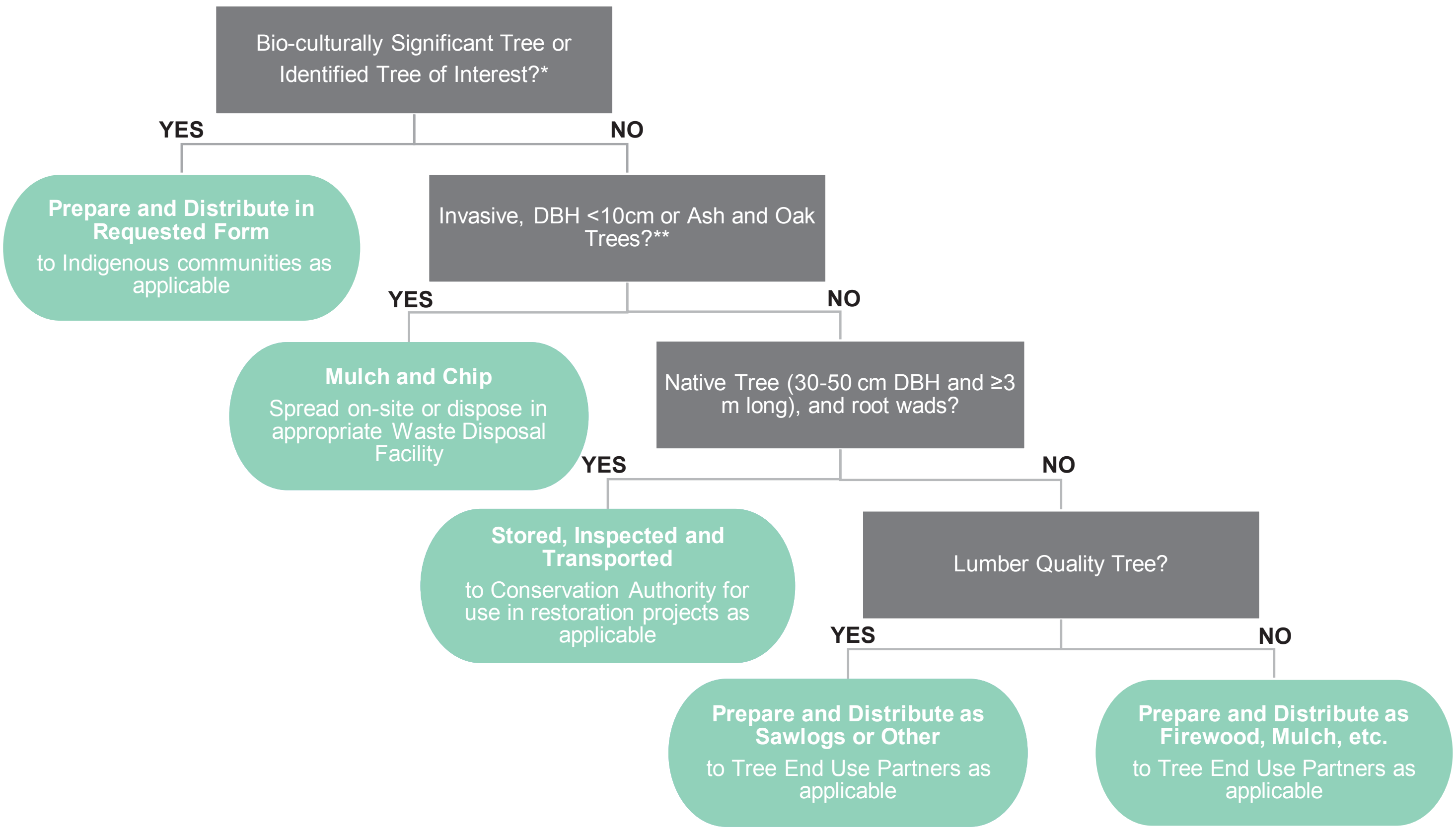
The following trees and tree materials are non-lumber quality that may require removal:

- Invasive species;
- Trees that measure <10 cm DBH;
- Ash and oak trees (due to EAB and Oak Wilt, respectively); and,
- Branches and foliage removed from trees that need to be pruned.

It is anticipated that most of the trees to be removed within the right-of-way (ROW) and many Metrolinx Projects will be invasive or younger trees that are not suitable for end use due to small size, irregular growth, or wide growth rings. These trees are typically unsuitable for restoration, as sawlogs or any reuse as lumber and will be mulched on-site. There will be circumstances under which non-lumber quality trees and other tree materials will be required to be transported off-site, such as when there's limited capacity on site to handle the chip material which cannot exceed 10 cm depth within the ROW.

Trees End Use - Flow Chart

Figure 5-1: Tree End Use Flow Chart



* This excludes invasive species which cannot be transported off-site or outside of a regulated area

** See Section Emerald Ash Borer and Oak Wilt **Section 5.4.2.3** regarding removal of Ash and Oak trees

To reduce the potential for accidental movement of EAB and Oak Wilt , ash and oak trees are not suitable for end use and cannot be transported off-site without compliance with CFIA regulations and guidelines.

Disease-ridden trees will not be transported outside of quarantine areas and tree distribution and transportation will comply with CFIA regulations. As such, the tree species identified as lumber quality will need to be reassessed on an as-needed basis to ensure compliance with the CFIA.

The following subsections provide information on chipping and mulching, EAB and Oak Wilt, which will be considered in determining tree end use options for non-lumber quality trees.

5.4.2.1 Chipping and Mulching

Trees measuring less than 10 cm DBH, invasive species, ash and oak trees and other tree materials can be chipped and either used for mulch on-site or transported off-site if free from invasive species and pests. If an area has less than 10% coverage of invasive species, the invasive plants shall be removed first following proper Ontario Invasive Plant Council (OIPC) BMPs and then chipped separately on-site (if a woody invasive) and treated (if required as per OIPC BMPs) to prevent further spread. After invasive plants have been removed, the remaining vegetation in that area can then be chipped and spread on-site or transported off-site. Using the chipped material for mulch on-site has several benefits, such as reducing costs to transport and dispose of removed trees as waste products, supporting soil health, minimizing erosion and invasive species proliferation, and reducing negative climate impacts by minimizing transportation.

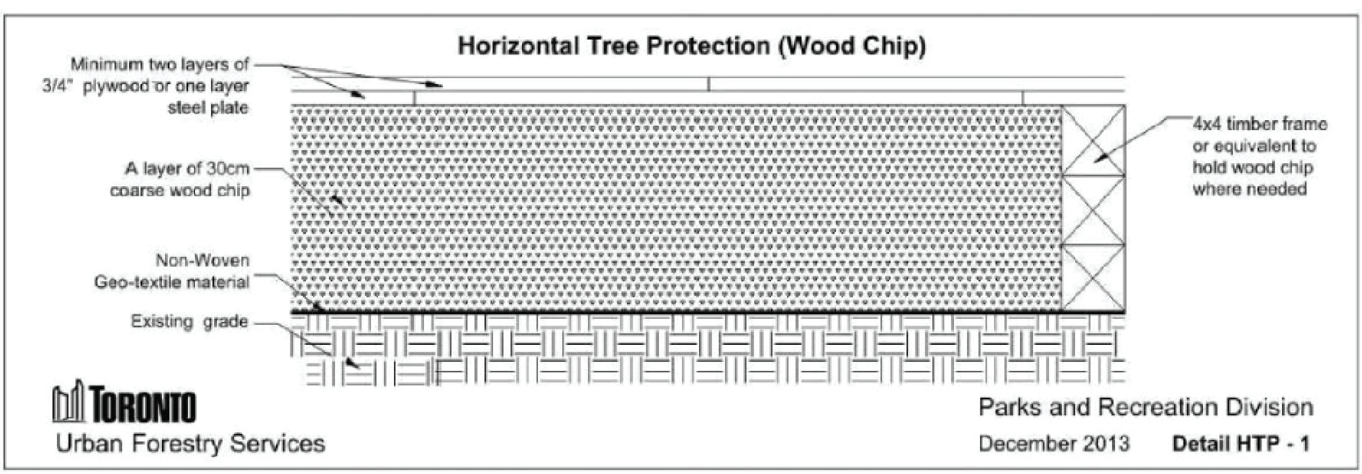
It is anticipated that much of the wood chips produced on site will require removal, either to an interested Indigenous community or stakeholder community partner who may be able to reuse the wood chips for pulp, fuel, or compost or as a last resort to a landfill. If wood chips are to be used as fuel, the chipping process will have to be tailored to the end user as variables such as woodchip size, moisture content and source material must be compatible with the energy generation process. Further details around chipping and on-site logistics are described in **Appendix L.**

[2] Oak wilt is an invasive, vascular disease of oak trees, caused by the fungus Bretziella fagacearum. The fungus grows on the outer sapwood of oak trees, restricting the flow of water and nutrients through the tree. Some oak species are more vulnerable than others and can die within a year of infection. In some severe cases, red oaks mortality can occur within 2-6 weeks following infection.

5.4.2.2 Active construction site

During construction, removed trees that are to be chipped on-site can be used as a dense (30 cm thick) temporary measure for a variety of mitigation measures to reduce soil compaction from construction equipment; prevent invasive species growth; and for erosion and sediment control. A layer of partially composted wood chips spread over the protected root zone of trees on a construction site will improve soil structure; protect the minimum preserved root zone; and conserve soil moisture levels. The recommended thickness for mulch left on site post construction varies by municipality but is generally 15 cm outside of rail corridors and 10 cm inside.

Figure 5-2: Example of City of Toronto specification for wood chips as tree protection



5.4.2.2.1 Adjacent to designated natural area

Chipped material can be used to protect the edge of the project site when working adjacent to a natural area. Native plant material can be chipped and spread on both sides of perimeter silt fence and tree protection fencing to retain moisture and act as erosion and sediment control. Further information on how chipped material can be used to benefit a project site can be found in

5.4.2.2.2 Rail Corridor

Wood chips should be applied in softscape areas and a minimum of 3 m from ballast, especially in areas where trees were removed, since the removal of trees and undergrowth may encourage the establishment of invasive species, which readily colonize areas of exposed soil. In some cases, chipping may not be possible at or nearby the tree removal location so chipped material should be spread out evenly in the rail corridors in areas that maximize its effective use. The depth of the mulch should be between 8 and 10 cm where supression of undesirable plant growth is required. In areas to be seeded with desirable species, the depth of mulch should support seed germination.

Chipping and mulching on-site are options except where the available space limits the amount of chipped material to be spread. The on-site disposal capacity of mulch can be calculated by the tree removal area multiplied by the maximum depth of 10 cm. If the wood chips to be generated exceeds the on-site disposal capacity and is free of invasive species and pests, excess wood chips will be transported off-site and either given away or used to produce material for pulpwood, pellets, hog fuel, pulp wood, biofuel, gardening and landscaping, or other uses such as the production of compost. The size of the chips can be adjusted by equipment settings, depending on the end users' requirements. Excess chipped material from areas where invasive plant species were present will be disposed of at an appropriate waste disposal facility. Trees (other than invasive species, oaks or ash trees) that are too large to be chipped on-site and have not been identified for tree end-use may be removed as logs for chipping off-site.

5.4.2.3 Emerald Ash Borer and Oak Wilt

Metrolinx Projects are within the EAB regulated area, and all ash trees in the regulated area are considered in danger of being EAB infested. To prevent the spread of EAB, ash trees will be chipped and spread on-site within Metrolinx-owned-lands. However, there may be situations where capacity issues preclude ash trees from being chipped and spread on-site, in which case all ash materials (bark, chips, branches, fresh leaves, and wood) to be moved to non-regulated areas must be chipped to a diameter of less than 2.5 cm in any two (2) dimensions prior to moving to an approved Emerald Ash Borer Approved Facility Compliance Program (EABAFCP).

In situations where ash trees have a DBH that is too large for the chipper to process on-site and require offsite processing, ash logs could be made into lumber and then moved in accordance with EABAFCP requirements. Between October 1 and March 31 of any year, ash lumber may be shipped to an approved EABAFCP after it either has had all of the bark and at least 1 cm of sapwood removed, or it has been treated to attain a minimum core temperature of 56°C throughout the profile of the wood (including the core) for a minimum of 30 minutes, or so long as it has been processed at an approved EABAFCP in accordance with EABAFCP requirements. For more details, refer to the latest information provided by the CFIA.

Removal, handling and transport of ash trees must be done in a manner compliant with the Ministerial Order which has been issued by the Federal Government restricting the movement of wood out of the regulated area.

Similarly, oak trees in Ontario are at risk of transmitting Oak Wilt and will be chipped and spread on-site within Metrolinx-owned-lands. As Oak Wilt has (June 2023) been documented in Ontario and Canada for the first time, CFIA directives regarding preventing the spread of Oak Wilt through domestic movement of oak logs have not been established at the time of the Guideline being published. If an Oak Wilt regulated area is established, Metrolinx will adhere to these requirements as well as all other CFIA directives related to Oak Wilt management. In the interim, oak trees that are too large to be chipped on-site will be inspected and tested for Oak Wilt prior to being moved for processing.

5.4.3 Trees to be used in Restoration

Native trees that are between 30 to 50 cm DBH and at least 3 m long can be donated to Conservation Authorities or restoration practitioners to be used as habitat features in projects such as salamander logs, cover for small animals, bat house posts, habitat structures. Logs or stumps with root wads intact are especially desirable for restoration as they can provide bank stabilization, habitat, and many other benefits to the natural environment. Suitable sized logs with or without root wads require a mechanism to be stored, inspected and transported and should be arranged by the company removing the trees well in advance of tree removal.

5.4.4 Lumber Quality Trees

Lumber quality trees are defined as trees that can potentially be used for lumber or can be sustainably diverted for alternative use and are identified based on the tree species as well as size and wood quality. Lumber quality trees can be identified in the field as those having a straight trunk at least 3 m long, with no large branches (greater than 5cm diameter), a minimum DBH of 15 cm, and no visible defects. The common characteristics of the lumber quality trees to be used for lumber are identified as great strength, durability, resiliency, shock resistance, and decay resistance.

This Guideline uses the species identified by Hilts and Mitchell (2009) to be considered lumber quality trees for the purposes of assessing tree end use options. These species, as provided in Table 5 1, are based on western science and values and may not capture tree species used by Indigenous communities.

Table 5 1: Lumber Quality Tree Species (Hilts and Mitchell, 2009)

Category 1	Category 2	Category 3
Black Walnut	Basswood	Aspen
Black Cherry	Tulip Poplar	Beech
Red Oak*	Yellow Birch	Hop Hornbeam
White Oak*	White Birch	Hemlock
White Ash**	Red Maple	White Cedar
Sugar Maple	White Pine	Butternut
	Red Pine	Hickory
	White Spruce	Elm

* Re-use of Oaks subject to CFIA directives
** See **Section 5.4.2.3** regarding removal of Ash trees

Lumber quality trees will be identified by an Arborist and documented in the Integrated Arborist Report. If, after being cut, a tree is found to have a defect (e.g., rotting core), it may no longer qualify as lumber quality or be suitable for distribution to end users. Therefore, following cutting, an Arborist should re-evaluate lumber quality trees to confirm their suitability for end use and absence of diseases and pests.

Following removal, lumber quality trees will be cut into sawlog size or into other requested forms, transported, and reused as appropriate as commercial grade wood. It is intended that most of the lumber quality trees will be distributed to end use partners including Indigenous communities, conservation authorities, artists or other identified end users dedicated to carving, woodturning, furniture, restoration, and other wood products/uses. Lumber quality trees can also be distributed to end users focused on enhancing urban trees or events related to urban tree enhancement and repurposing. The Integrated Arborist Report provides opportunity for feedback from Indigenous communities on trees that should be identified as bio-culturally significant, identified as lumber quality, and/or specifications for delivery on a per project basis as appropriate.

Options for re-purposing lumber quality trees are listed below in order of priority:

- Indigenous communities' requests;
- Community stakeholder requests such as park infrastructure (e.g. benches or picnic tables, etc.);
- Art installations;
- Ecological restoration features and,
- Diverting commercial grade lumber to local sawmills and other businesses.

The sawlogs from felled trees are to be stacked in the storage area and sorted/inspected by a Registered Professional Forester or Qualified Person to verify that all felled trees are lumber quality and appropriate for distribution to end users based on quality, species, size, and other factors. It is possible that some sawlogs, originally determined by the contractor on-site to be of lumber quality, may ultimately be rejected once inspected in the storage area, and will be diverted to end uses appropriate for non-lumber quality trees.

5.4.5 Tree End Use Partners

Trees that are to be removed can be transported from Metrolinx Projects and provided to tree end use partners who are identified on a project-by-project basis, depending on their needs and capacity. Potential partners include:

- Indigenous communities;
- Conservation Authorities (wildlife habitat creation);
- Organizations dedicated to ecological restoration;
- NGO’s, local community organizations and foundations focused on enhancing urban trees and parks;
- Municipalities; and,
- Wood products and services – sawmills, artists, firewood, woodturning, furniture and wood products, other organizations/NGOs.

Metrolinx-approved potential end users will be contacted to identify those interested in receiving wood diverted for re-use for the following information to determine their suitability as tree end use partners:

- Their capacities (what types of processing and/or transportation they can perform);
- Their need (what species, quality, quantity, and size and form of wood are they interested in, e.g. firewood, tree lumber, mulch/chips/pulp or other forms); and,
- Their location and distribution/storage centres.

Once it has been determined that a tree suitable for end use is required, partners will be contacted in the order of priority presented above to identify their interest in receiving the available product. Metrolinx and the contractor removing trees will collaborate on the needed communications to ensure Metrolinx needs are met. It is important to determine the storage space, transportation capability, equipment, and capacity of all potential end use partners. The ideal end users should be able to process wood to its desired end-product and have wood storage areas and trucks available to haul the wood to its destination, to reduce the time for wood processing and the need for on-site storage. Potential end-users like Indigenous communities, artists and NGOs may not have the ability of accepting, transporting, or processing large quantities of wood. These logistical challenges will be addressed on a project-by-project basis.

If tree end use is determined to be for habitat restoration, the restoration practitioner or Conservation Authority is to be contacted and a plan outlined for inspection of materials, storage locations, and delivery which is to include at least one on-site inspection by an Arborist or Conservation Authority staff prior to handoff. Please see **Appendix L** for transportation and storage considerations that determine how the wood will be collected, stored, transported, inspected and eventually delivered to the appropriate end users for both lumber quality trees and other trees.

5.4.6 Implementation Framework for Tree End Use

It is estimated that 95% of all trees will be mulched or left on site as most vegetation will likely be unsuitable for diversion. The objective with tree end use is to divert as many downed trees of bio-cultural significance, restoration potential or lumber quality as possible for reuse. The anticipated minimum of 5% diversion of trees towards Indigenous communities or stakeholder community partners may be challenging due to the following:

- availability and accessibility of lumber quality trees;
- available storage for collecting, sorting, and/or processing removed trees;
- available facilities to process lumber, firewood, chips, and mulch;
- considerations of noise, access, and traffic related to transportation and collection of wood materials; and,
- compliance with regulations restricting transportation, as mentioned above, under the CFIA.

5.4.6.1 End Use Planning

Urban areas along Metrolinx Projects may present a challenge for tree reuse. Therefore, finding end users and organizing collection, storage, and transportation must be completed in advance. The storage and transportation plan must identify the delivery of wood products to identified end users in a timely and efficient manner. The project contractor shall create the storage and transportation plan and lead logistics except where otherwise identified. Beginning with the Integrated Arborist Report, the storage and transportation plan should be submitted a minimum of 60 days prior to any removals for review and approval by Metrolinx and should include the following information:

- End use partners identified to receive vegetation materials;
    - Metrolinx will support this and lead communications with Indigenous communities, Conservation Authorities and community groups as needed.
- Identification of end use products (e.g. firewood, full size logs for restoration etc.);
    - Metrolinx will support this and lead communications with identified end use partners as needed.
- Logistics of preparing the identified end use product;
- Identification of storage and sorting location;
- Logistics of coordinating sorting and inspection of vegetation for end use;
- Logistics of transporting end use product to storage and receiving location; and
- Considerations to mitigate negative impacts to local communities (e.g., noise of end use processing, air quality and traffic impacts from transportation).

Further information on tree end use planning can be found in **Appendix L.**

Integrated Vegetation Management

6.0 Integrated Vegetation Management

Integrated Vegetation Management is a system of information gathering, planning, implementing, reviewing, and improving vegetation management (Nowak and Ballard, 2005). The following provides an Integrated Vegetation Management (IVM) framework for managing vegetation on Metrolinx-owned-lands, capital projects, electrified and non-electrified rail corridors, elevated guideways and raised guideways, and restoration areas. The IVM approach provides decision-making guidance on how to initiate, continue, and modify vegetation management practices as needed over the long term. IVM programs should be outlined, documented, and reported in an IVM Plan as necessary for rail corridor management, capital projects and restoration projects, see **Section 6.2.**

Developing an IVM program for Metrolinx's capital projects, rail corridors and other transit infrastructure such as elevated/raised guideways, addresses the fundamental need to provide safe and reliable transport in addition to providing social, economic, and ecological benefits.

Several additional important objectives of IVM are to:

- Establish and maintain a vegetation management zone which protects ballast sections and infrastructure from incompatible vegetation growth;
- Where feasible, restore disturbed areas with southern Ontario native species that is compatible with best practices as well as federal and provincial railway and electrification requirements; and
- Control the growth and overgrowth of vegetation, particularly the management of noxious weeds and invasive species.

The vegetation replacement and restoration approach recommended in the Guideline applies to tree removals associated with Metrolinx capital projects and does not apply to vegetation removal associated with IVM and other routine operational maintenance work conducted to ensure safe railway operations and sightlines. However, certain principles outlined in the Guideline are integrated in operational and maintenance practices such as avoiding tree removal wherever possible, with pruning being a preferred approach where trees pose a risk to safe operations and infrastructure.

6.1 Vegetation Management Zones for Transit Infrastructure

To achieve one of the aforementioned goals of IVM, it is useful to understand vegetation management and clearance zones. A Vegetation Management Zone (VMZ) is required to provide safe clearances from critical infrastructure to any existing vegetation along rail corridors and guideways. If not managed properly, unwanted vegetation can lead to safety and operational issues if the integrity of key structures (e.g., ballast, overhead lines, operational signals, switches, etc.) is compromised. Therefore, vegetation management planned with a zoned approach looks to clearly outline management and restoration parameters which align with the safety parameters of transit operations. Vegetation management for Light Rail Transit (LRT) and Bus Rapid Transit (BRT) infrastructure constructed at-grade within roadways will follow the applicable municipal and/ or provincial (Ministry of Transportation) setbacks and maintenance requirements needed to maintain safe roadways, as well as any project specific setbacks required for the design (e.g., around Overhead Contact System (OCS) poles if applicable), therefore VMZs for LRT and BRT is not discussed in this Guideline.

A summary of detailed management objectives specific to each zone and control thresholds for vegetation within rail corridors and around guideways is provided in **Appendix K**. Representative illustrations of the zones for Rail Corridors and Guideways are provided in **Appendix M** and **Appendix N**, respectively.

Metrolinx has managed and maintained vegetation in rail corridors through a variety of measures, including:

- Managing fallen trees and hazard trees that could impact rail and rapid transit operations/services;
- Maintenance of clear sightlines for signal systems and at crossings;
- Maintenance of vegetation-free zones between the rails and on ballast to allow for better visual inspection of track components/equipment and maintain rail integrity **(Figure 6-1)**;
- Maintenance of woody vegetation-free zones adjacent to guideway piers and retaining walls to allow for better visual inspection and maintenance;
- Removal and management of select deciduous trees and canopy overhanging and within the railway corridor or guideways to reduce leaf volume and address rail/ track adhesion issues; and,
- Removal and management of invasive species.

Figure 6-1: Photos Illustrating Clear Sightlines and Vegetation Management Zones within Non-Electrified Corridors as Required for Rail Safety and Daily Operations

Approaches to vegetation management involve the use of a variety of control methods including mechanical cutting equipment and manual brushing/mowing. The use of herbicides is generally limited to track and ballast areas. The approach to tree management includes removal and trimming of trees within the rail corridors and in areas adjacent to guideway infrastructure.

The IVM framework provides vegetation control measures for maintaining rail and rapid transit operation and maintenance safety while allowing the growth of compatible native plant species in select zones measured from the centreline of the outermost track or edge of guideway infrastructure.

6.1.1 VMZs in Electrified Corridors

Vegetation management within the rail corridors is driven primarily by safety concerns and, as such, management will differ depending on location within the rail corridors. The ballast and ballast shoulder are to be kept free of vegetation to avoid infrastructure deterioration.

Based on management objectives and control thresholds, VMZs have been developed to address electrification infrastructure, including the 7 m vegetation clearance zone, which is comprised of Zones 1, 2, and 3. The VMZs are intended to apply to the electrified Metrolinx rail corridors. Zones 4 and 5 will not require management based on vegetation height and density; however, a maximum height of vegetation within these zones has been established to guide future planting. For adjacent land not owned by Metrolinx, Zones 4 and 5 serve as guidance only. Representative illustrations of the zones for electrified rail corridors is shown in **Figure 6-2** and are also provided in **Appendix M.**

Zone 1: This zone includes the ballast (main track, siding, back track, storage track) as well as the 2.9 m area from the centreline of the track to the OCS poles. This area is to be kept free of all vegetation.

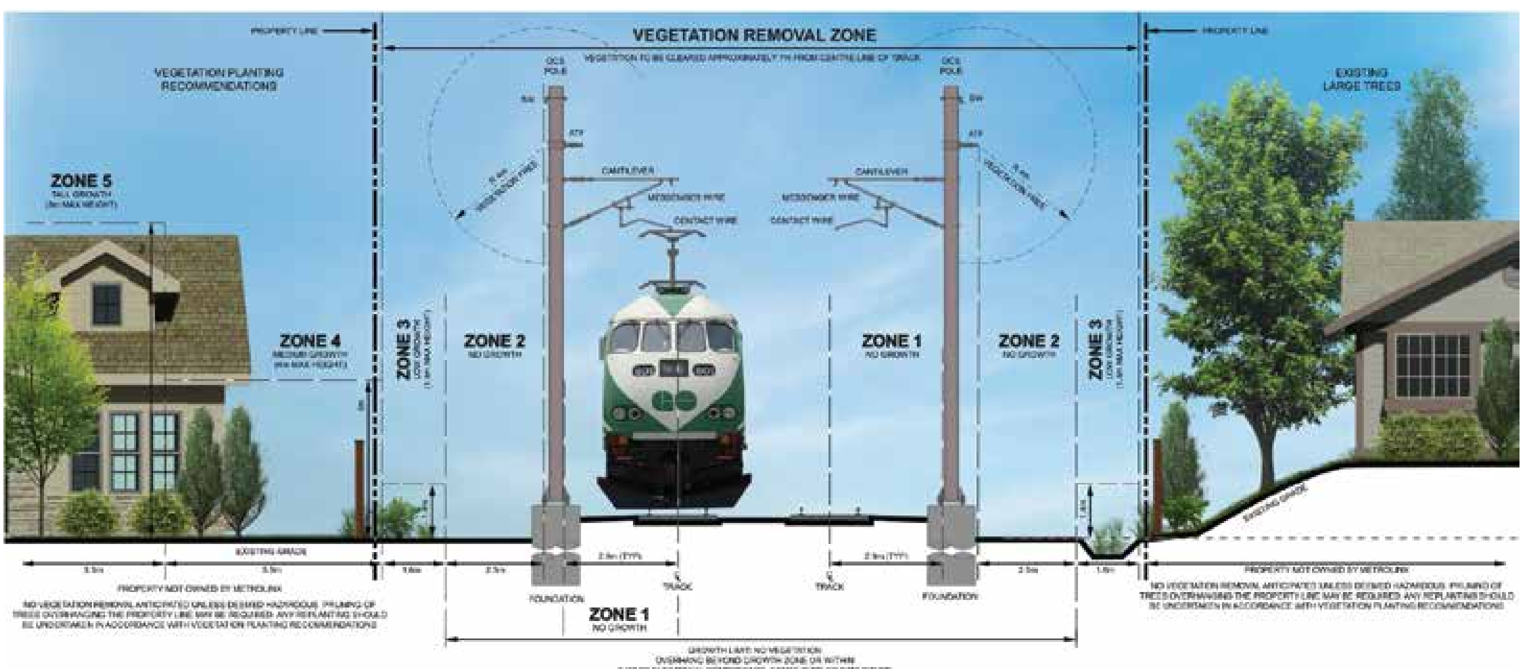
Zone 2: This zone includes the 2.5 m area from the electrical components. This area is to be kept free of all vegetation.

Zone 3: This is a 1.6 m wide low growth zone within the vegetation clearance zone. Within this area, vegetation up to a height of 1.4 m above track is compatible. On a downslope, there is potential to plant low shrubs in this zone.

Zone 4: This is a 5.5 m wide area outside of the vegetation clearance zone (between 7 m and 12.5 m from the track centreline). This zone does not require management of existing vegetation (unless deemed hazardous); however, in cases where this zone is being planted, it is recommended that vegetation be composed of medium height species that grow up to 4 m above track. On a downslope, there is potential to plant tall trees.

Zone 5: This is a 3.5 m wide area outside of the vegetation clearance zone (between 12.5 m and 16 m from the track centreline). This zone does not require management of existing vegetation (unless deemed hazardous); however, in cases where this zone is being planted, it is recommended that vegetation be composed of species that grow up to 8 m above track. On a downslope, there is potential to plant tall trees.

Figure 6-2: Vegetation Management Zones for Electrified Corridors



6.1.2 VMZs in Non-Electrified Corridors

Based on management objectives and infrastructure, VMZs have been developed to address non-electrified Metrolinx rail corridors. These VMZs are like those developed for electrified corridors, except for the 2.5 m area from electrical components. The resulting VMZs include Zones 1 to 4. Like Zones 4 and 5 within electrified corridor, non-electrified Zones 3 and 4 do not require management based on vegetation height and density. The maximum height of vegetation within these zones has been established to guide future planting within these zones. For adjacent land not owned by Metrolinx, non-electrified Zones 3 and 4 serve as guidance only. Representative illustrations of the zones are provided in **Appendix M.**

Zone 1: This zone includes the ballast (main track, siding, back track, storage track) as well as the 2.9 m area from the centerline of the track. This area is to be kept free of all vegetation.

Zone 2: This is a 1.6 m wide low growth zone within the vegetation clearance zone. Within this area, vegetation up to a height of 1.4 m is compatible.

Non-Electrified Zone 3: This is a 5.5m wide area outside of the vegetation clearance zone (between 4.5 m and 10 m from the track centerline). This zone does not require management of existing vegetation (unless deemed hazardous); however, in cases where this zone is being replanted, it is recommended that vegetation be composed of medium height species that grow up to 4 m tall.

Non-Electrified Zone 4: This is a 3.5 m wide area outside of the vegetation clearance zone (between 10 m and 13.5 m from the track centerline). This zone does not require management of existing vegetation (unless deemed hazardous); however, in cases where this zone is being replanted, it is recommended that vegetation be composed of species that grow up to 8 m tall.

6.1.3 VMZs for Elevated Guideways

Elevated guideways are sections of track infrastructure that are above-grade and supported by piers that allows for an underpass beneath the guideway structure. Vegetation management adjacent to the elevated guideways is driven primarily by safety and maintenance concerns and, as such, management will differ depending on the height of the guideway and location of the piers. The zone boundaries apply to the approximate anticipated horizontal spread of the tree/plant canopy.

Based on management objectives and control thresholds, VMZs have been developed to address safety needs for the elevated guideway infrastructure. Zones 1 to 5 will require management based on the offsets from varying infrastructure and vegetation height. A horizontal distance of tree trunks (i.e., 3 m from piers) and maximum height of vegetation within these zones has been established to guide future planting and reduce the need for maintenance (i.e., pruning). A 1 m offset around the elevated guideway infrastructure is recommended to reduce the need for constant pruning.

If the elevated guideway is of sufficient height, large shade trees are permitted in Zones 2, 3, 4, 5 and beyond. Additionally, large tree species which respond well to heavy pruning can be pruned to fit in these zones. Representative illustrations of the zones are provided in **Appendix N.**

Given the inherent elevation of guideways above the ground, vegetation management is focused on selecting nearby native plant species for compatible, restricted heights which keep vegetation control to a minimum.

6.1.4 VMZs for Raised Guideways

Raised guideways are segments of track infrastructure that are above-grade and stabilized through support of a retaining wall. Raised guideways also typically consist of a noise barrier on top of the retaining wall to reduce noise by blocking or absorbing sound waves produced by the railway activity. The methods to determine Zones 3 to 6 remain the same regardless of the height of the combined retaining and noise barrier wall. However, Zone 2 contains the retaining wall planting zone, which has visual inspection requirements. Retaining wall vegetation management should consider the following:

All tree trunks must be located beyond a minimum 3 m offset from the face of the wall to allow for equipment access.

- Every exposed surface of the wall must be accessible for visual and physical inspection.
- The 1 m directly adjacent to a retaining wall shall be clear of all structural branches to the top of the noise barrier.
- No planting over 0.5 m in height is permitted between the face of the wall and a 0.5 m offset from the wall except vines. Plant material in this area may be pruned to facilitate inspection.

Planting within the intended maintenance access route for raised guideways must not prevent access by foot or via machinery as needed. Appropriate planting could include low growth comprised of non-woody vegetation, hardy perennials or groundcovers that can be mowed as well as shrubs that can be cut to ground for maintenance when required. Representative illustrations of the zones are provided in **Appendix N.**

6.2 Integrated Vegetation Management Plan

On top of the management of incompatible vegetation required for rail and rapid transit operations and safety, Metrolinx has a responsibility to prevent or limit the spread of invasive plant species on Capital Project sites and Metrolinx owned lands throughout construction, restoration, and operations and maintenance. Therefore, each project should develop an Integrated Vegetation Management Plan (IVMP) in order to understand the incompatible, noxious and invasive plant species that are present on-site throughout the Project life-cycle to reduce risks associated with these species. The IVMP should identify objectives and include preventative and management objectives following the framework described in **Section 6.3** and the template provided in **Appendix O.**

At a minimum, the IVMP must be updated on a biennial basis and as the Project transitions from one phase to the next to capture objectives changes and adaptive management considerations. Depending on the Project's contract model, the development of multiple IVMPs may be required.

6.2.1 IVMP for Capital Projects during Construction

The goals of the first iteration of the IVMP will focus on preventing or limiting the spread of invasive species on and adjacent to Capital Project sites during construction. The IVMP should incorporate information captured in the NERs and Arborist Reports to understand the pre-existing incompatible, noxious and invasive species that are present on-site and identify risks associated with these species. The IVMP should identify species-specific BMPs for removal, prevention and management following the template provided in **Appendix O**. For Projects undertaken through multiple contracts and/or that require site handover, the development of multiple contract specific IVMPs may be required and should be tailored to each contract's construction limits and scope of work.

The IVM activities undertaken during construction will support the subsequent IVM needed for on-site restoration and operations and maintenance.

6.2.2 IVMP for On-Site Restoration Areas

Metrolinx is typically responsible for IVM associated with on-site restoration that is on Metrolinx-owned-lands, within the rail corridor or a property that was used temporarily (e.g., through easements), and at times, Metrolinx may also be responsible for IVM on adjacent to site restoration. Implementation of IVM should reflect the on-site restoration plan, length of the establishment and stewardship period, site conditions, existing IVMP(s), applicable permitting conditions, and Indigenous community or local community requests. The project should develop a standalone IVMP or update the existing IVMP(s) as the project transitions from the construction phase to the restoration, maintenance and monitoring phase.

IVM planning and implementation as described in this section does not apply to off-site restoration, however invasive species removal and management during site preparation and the establishment and stewardship period remain as requirements for off-site restoration.

6.2.3 IVMP for Operations and Maintenance

Project contracts that are responsible for the operations and maintenance of the rail corridor or applicable rapid transit infrastructure (e.g., guideways) must develop, update, and implement an IVMP throughout the operations and maintenance term. The main objective of this iteration of the IVMP is to implement control measures as per the applicable VMZs described in **Section 6.1** and **Appendix K, Appendix M** and **Appendix N.** Secondary objectives include the management of invasive and noxious plant species with a focus of management within and adjacent to Sensitive Features.

6.3 Implementation Framework for Integrated Vegetation Management

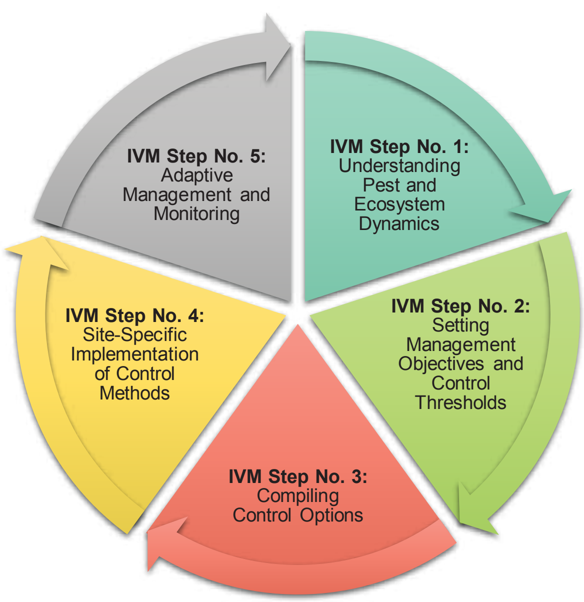
Metrolinx's IVM program is presented in five (5) steps and should be interpreted as a cyclical and adaptive framework **(Figure 6-3)**. A detailed flowchart and additional details on implementation can be found in **Appendix K.**

In principle, IVM will allow for the long-term flexibility needed to (re)adjust to the changes expected to take place on Metrolinx-owned-lands, the rail corridors, along guideways, temporary Project areas and on-site restoration areas, including incorporating feedback through engagement with Indigenous communities on IVMPs. Over the implementation period, it is anticipated that managerial, operational, and environmental conditions will change. This framework will allow Metrolinx to react and respond as appropriate.

Following this approach, it is expected Metrolinx will move through each step on an as-needed basis, cycling through the five (5) step process as appropriate. Once IVM Step No. 5 has been applied, vegetation managers are expected to reassess the effectiveness of the program and potentially reapply or readjust the framework starting at Step No. 1, as necessary. Accordingly, IVMPs are to document these decisions and be updated to suit site conditions, objectives, and project needs.

This implementation framework is intended to guide an IVM program/plan for managing vegetation within Metrolinx's-owned-lands, temporary project areas, on-site restoration areas, the electrified and non-electrified rail corridors, and along guideways.

Figure 6-3: Cyclical Steps of Integrated Vegetation Management



Goal

Develop and maintain a comprehensive understanding of the existing ecological conditions within project areas including Metrolinx-owned-lands, temporary project areas, the rail corridors, along guideways, and/or on-site restoration areas.

Objectives

- Undertake an inventory of vegetation conditions;
- Monitor plant community composition and structure; and,
- Monitor the presence of incompatible and compatible species within and adjacent to the rail corridors and guideways for safe operations per the management zones, and success of restoration areas and Metrolinx-owned-lands.

The first step in conducting IVM is to develop a working knowledge of the vegetation in the managed system. This information enables vegetation managers to determine if existing vegetation is compatible and can be retained, or if it is incompatible (e.g., height or invasive) and requires intervention. Thus, this IVM framework begins with the collection of data to document and assess the condition, including the location, quantity, and character of vegetation. All Arborist Report data (including spatial data described in **(Appendix B)**, natural heritage mapping and restoration planting polygons should be submitted to Metrolinx to include in system mapping to inform IVM.

Throughout implementation, Metrolinx will need to frequently revisit this step to fully capture an understanding of the local ecology. This is especially important given that the project site will be moving through various construction, managerial, and ecological phases that will result in changes to existing conditions. This inventory will be maintained by completing monitoring as part of the program's monitoring of managed sites at a justifiable interval (e.g., biennial), prior to implementation of control methods.

Appendix K further details monitoring events that will take place throughout implementation to maintain an understanding of the ever-changing ecosystem dynamics.

6.3.2 IVM Step No. 2: Setting Management Objectives and Tolerance Levels

Goal

Minimize, to the greatest extent possible, the percentage of incompatible, noxious and invasive vegetation within Metrolinx-owned-lands, temporary project areas, the rail corridors, along guideways, and/or on-site restoration areas to ensure that biodiversity and safety are upheld.

Objectives

- Set control thresholds that aim to minimize and prevent the establishment of incompatible, noxious and invasive species.
- Enable required vegetation removal while retaining compatible vegetation for safe operations.
- Support successful restoration, where applicable.

Once an understanding of the ecosystem has been established, it is used to inform management objectives and tolerance levels within the IVMP's site limits. Consistent with Metrolinx's focus on providing safe and reliable service, key management objectives for IVM are to:

- Prioritize worker and operational safety;
- Maintain reliable GO train and subway service by minimizing disruption caused by fallen trees, tree limbs, and debris;
- Protect rail infrastructure;
- Support ecological restoration projects; and,
- Reduce the spread of invasive species.

Tolerance levels are determined based on the existing vegetation and its alignment with management objectives. Tolerance levels can be quantified by control thresholds, which provide a measurement tool for determining whether action (i.e., control methods) are required to manage vegetation. In general, vegetation that exceeds a control threshold requires a management action or decision.

Recommendations

To achieve these benefits of IVM, the following is recommended:

- Necessary action is applied in a timely manner, informed by risk considerations;
- Vegetation is maintained in accordance with the control thresholds established and applicable regulations;
- Control thresholds are not breached, particularly so within the 7 m vegetation clearance zone (represented in Zones 1, 2, and 3) for the rail corridors;
- Invasive species, imminently hazardous trees and vegetation are handled in accordance with this framework and opportunities for appropriate native vegetation planting identified with consideration of future climate conditions;
- Any problematic or other incompatible vegetation is removed if posing a hazard to safety, ecology, or rail operability;
- Responsibility for removal and maintenance is assumed for vegetation within any newly identified areas requiring integrated management; and,
- It is recommended that removals or other control actions are applied according to BMPs and are not implemented before a control threshold has been breached.

To allow for the growth of a compatible plant community, control methods must be avoided unless the control threshold is exceeded. If controls are over-applied, this may compromise the health of compatible vegetation, the local ecosystem and IVM objectives.

Appendix K presents further discussion on determining control thresholds and defining compatible and incompatible vegetation. Included is clear guidance on how to measure the existing vegetation within Metrolinx-owned-lands, temporary project areas, the rail corridors, along guideways, and/or on-site restoration areas against control thresholds to determine if management is needed.

6.3.3 IVM Step No. 3: Compiling Vegetation Control Options

Goal

Develop a vegetation control method that considers environmental, cultural, and economic concerns and restraints.

Objectives

- Develop a vegetation control approach that will most effectively address site-specific conditions and vegetation composition; and,
- Develop a vegetation control approach that encourages the establishment of a compatible, self-sustaining, native vegetative cover which, over the long-term, becomes less dependent on management.

Once a decision has been made that vegetation control is required, the next step is to determine what control method, or combination of methods, should be used. Determining the appropriate action will depend on site-specific conditions and considerations.

Appendix K provides an overview of the control options that may be applied. It details the rationale, benefits, and limitations of the various options, which include chemical, mechanical and cultural controls.

Mechanical and manual methods (e.g., tree removal, mowing and pruning) can be used to cut or remove vegetation on-site. Efficacy is often increased by combining with other control approaches. Mechanical and manual controls are regarded in rail corridor and guideway management as important tools for addressing imminently problematic vegetation and are one of the most effective methods where time and risk are major concerns.

Chemical control should be minimized as much as possible to reduce known and unknown environmental and cultural impacts, especially in proximity to wetlands or watercourses. Where chemical controls are selected for use, efforts to reduce risks to the environment and non-target species or areas should be prioritized such as chemical selection, application method, location, and timing. When applied following BMPs (including those from OIPC), chemical treatments can effectively control incompatible vegetation (BCRC, 2012), particularly if they are applied in combination with other methods or selectively, using advanced application technologies and appropriate timing.

Cultural controls involve the introduction of specific plants, ground covers, soil amendments or mulches to control vegetation growth and are best used as a preventative measure. They are used in rail corridor and guideway infrastructure vegetation management as a means of creating a vegetative community compatible with the requirements of railway and guideway safety as well as the social and environmental values important to Metrolinx.

As noted, the effectiveness of each method is potentially more effective when chemical, cultural, and mechanical vegetation control methods are used in combination.

Selection Criteria

Determining which method, or combination of methods should be used of mechanical and manual, chemical, or cultural control options hinges on a number of considerations/ constraints such as:

- Site characteristics, including the proximity to a DNA or other feature requiring protection;
- Type and abundance of invasive, incompatible, and/or noxious species;
- Potential impact to safety, site security, and biodiversity;
- Efficacy of previously implemented control options; and,
- The possibility of adverse impacts to surrounding environments, land, workers, and bystanders.

Table 6-1, Table 6-2 and **Table 6-3** provide a summary of the zones for electrified corridors, non-electrified corridors, elevated guideways, and raised guideways respectively, along with their respective control thresholds and suitable management treatment options for each zone. The IVM manager with collaboration with Indigenous communities and stakeholders will have to determine which option or combination of options will most appropriately meet IVM objectives and address risks based on the selection criteria.

Table 6-1, **Table 6-2** and **Table 6-3** provide a summary of the zones for electrified corridors, non-electrified corridors, elevated guideways, and raised guideways respectively, along with their respective control thresholds and suitable management treatment options for each zone. The IVM manager with collaboration with Indigenous communities and stakeholders will have to determine which option or combination of options will most appropriately meet IVM objectives and address risks based on the selection criteria.

Table 6-1: VMZs and Management Control Options for Electrified and Non-Electrified Corridors

Zone	**Location/ Description**	**Target Vegetation**	**Control Threshold**	**Control Options**
Zone 1	Ballast area (which includes the main track, siding, back track and storage track)	No growth zone	3% cover	Chemical AND Cultural
Zone 1	2.9 m clearance from the track centerline [for electrified corridors: extending to the Overhead Contact System (OCS)]	No growth zone	3% cover	Chemical AND Mechanical AND Cultural
Zone 2	Non-Electrified: 2.9m - 4.5 m from track centreline maintenance zone starting immediately adjacent to the Exclusion Zone infrastructure. Electrified: 2.5 m clearance from the Overhead Contact System (OCS) and electrified infrastructure	Non-Electrified: Low growth zone comprised of non-woody vegetation. Electrified: No growth zone	20% cover 0.5 m or less in height OR 10% cover 0.5 m to 1.4 m in height (Non-electrified)	Chemical AND Mechanical AND Cultural
Zone 3	Non-Electrified: 5.5 m area (between 4.5 and 10 m from the track centerline) outside of the vegetation clearance zone where management is not required but future plantings should be limited. Electrified: 1.6 m maintenance zone starting immediately adjacent to the Exclusion Zone infrastructure	Non-Electrified: Medium growth zone comprised of shrubs and non-woody species that grow up to 4 m above track when mature. Electrified: Low growth zone comprised of non-woody vegetation. Electrified:	Non-electrified: N/A Electrified: 10% cover 1.4 m or more in height	Chemical AND Mechanical AND Cultural
Zone 3	Non-electrified: 3.5 m area (between 10 and 13.5 m from the track centerline) outside of the vegetation clearance zone where management is not required but future plantings should be limited. Electrified: 5.5 m area (between 7 and 12.5 m from the track centerline) outside of the vegetation clearance zone where management is not required but future plantings should be limited.	Non-electrified: Tall growth zone comprised of trees, shrubs, and non-woody species that grow up to 8 m above track when mature. Electrified: Medium growth zone comprised of shrubs and non-woody species that grow up to 4 m high when mature.	N/A	Chemical AND Mechanical AND Cultural

Zone	Location/ Description	Target Vegetation	Control Threshold	Control Options
Electrified Zone 5	Electrified: 3.5 m area (between 12.5 and 16 m from the track centerline) outside of the vegetation clearance zone where management is not required but future plantings should be limited.	Tall growth zone comprised of trees, shrubs, and non-woody species that grow up to 8 m high when mature.	N/A	Chemical AND Mechanical AND Cultural
All	Invasive species	Minimize presence	0% tolerance within 30m of DNA, >30m of DNA species specific	Chemical AND Mechanical AND Cultural
All	Hazard tree(s)	Minimize presence	0% tolerance level if imminently hazardous	Chemical AND Mechanical
All	Hazardous vegetation	Minimize presence	% tolerance level	Chemical AND Mechanical AND Cultural

Table 6-2: VMZs and Management Control Options for Elevated Guideways

Zone	Location/ Description	Target Vegetation	Control Threshold	Control Options
Zone 0g	Air space 1m offset from elevated guideway structure (i.e. from pier and parapet)	No vegetation breach	20%	Mechanical
Zone 1g (below guideway)	Area under the guideway structure between Zone 0g, the finished grade and within the dripline of the parapet	Low growth zone comprised of non-woody vegetation (pier) and/or shrubs (no pier)	N/A	Mechanical AND Cultural AND Chemical (pier only)
Zone 1g (adjacent guideway)	Area between the dripline of the parapet structure and a 1 m horizontal offset from the parapet outside of Zone 0g	Low or medium growth zone comprised of shrubs and non-woody species that will not grow to breach Zone 0g when mature	N/A	Mechanical AND Cultural
Zone 2g	1.6 m area (between 1 m and 2.6 m horizontally from the dripline of the parapet structure) plus a 1.4 m vertical offset area from the top of parapet	Medium or tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 1.4 m vertical offset from the top of parapet	N/A	Mechanical AND Cultural

Zone	Location/ Description	Target Vegetation	Control Threshold	Control Options
Zone 3g	5.5 m area (between 2.6 m and 8.1 m horizontally from the dripline of the parapet structure) plus a 4.0 m vertical offset area from the top of parapet	Tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 4.0 m vertical offset from the top of parapet	N/A	Mechanical AND Cultural
Zone 4g	3.5 m area (between 8.1 m and 11.6 m horizontally from the dripline of the parapet structure) plus an 8.0 m vertical offset area from the top of parapet	Tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 8.0 m vertical offset from the top of parapet	N/A	Mechanical AND Cultural
All	Invasive species	Minimize presence	5% tolerance within 30m of DNA, >30m of DNA species specific	Chemical AND Mechanical AND Cultural
All	Hazard tree(s)	Minimize presence	0% tolerance level if imminently hazardous	Mechanical AND Chemical
All	Hazardous vegetation	Minimize presence	0% tolerance level	Chemical AND Mechanical AND Cultural
Zone 1w	Space between finished grade and height of the adjacent noise barrier	No vegetation breach	20%	Mechanical
Zone 2w	Area between the noise barrier and a 3.0m horizontal offset from the noise barrier, and from the grade up to the height of the noise barrier	No vegetation breach within the 3.0m radius of the Auto Transformer Feeder (ATF) wire. No tree trunks within 3.0m offset from the noise barrier	20%	Mechanical AND Cultural
Zone 3w	1.6 m area (between 3 m and 5.6 m horizontally from the noise barrier) plus a 1.4 m vertical offset from top for noise barrier	Medium or tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 1.4 m vertical offset from the top of noise barrier	20%	Mechanical AND Cultural
Zone 4w	.5 m area (between 5.6 m and 10.1 m horizontally from the noise barrier) plus a 4.0 m vertical offset from top for noise barrier	Medium or tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 4.0 m vertical offset from the top of noise barrier	N/A	Mechanical AND Cultural

Zone	Location/ Description	Target Vegetation	Control Threshold	Control Options
Zone 3g	5.5 m area (between 2.6 m and 8.1 m horizontally from the dripline of the parapet structure) plus a 4.0 m vertical offset area from the top of parapet	Tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 4.0 m vertical offset from the top of parapet	N/A	Mechanical AND Cultural
Zone 5w	3.5 m area (between 10.1 m and 13.6 m horizontally from the noise barrier) plus a 8.0 m vertical offset from top for noise barrier	Tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 8.0 m vertical offset from the top of noise barrier	N/A	Mechanical AND Cultural
All	Invasive species	Minimize presence	0% tolerance within 30m of DNA, >30m of DNA species specific	Chemical AND Mechanical AND Cultural
All	Immediate Hazard tree(s)	Minimize presence	0% tolerance level	Mechanical AND Chemical
All	Hazardous vegetation	Minimize presence	0% tolerance level	Chemical AND Mechanical AND Cultural

The information provided in **Appendix K** should be regarded as a decision-making tool to determine what control option (or combination of options) will most effectively meet management needs and objectives given the circumstances.

Metrolinx owned-lands, temporary project areas, the rail corridors, along guideways, and/or on-site restoration areas have the potential to provide habitats and functional connectivity for plants and wildlife. Management practices that involve small-scale revegetation have been recommended to help increase these positive effects of railway corridors and other land types.

6.3.4 IVM Step No. 4: Site-Specific Implementation of Control Methods

Goal

Apply a control action that is tailored to varying site conditions, needs, and sensitivities. The selected option should aim to represent a balance between meeting IVM targets/objectives while considering indirect and direct impacts to the environment and society.

All applicable regulations and Health and Safety considerations need to be thoroughly understood, planned for, and hazards mitigated before implementation of control methods begins.

Objectives

Adhere to the selection criteria/decision-making process to determine which potential control type and method (e.g., pruning, mowing, foliar chemical application, seeding, etc.) best addresses management objectives and constraints, (e.g., site conditions, environmental sensitivities, timing windows etc.).

Once a control option has been determined, the next step will be to decide on the application approach to be used to apply the chemical, mechanical and/or cultural control(s). Each method of control comes with a host of application options in terms of the techniques and technologies that can be used for application. Determining which approach to take hinges on a variety of species-specific and site-specific sensitives, constraints, and conditions that will need to be accounted for.

Appendix K overviews the application techniques and technologies that may be used to implement control methods. It provides a summary of the benefits and limitations of application options and gives recommendations on which approach should be taken. **Appendix K** also summarizes the decision-making process to be followed to ensure that the most suitable, cost-effective, and environmentally compatible control method(s) is applied within Metrolinx owned-lands, the rail corridors, guideways and restoration areas.

Selection Criteria

In determining which application method to use for chemical, mechanical or cultural controls, the following should be considered:

- Risks to the local environment for any control method;
- Location and size of the area requiring management;
- Site conditions including slope and aspect, drainage, edge habitat, soil type;
- Existing/adjacent vegetation – species, composition, and density;
- Previous management (successes and failures);
- Proximity to DNAs or other Sensitive Features requiring protection;
- Adjacent land uses (e.g. residential); and,
- Work schedule, funds and timeline requirements.

The application of herbicides should always adhere to applicable regulations, BMPs and label instructions. Caution should be applied when handling herbicides. In particular within the context of parks, environmentally significant features or species, protected areas, and landscapes of cultural significance. Prior to the use of chemical methods, Indigenous communities, municipalities, MECP, Ontario Parks, Parks Canada, Conservation Authorities and DFO (depending on location) will need to be notified.

6.3.5 IVM Step No. 5: Adaptive Management and Monitoring

Goal

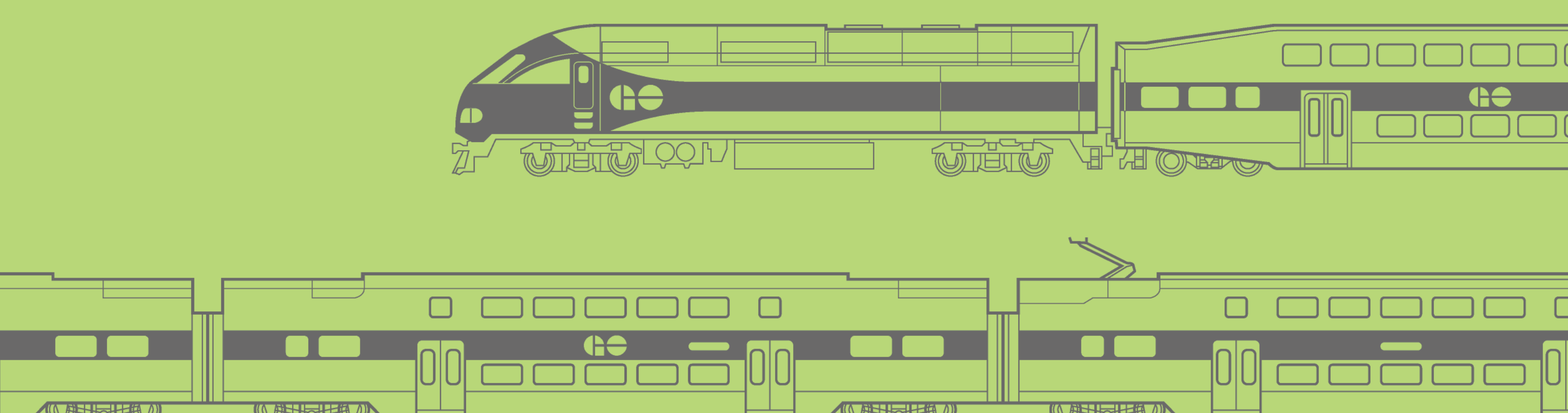
Allow for ongoing improvement to the IVM based on learned experiences and to meet new objectives and conditions.

Objectives

- Monitor and evaluate the success of the IVM program and plan.
- Adjust and revise IVMP to allow for ongoing improvements based on field observations and learned experiences.

The final step of IVM, post-implementation monitoring, will be undertaken to evaluate the success of implemented approaches. Successful IVMPs are consistently implemented over a series of years and annually adjusted as necessary based on field observations. This monitoring and evaluation will work to inform adaptive management needs, providing guidance for future work. This adaptive management approach allows ongoing improvement to the established IVMP based on learned experiences. It also allows the IVMP to be revised as needed to meet new objectives and conditions. **Appendix K** details the methodology of the monitoring and management approach that will be followed at this stage and a framework for ongoing documenting and reporting.

References and Resources



7.0 References and Resources

Bhadah, J. H., Capasso, J. M., Khatiwada, R., Swanson, S. and LaBorde, C. 2021. Raising soil organic matter content to improve water holding capacity - Water Quality and Conservation, Issue SL447, Department of Soil, Water and Ecosystem Science, UF/IFAS Extension, University of Florida, Institute of Food and Agricultural Sciences, Gainesville, FL. https://doi.org/10.32473/edis-ss661-2017

British Columbia Rail Company. BCR Port Subdivision Ltd. Draft #1 Integrated Vegetation Management Plan 2008 – 2013. Available at: https://www.bcrco.com/IVMPLAN2007.pdf

Canadian Pacific Rail. Canadian Pacific Rail 2015 Integrated Vegetation Management Plan. Available at: https://www.cpr.ca/en/community-site/Documents/CP-IVMP-2015-BC.pdf

Cornell University Woody Plant Database. Available at: https://woodyplants.cals.cornell.edu/home

Cowett, F., & Bassuk, N. L. (2014). Statewide assessment of street trees in New York State, USA. Urban Forestry & Urban Greening. 13:213-220

Government of South Australia. Vegetation Removal Policy Standard Operating Procedure under the Native Vegetation Act 1991. Available at: https://dit.sa.gov.au/__data/assets/pdf_file/0008/35657/v36E-Environment_-_Technical_Standards_-_Vegetation_-_Vegetation_Removal_Policy.pdf

Hahn, Jerold T. 1984. Tree volume and biomass equations for the Lake States. Research Paper NC-250. St. Paul, MN: U.S. Dept. of Agriculture, Forest Service, North Central Forest Experiment Station. Available at: https://www.fs.usda.gov/treesearch/pubs/10037

Henry, J. McGrath, D. and Munroe R. Vineland Research and Innovation Centre (2019) Ontario Landscape Tree Planting Guide revised 2019 Landscape Ontario Horticultural Trades Association revised Milton, ON https://landscapeontario.com/assets/1570803523.Ontario_Landscape_Tree_Planting_Guide-2019_updated.pdf

Hydro One. Hydro One Vegetation Management Study 2016. Available at: http://publicsde.regie-energie.qc.ca/projets/414/DocPrj/R-4011-2017-C-OC-0007-Preuve-Dec-2017_11_13.pdf

Inglis, Julian, 1993. Traditional Ecological Knowledge: Concepts and Cases. Canadian Museum of Nature / IDRC. Preface vi.

José Martínez Cobo, 'Study on the Problem of Discrimination against Indigenous Populations' (7 July 1986) UN Doc. E/CN.4/Sub.2/José Martínez Cobo, 'Study on the Problem of Discrimination against Indigenous Populations' (Report) (7 July 1986) UN Doc. E/CN.4/Sub.2/1986/7 para 379–382.1986/7, para 379–382.

Kershaw, Linda, 2001. Trees of Ontario. Lone Pine Publishing.

Lilly, S.J., 2010: The Arborists' Certification Study Guide. International Society of Arboriculture. Third Edition.

Magdoff, F. & Van Es, H. (2021). Building Soils for Better Crops Ecological Management for Healthy Soils 4e. Chapter 3 Amount of Organic Matter in Soils. Handbook Series Book 10. Sustainable Agriculture Research and Education (SARE) program, 31–43. https://www.sare.org/wp-content/uploads/Building-Soils-for-Better-Crops.pdf

McIntosh Perry, 2018. Initial Business Case (IBC) for the Metrolinx Vegetation Policy Framework.

Ministry of Natural Resources and Forestry, 2020. Ontario Tree Seed Transfer Policy. Available at: https://filesontario.ca/mnrf-ontario-tree-seed-transfer-policy-en-2021-01-11-v2.pdf

Moebius-Clune, B.N., D.J. Moebius-Clune, B.K. Gugino, O.J. Idowu, R.R. Schindelbeck, A.J. Ristow, H.M. van Es, J.E. Thies, H.A. Shayler, M.B. McBride, K.S.M Kurtz, D.W. Wolfe, and G.S. Abawi, 2016. Comprehensive Assessment of Soil Health – The Cornell Framework, Edition 3.2, Cornell University, Geneva, NY at: https://cornell.app.box.com/s/ryy6xgtwok5l85zzy9fgms1276drud0y and https://bpb-us-e1.wpmucdn.com/blogs.cornell.edu/dist/7/9922/files/2023/02/soil-health-manual-factsheets-all-2023.pdf

North Carolina State University (NCSU), 2019: Managing Forest Edges for Wildlife. Available at: Managing Forest Edges for Wildlife | NC State Extension Publications (ncsu.edu)

Nowak, Christopher A. and Ballard, B.D. 2005. A framework for applying integrated vegetation management on rights-of-way. International Society of Arboriculture. Available at: https://joa.isa-arbor.com/request.asp?JournalID=1&ArticleID=173&Type=2

Ontario 2024 NEW HORIZONS Ontario's Agricultural Soil Health and Conservation Strategy at: https://www.ontario.ca/page/new-horizons-ontarios-agricultural-soil-health-and-conservation-strategy#th3

Pfeiffer, Christina & Pond, Rodney, 2025. University of Washington State Getting Down to Earth: Understanding Soils for Ecosystem Resilience & Repair 2025

Remediating Compacted Soils Compromised by Urban Construction at: https://www.youtube.com/watch?v=MQnI21l48yo

Smith, Paul & Turnbull, Jen & Festin, Therese & Harris, Lois. (2018). NEW HORIZONS Ontario's Agricultural Soil Health and Conservation Strategy.

Ste-Marie, Catherine; Nelson, Elizabeth A., Dabros, Anna, and Bonneau, Marie-Eve, 2011. Assisted migration: Introduction to a multifaceted concept. The Forestry Chronicle 87(6):724-730.

Toronto Directory of Urban Wood Products and Services, Including companies located in the Greater Toronto Area, Third Edition Prepared by Economic Development and Culture, City of Toronto January 2016. Available at: https://www.yourleaf.org/sites/default/files/toronto_directory_of_urban_wood_products_and_services_3rd_edition_jan_20.pdf

Toronto and Region Conservation Authority, June 2023. Guideline for Determining Ecosystem Compensation. Available at: https://trcaca.s3.ca-central-1.amazonaws.com/app/uploads/2022/03/30134818/TRCA-Guideline-for-Determining-Ecosystem-Compensation-June-2018-v5.pdf

Toronto and Region Conservation Authority Preserving and Restoring Healthy Soil: Best Practices for Urban Construction June 2012 Available at: https://trcaca.s3.ca-central-1.amazonaws.com/app/uploads/2021/10/20103048/preserving_and_restoring_healthy_soil_trca_2012.pdf

Toronto and Region Conservation Authority Preserving and Restoring Healthy Soil: Best Practices for Urban Construction June 2012 Available at: https://trcaca.s3.ca-central-1.amazonaws.com/app/uploads/2021/10/20103048/preserving_and_restoring_healthy_soil_trca_2012.pdf

Toronto and Region Conservation Authority, January 2022. Seed Mix Guideline V.2.0. Available at: https://trcaca.s3.ca-central-1.amazonaws.com/app/uploads/2022/02/01124117/Seed-Mix-Guidelines-Update_January-19-2022.pdf

Vermont Rail System. Integrated Vegetation Management Plan for Vermont Rail System for Railroad Rights-of-Way in the State of Vermont (April 2006 – December 2011). Available at: https://outside.vermont.gov/agency/agriculture/vpac/Other%20VPAC%20Documents/Railroad_Alternative_Vegetation_Management/Integrated_Vegetation_Management_Plan___FINAL1%20041806.pdf)

APPENDIX A: NATURAL ENVIRONMENT MITIGATION HIERARCHY MEMORANDUM (MITIGATION MEMO)

The purpose of the Natural Environment Mitigation Hierarchy Memorandum ("Mitigation Memo") is to track proposed vegetation removals and impacts to Environmentally Sensitive Features (ESFs), identify opportunities to avoid, minimize and/or mitigate impacts, and to document changes to tree removal numbers and temporary and permanent impacts to ESFs throughout the design development and construction process. The Mitigation Memo will detail the rationale for impacts and identify options for reducing impacts through design changes and alternative construction methods.

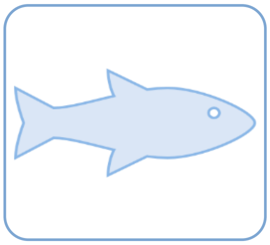
Environmentally Sensitive Features (ESFs) categories and criteria are provided in **Figure 1** and include Natural Heritage Systems and Features (NHS ESF), Hydrological (Surface Water and Aquatic) Features (SW ESF), Species at Risk and their habitat (SAR ESF), and Lands, Structures and Species with Potential Significance to Indigenous communities (IC ESF). Each ESF includes a relevant distance for inclusion, relevant impact duration, and the specific relevant features to be impacted by the project.

Members from the environmental technical team, including the project's arborist, biologist/ ecologist, hydrologist, storm water engineer and other environmental specialists, should be consulted at each phase of design to identify opportunities and make recommendations within the Mitigation Memo on how to avoid, minimize and/or mitigate impacts to vegetation and ESFs. The Mitigation Memo will include clear reasoning for all removals and impacts and if potential design alternatives were explored. Potential design changes that may be identified through the Mitigation Memo includes, but is not limited to, relocating laydown areas, identifying alternate access points, adjusting the alignment and/or width of multi-use paths and incorporating existing trees in landscape design to reduce impacts to vegetation and ESFs to the extent reasonably possible. On top of design changes, construction methods can also be adjusted to reduce impacts such as having less cut or fill around trees and opting for directional drill instead of open cut. The project team can explore additional innovative designs and construction method alternatives to reduce impacts to ESFs where possible.

The environmental technical team from the design team would prepare the Mitigation Memo highlighting its recommendations as to where design can be optimized to reduce impacts to vegetation and ESFs and identify where ESFs can be restored on the landscape once construction is completed. As the Mitigation Memo is updated at each design stage, it may transition from one environmental technical team to another depending on the contract model. For example, in a Progressive Design-Build (PDB), the first iteration of the Mitigation Memo may be prepared by the Technical Advisor during the reference concept design and later versions will be prepared by the design-build contractor as the design is progressed.

Natural Heritage Systems and Features (NHS)

- Distance: Works directly within feature and/or within 30 meters
- Duration: Temporary and permanent
- Relevant Features: Mapped woodlots, natural areas, parks, ravines and/or linkages that may result in impacts to natural features or functions



Hydrological, Surface Water and Aquatic Features (SW)

- Distance: Works directly within feature and/ or within 120 meters
- Duration: Temporary and permanent
- Relevant Features: Regulated Area or where a surface water feature (i.e., headwater drainage feature, wetland, other) has been mapped that may result in direct or indirect impacts to surface water and aquatic features or functions

Species-at-Risk and their Habitat (SAR)

- Distance: Works directly within habitat and/or within the applicable species-specific buffer
- Duration: Temporary and permanent
- Relevant Features: Provincially and/or Federally listed SAR and their regulated habitat

Lands, Structures and Species with Potential Significance to Indigenous Communities (IC)

- Distance: Works directly within and/or within buffer as applicable
- Duration: Temporary and permanent
- Relevant Features: Lands, structures and/ or flora and fauna species identified by Indigenous Communities as having significance through Indigenous consultation, engagement and screening

Figure 1: Environmentally Sensitive Feature Types and Criteria

The Mitigation Memo includes, but is not limited to:

- A summary of what is required to facilitate the works. Details shall include:
    - Machinery and equipment to be utilized
    - Construction methodology, phasing and duration (e.g. grading, fill, storage and stockpiling, open cut vis direction drill, tie backs, and etc.)
    - Approximate size and impact of machinery type (e.g. crane and crane pad, equipment access, etc.)
- A statement of intent to follow the mitigation hierarchy and reduce impacts to the greatest extent possible.

- An analysis of alternative options for design and construction methods that reduce impacts.
- Documentation of where project scope and/or design has been changed to reduce removals. For example, "…proposed multi-use path has been shifted in 90% detailed design in order to retain 14 additional trees".
- Rationale where construction impacts could not be avoided, minimized and/ or mitigated.
- Identification of restoration opportunities both on-site where there are temporary impacts, and adjacent to site where there is potential for off-setting impacts.

The following is an example template for creating a Mitigation Memo. Details can be added, combined, refined, and/or removed as appropriate per project in consultation with the Metrolinx environmental project team.

TABLE OF CONTENTS

1 INTRODUCTION

Summarize the project's location, scope of work, and objectives of the Mitigation Memo.

The main objectives of the Mitigation Memo are as follows:

- Identify all Environmental Sensitive Features (ESFs) within the project's study area that may be impacted by the project.
- Identify opportunities to apply the mitigation hierarchy and avoid, minimize and mitigate impacts on each ESF throughout design
  - Demonstrate how impacts to ESFs were avoided, minimized and mitigated.
  - Where impacts could not be avoided, minimized or mitigated, detail the rationale and provide recommendations for compensation through restoration where appropriate.
  - Document changes in impacts during design and construction with rationale.

1.1 Project Scope

Summarize the current project scope and high-level site features with a key map and associated project timelines and current state (e.g. 30% detailed design, construction).

Provide projection for next submittal and information to be obtained at next phase that was missing or requires updates.

2 METHODOLOGY AND DESIGN PROCESS

A description of the Mitigation Memo process, including details on how each step of the mitigation hierarchy will be applied and what this will involve. The methodology for achieving the Mitigation Memo objectives should be outlined and include at a minimum:

1) Identification of applicable environmental requirements
2) Methods for the identification of ESFs within the study area such as listing applicable regulatory mapping and environmental reports (e.g. Natural Environment Reports, Arborist Reports, etc.) that were reviewed and Indigenous community feedback
3) Application of the mitigation hierarchy for each ESFs:
   - Avoidance
     - Describe how impacted ESFs will be analyzed for alternatives to avoid any impacts. For example, laydown areas were reviewed to assess potential placement in less impactful locations.
   - Minimization
     - Describe how after avoidance could not be achieved, how minimization of impacts to ESFs will be determined. For example, laydown area size was reviewed to assess for reduction of tree removals.

- Mitigation
  - Describe how after avoidance and minimization could not be fully achieved, how mitigation of impacts to ESFs will be determined. For example, edge management measures are assessed for use around the laydown area.
- Compensation

As design progresses, the application of the mitigation hierarchy is reviewed for each ESF including various design options considered and rationalized. If the study area shifts with design or scope changes, ESFs may be added or removed as needed.

2.1 Environmental Requirements and Resources

Provide list with brief descriptions of the associated environmental requirements, regulations, guidance and resources as applicable.

2.2 Collaborative Decision Making on Design Progression

List the technical staff specialties that have reviewed the design and construction methods to provide recommendations for the application of the mitigation hierarchy and design decision making.

3 ENVIRONMENTALLY SENSITIVE FEATURES

The Mitigation Memo should include a table summarizing the ESFs that were identified in applicable regulatory mapping, environmental reports (e.g. Natural Environment Report, Arborist Report, etc.) and through Indigenous community engagement on the project site. Naming of ESFs should be based on environmental terms and not anthropogenic boundaries. For example, Ecological Land Classification (ELC) vegetation communities rather than Conservation Authority regulatory area. Summary of the identified ESFs table columns should include (Metrolinx can provide an example table upon request):

- ESF name and type
- Description of location and/or specific location
- Brief description of feature
- Indicate if identified as Indigenous community Interest
- Additional considerations

In a separate table, briefly describe how project scope (e.g. laydown area) may potentially impact these ESFs. See **Table 1** for an example.

Table 1: Summary of Environmentally Sensitive Features and Scope of Work Impacts

ESF Name	ESF Type	Project Scope impacting ESF	Scope Location	Duration of Impact	Description of Impact
Example: FOD5-3 Forest	*NHS*	*Station Building Access routes Crane Pad*	*Within*	*Permanent and Temporary*	
Example: Contributing fish habitat - warmwater stream	*SW*	*Construction staging*	*Within 50 m*	*Temporary*	

Map figures (scale of 1:5,000 or less) should be included for entire project area with appropriate study area buffer with the following features:

- ELC communities and/or individual trees with tag numbers project dependant
- Project features, both permanent and temporary (e.g. laydown, new track, SWM features, limit of grading etc.)
- Water courses/surface water features with known fisheries data and flow direction
- SAR habitats and individuals where known (e.g. Butternut trees)
- Significant Wildlife Habitat (potential or confirmed)
- Conservation Authority regulated area
- Municipal, Provincial, Federal designated areas
- Trails, Roads, Rail Right-of-Way
- Any hydrological or hydrogeological resources and issues, and where applicable groundwater elevations if known and flow directions, connections for groundwater and surface water features.
- Culverts (including any changes proposed)
- Any other significant features (e.g. bio-culturally significant vegetation)
- Any other applicable features

4 ENVIRONMENTAL INPUT INTO DESIGN

This section will document the application of the mitigation hierarchy step by step, for each ESF, including how ESFs were considered throughout the design process and how design has changed through environmental consideration.

Each subsection (Avoidance, Minimization etc.) should include a table with the below columns (Metrolinx can provide an example table upon request). Although avoidance and minimization is the priority of design review and improvement earlier in the design process, mitigation may become the priority later in design.

- ESF name
- Specific location
- Description of Feature
- Description of ESF impact with design 30% (update as design progresses, details should include areas or total numbers impacted)
- Description of ESF impact with 60% design (update as design progresses, details should include areas or total numbers impacted)
- Description of ESF impact with 90% design (update as design progresses, details should include areas or total numbers impacted)
- Description of ESF impact with 95% design (update as design progresses, details should include areas or total numbers impacted)
- Opportunities for Avoidance/minimization/mitigation per ESF (as applies to each subsection)
- Description of how Avoidance/Minimization/Mitigation/Compensation analysis has been applied for each ESF (this should be updated as design progresses) Examples: Construction laydown was moved to avoid 50 Butternut trees losses; new technology allowed for grade separation pump to be built into structure and reduce project footprint and minimize wetland losses.
- Rationale for how Avoidance/Minimization/Mitigation/Compensation analysis has been applied for each ESF (this should be updated as design progresses) Example: ROW footprint cannot be shifted and therefore 100m2 of forest is proposed to be lost.
- Connection to previous TPAPs/TRPAPs/EAs should be reviewed and included where applicable in this process (e.g. there may be a commitment to reduce impacts to wetlands).

4.1 Avoidance

Table to include summary of ESFs that were assessed for avoidance and description of how design and/ or construction methods support avoidance. Rationale should be included for ESFs where avoidance is determined to not be feasible. This section's table should answer the question: how has design changed to avoid impacts to ESFs? Avoidance of impacts to ESFs need to be first considered before moving to the next step in the hierarchy.

4.2 Minimization

Table to include summary of ESFs that were assessed for minimization where avoidance of impacts was not feasible. Table to provide description of how design and/ or construction methods support minimization. For example, using retaining walls vs grading to existing grade, reducing parking, and altering access routes for construction. This section's table should answer the question: how has design changed to minimize impacts to ESFs? Minimization of impacts to ESFs need to be first considered before moving to the next step in the hierarchy.

4.3 Mitigation

Table to include summary of ESFs that were assessed for mitigation where avoidance of impacts was not feasible. Table to provide description of how design and/ or construction methods support mitigation. For example, mitigation measures can include erosion and sediment control, edge management, and wetland water balances. This section's table should answer the question: how has design changed to mitigate impacts to ESFs? Mitigation of impacts to ESFs need to be first considered before moving to the next step in the hierarchy.

4.4 Compensation

Table to summarize the impacts to ESFs (permanent and temporary) that could not be fully avoided, minimized and/ or mitigated with rationale where compensation through restoration or other means would be required as per applicable regulatory requirements and the Metrolinx Vegetation Guideline.

5 RESULTS

This section should provide the summary of results of the environmental input into design from the application of the mitigation hierarchy in table format. This section should answer the question: what ESFs were avoided, or impacts reduced? What impacts to ESFs could not be avoided and why?

See example Table 2 Reference source not found. to track how potential impacts to ESFs have changed over the design stages and how the mitigation hierarchy was applied (avoidance, minimization and mitigation) to be included in the Mitigation Memo.

Table 2: Summary of Potential Impacts to ESFs through Design Stages

ESF Name	Specific Location	Description of Feature (ELC, Species)	Area/ amount of Impact with 30% Design	Description of Impact with 100% Design	Construction Impacts	Description of Design change	Rationale of impact	Total environmental impacts prevented throughout design
Examples: Tree IDs #1-50	Laydown	FOD (oak)	25 trees	reduced tree removals by 15 trees		City was persuaded to provide parking lot for section of laydown reducing impacts to oak forest.		Example: avoided the loss of 100m2 of forest by descoping redundant fencing in 60% design
Sensitive feature Wetland SWM-01								
Sensitive feature Meadow CUM-01							Within new ROW footprint, unavoidable	

APPENDIX B: TREE INVENTORY AND INTEGRATED ARBORIST REPORT DATA COLLECTION REQUIREMENTS

Determining Designated Natural Areas

Designated Natural Areas (DNAs) are systems which are made up of Environmentally Sensitive Features including natural heritage features, linkages and areas, intended to provide connectivity (at the regional or site level) and support natural processes which are necessary to maintain biological and geological diversity, natural functions, and viable populations of native species and ecosystems. These areas may be identified by resource agencies, municipalities, and the government through legislation, policies or approved management plans and documented in project natural environment studies/reports. Furthermore, Indigenous communities and Knowledge Keepers can identify areas of natural significance that should be included within the DNA. Site-specific natural heritage studies are critical to identify wildlife connectivity for life-cycle phases such as spawning, rearing, nesting, or overwintering.

DNAs should be mapped by, or in consultation with, the project's Biologist through a desktop exercise prior to field surveys to ensure appropriate tree inventory methodology is applied for the field survey. The mapped DNA should encapsule and build upon the following features that are already identified by resource agencies, municipalities, and government:

- Provincially mapped natural heritage features (Provincially Significant Wetlands (PSWs), Areas of Natural and Scientific Interest (ANSIs), Natural Heritage System (NHS), Deer Wintering Yards, etc.)
- Conservation authority NHS Mapping (including consideration of the conservation authority's Targeted NHS)
- Natural Areas, NHS and Linkages identified in Municipal Official Plans
- Regulated and/or Significant Wetlands
- Regulated and/or Significant Woodlands
- Environmentally Significant Areas
- Species at Risk (SAR) Habitat
- Confirmed Significant Wildlife Habitat (SWH)
- Other mapped natural resources as identified by the Biologist's desktop review

The following areas should be mapped for inclusion in the DNA based on the site-specific assessments completed by the Biologist and/or identified in previous natural heritage studies:

- SAR Habitat (potential and confirmed) in naturalized areas
- Potential and Confirmed SWH in naturalized areas identified by the Biologist in the study area such as:
    - Seasonal Concentration Areas of Animals
    - Rare Vegetation Communities
    - Specialized Habitat for Wildlife
    - Habitat for Species of Conservation Concern
    - Animal Movement Corridors

- Sensitive features (e.g. woodlands/ woodlots) and hydrological features (e.g. wetlands) that were not already identified by other resource agencies, municipalities, and government
- Lands, structures and species with significant to Indigenous communities
- Potential linkages between natural heritage features

Potential linkages between features should be delineated by the appropriate Biologist through consideration of a combination of factors, such as the type of habitat, species, and ecological features and functions present within the adjacent natural areas and the linkage itself. As the rail corridors have a limited ability to provide habitat for life-cycle functions, its potential supportive ecological function is to act as a stepping stone between habitats in the landscape. Mammals, reptiles, and amphibians all may travel long distances relative to their body size during seasonal migration from overwintering habitats to reach their nesting/ breeding sites and are likely to traverse road and/or rail infrastructure, either above ground or through bridges and culverts, to do so.

For the purposes of determining potential linkages to include in the DNA for Metrolinx Projects, the focus is at the site level rather than the regional level that is typically identified by resource agencies, municipalities, and government. At the site level, the DNA linkages delineated would primarily include identifying potential connections of isolated natural area pockets to a larger system or extending the DNA over where the rail corridors separate what would have been a continuous natural feature.

The length of potential linkages would vary based on the factors described above and the extent of urban development in the landscape. In urban areas with typically smaller naturalized/ vegetated pockets such as shrub thickets and woodlots (treed habitat between 0.2 to 1 hectare in size) that are primarily located along riparian corridors and valleys, the main consideration when mapping the DNA is to capture potential connections between these isolated naturalized habitat features for animals that almost exclusively use these habitats, such as some amphibian, reptile or smaller mammal species. Therefore, potential linkages between features in the urban landscape will typically fall under a 1 km range. Whereas in rural or more naturalized landscapes that can support larger mammals and a greater variety of species, longer potential linkage distances between isolated features and the natural heritage system should be considered as their habitat needs and area of travel are more diverse and larger. A linkage between features in a rural landscape could range in length from several hundred meters to several kilometers depending on the species and habitat present, where extent is furthest where habitat connections between overwintering and congregation areas for larger mammals, such as deer, are present.

Field Surveys

Data will be collected by field crews using a submeter GPS unit and digital forms to enable data to be recorded consistently and uploaded in digital GIS format.

Outside of a Designated Natural Area, inventories will include (at minimum) all trees 10 cm diameter at breast height (DBH) or greater, whose canopies or Tree Protection Zones (TPZ) extend into the study area (except for finer branches, less than 1 cm diameter).

Trees smaller than 10 cm DBH should be documented individually where possible or as groupings unless an applicable by-law requires other standards to be followed. Trees of all sizes (≥ 1 cm DBH) and shrub thickets will be documented within Designated Natural Areas. In determining which trees to include in an inventory as well as the inventory methodology, consideration must also be given to applicable by-law requirements and the nature of the proposed work.

Characteristics documented during the inventory will include:

- Species;
- Diameter at breast height (DBH – indicate if estimate);
- Number of stems;
- DBH of additional stems (if applicable);
- Location (UTM coordinates – indicate if estimate);
- Ownership;
- Height (for trees adjacent to corridors and elevated guideways);
- Crown extension into project site;
- Overall health/condition;
- Trunk Integrity;
- Canopy Structure;
- Canopy Vigour;
- Evidence of pests or disease (e.g. Emerald Ash Borer (EAB),Oak Wilt, etc.);
- Physical defects, including lean and direction of lean;
- Tree canopy growing within/immediately adjacent overhead wires, power lines, or light fixtures, or were growing within a fence or other structure;
- Species significance (i.e. SAR, and regional/local rarity);
- Cultural significance (i.e. bio-cultural species, marker tree);
- Species invasiveness;
- Imminently Hazardous Trees;
- Suitability for lumber;
    - i.e. have a straight trunk (a minimum of 3 m long) with no large branches (branches greater than 5 cm diameter), no visible defects, and have a minimum DBH of 15 cm;
- Suitability for Transplanting;
- Shrub thickets are documented as groupings with dominant species identified;
    - Individual stem count and health assessment of shrubs is not required unless otherwise indicated by applicable municipal by-laws, policies, standards and/ or guidelines;t
- In areas within a Designated Natural Area, vegetation communities in accordance with the *Ecological Land Classification for Southern Ontario* (ELC) system will be delineated; and
- Additional incidental observations including, but not limited to, seed forecasting, wildlife sightings, habitat features, rare herbaceous vegetation etc.

A full list of characteristics and defects that may be documented and codes used for the tree data are provided below. The basic assessment techniques will include visual examination of above ground parts of each tree. Trees are not to be probed, cored, or dissected. Excavation for detailed root crown inspection will not be conducted as part of tree inventory work.

In cases where the ability of the field crews to perform a full visual assessment is limited (e.g. when trees were not as accessible visually or physically because they are located on top of retaining walls, behind existing noise walls, or behind fences etc.), the visible parts of the tree will be used to estimate the assessment characteristics.

Individually surveyed points for each tree is the preferred approach, however location estimates and/or groupings may be used where warranted. Where direct access to a tree is not possible (e.g. for safety reasons on an active rail corridor, or due to being located outside of the Metrolinx-owned-lands, etc.), the tree location will be determined either: through the use of a laser rangefinder in the field; or, as a desktop exercise with the use of high-resolution aerial imagery. For stretches of DNA being surveyed with a large number of trees smaller than 10 cm DBH, a plot-based methodology may be used to estimate number of stems between 1-10 cm DBH per species in each vegetation community within the DNA provided that the methodology is approved by Metrolinx prior to site investigations. For areas within the rail corridors and the DNA that were recently cleared (within past 5 years) and have regenerated and are dominated by shrub species, the Arborist may utilize the linear length or area of the thicket being impacted to calculate required replacement instead of using a stem count or plot-based methodology. In this case, 5 linear m or 10m^2 equates to 1 tree for replacement.

The arborist completing the tree inventory will identify any hazard trees, invasive species (including if any regulated invasive species are present in the area surveyed), SAR trees, significant trees, bio-culturally significant trees and/or any lumber quality trees based on up-to-date species status and input from Indigenous communities on a project-by-project basis.

GIS Analysis

The data must be submitted in a precisely consistent format for proper GIS integration and analysis. GIS data must be submitted using the NAD 1983 CSRS MTM 10 coordinate system. The data formatting, such as headers and order of data, must be consistent with the standards provided as per the Metrolinx Integrated Arborist Report data template to avoid reformatting. The GIS data submitted should include attributes capturing all required tree inventory data collected as detailed in this Appendix or be submitted with an accompanying spreadsheet table following the Metrolinx Integrated Arborist Report data template that can be linked through matching Tree ID. This includes all applicable characteristics as documented in the list above, uses consistent names for tree species, unique Tree IDs, a Global ID, UTM coordinates, timestamps from the time of inventory, and company name (or also surveyor names). For documenting characteristics such as defects or other symptoms of poorer health, the codes and numbers in the list at the end of this Appendix should be used.

Species and Condition

Based on the assessment characteristics, each tree will be given a condition rating of Good, Fair, Poor, or Dead, as defined below:

Good: No or minimal apparent health problems; good structural form

Fair: Moderate problems with health and/or structural form

Poor: Major problems with health and structural form

Dead: Currently dead; includes trees that have epicormic growths from the base (except for Butternut with epicormic growth - a condition rating of ‘Poor’ will be assigned)

The tree height will be recorded using the following height categories:

- A: 1-2 m
- B: 3-5 m
- C: 6-8 m
- D: 9-12 m
- E: 13-16 m
- F: >16 m

DBH

Diameter at breast height is measured 1.4 m from the ground according to International Society of Arboriculture (ISA) standards. The DBH will be recorded to the nearest centimeter. Determining the DBH for multi-stemmed trees shall follow the applicable municipality’s methodology requirements.

Outside of a DNA, the largest stem is used to determine the DBH for a multi-stemmed tree. To determine the calculated DBH (DBH CALC) for multi-stemmed trees within a DNA, the following calculation will be used:

DBH CALC = SQRT(dbh^2/number of stems)*number of stems

For the purposed of this calculation, only the number of stems ≥10 cm DBH will be used.

e.g. a Multi-stemmed Tree with 3 stems and the DBH of the largest stem was 15 cm: DBH CALC = SQRT((15cm)^2/3)*3 = 25.98 cm

Where the DBH CALC on Multi-stemmed Trees exceeded 100 cm and where the number of stems exceeded three (3), the calculated DBH will be adjusted to account for a potential overestimate of the calculated DBH. To determine the calculated DBH (DBH CALC) for Multi-stemmed Trees where the original calculation returned a value over 100 cm DBH or where there were more than 3 stems, the following calculation will be used:

DBH CALC = SQRT(dbh^2/number of stems)*(number of stems – (number of stems*0.2)).

This accounts for the fact that as DBH and age increase, or as trees have more than a few stems, trees invest less energy into expanding the radial distance of their roots. Roots radial distance from the tree generally follows a logarithmic curve with number of stems, age, and increased size.

Tree Canopy and Tree Protection Zones

Tree canopy will be documented to the nearest meter to allow for the determination of where pruning of the canopy may be required. Tree Protection Zone (TPZ) size and installation shall adhere to the applicable municipal bylaw and TPZ requirements. For trees within Metrolinx-owned-lands or the rail corridors, the TPZ will be based on the City of Toronto's *Tree Protection Policy and Specifications for Construction Near Trees* (Table A1) or the dripline of the tree, whichever of the two is greater. In addition to trees with canopy extensions into the study area, trees with TPZs that extend into the study area will be inventoried. The TPZ is a zone within which impacts due to soil compaction, equipment operation, excavation and filling are to be avoided as the loss, disturbance, or damage to any roots in this zone will adversely affect the tree's long-term health and structural stability. Although root damage in this zone may not directly kill the tree, secondary stresses caused by root damage and compaction may kill the tree sometimes months or years later. Thus, protection of this area against compaction during tree removals and construction activities is vital.

Note that TPZ enclosure specifications vary based on the applicable municipality and permit requirements. For trees where municipal by-law protection does not apply, snow fencing or similar shall be used to demarcate the TPZ of trees to be protected at a minimum.

Table A-1: Recommended Minimum Protection Distances

Trunk Diameter (DBH)	Minimum Protection Distances Required for Trees (Tree Protection Zones)	
	Trees outside DNA	Trees within DNA
< 10 cm	The drip line or 1.2 m	The drip line or 1.2 m
10 – 30 cm	The drip line or 1.8 m	The drip line or 3.6 m
31 – 40 cm	The drip line or 2.4 m	The drip line or 4.8 m
41 – 50 cm	The drip line or 3.0 m	The drip line or 6.0 m
51 – 60 cm	The drip line or 3.6 m	The drip line or 7.2 m
61 – 70 cm	The drip line or 4.2 m	The drip line or 8.4 m
71 – 80 cm	The drip line or 4.8 m	The drip line or 9.6 m
81 – 90 cm	The drip line or 5.4 m	The drip line or 10.8 m
91 – 100 cm	The drip line or 6.0 m	The drip line or 12.0 m
> 100 cm	6 cm Protection for Each 1 cm Diameter or the drip line	12 cm Protection for Each 1 cm Diameter or the drip line

Boundary Trees and Tree Ownership

A boundary tree is defined as a tree whose trunk is growing across one or more property lines. Based on the *Forestry Act, RSO 1990, c. F*.26, tree ownership is determined by where it is rooted, and by the location of the trunk below the first branches. If the tree parts above the ground up to the first branches overlaps more than one property, it is jointly owned by both property owners and may not be removed without permission from both owners.

The ownership of each tree within the study area will be determined within the GIS platform using Teranet information and recorded in the tree inventory table. The Integrated Arborist Report will include mapping of each tree inventoried, documenting the property owner (e.g. private, municipal, provincial, or federal, including PIN). Where ownership cannot be determined as part of the tree inventory, a surveyor licensed in the province of Ontario will determine the ownership (following Metrolinx approval), or the potential owners will be consulted by Metrolinx to verify ownership.

Hazard Trees and Risk

A hazard tree can generally be defined as a tree with structural defects likely to cause the failure of all or part of the tree. Risk is related to the chance that the tree could potentially strike a target if left untreated, thus a tree is only considered hazardous when it poses a risk to life or property.

To determine hazard trees and risk, trees will be assessed on the likelihood of failure during normal weather conditions during the first 12 months following the date of assessment. If more than one serious defect is noted on the tree’s main stem, the tree may be assessed to pose a very high risk of failure. Hazard trees should be assessed and identified by an Arborist that also holds the Tree Risk Assessment Qualification from ISA and documented in the tree inventory table.

The falling distance of the tree will be estimated to be one (1) times the height of the tree category’s highest dimension (i.e. for height category D, the striking distance will be estimated as 12 x 1 = 12 m). Note that a tree may shatter when striking, thus debris from a fallen tree may spread up to 1.5 x the height of the tree (e.g. for height category D, the striking distance is estimated as 12 x 1.5 = 18 m).

The terms that are used are defined below:

Improbable: The tree or branch is not likely to fail during normal weather conditions and may not fail in many sever weather conditions within a specified time frame. For simplicity, this includes trees with a condition rating of 1 or 2.

Possible: Failure could occur, but it is unlikely during normal weather conditions within a specified time frame. This includes trees with a condition rating of 3.

Probable: Failure may be expected under normal weather conditions within a specified time frame. This includes trees with a condition rating of 4.

Imminent: Failure has started or is most likely to occur in the immediate future, even if there is no significant wind or increased load. This includes trees with a condition rating of 4 or ≥5.

Trees requiring immediate attention on an urgent basis will be given a rating of HIGH Risk due to the following characteristics:

- Have serious defects (are in poor condition with lean towards the corridor, or dead condition) and likelihood of failure is imminent or probable; AND,
- The rail line or electrification infrastructure is within the potential fall zone.

Trees requiring attention on a short-term basis, within the next 12 months, will be given a rating of MODERATE Risk due to the following characteristics:

- Have serious defects (including any of the following: are in poor condition, or dead, or have a lean towards the corridor) and likelihood of failure is possible; AND,
- The rail line or electrification infrastructure is within to the fall zone.

Trees requiring future monitoring following 12 months or due to abnormal weather conditions will be given a rating of LOW Risk and include trees with the following characteristics:

- Have moderate defects (fair condition) and likelihood of failure is improbable; AND,
- The rail line or electrification infrastructure is within the fall zone.

The potential hazard assessment ratings provided above are based on normal conditions and not on unusual or extreme conditions.

Invasive Species and Pest & Disease Prone Trees

To develop the list of species indicated to be Invasive, invasive trees should include those that are listed as priority invasives (categories 1-3) by the City of Toronto, York Region, the Toronto Region Conservation Authority (TRCA), the Lake Simcoe Region Conservation Authority (LSRCA), Credit Valley Conservation (CVC), Central Lake Ontario Conservation Authority (CLOCA), Conservation Halton (CH), and Ontario's Invading Species Awareness Program (OISAP). Common pests and diseases that may be found within the project area and the tree species that are typically affected should be designated as Pest & Disease Prone. Trees that are invasive and/or pest & disease prone will be documented in the tree inventory table.

Species Significance and Lumber Quality Trees

Species at Risk (SAR) trees are plants that are considered by the Government of Ontario to be endangered, threatened, of special concern, or extirpated. Significant trees should include species identified by the applicable Conservation Authority as being locally rare.

Trees that are SAR and/or significant tree species should be identified in the tree inventory table.

Lumber quality trees are currently defined as those trees that were identified in the field as having potential characteristics to be lumber quality as described in **Section 5**. Lumber quality trees should be identified in the tree inventory table.

Bio-Cultural Significance and Marker Trees

Bio-culturally significant tree presence will be determined on a project-by-project basis through consultation with Indigenous communities.

Marker trees, or trail trees, are trees with trunks or branches that have distinct bends that do not appear to have been caused by natural processes. These trees may have been manipulated by Indigenous communities to demarcate trails, water crossing locations, medicinal plants, and/or areas of cultural significance. These trees are to be photographed and labelled as bio-culturally significant as marker trees in the tree inventory and mentioned in the arborist report.

Lean and Tree Health

The lean of trees will be recorded in the tree inventory table to allow for the recognition of trees that might be rooted in one location, but the trunk and canopy were leaning into or out of the study area, thus potentially requiring pruning or removal. Leaning trees are often also at a higher risk of failing (falling over), and removals of leaning trees may require extra caution. Additionally, trees that are growing into overhead wires, power lines, or light fixtures, or are growing within a fence or other structure will be documented, as their removal or pruning will be more complicated and may require additional safety measures.

Where defects are apparent, they will be documented in the tree inventory table following the tree characteristic codes provided below and used to determine the condition rating of each tree, as defects on otherwise healthy trees may make them prone to future issues. The term “defects” is used to include damage and structural issues, both of which may result from natural events, natural growth patterns, or human activities.

Naturally caused defects, such as co-dominant stems with included bark where bark is growing in the crack between two or more branches, tend to prohibit the growth of fibrous tissue which connects and strengthens the branch union. Fungal growths within defects typically indicate advanced wood decay, which is often a serious defect. All these conditions may be exacerbated by a lean in the tree or by an unbalanced crown.

Defects can also be caused by human activities and include torn bark or large pruning wounds. These defects can increase susceptibility to decay and dieback which is characterized by death of the young shoots and can spread to the larger branches. The decay and dieback may in turn cause structural weakness, loss of limbs, or even death. Other human caused defects can include trees that have been topped (when the main leader is cut off to reduce the height or is broken off), over-pruned (when more than 1/3 of the tree's crown is removed), or branches that have been torn off flush to the trunk or left with a long stub. Each of these defects may also lead to future decay, structural weakness, or death.

A tree's response to defects typically takes many months to years to become apparent. Over time, vigorous healthy trees will compartmentalize wounds and grow compensation wood, which can partly or mostly offset damages. Thus, trees will be inspected for signs of callus tissue (a sign that the tree is able to compartmentalize wounds) and assessed accordingly. Some defects are critical, and some species are more susceptible to certain types of defects than others. If possible, trees should be monitored for their response to defects, to ensure that timely corrective action is undertaken where possible.

Tree Characteristics Codes and Descriptions (if applicable)

1. Symptoms & Location (location on tree only if not obvious, like dieback always being in crown (e.g. Re-F, D2, S1-T…)
   - Br: Leaf Browning
   - Ca: Cavity/Cavities – indicate height of highest cavity in meters from ground after tree location as additional descriptor – e.g. Ca-T-10; to be included as applicable on trees with condition ratings 2 through 8
   - Ch: Chlorosis
   - D1: Dieback 5-15%
   - D2: Dieback 16-30%
   - D3: Dieback 31-60%
   - D4: Dieback > 60%
   - Ep: Epicormic Growth
   - Ga: Galls
   - Bu: Burls
   - Po: Powdery Mildew
   - Re: Bark Removed
   - S1: Scar over 5-15% main limb
   - S2: Scar over 16-30% main limb
   - S3: Scar over >30% main limb
   - Sp: Spotted Leaves
   - Ta: Tar Spot
   - Ye: Yellow Leaves
   - Optional location criteria for symptoms:
   - F: Root Flare
   - R: Roots
   - T: Trunk
   - C: Crown

2. Cause (if obvious)
   - DED: Dutch Elm Disease
   - EQI: Equipment
   - EAB: Emerald Ash Borer

- FUN: Fungal Damage
- GIR: Girdling
- INS: Insect Damage
- MOT: Motor Vehicle Accident
- NAT: Natural, Other
- OWD: Oak Wilt Disease
- ROD: Rodent
- STO: Storm
- PRU: Pruning
- VIN: Vines

3. Structural Issues (may include more than one)
   - FRO: Frost Cracks
   - INC: Included Bark
   - LIO: Lion's Tail
   - NOL: No Leader
   - NRG: No Response Growth around scars or cavities
   - BRO: Broken or severely cracked leader or main branches
   - OVE: Over pruned
   - STR: Stress Cracks
   - UNB: Unbalanced Crown
   - BUL: Bulging root plate

4. Lean – L-E,W,N,S: Lean, direction AND into corridor –-> YES/NO

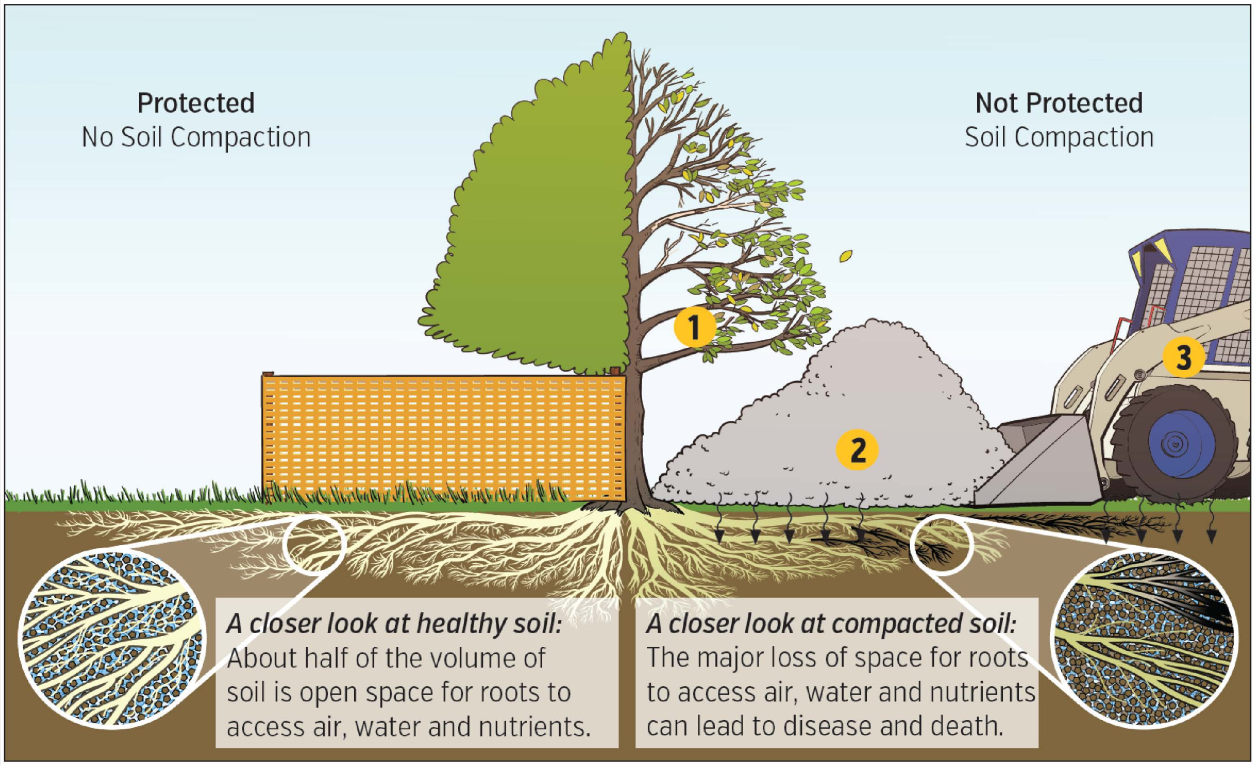
5. Treatments and Special Conditions (may include more than one)
   - W: High Voltage Wires, Power Lines, Light fixtures within crown
   - F: Growing within a fence or other structure (e.g. sidewalk, shed, electrical box, fire hydrant, etc.)
   - G: Grate
   - C: Hard Surface (Asphalt, concrete, etc.)
   - M: Over mulched
   - P: Planter
   - H: Planted High
   - L: Planted Low or fill over roots
   - S: Structural Support
   - T: Staked
   - G: Tree Guard/Collar
   - Other: blank for adding text

APPENDIX C: ARBORICULTURAL MITIGATION MEASURES AND BEST MANAGEMENT PRACTICES

Metrolinx will adhere to the arboriculture Best Management Practices (BMPs) and mitigation requirements of the local municipality where vegetation removals and construction work is taking place as well as the additional measures provided in this Appendix. These requirements and recommendations may vary between municipalities; however, several arboricultural BMPs that are typically recommended in arborist reports can be found in The Arborists' Certification Study Guide (Lilly, 2010), City of Toronto's Guidelines for Completion of an Arborist Report (2011), and City of Toronto's Tree Protection Policy and Specifications for Construction Near Trees (2016). The following subsections summarize the mitigation measures and BMPs that shall be followed at a minimum. These measures as well as any additional applicable mitigation and BMPs are to be identified by the Arborist and provided within the Integrated Arborist Report.

Tree Protection Fencing

Tree protection fencing shall be installed around each tree recommended for protection prior to any work activities taking place within the project footprint. Tree protection fencing will be installed along the perimeter of each Tree Protection Zone (TPZ) as calculated according to the applicable municipality's tree protection requirements (e.g. City of Toronto's Tree Protection Policy and Specifications for Construction Near Trees (2016)), which will reduce the potential for negative impacts including soil and root compaction (see **Figure C-1**) as well as the potential for mechanical damage to trunks or branches. The tree protection fencing shall be installed in accordance with the municipality's applicable standards and specifications (e.g. City of Toronto's Detail TP-1) and in consultation with Metrolinx Safety where appropriate. All tree protection fencing shall remain in place prior to any construction activity and in good repair until construction is complete. Fencing must be reinstated or repaired where required. Tree protection is to include mitigation measures to ensure existing tree health is maintained during construction to include mulching, watering, fertilizer and possibly soil decompaction using techniques described in **Appendix D**.



Understanding soils and tree injury. The numbers on the figure refer to: 1) Die-back over several years because of root loss due to lack of water and nutrients; 2) Weight of temporary pile of material; 3) Weight of machinery.

Figure C-1: Soil compaction impacts on trees not protected during construction. Image Source: City of Burlington's Guide to Tree Protection.

Branch and Root Pruning

All limbs damaged or broken during construction should be pruned cleanly, utilizing by-pass secateurs in accordance with best arboricultural practices. All pruning cuts should be made to a growing point such as a bud, twig or branch, cut just outside the branch collar (i.e., the swollen area at the base of the branch that sometimes has a bark ridge), and perpendicular to the branch being pruned rather than as close to the trunk as possible. This minimizes the size of the wound while also preserving the tissue responsible for healing the wound. Avoid leaving stubs, living or dead, as these do not heal and remain vulnerable to pathogens. Extensive pruning is best completed during the dormant/winter season. Pruning should be limited to the removal of no more than 1/3 of the total bud and leaf bearing branches. Where branches are likely to be damaged during construction, branches shall be pruned to avoid branches being broken off, so that bark is not torn, and wounds are not more extensive than necessary.

Root damage should be minimized by restricting activities in the vicinity of retained/protected trees and shrubs. If root damage is unavoidable, several considerations pertaining to root pruning should be followed. Root pruning should occur prior to the start of construction and after leaves have fallen from deciduous plants in the fall or before bud break in the spring. Plants may be damaged severely if roots are pruned at other times. All pruning should be done with clean, approved root-pruning equipment and conducted by or under the supervision of an Arborist. Roots should be protected from drying with the application of mulch and scheduled watering (for temporary exposure) or with clean native fill as soon as possible to prevent desiccation and promote root growth. Structural roots (roots of approximately 5cm in diameter and greater) should be preserved whenever possible so that the tree's stability is not compromised. Project design should consider measures to avoid root pruning whenever possible (for example, a ramped walkway over large roots that allows for the retention of the roots). If root pruning is proposed within a TPZ then a tree injury permit may be required. If excavation is occurring at edge of forest additional mitigation is needed as outlined in the **Appendix F,** Edge Mitigation and Management.

The following recommended language regarding proper branch and root pruning practices should be captured in the Arborist report and/ or contract language including, but not limited to:

- Branch Pruning:
  - All limbs damaged or broken during construction shall be pruned cleanly, utilizing by-pass secateurs in accordance with best arboricultural practices.
  - All pruning cuts should be made to a growing point such as a bud, twig or branch, cut just outside the branch collar (i.e., the swollen area at the base of the branch that sometimes has a bark ridge), and perpendicular to the branch being pruned rather than as close to the trunk as possible to minimize the site of the wound. Avoid leaving stubs, living or dead.
  - Extensive pruning is best completed during the dormant/winter season. Pruning should be limited to the removal of no more than 1/3 of the total bud and leaf bearing branches.
  - Where branches are likely to be damaged during construction, branches shall be pruned to avoid branches being broken off, so that bark is not torn, and wounds are not more extensive than necessary.
- Root Pruning:
  - Shall be timed appropriately to increase survivability and should occur prior to the start of grading and after leaves have fallen from deciduous plants in fall or before bud break in the spring.
  - Pruned root ends shall be neatly and squarely trimmed with clean and approved root-pruning equipment.
  - The area shall be backfilled with healthy soils as described in **Appendix D** as soon as possible to prevent desiccation and promote root growth. Soil quality report shall be provided to Metrolinx for review prior to root pruning.
  - Texture of backfill soil should maximize the permeation and percolation of water and promote proper root growth and structure post-transplant.
  - Exposed roots shall not be allowed to dry out such as with the application of mulch and an appropriate watering schedule shall be undertaken for temporary exposure (e.g., water twice weekly between June 1st and September 15th) so that the roots maintain optimum soil moisture during construction and backfilling operations.

- Pruning of Oak trees shall not occur during the months of April through October to avoid exposing trees to Oak Wilt. If pruning must occur or accidental injury/ damage occurred during this window, commercial tree paint shall be used to cover and protect the wounds from infection.

Tree Relocation/ Transplanting

Smaller trees with a high probability of survival will be identified and moved prior to construction. Root pruning should be completed in the spring or fall before transplanting as transplanting is best done in spring or fall. Translocated plants that will be moved in the fall (October or November) should have their roots pruned in the spring (March) while those to be moved in spring (March) should have their roots pruned in the fall (October). For transplanted trees, apply sufficient water to moisten the soil to 0.3m in depth, using a slow and gentle method of watering (i.e. an irrigation bag). If fertilizer is used in the first growing season after transplanting, a slow-release nitrogen fertilizer shall be used to minimize further water stress and to promote root growth. Organic mulch should be placed around the base of the tree, but not in direct contact with the trunk. The mulch encircling the base of the tree should be 5-10cm in depth, while the diameter will vary on size of tree. As a guideline, a 5 cm caliper tree should have a mulch circle at least 1.8m in diameter. After transplanting, branch pruning shall be limited to removing broken or damaged limbs and to promote good crown structure (i.e. the practice of branch pruning to compensate for root loss should not take place as this can hinder the tree's ability to establish). Staking of transplanted trees should be used with caution, as staking can have detrimental effects on tree development. Young trees that have been staked for prolonged periods of time produce less trunk taper, develop smaller root systems, and are more likely to break or tip after removal of stakes. Staking materials may also girdle the trunk over time.

Retained trees that were pruned, injured or transplanted shall be watered twice weekly between June 1st and September 15th if there is less than 25 mm rainfall (forecasted) over a period of seven (7) days and maintenance to be continued in restoration areas during the restoration warranty period and tree health included in any monitoring reporting.

Timing of Vegetation Clearing

Vegetation removals will be limited to the specified activity areas and shall not commence until required arborist documentation, permits, and approvals are obtained. Removals may be restricted by bat active and/or maternity windows dependent on whether the vegetation communities identified on-site are suitable habitat for bats. Clearing vegetation outside of the breeding bird season (breeding bird season is generally April 1 to August 31 in southern Ontario but can include shoulder months, especially in complex habitats) is recommended to reduce potential impacts to migratory birds and avoid contravention of the Migratory Birds Convention Act (1994). Metrolinx schedules vegetation removals to occur outside of the breeding bird season wherever possible. However, if removals must occur during this period, the bird nest avoidance mitigation measures provided in **Appendix E** will be followed. If SAR or suitable SAR habitat is identified on-site, timing restrictions associated with those species will be identified through the permitting or registration process and will also be adhered to.

Excavation and Grade Changes

Methods of excavation within the TPZ encompassing the critical root zone of trees proposed for preservation shall include those which are less harmful to the tree, such as pneumatic or hydraulic excavation. These methods include tools which use high-pressure air or water to remove the soil around the roots without damaging the larger roots. To protect roots from high pressure, pneumatic and/or hydraulic excavation tools shall not exceed a pressure of 500psi. Where hydraulic excavation tools lack pressure gauges, work should begin with the lowest pressure possible when working in root zones and gradually increase until soil starts to liquify. At this point, pressure should not be increased any further. An arborist must be present for the initial excavation and any roots observed during excavation shall be pruned by an Arborist (or under the supervision of an Arborist) using proper arboricultural techniques.

Excavation adjacent to trees that are identified for protection shall be monitored and modified to ensure trees protected do not become injured or damaged and result in becoming a hazard.

Grade changes can be devastating to trees. If the grade is to be lowered, a tree island delineated by vertical retaining walls should be constructed. Increases in grade pose greater complexity in tree preservation efforts and are best avoided by altering project design. The greater percentage of the root system that remains at the original grade, the greater the chance of tree survival.

Tree health and soil conditions shall be assessed in the spring and fall for retained trees and the Arborist shall determine if soil amendments, including fertilizer, is needed.

Structural Soils/ Soil Cells

Structural soils are “designed” soils that can be compacted to meet engineering requirements and still allow root growth and development. Structural soils are designed to create a load-bearing surface with sufficient soil pore space to support root growth and establishment of trees. Suspended sidewalks that use structural cells (i.e. Silva Cells) can be incorporated into project designs to provide adequate root space under paved surfaces. Soil cells consist of a three-dimensional grid of cell-like modular units that can be filled with soil to support root growth and development. This allows for tree growth in areas with limited space.

APPENDIX D: HEALTHY SOILS REQUIREMENTS FOR RESTORATION

1 INTRODUCTION

Restoring currently degraded lands to maintain ecosystem function and productivity, mitigate climate change, and improve biodiversity begins with the assessment of the existing soil conditions. Healthy soils are critical to support the biota of an ecosystem, both above and below ground. Healthy soils provide conditions that allow soil organisms to thrive that can complete the critical task of returning carbon to the soil as organic matter as plant matter decomposes.

Soil health is understood to be closely related to soils having enough organic matter to provide a range of physical, chemical, and biological functions. These include adequate water retention and infiltration, soil aeration, nutrient cycling and availability, and diverse and robust soil microorganism communities supporting flora and fauna. Soils with low organic matter require the addition of amendments to prevent likely failure as low organic matter soils are generally more susceptible to drought. (Vineland Research and Innovation Centre, 2021)

Healthy soils must have adequate pore space (i.e. porosity) to allow for the transport and storage of air, water and nutrients. When soil is compacted, porosity decreases and bulk density (dry mass divided by volume) increases, which affects the soil's ability to infiltrate and store water, limits diversity of soil organisms and nutrient uptake by vegetation and impedes root growth. Generally, once bulk density exceeds 1.7 grams per cubic centimetre (g/cm^3), roots are no longer able to penetrate through the soil. Likewise, compacted soils have lower oxygen transfer, higher summer temperatures, less nutrient cycling, and less mycorrhizal fungi compared to non-compacted soils. (TRCA, 2012)

Improving soil quality improves water quality, reduces greenhouse gas emissions and addresses other environmental issues. Compacted soil lacks the necessary structure and pore space to hold and store carbon effectively. Compaction also reduces the soil's ability to absorb water and nutrients, leading to decreased plant growth and reduced carbon uptake. Healthy soils with good infiltration and aggregate stability reduces surface runoff and topsoil loss, resulting in better water quality and groundwater recharge (Smith, 2018).

It is critical to create a topsoil rich in organics in the top 50 cm of the soil profile as well as a subsoil that is well decompacted, improving soil density to allow optimal root growth and increase soil drainage. The greater the usable soil volume for plant root development, the greater the plant's growth and success potential.

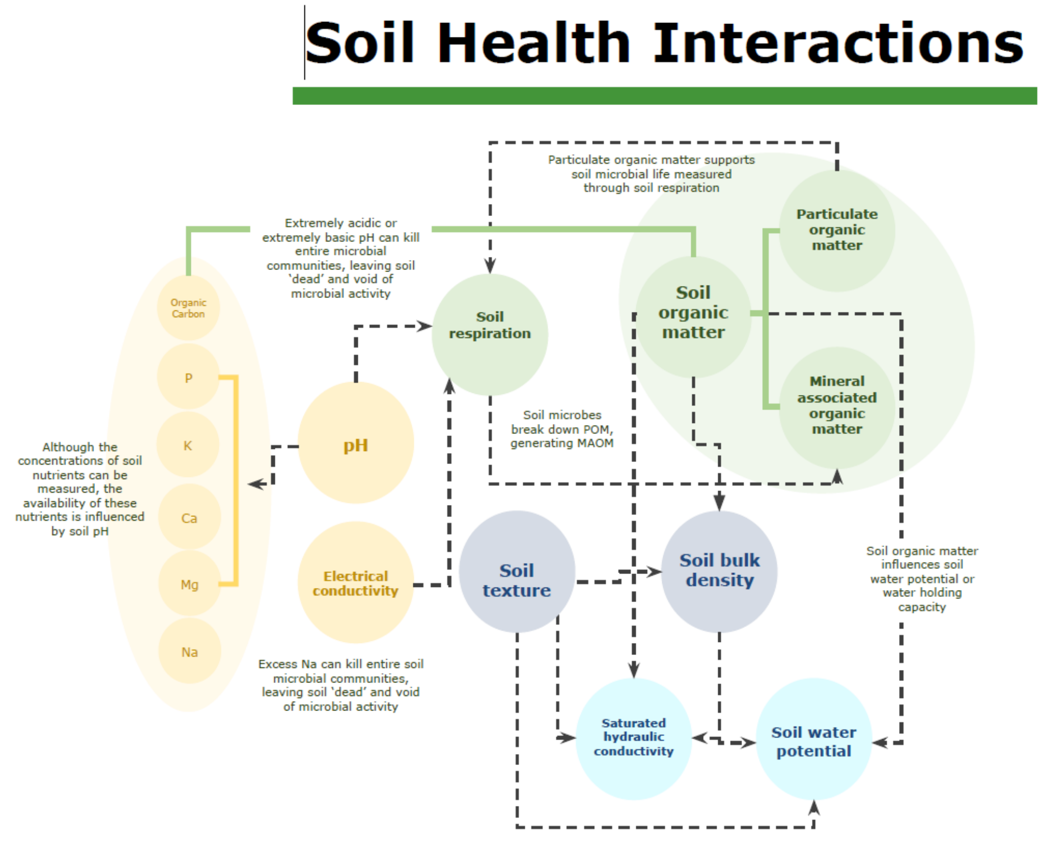


Figure D-1: Soil characteristics that support healthy soils (source Soil Health 101 Vineland Research and Innovation Centre, 2023)

2 HEALTHY SOIL

A critical step to ensure planting success is the preservation and creation of healthy soils. A Soil Amendment and Decompaction Plan shall be developed for any areas on-site or adjacent to site to protect existing vegetation and areas with active construction that will be planted post-construction.

A one (1) meter depth of soil is to be evaluated and managed, including both the topsoil and subsoil layers.

Each site will require its own site-specific Soil Amendment and Decompaction Plan based on municipal requirements, regulations, and vegetation needs. Below is a list of minimum requirements to be included in the **Soil Amendment and Decompaction Plan:**

A. Vegetation species-specific requirements for restoration success
B. On site Soil Management
    i. Soil storage and reuse methods
    ii. Soil Mitigation for on / adjacent to site soils
C. Soil sampling to determine amendments needed
    i. Requirements for existing soils for restoration
    ii. Identification of existing soils conditions
    iii. Assessment of results that do not meet optimal/ sufficient criteria
    iv. Requirements for imported soils/ compost for restoration
D. Soil compaction, prevention and decompaction
    i. Compaction prevention methods
    ii. Identification of soil decompaction depths
    iii. Methodology for decompaction
E. Application of soil amendments
    i. Mycorrhizae application
    ii. Organic material
    iii. Other amendments
F. Verification of Healthy Soils prior to Planting

A. Vegetation Species Specific Requirements

Soil criteria outlined in this section is based on a typical restoration plan. The type of soil, moisture regime, pH, organic content etc. contribute greatly to the vegetation present on the landscape. The vegetation communities of Ontario can be surveyed and classified using a process called Ecological Land Classification (ELC). This classification provides a cross-scalar (ecosite to landscape scales) method of understanding, identifying, and classifying the interactions between different ecosystem factors using the structure and function of soils, vegetation, and physiography. Often in urban areas the soils are the best indicator of historic ecosystems. Understanding the soil characteristics prior to construction is important for restoration if looking to recreate the historical landscape.

A simple handheld soil auger or Oakfield tube is typically used to collect a soil core to determine soil texture, depth of organic layer, depth to bedrock (if not too deep), soil moisture, and soil drainage regime of the area. This type of soil profile is typically as part of any Natural Heritage Study to support determining vegetation community (ELC) If it is not readily available it shall be completed to support the Soil Amendment and Decompaction Plan. Soil data may be accumulated from multiple on-site studies including information from test pit/ boreholes included in the geotechnical report and phase 2 environmental soil assessment which may supply soil texture, topsoil depth, depth of bedrock, ground water level and soil moisture.

To create a successful planting when restoring a particular vegetation community, there may be specific soil type and soil amendments required that are *not included in this appendix.* For example, Butternut trees prefer deep, moist, well-drained, loamy soil with recognizable darker organic proportion in the upper level and a pH ranging from 6.8 to 7.2. These species-specific requirements must be considered in addition to the general guidelines provided here. Proposed amendments are to be confirmed by the urban forester or landscaper supporting the planting installation.

B. On Site Soil Management

The first step in soil management is to test the soils prior to construction to determine the condition and characteristics of the soils on-site. This information will determine how the soil will be managed during construction for reuse on-site based on site restoration needs.

Figure D-2 Topsoil and compost to be mixed. *(courtesy of Pfeiffer, Christina & Pond, Rodney &, University of Washington State Getting Down to Earth: Understanding Soils for Ecosystem Resilience & Repair 2025)*

The on-site soil restoration process, in which disturbed, compacted urban soil is improved by addition of an organic amendment is preferred when topsoil is present on site, but is degraded (e.g. compacted soil, low nutrients, low soil organic matter, etc.). Reuse as much soil on the lands as possible in a manner that is consistent with Ontario Regulation 153/04, Ontario Regulation 406/19 and the MECP's Rules for Soil Management and Excess Soil Quality Standards, as amended. A process for soil restoration involving decompacting the soil and adding in an organic amendment shall be included in the Soil Amendment and Decompaction Plan. The Plan should address any restoration areas for on, adjacent to, and off-site plantings to meet requirements described throughout this appendix and any specifications provided by municipality based on the proposed planting materials.

The Soil Amendment and Decompaction Plan shall identify materials to salvage from the excavation operations that contain peat, topsoil, and subsoil materials in separate stockpiles in accordance with Good Industry Practice and as described in this section.

The Soil Amendment and Decompaction Plan shall not allow burial of any peat or topsoil materials. *To the extent possible, with the exception of peat materials, geotechnically and environmentally suitable salvaged topsoil and subsoil materials shall be re-used on-site. in a manner that is consistent with Ontario Regulation 153/04, Ontario Regulation 406/19 and the MECP's Rules for Soil Management and Excess Soil Quality Standards, as amended.*

Soil core, bore hole or test pits, in each target area are to be completed to determine the presence of topsoil, depth of soil horizons, and texture of soil horizons up to 1 meter in depth. Soil testing is also to be completed as outlined in Table D-2 to determine quality of topsoil.

The results of existing soil testing will inform storage and reuse requirements. This section provides a high-level description of topsoil storage. Topsoil storage and reuse shall be included within the Soil Amendment and Decompaction Plan.

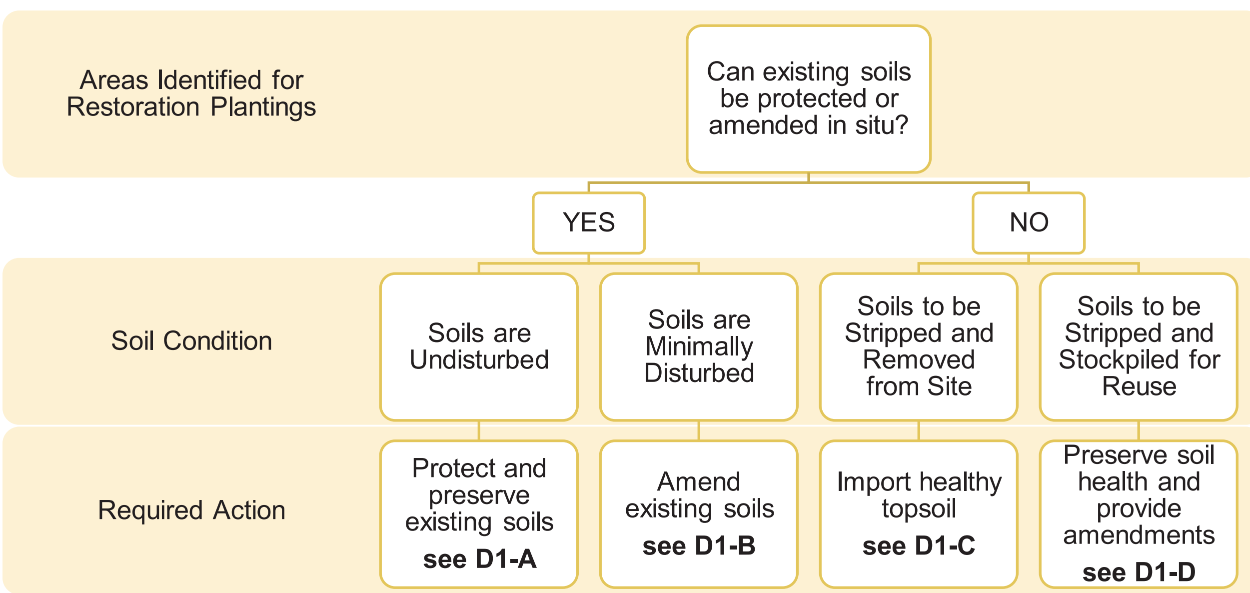


Figure D-3. Decision matrix for determining soil management recommendations
CVC Healthy Soils Guideline for the Natural Heritage System (2017)

D1-A Soils in Undisturbed Areas:

Healthy soils adjacent to the work area shall be protected through appropriate erosion and sediment controls to minimize sediment runoff from site and ensure no erosion or rilling occurs due to concentrated flows or sediment deposition from active construction. For vegetated areas is vegetated see **Appendix F** Edge Mitigation and Management Plan for further details.

Areas where work is minimal and soils are left in place, the contractor shall implement appropriate mitigation measures, for example avoid works during times where soils are saturated (wet) to minimize compaction, using no or low-pressure machinery, applying soil mats or mulch to reduce compaction, etc.

Monitoring of mitigation measures should occur on a seasonal basis throughout active construction to ensure healthy soils are being preserved in minimally disturbed areas.

D1-B Amending Existing Soils

Where existing topsoil is compacted or deficient or where planting will occur adjacent to construction site:

Till the topsoil to just greater than the depth of the compacted area, or the entire topsoil horizon to a 50 cm depth. Spread 10 cm of organic matter compost on the surface of the tilled soil and till the compost into the loosened soil to the same depth if possible, or a minimum of 45 cm. Amend physical and chemical soil properties based on the results of soil testing as outlined in **Table D-2** as needed, to make a final topsoil that meets the thresholds for optimal vegetation growth.

Where subsoil is compacted and requires amendments:

Loosen subsoil by deep tilling/ subsoiling/ripping to a depth greater than the compacted subsoil depth indicated by soil sampling, or to a depth of 95 cm, whichever is greatest. Spread 5 cm of organic matter compost on the surface of loosened subsoil and till the compost into the loosened subsoil.

For further details on decompaction methods see Section D of this appendix.

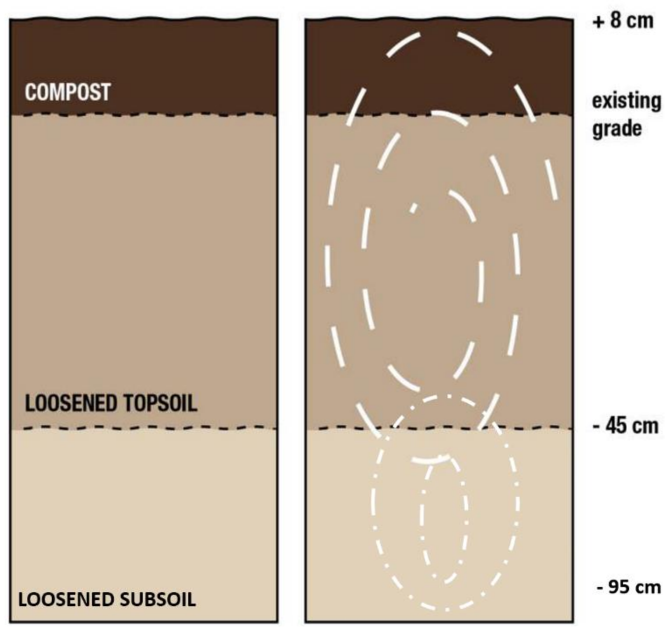


Figure D-4: Soil decompaction of existing soils. Image source: CVC Healthy Soils Guideline For the Natural Heritage System (2017)

"D-1C Importing Soils"

The Project shall reuse (rather than remove or replace), where feasible, as much soil on the lands as possible in a manner that is consistent with Ontario Regulation 153/04, Ontario Regulation 406/19 and the MECP's Rules for Soil Management and Excess Soil Quality Standards.

However, due to the storage constraints of many Metrolinx projects, replacing soils is common on sites that have acted as the staging area for construction projects. In this case, imported soils shall support specific planting plans and reflect an optimal topsoil and subsoil criteria. Refer to **Tables D-3** and **D-4** for details.

D1-D Reuse of on-site soils

For healthy soils stored on-site, ensure that soils are stored in separate stockpiles based on soil type (top, middle or bottom soil layer) to ensure proper storage and replacement. Refer to the Credit Valley Conservation Authority Healthy Soils Guideline for the Natural Heritage System (2017) for further information on proper storage. Ensure topsoil and subsoils are tested prior to restoring on the site to ensure the appropriate amendments are added prior to tilling (mixing). It is recommended that topsoil is placed in lifts of 15cm to a maximum of 25 cm.

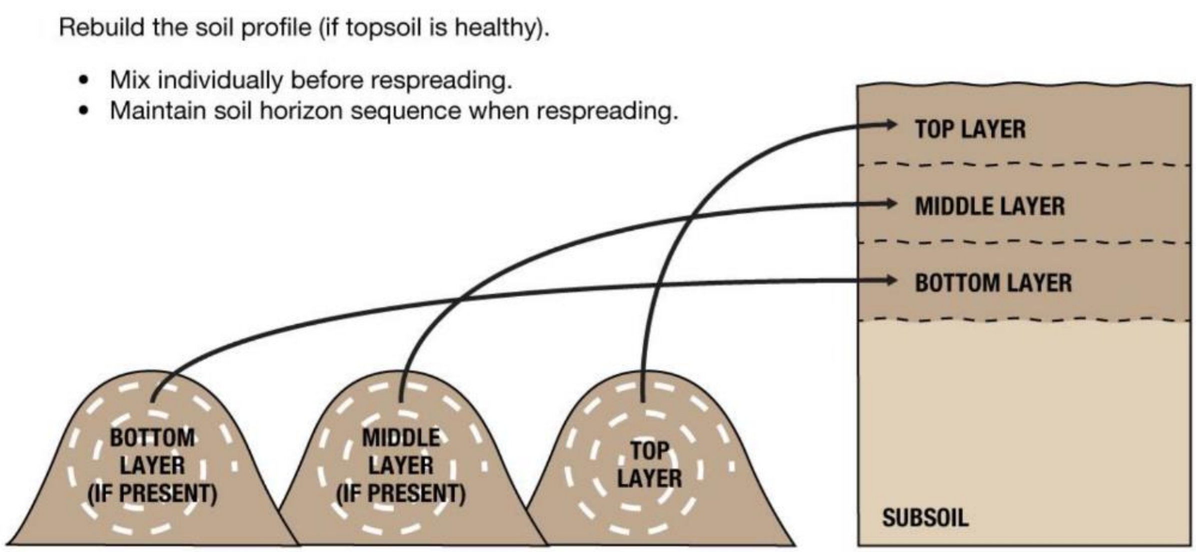


Figure D-5: Stockpiling of Existing Soils for reuse. Image source: CVC Healthy Soils Guideline For the Natural Heritage System (2017)

C. Soil Sampling to Determine Amendments Needed

The Soil Amendment and Decompaction Plan is to be broken down into sections focusing on results of preconstruction soil conditions and proposed site restoration. The Plan is to be amended based on the results of post construction testing, as warranted. Soil amendments are to be assessed based on criteria listed in Table D-2 and categorized per the values in Table D-1. The Plan is to provide clear direction to ensure all properties meet optimal conditions for imported soils and sufficient conditions for soils amended on site. It is suggested that results and assessments are divided into the below categories to describe deficiencies and outline steps to create a healthy growing medium:

A. Biological properties: Quantity and quality of organic matter, as well as the microorganisms and insects responsible for decomposing organic matter to release plant-available nutrients in the soil. This can be measured in the quantity of soil organisms, as well as the species found in the soil.
B. Physical properties: Soil texture and structure (porosity) influence the movement of air, water, and nutrients within the soil layers.
C. Chemical properties: Soil nutrients, pH and contaminants.
D. Hydrological properties: depend on all three of the above properties including physical (e.g. texture), chemical (e.g. electrical conductivity) and biological indicators (e.g. organic matter) provide information on how water moves through the soil by evaluating infiltration rates and water retention capabilities that influence the availability of water to plant roots. (Vineland, 2024)

Key Soil Health Properties

Common Soil Health Parameters

Physical	Biological	Chemical
Texture	Soil organic matter	pH
Bulk Density	Particulate Organic Matter	Electrical conductivity
Porosity	Mineral Associated Organic Matter	Macro and Micro Nutrients
Aggregate Stability	Active Carbon	Heavy Metals
Penetration Resistance	Soil Respiration	
Available water capacity	Potentially mineralizable nitrogen	
Saturated Hydraulic Conductivity	Root pathogen pressure assessment	
Infiltration		

Figure D-6: Soil Health Parameters courtesy of Soil Health 101 Vineland Research and Innovation Centre (2023)

Vegetation growth is dependent on mineral nutrients available in the soil. Nutrients are needed for basic cellular processes. Symptoms of nutrient deficiency may include stunted growth, death of plant tissue, or yellowing of the leaves caused by a reduced production of chlorophyll. Macronutrients and micronutrients are both important to plant function. Macronutrients including nitrogen, phosphorus, magnesium, and potassium are the building blocks of crucial cellular components and are required in large quantities as they are some of the most important macronutrients. Carbon, hydrogen, and oxygen represent the non-mineral class of macronutrients as they are required in large quantities to build the larger organic molecules of the cell. Micronutrients, including iron, zinc, manganese, and copper, are required in very small amounts and are often required as cofactors for enzyme activity. Mineral nutrients are usually obtained from the soil through plant roots, but many factors can affect the efficiency of nutrient acquisition. First, the chemistry and composition of certain soils can make it harder for plants to absorb nutrients. The nutrients may not be available in certain soils or may be present in forms that the plants cannot use. Soil properties like water content, pH, and compaction may exacerbate these problems.

A process for soil restoration involving de-compacting the soil and adding in an organic amendment shall be included in the Soil Amendment and Decompaction Plan. The plan should address any restoration areas for on-site, adjacent to and off-site plantings to meet requirements outlined in this appendix and any specifications provided by the applicable municipality based on proposed planting materials.

Assess Soil Criteria and evaluate in terms of plant growth

The Soil Amendment and Decompaction Plan should evaluate the soils as a whole and review threshold values with the lens of plant growth and long-term health using the **Table D-1** and valuing the criteria of all four categories (physical, chemical, biological, hydrological) to achieve a clear understanding of soil health. Amendments for imported topsoil should meet the optimal criteria listed in Tables D-2 to D-4 with on-site soil amendments striving for optimal, but in some cases falling under sufficient. Evaluation based on Table D-5 are to be measured for plant success as optimal, sufficient or deficient.

Table D-1 Evaluation criteria for soil properties and proposed amendments

Optimal	Soil conditions best suited to successful plant growth. Requires no soil amendments.
Sufficient	Soil conditions are less than ideal, but entirely sufficient for plant growth. May require minor amendments such as micro and macro nutrients.
Deficient/ Poor	Refers to soil conditions insufficient for proper plant growth and productivity. Vegetation grown in this soil will most likely have reduced growth and survival. Strategies to improve soil health are required.

To date, physical and chemical attributes have been the main indicators used to assess soil quality. Soil organic carbon, total nitrogen and pH, among other chemical properties, particle size distribution, bulk density, available water, soil structure, and aggregate stability are the most widely used parameters to assess soil quality. More recently, value has been placed on the crucial role that the soil biological component plays in soil quality assessments. The soil biota is responsible for countless functions of the soil ecosystem and may respond rapidly to ecosystem changes, e.g. following ecosystem disturbance or recovery. Individual soil properties may not be adequate indicators of the soil status or can be interdependent, therefore soil conditions should be considered as a whole.

An excel table is to be submitted as part of the assessment with the locations of each soil test including UTM coordinates, results and associated criteria, color coded to reflect Table D-1. An example table is provided at end of this appendix for reporting format.

Soil Testing Frequency

When a site is considered homogeneous with similar existing conditions and previous use that did not indicate soils from different sources the testing may follow the below frequency outlined below. *Please note that the Municipality or Region may request more frequent testing.*

- A minimum of 3 samples up to 2,000m^2
- 1 sample per 2,000m^2 thereafter

For sites with atypical conditions including multiple contractors or where long term where construction has occurred with materials brought in to facilitate works or fill is suspected to be present from different sources a more frequent sampling regime will be needed. More frequent testing may also occur if compaction is apparent, sol texture or topsoil appearance is observed to be heterogenous or landscape installer requests testing due to concerns regarding planting success.

Soil Testing Parameters

Soil testing is to be completed for existing soils remaining on site, amended soils and any imported soils and must include at minimum the following analyses as outlined in Tables **D2 to D5** based on Soil type: A one (1) meter depth of soil is to be evaluated and mitigated including both the topsoil and subsoils.

Soil testing should be completed prior to any ground disturbance to determine existing conditions. It is suggested that testing is completed prior to the project going to market to ensure bidders are aware of soil quality and soil amendments requirements to ensure healthy subsoil and topsoil for restoration. Compaction testing is to occur after project works are completed to reassess soil health and determine how soils must be modified in response to both pre-existing conditions and construction activity impacts.

Soil testing is to be completed prior to final grading to ensure equipment is still available to modify soils if test results indicate further need for decompaction and amendments. Soil testing results are to be reviewed by Metrolinx and the Municipality to ensure conditions are adequate for planting success.

Topsoil shall be free of any admixture of subsoil, lumps, stones, roots over 25 mm in diameter and any other extraneous matter. The topsoil shall be reasonably free of weeds, weed seeds and rhizomes. An herbicide program may be required to eliminate undesirable, invasive and/or noxious plant material from the topsoil.

Table D-2: Existing Topsoil (Reuse)- Soil Testing Results Requirements for all restoration sites pre-planting*

Test	Optimal value*	Sufficient
Topsoil depth	50 cm	
pH (saturated paste method)	5.5 to 7	
Soluble salts (i.e., electrical conductivity; saturated paste method);	less than 1.5 (mmhosS/cm)	
Carbon to nitrogen (C:N) ratio;	C:N ratio less than 25:1	
Bulk Density g/cm3)	See Table D 5 (based on site soils)	
Foreign matter, Total Sharps, Total Plastics (TMECC 03.08);	Less than 3%	
Concentrations of 11 regulated metals (Arsenic, Cadmium, Chromium, Cobalt, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium and Zinc);	Less than or equal to applicable MECP Site Condition Standards listed in "*Soil, ground water and sediment standards for use under Part XV.1 of the Environmental Protection Act*" dated July 1, 2011.	
Exchangeable Nutrients (i.e., plant available) reported as part per million (ppm) or milligrams per kilogram (mg/kg)		
Phosphorus;(ppm)	10 to 50	
Potassium (ppm)	80 to 250	
Magnesium;(ppm)	100 to 300	
Calcium (ppm)	1000 to 4000	
Sodium (ppm)	Less than 200	
Chloride(ppm)	Less than 100	
Sodium adsorption ratio	Less than 15	
Cation Exchange Capacity CEC (meq/100g)	greater than 20 meq/100g	
Total phosphorus (P2O5; dry weight %)		
Pathogens (temperature and pathogen tests)		
Soil particle size distribution		
Sand (0.05-2mm)	25 - 70%	
Silt (0.002- 0.05mm)	5 - 40%	
Clay (less than 0.002mm)	15 - 30%	
Gravel sized particles (2 to 50 mm)	Less than 5%	
Organic Matter %	15%	
Organic matter by loss-on-ignition method	greater than 35%;	
Sandy Loam	5-20%	
Loam	5-9%	
Silty Loam	6-10%	
Upper limit of embedded debris/ stones	350 mm	
Free of roots, vegetation and rhizomes	Yes	

* Note that subsoil and topsoil quality requirements will vary per municipality.

** Healthy soil requirements may vary based on vegetation type being restored.

Imported Topsoil, subsoil and compost:

Imported soils and compost must meet the following optimal values described in (**Table D-1**). A fertile, friable, natural loam (A-horizon layer), capable of sustaining vigorous plant growth, free of weeds, subsoil contamination, stones greater than 30mm in diameter, roots and fragments greater than 40mm diameter, and must meet the following requirements:

Table D-3 Imported Topsoil (0- 50 cm) to be reported prior to importing to site

Test	Optimal value
Top Soil Texture Range (OMAFRA soil texture triangle):	Loam to sandy loam
pH range:	5.5 to 7.2
Organic Matter (%):	12 % or greater
P - Phosphorus (ppm):	10 – 60
K - Potassium (ppm):	80 – 250
Mg - Magnesium (ppm):	100 – 300
Ca - Calcium (ppm):	1000 – 3000
Soluble Salt / Electrical Conductivity (mmhos cm^{-1})	less than 1.0
Cation Exchange Capacity (meq/100)g:	greater than 20

Table D-4 Imported Subsoil (50 to 100 cm)

Test	Optimal value
Sub Soil Texture Range	Loam to sandy loam
pH range:	5.5 to 8
Organic Matter (%):	3% or greater
P - Phosphorus (ppm):	10 – 60
K - Potassium (ppm):	80 – 250
Mg - Magnesium (ppm):	100 – 300
Ca - Calcium (ppm):	1000 – 3000
Soluble Salt / Electrical Conductivity (mmhos cm^{-1})	less than 1.0
Cation Exchange Capacity (meq/100g) :	greater than 20

Table D-5 Grade AA or A Ontario Compost Quality Standards; for mixing with soils

Test	Optimal value
mature and stable product with a Solvita Maturity Index	7 or 8
pH	6 to 7.5
Electrical conductivity (mmhos cm^{-1})	less than 4.0
C:N ratio	between 10:1 and 20:1
Organic matter content by weight	greater than 35%
Phosphorus content (P2O2 dry mass)	below 1.0%
Exchangeable sodium content (ppm)	below 500

D. Soil Compaction, Prevention and De-compaction

After construction, the soil that remains on site is often compacted and poorly draining, conditions that reduce root penetration and successful restoration. Soil compaction is the single most difficult abiotic condition for tree and shrub survival. If a plant's roots can't grow into the soil, there is little opportunity for plant survival.

Best Management Practices

The first step to managing compaction is to protect any existing healthy soils by preventing compaction. Please ensure that construction notes provide adequate setbacks and tree protection zones for vegetation that will remain after works are completed. Include language to provide mitigation for haul routes and storage areas to reduce compaction such as coarse wood chips, plywood, metal sheeting, swamp mats, etc. where feasible.

During construction deep compaction can only be reduced by reducing the axle weight of machinery. Shallow compaction may be reduced by using lower tire inflation, or using equipment with tracks rather than tires, which reduces the downward force on the soil. Soil must be protected from degradation including erosion, compaction, loss of organic matter and breakdown in structure.

Figure D-7: Construction Compaction (left) Surface rooting often evidence of soil compaction (right)

Identification of Soil Decompaction Depths

The first step in decompaction is to complete In-Situ Compaction Testing. Existing conditions and installed growing medium shall be tested in-situ with a cone penetrometer and a soil moisture meter.

For testing of decompaction one test shall be performed every 25 m² of growing medium surface for smaller sites, and one soil sample for every 4000 m² on larger sites with a minimum of five measurements per hectare.

Maintain a record log of all compaction testing for submission. The record log shall include the date, location, UTM coordinates, depth and pressure reading of each test. Test location data shall be plotted on a site plan.

Depth of decompaction must be verified in the field at the completion of the works, prior to planting.

Cone penetration tests involve simple mechanical measurements of the total penetration resistance to pushing an instrument with a conical tip into the soil at a controlled rate (usually 2 centimetres per second). The instrument used to conduct the measurement is called a cone penetrometer. There are two general types of hand-held cone penetrometers: static penetrometers and dynamic penetrometers. (TRCA, 2012)

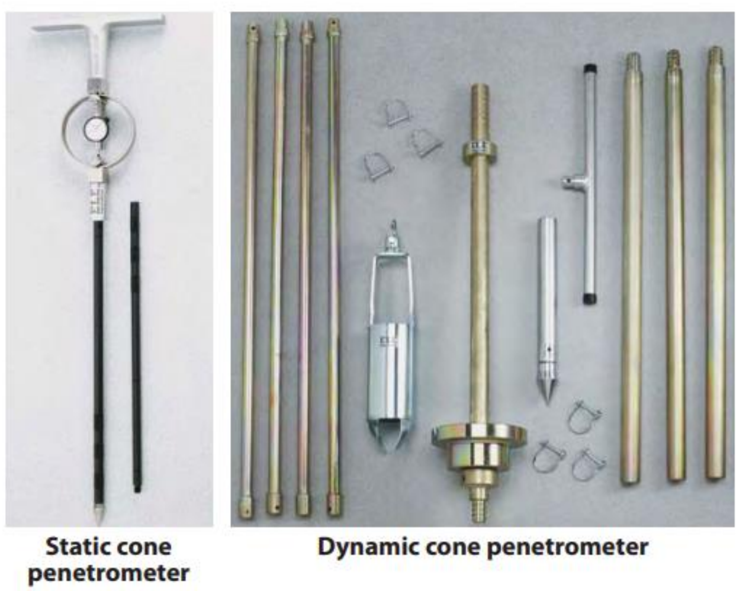


Figure D-8: In Situ Compaction Testing Equipment (courtesy of TRCA, 2012)

Both measure soil resistance to vertical penetration of a probe or cone of standard dimension and slope angle. The distinction between the two penetrometers lies in how force is applied to the cone.

Readings depend on cone properties (angle and size) and soil properties (e.g., bulk density, texture, and soil moisture). As cone penetrometer readings are strongly related to soil moisture, measurements shall be performed after wetting (i.e. within 24 hours of a heavy rainfall event such as 15 millimetres total depth or greater in 24 hours) and allowing a minimum of one week for settling. Penetration resistance shall be to the full depth of the installed soil profile or 950 cm, whichever is less, when the soil profile is thoroughly wetted and confirmed by in-situ measurements using a soil moisture meter and when soil moisture falls within the acceptable ranges below.

Table D-6: Moisture Percentage Based on Soil Texture

Soil texture	Soil moisture (%)	Resistance not to exceed (PSI)
Surface soils (all textures)		110
sand, loamy sand, sandy loam	12–18	260
loam, sandy clay, sandy clay loam	27–36	260
clay loam, silt loam	31–36	260
silty clay, silty clay loam	38–41	225

Acceptable procedures for performing and interpreting the results of cone penetration tests on soils using a mechanical or electronic static cone penetrometer are provided in the American Society of Agricultural Engineers' Standard EP542.

Soil texture is determined by the relative proportion of sand, silt and clay found in a given soil. Soil texture does not refer to the amount of organic matter present in the soil. Soil texture can be assessed with the aid of a soil texture calculator

Bulk density is an indicator of soil compaction. It is calculated as the dry weight of soil divided by its volume. This volume includes the volume of soil particles and the volume of pore spaces among soil particles. Bulk density is typically expressed in g/cm3. It affects infiltration, rooting depth, available water capacity, soil porosity and aeration, availability of nutrients for plant use, and activity of soil micro-organisms, all of which influence key soil processes and productivity. Table D-7 describes the bulk density values for different soil textures.

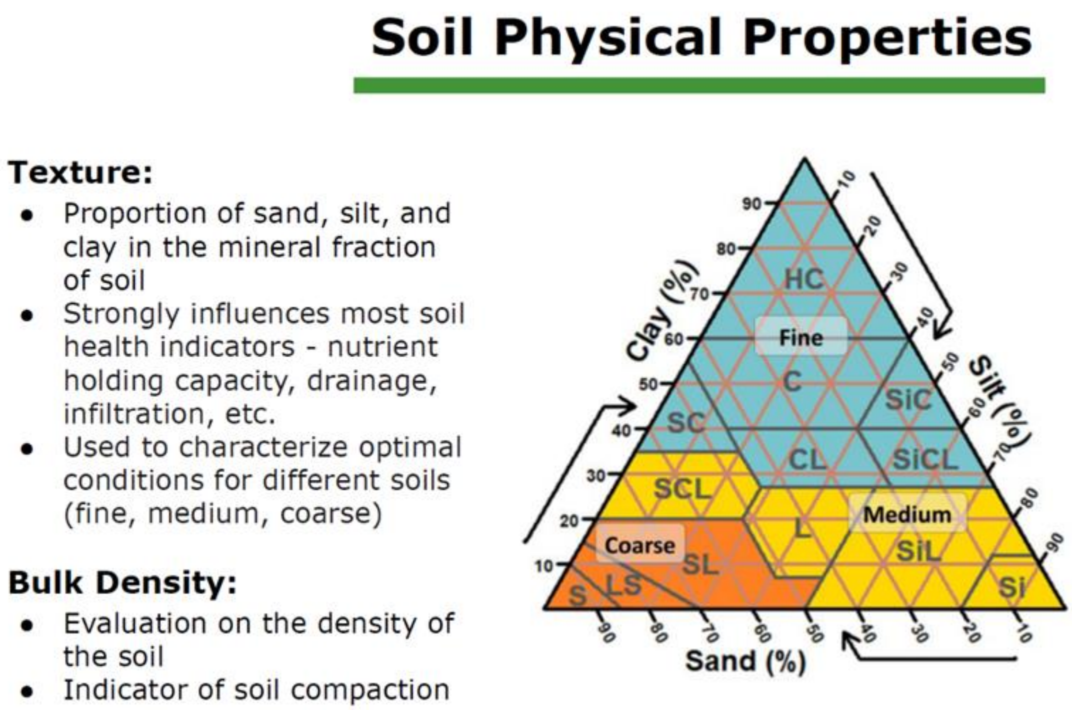


Figure D-8 Soil Texture Triangle (Vineland 2024)

Texture	Optimal bulk density (g/cm^3)	Sufficient Bulk density (g/cm^3)	Deficient/Poor Bulk density (g/cm^3)
Sands, loamy sands	< 1.60	1.60- 1.79	> 1.80
Sandy loams, loams	< 1.40	1.41-1.79	> 1.80
Sandy clay loams, loams, clay loams	< 1.40	1.41-1.74	> 1.75
Silts, silt loams	< 1.40	1.41-1.74	> 1.75
Silt loams, silty clay loams	< 1.10	1.11 -1.64	> 1.65
Sandy clays, silty clays, some clay loams (35 to 45% clay)	< 1.10	1.11 – 1.57	> 1.58
Clays (> 45% clay)	< 1.10	1.1.11-1.46	> 1.47

Table D-7: Bulk Density Values for Topsoil

Soil remediation depths

Soil remediation depths

The Soil Amendment and Decompaction Plan shall describe the application of restoring topsoil on-site and the preparation of the subsoil layer. If the site soil is not to be removed from the site, it is to be combined with approved compost and soil amendments that meets the specifications detailed in the tables D-2. Sub-soiling and rotary spading are to be used for incorporation/ blending with the existing soil.

Drainage and aeration are important for compacted soil under newly added soil or amended soils to drain well. With the addition of amendments, or the use of good soil on a site, drainage should be fine within that depth of modified soil. However, below the added soil there are often layers of poorly draining, compacted soil that can force excess water to ‘back up’ into the plants’ root zones. Water should drain freely through the replaced soil and the subsoils.

There are a number of mechanisms that can be used to de-compact soils and selection of methods will be determined by the amount of compaction on the project site and the proposed restoration. If a Project site is able to prevent compaction through mitigation methods and post construction testing shows minimal compaction, then the site will likely only require soil mixing for soil amendments, however for most sites the following will be applicable and depth and methods are to be outlined in the Soil Amendment and Decompaction Plan

Techniques for Decompaction in Areas with No Existing Trees

The decompaction of existing topsoil for areas to be planted are to be a maximum of 85% standard proctor density. If the primary goal is to maintain a loose, well-draining soil (e.g., for planting beds), a compaction level closer to 80%, is preferred.

Soil Ripping: Deep loosening of overly compacted soil by dragging a single or multiple shank plow through the soil at a specified depth and spacing.

Soil ripping requires heavy equipment to be able to operate in the space. Soil ripping can be performed over large areas by dragging a multiple shank plow (i.e., subsoiler) behind a tractor or wide tracked, low ground pressure rated bulldozer with the shanks oriented behind the tires or tracks of the machinery. In locations constrained by utilities or structures, soil ripping can be performed with an excavator or backhoe equipped with a single or multiple shank bucket ripper attachment. This improves drainage and over time loosens the soil between the rip lines. Ripping is not practical when soil moisture is close to or above field capacity.

Soil Fracturing: Deep loosening of overly compacted soil by using a toothed bucket excavator or backhoe to excavate and replace the loosened material to a specified depth.

The backhoe method of soil fracturing is more practical than soil ripping in small spaces and can be more selective in areas and depths to be loosened when constrained by utilities and structures such as sidewalks, curbs or walls. The backhoe digs into the soil, lifting and then dropping the soil immediately back into the hole. The bucket then moves to the adjacent soil and repeats. Fracturing is not practical over large areas (e.g., parks, sports fields) or when soil moisture is close to or above field capacity.

Decompaction and soil mixing are best completed in the scoop and dump method placing 10 cm of organics on the surface and then scooping and mixing up the organics with the soils beneath the organics.

Soil restoration sub-soiling and rotary spading shall not occur when the soil is wet (i.e. the surface soil is sticky). Ideal timing to conduct sub-soiling is when the soil is dry. Using a full-sized excavator with a single tine will enable effective sub-soiling, even in dry conditions when soil strength is high. Scarify or till subsoil using discs, harrows, or other suitable equipment that will loosen subsoil before placing any topsoil. Repeat sub-soiling in areas where equipment used for hauling and spreading topsoil has compacted subgrade soil. Other methods may be applied to incorporate organic materials and to allow for aeration such as air spading (pneumatic excavation or loosening) to break up the compacted soil.

Figure D-9: Shank for deep ripping (left) Toothed bucket backhoe for soil fracturing and de-compaction/(right)

Treat entire area which is to receive topsoil to depths required for vegetation installation as follows:

- Minimum 700mm for shrubs, small trees (<5m maximum height), and whips, to 1000mm depth of combined decompacted existing soil and amended or imported topsoil
- Minimum 900mm for large trees, to 1000mm depth of combined decompacted existing soil and amended or imported topsoil.

Techniques for Decompaction in Areas with Existing Trees

In areas in which restoration is to occur within or adjacent to forested areas in which damage to existing tree roots is a concern, decompaction requires special techniques.

Radial trenching with an AirSpade is done to modify soil composition, improve aeration, and encourage root growth. This application can be useful in planting areas where disturbance needs to be isolated. It may be preferable to augment soil within radial trenches with a higher percentage of porous inorganic materials (such as sand) to improve aeration and to then amend the topsoil with a higher percentage of organic nutrients using the more uniform air tilling (or root invigoration) procedure.

Typical methodology includes excavation with an AirSpade with eight trenches from the trunk of the tree radially out 6m. The excavated trench shall be 30cm wide and 50cm deep. A further eight trenches will start at 2m from the trunk and finish at the 7m mark, these will be the same depth and width, and be centred between the longer trenches. The trenches should be filled with a sandy loam with 10% well composted mulch and mycorrhizal supplement as well as fertilizers appropriate for the proposed plantings and existing trees present. The replacement soil will be installed in two lifts of 25cm, between lifts the soil will be walked on once. The entire area to be covered in 10cm of composted wood mulch which can be mixed in to the top 25 cm of soil.

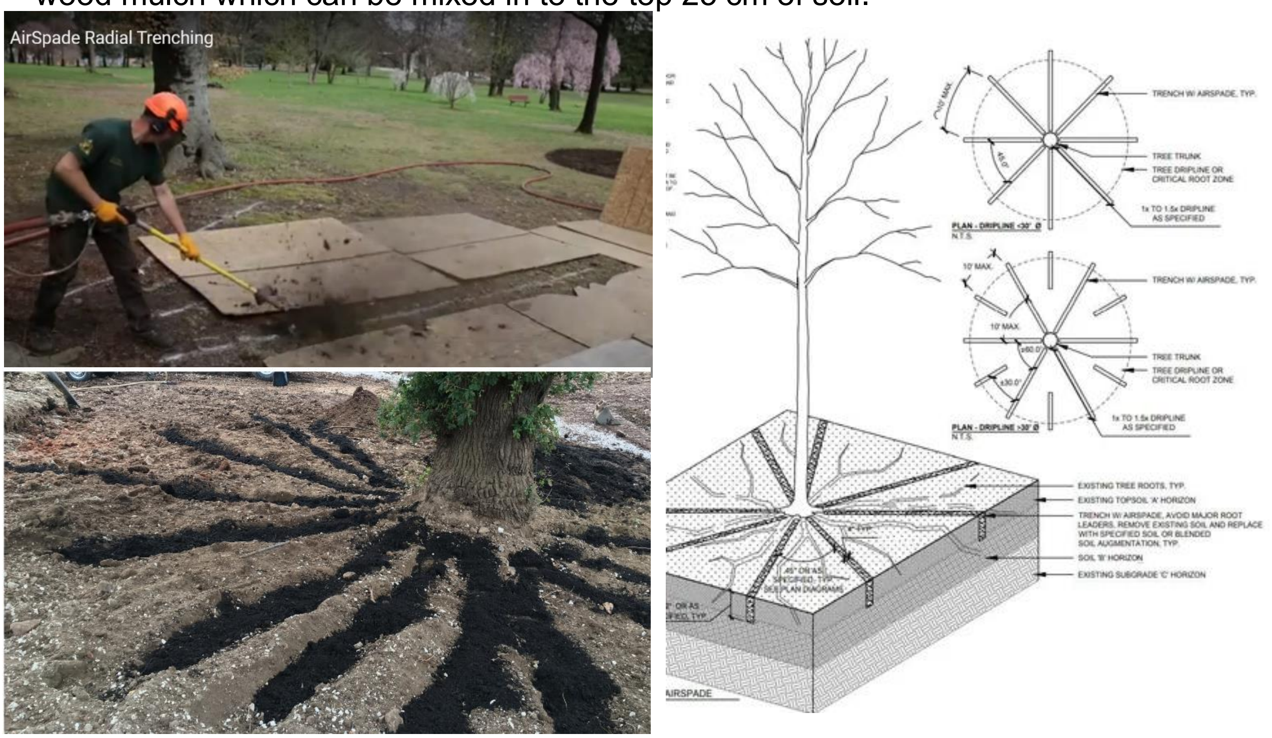


Figure D-10: AirSpade courtesy of Pneumatic Soil Excavation Division of Guardair Corporation Chicopee, MA at: https://www.airspade.com/blogs/educational-library/radial-trenching

Vertical mulching is a technique used to assist in alleviating soil compaction within the critical root zones of trees (i.e. area under the tree canopy or in areas considered for edge plantings). This technique allows necessary aeration during wet periods and sub-soil water penetration during dry periods. This technique allows for the addition of organic matter directly into the soil and around the root system which further promote beneficial soil biological activity (worms, mycorrhiza etc). Use a mechanical auger with a 7.5 cm drill bit to create holes that are 7.5 cm wide and 30 cm deep. The holes should be arranged in a grid pattern under the tree canopy with a 50 cm spacing between holes. Dispose of the soil dislodged by the auger and fill each hole with a diluted liquid fertilizer. The liquid fertiliser used and dilution rate (1:100 or 1:50) will depend on the results of a soil nutrient analysis. Once the liquid fertiliser has drained away refill each hole with the following blend of fresh soil: Biochar (5%):John Innes Soil No 2 or 3(50%):Multi-Purpose Compost (40%): Slo Release (6-12 month) inorganic or organic fertiliser (5%). Add microbial inoculants, pH amendments - Cover the entire treated area with 10cm layer of woodchip mulch and protective fencing once plants are installed.

Surface treatment of Woodchips and compost improve soil and tree health due in most instances to increased soil building organisms. For weed suppression and moisture retention for plantings 15 cm of mulch is suggested but for disturbed soils suggest up to 30 cm depth of mulch. Note that installation of mulch on top of compacted soils will not lead to healthier soils, compost is to be mixed into the topsoil.

E. Application of Soil amendments

Mycorrhizal Fungi

Biological: mycorrhizal fungi grow on the surface layers of the roots colonizing plant roots. In exchange for carbon from the plant, mycorrhizal fungi help solubilize phosphorus and bring soil nutrients (phosphorus, nitrogen, micronutrients) and water in a form the roots can absorb. Mycorrhizas are fungal associations between plant roots and beneficial fungi. The fungi effectively extend the root area of plants and are extremely important to most wild plants, but less significant for garden plants where the use of fertilizers and cultivation disrupts and replaces these associations. It is important to add this to any soil amendment plan.

Consider using biostimulants to improve phosphorus availability in soil with high pH and calcium. Calcium can bind up available phosphorus and make it unavailable for uptake by roots. Biostimulant components include microorganisms, plant and algae extracts, amino acids, humic substances, mineral salts and some chemicals with biostimulant properties. Unlike fertilisers, which directly supply nutrients to plants, biostimulants stimulate the plant's own processes to better utilise nutrients and water. They increase availability of phosphorus as the microorganisms can mine the phosphorus and make it plant available. The application of plant growth-promoting rhizobacteria (PGPR) Bacillus *subtilis,* which is a common PGPR present in rhizosphere, can interact with plants directly for enhancement of nutrient uptake (macro and micronutrients), Bacillus-Loaded Biochar as Soil Amendment is an excellent substitute to fertilizer. (Vineland Research and Innovation Centre, 2019).

Amending Soils with Organic Material

The most important amendment and the one required for almost all planting sites is the addition of organic materials mixed into the topsoil in parallel with decompaction. The on-site soil restoration process, in which disturbed, compacted urban soil is improved by adding an organic amendment is preferred when topsoil is present on-site, but is degraded (e.g. compacted soil, low nutrients, low soil organic matter, etc.).

Organic matter content and compaction also affect the total water capacity and available water capacity of soil. Organic matter increases the ability of soil to hold water, both directly and indirectly. Compaction increases bulk density and decreases total pore space, reducing available water capacity. Organic amendment can have beneficial effects in reducing soil density to below root-limiting levels, even in soils that had been re-compacted after the amendment was added.

Soil organic carbon is linked to numerous soil functions but is also the major carbon sink in terrestrial ecosystems and is thus critical for climate change adaptation and mitigation strategies and is good indicator of soil degradation or recovery.

Soils with low organic matter content typically exhibit a low cation exchange capacity (CEC). A CEC reported on a soil test is estimated using the reported K, Mg and Ca values. The reported values are converted to milli-equivalents per 100 g of soil (meq/100g) and added together to estimate the CEC. Organic matter provides more exchange sites than clay therefore increasing organic matter raises soil CEC. A higher CEC value (30 to 50 meg/100g) results in a higher capacity to hold nutrients and water in the soil available for plant growth.

Soil Respiration measures microbial activity. Carbon dioxide (CO_2) is the product of oxidation of active organic matter. The more CO_2 that is respired, the more active organic matter is in the soil.

Application of Organic Matter

The correct way to add organic matter is over a site, not in a hole. The amendment should be tilled or dug into a depth of 40cm and enough added to make a measurable difference. With a compacted sandy loam, it is necessary to add at least 25% by volume to the entire 40 cm depth profile to make a positive change in soil density and drainage. 10 cm of compost should be added over a site and then a backhoe should dig down to 40 cm- 50 cm, picking up the soil and compost and then dumping the mixture on site. This provides veins of compost that aid in plant establishment. In a compacted, heavy, clayey soil, at least 50% of organic matter would have to be added to the same depth to decrease soil density below root limiting thresholds. Therefore, with a heavy, clayey soil, amendments should be added to reduce bulk density; however, plants should still be chosen that could tolerate intermittently wet soils due to soil conditions. A sustainable source of compost is recommended, and there may be other issues that will need to be addressed when using compost. Organic amendments should always be well-composted, and a lab test run to verify pH, soluble salts, nutrient availability, and organic matter content. Moreover, if the amendment is too fresh and not well-composted, there may be high soluble salts, an abundance of weed seeds or wood chips, which can tie up some soil nitrogen while they are decomposing. (Cowett, 2014).

Application of Amendments:

It is recommended to use a bucket with an articulated edge to grab, mix and dump soils. A backhoe is suitable to fracture soil and retain aggregation. In general, select the smallest equipment on the driest soils with the least passes. Document all amendments applied to soils and mixing techniques to meet optimal or sufficient thresholds including:

(a) Apply and evenly spread soil amendments at the specified rate as recommended in soil analysis report and as discussed in the Table D-4.
(b) Emulate the natural soil profiles while ensuring transition zones to prevent "cake layering" stratification.
(c) Imported soils and reused soils are to be placed in lifts of 15cm with a maximum of 25 cm per layer.
(d) Mix soil amendment well into full depth of topsoil. Retest amended topsoil as described in Sections 1.7 and 1.8 of Vineland 2021.
(e) At a minimum add 15% compost volume to existing soils
(f) DO NOT WORK SOIL WHEN WET this will cause increased compaction and destroy soils, with the most sensitive being clay soils.

F. Verification of Healthy Soils prior to Planting

Refer to Project Requirements, agreements and any municipal permitting conditions for project phase and timing of inspections and testing as described in Section C. The Soil Amendment and Decompaction Plan shall provide clear recommendations and direction for required soil amendments to address sub-optimal soil conditions. Healthy soils shall be described in relation to the properties below and a table created to demonstrate the presence of optimal to sufficient values required for successful restoration:

A. Biological properties - Quantity and quality of organic matter, and microorganisms
B. Physical properties - Soil texture and structure
C. Chemical properties - Soil nutrient, pH and contaminants
D. Hydrological properties - Evaluating infiltration rates and water retention capabilities that influence the availability of water to plant roots

Testing is to be completed, and records of amendments submitted to verify healthy soils.

- Compaction testing shall be performed every 25 m² of growing medium surface for smaller sites, and for every 100 m² on larger sites with a minimum of three measurements per planting area. All other testing to follow frequency outlined in Section C.
- Maintain a record log of all amendments. The record log shall include the date, location, depth and pressure reading of each test. Test location data shall be plotted on a site plan.
- Depth and compaction must be verified in the field at the completion of the works, prior to planting.
- Post-installation topsoil depths are best measured using soil pits.

Soil Amendment and Decompaction Plan to include at a minimum:

A. Vegetation species specific requirements for restoration success
B. On site Soil Management
    i. Soil storage and reuse
    ii. Soil Mitigation for on / adjacent to site soils
C. Soil sampling and testing results
    i. Requirements for Healthy Soils for restoration
    ii. Identification of existing soils conditions and assessment of measurements that do not meet optimal/ sufficient soil specifications Table D-5.
    iii. Imported Soils for Restoration specifications
D. Identification of soil decompaction depths
    i. Compaction prevention
    ii. Methodology for decompaction
E. Description of and methodology for application of amendments- including organics and mulch.
    i. Mycorrhizae application
    ii. List of Soil amendments including Organic Material
F. Verification of Healthy Soils prior to Planting

Table D-8: Soil Reporting Template

Test Description	Optimal thresholds	Sufficient Thresholds	Sample 1	Sample 2
Topsoil depth (cm)	50			
Topsoil texture class				
Topsoil Organic Matter (%)	15			
Topsoil Soil Respiration (mg/g)				
subsoil depth (cm)	100			
subsoil texture class				
Subsoil Organic Matter (%)	4 - 15			
Subsoil Soil Respiration (mg/g)				
bulk density (g/cm3)	< 1.4			
pH	5.5 - 7.5			
Total Salts (mmhos/cm)	< 1.5			
Phosphorus (ppm)	10 - 60			
Potassium (ppm)	80 - 250			
Calcium (ppm)	1000 - 4000			
Magnesium (ppm)	100 - 300			
Sodium (ppm)	< 200			
Sodium Adsorption Ratio	< 15			
CEC (meq/100g)				
Chloride (ppm)	< 100			
Sand (%)	20 - 75			
Silt (%)	5 - 50			
Clay (%)	5 - 30			
UTM coordinates (location)				

Table D-8 describes minimum reporting information required for existing conditions and restored areas for restoration. All values that are not considered optimal or sufficient for plant growth and success are to be highlighted in bold. Please include table as an excel file with locations of samples on a map. Proposed amendments are to be listed with clear quantities, application methods and confirmation of healthy soils by the urban forester or landscaper supporting the planting. For imported topsoil and compost refer to Tables D-3 to D-5.

Soil Restoration Considerations

1. In preparation of developing the soil restoration plan ensure all relevant data is obtained including the review any existing soil testing as part of geotechnical and/ or Phase 2 ESA soil quality/ groundwater reporting to ensure soil qualifies for re-use.
2. Ensure good construction practices are implemented – prevent high pH from salt application and concrete washout in and around soils that will be used for plantings on site or around topsoil storage locations.
3. Review site specific requirements as soil restoration may vary per municipality and soil amendments may vary based on vegetation species type being restored.
4. The Contractor shall reuse (rather than remove or replace), as feasible, as much soil on the lands as possible in a manner that is consistent with Ontario Regulation 153/04, Ontario Regulation 406/19 and the MECP's Rules for Soil Management and Excess Soil Quality Standards.
5. Remove foreign materials resulting from construction operations, including contamination, stone, gravel and other construction material from the existing soil surface.
6. Identify machinery required for decompaction based on site conditions and size, and decompact the soil and subsoil to a minimum of 900mm.
7. Work backwards to avoid driving on the decompacted soil.
8. Remove any foreign materials unearthed from sub-soiling (i.e., large boulders, concreate, rebar, etc.).
9. Add soil amendments including compost over the decompacted soil to a depth of one meter. Use tracked equipment as to not re-compact the soil that has been disturbed.
10. Incorporate the organic amendment into the decompacted soil to a depth of 450 - 500mm. Check the incorporation depth to ensure the required depth is met.
11. Ensure subsoil and topsoil meet soil quality and decompaction requirements to a depth of one meter for restoration areas. Installer is to provide a Planting Soil that meets healthy soils requirements.
12. Ensure handover condition is agreed upon with municipality, if required. Soil acceptance should occur prior to any planting.
13. Evaluation Test is to be submitted to Metrolinx and applicable Municipality for their review and acceptance.
14. Apply terraseed in phases as final grading is completed prior to landscape installation to prevent riling or degradation of soil prior to planting season.

APPENDIX E: BREEDING BIRD ACTIVITY PROTOCOL

Protocol for Surveys for Nesting Birds and Best Management Practices

Migratory bird species, including their eggs and nests, are protected under the Migratory Bird Convention Act (1994). The Act prohibits the killing, injury, or harassment of migratory birds and the damage, destruction, disturbance or removal of a migratory bird nest[1]. The nests of 18 species (listed in Schedule 1 of the Migratory Bird Regulations, 2022), whose nests are reused by migratory birds, continue to have year-round nest protection unless they have been shown to be abandoned. To be considered abandoned, the Minister must be notified via an online registration system (the Abandoned Nest Registry), that the nest does not contain a live bird or viable egg; and the nest is to remain unused by migratory birds during the designated wait time for that species. Damaging or destroying a nest of species listed under Schedule 1 is prohibited at any time of year until the nest has been abandoned, registered, and the designated time period has passed per the regulations.

Vegetation removal shall not occur in naturalized, large and/or complex[2] habitats during the breeding bird window (generally April 1 to August 31 in southern Ontario but is weather dependent and can begin earlier and end later; it is the Project Team's responsibility to ensure no breeding birds are disturbed regardless of the calendar date). Bird nest and nesting behaviour surveys to confirm absence of nests prior to removals during the breeding bird window are only appropriate for use in simple[2] habitats. Simple habitats as described by Environment and Climate Change Canada (ECCC) includes anthropogenic structures, urban areas made mostly of manicured lawn with few and isolated trees, or areas with sparse vegetation. See definitions of simple and complex habitat below. Simple and complex habitats shall be delineated in the Natural Environment Report but may also be identified in the Arborist Report to specify which trees are in simple or complex habitats.

Bird nesting behaviour surveys should be conducted within 24 hours, or if within the active rail corridors, 48 hours prior to any vegetation removals taking place. Surveys should be conducted by or under the direction of a qualified avian biologist who has demonstrated bird survey experience. Individuals conducting the nesting behaviour surveys should have a background in birding, bird identification, and bird biology, and should be trained in the appropriate survey methods with at least five years' experience with conducting such surveys.

To ensure the survey does not impact nesting success, surveys are to be completed passively to locate nests. The avian biologist will base nesting activity on behavioural cues to locate nests. These may include behaviors such as adults transporting nest building material, adults carrying fecal sacs away from the nest, adults bringing food to

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[1] With some exceptions for certain species.

[2] The use of 'simple' and 'complex' habitats in this appendix is only used to describe habitat complexity in the context of determining whether a nest sweep is appropriate as per ECCC guideline. These are not defined terms that should be used outside of this context.

the nest, young begging for food, adults giving alarm calls or exhibiting agitated behavior. Surveys to observe breeding bird behaviours (e.g., territorial singing and foraging) are to be completed during early mornings hours before 9 am.

If a bird nest is found the nest must be protected from destruction or disturbance until fledging is confirmed by a qualified avian biologist (which can take up to 4-6 weeks, depending on the species) or until the designated wait time has been reached (for Schedule 1 species of the Migratory Bird Regulations). Nest protection is required when works will be conducted in the general nesting area and involves the delineation of a species-specific nest setback (buffer) within which works are prohibited.

If nests or nesting behaviour is observed, the avian biologist determines the buffer size that is to be applied around the nest or observed breeding activity that can range from 10 meters to 1 kilometer depending on the species and based on ECCC guidelines. It is recommended that the avian biologist is accompanied by someone familiar with the project works proposed as communication will be necessary between the avian biologist and clearing crews to ensure that clearing crews are kept apprised of what areas are free-to-clear and what areas are off limits for what period of time. Surveys should be followed by a daily written communication submitted to Metrolinx as soon as possible summarizing the results of surveys, the locations and buffer sizes of any nests observed, and the vegetation cleared.

Complex Habitat: is large and/or intricate habitat with many potential nesting areas, such as scrubland or woodland, or any habitat that does not fall into the Simple Habitat description according to ECCC guidelines.

Simple Habitat: is described in the ECCC guidelines and includes an urban park consisting mostly of lawns with a few isolated trees, a vacant lot with few possible nest sites, a previously cleared area which might attract ground nesters, a human-made structure (bridge, beacon, tower, and building), human-made settings or those with few potential nesting spots or few species of migratory birds.

APPENDIX F: EDGE MANAGEMENT MITIGATION AND MONITORING

Edge Management

Woodland or forest edges are sunnier, warmer, windier, drier and experience more dramatic environmental changes than the interior habitat (**Figure 1**). To mitigate the impacts of active construction and permanent infrastructure near woodlots, an edge management plan is required, and this will in most cases include plantings and maintenance of the edge as well as monitoring of the interior forest or woodland health.

The most effective edge to buffer from construction effects will have multiple vegetation layers from the ground to the canopy including grasses, shrubs and fast-growing small trees and conifers. This layering will assist in blocking excess light and noise; slow down, spread out and filter water runoff; clean the air of construction dust particles; and make it more difficult for invasive species to reach interior habitat.

Edge management applies to projects where a new woodland or forest edge is being created and/ or where works are within 30 meters of a woodland or forested area. A Forest Edge Management Plan is to be developed by the contractor in parallel with design and supported by multiple disciplines including the ecologist/biologist and storm water engineer, it is to be clearly identified in project phasing with any edge plantings installed to precede tree removals and grading.

Edge plantings as part of the contractor's Forest Edge Management Plan are required when works are within the dripline of a woodlot or grading is prosed with 5 meters of the dripline of the woodland or forest edge. Strive to install plantings a minimum one year prior to vegetation removals prior to active construction or in the spring of the year removals occur to mitigate edge effects for woodland or forested areas. If the contractor does not have access to the site a year prior to impacts, Metrolinx may choose to undertake edge plantings pre-emptively.

It's generally recognized that forest interior habitat starts at least 100 metres from the edge of the forest. Edge habitat includes the part of a forest or woodland next to open habitats like meadows and farm fields or human-created environments like roads and buildings. The forest interior is less windy as the trees along the edge act as windbreaks. This leads to less non-native plant seeds, like garlic mustard, getting blown in. The dense shrubs and trees along the edge protect the interior forest from sunlight and desiccation (drying) resulting in the interior forest being cooler and shadier. This makes it more damp compared to the edge. This is vital to maintain pools of water that wildlife need to live in including aquatic insects. The edge also protects the interior from noise effects which makes it easier for wildlife to avoid predators; attract a mate and use sound to navigate.

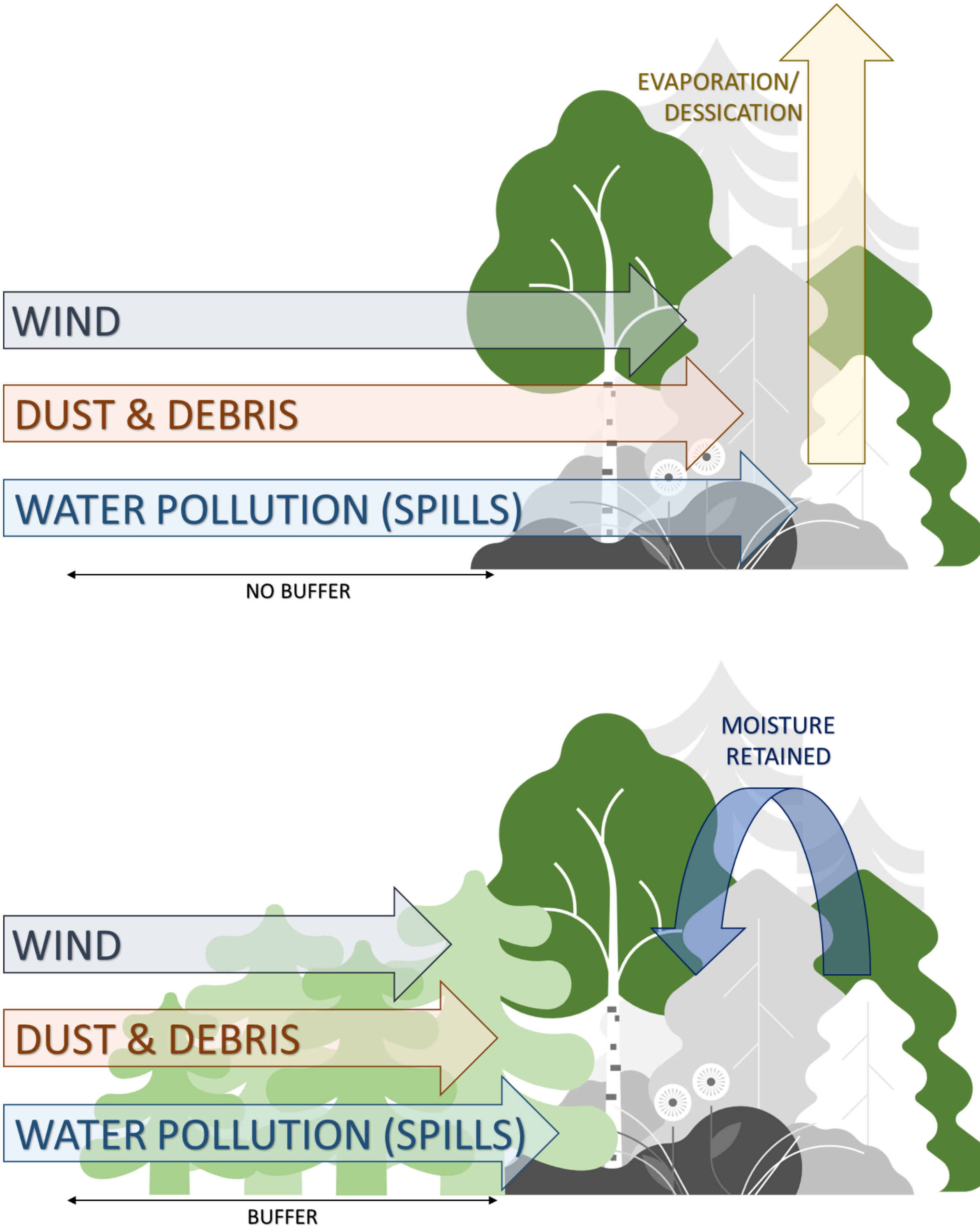

Figure 1. Illustration of wind, dust, debris and water pollution penetration into a wooded area where there is no naturalized buffer (top) and where there is a naturalized buffer (bottom). Illustration is based on King Township: https://www.king.ca/naturalizedbuffer

Edge Planting

Edge plantings as part of the Forest Edge Management Plan are required when works are within the dripline of a woodlot or grading is proposed within 5 meters of the dripline of the forest edge. Any trees identified for transplanting shall be considered for relocation into the edge plantings as relocation and edge plantings are to occur prior to construction beginning.

Refer to **Appendix I** for details of plant selection and planting methods. Planting of dense shrubs and trees where applicable including fast growing and slow growing species to mirror current ELC and healthy edge characteristics (**Figure 2**). Sizing may range from 1 to 2 gallon and larger if creating a new edge.

Provide planting list for input and approval by landowner and or municipality, Conservation Authority, and Indigenous engagement where applicable.

Shrubs to be planted 1 meter on center as dense edge planting with trees to be planted where openings allow at density of 2 meters on centre.

For edge plantings 100% of dead or dying stems will be infilled seasonally during construction and see appendix I for successful planting requirements.

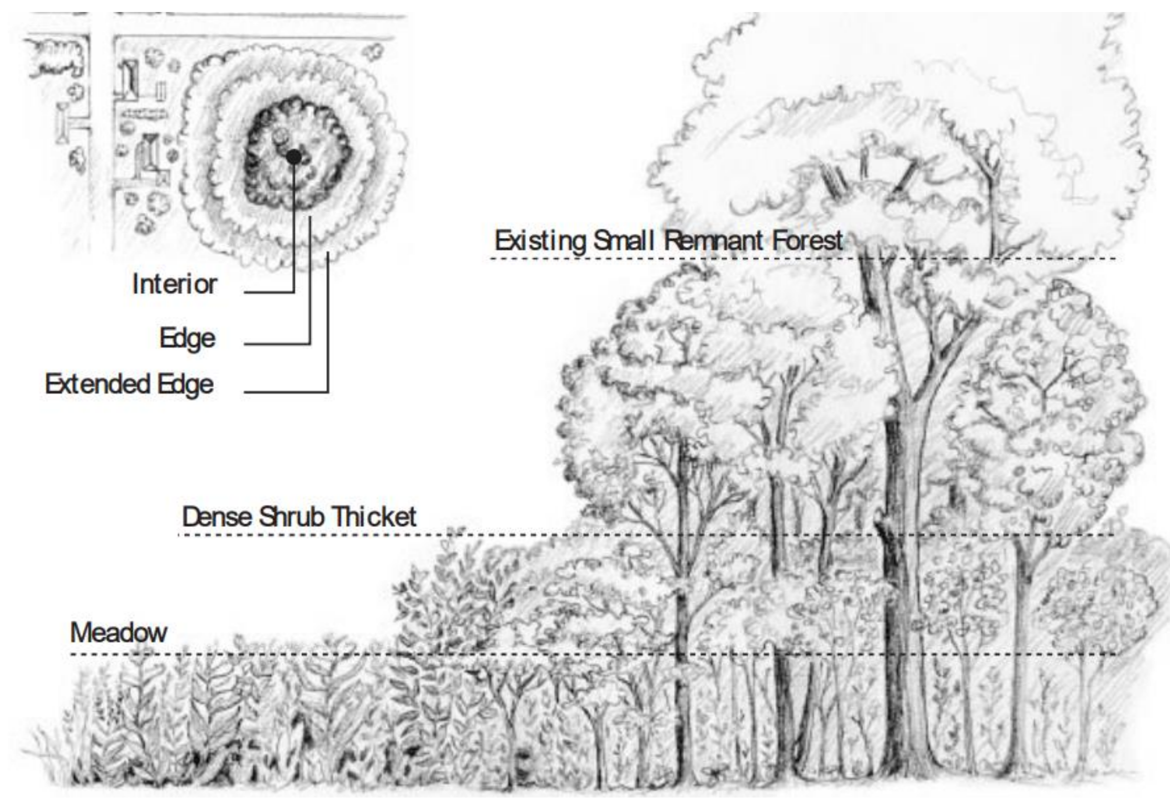

Figure 2 - Image from Conserving the forest interior a threatened wildlife habitat and Owner Resource Centre Ontario Ministry of Natural Resources http://www.lrconline.com/Extension_Notes_English/pdf/forInterior.pdf

Soil Restoration

If edge plantings are to take place outside of an existing woodland or forest, for example, between the construction footprint and the wooded area, soil restoration should occur as part of site preparation for the edge plantings. Site preparation should be undertaken by the contractor or whoever is installing the edge plantings. Aside from surficial mulch application, ground-disturbing soil amendments should not be practiced in existing woodland and forest edges. Soil decompaction and soil amendments in open spaces is typically completed using vertical mulching/ airspade (see Healthy Soils **Appendix D**)

Soil amendments within dripline of trees:

For areas being planted in and around existing mature trees soil decompaction and amendments will have to take care to not damage tree roots.

It is suggested that the following methodology be implemented:

a) Excavate with an airspade 8 trenches from the trunk of the tree radially out 6m, the excavated trench shall be 30cm wide and 50cm deep. A further 8 trenches will start at 2m from the trunk and finish at the 7m mark, these will be the same depth and width and be centred between the longer trenches. The trenches should be filled with a sandy loam with 10% well composted mulch and mycorrhizal supplement as well as fertilizers appropriate for the proposed paintings and existing trees present. The replacement soil will be installed in two lifts of 25cm, between lifts the soil will be walked on once. The entire area will be covered in 10cm of composted wood mulch and fenced off once plantings completed.
b) Use a mechanical auger with a 7.5 cm drill bit to create holes that are 7.5 cm wide and 30 cm deep. The holes should be arranged in a grid pattern under the tree canopy with a 50 cm spacing between holes. Dispose of the soil dislodged by the auger and fill each hole with a diluted liquid fertilizer. The liquid fertiliser used and dilution rate (1:100 or 1:50) will depend on the results of a soil nutrient analysis. Once the liquid fertiliser has drained away refill each hole with the following blend of fresh soil: Biochar (5%):John Innes Soil No 2 or 3(50%):Multi Purpose Compost (40%): Slow Release (6-12 month) inorganic or organic fertiliser (5%). Add microbial inoculants, pH amendments. Cover the entire treated area with a 5-10cm layer of woodchip mulch and protective fencing once plants are installed.
c) When planting proposed are outside existing dripline of mature trees decompaction using a tiller is acceptable. Churning the soil allowing for greater aeration, drainage, ease of planting and plant survivability. Composted mulch and mycorrhizal supplement as well as fertilizers should be mixed into the soil using a Khun tiller, further promoting aeration and drainage while also providing an organic additive to the soil. This organic component will lend nutrients to the soil and plants during their critical transplanting and development stages.

Site Access Approval: Ensure proper access agreement, traffic plan, utility locates and any other approvals are obtained prior to implementation as edge plantings typically occur on adjacent properties and not within project limits.

Monitoring for Plantings and Existing Edge

In addition to monitoring described in Appendix I for plantings, there are other monitoring requirements for projects working adjacent to woodlands/forests. Monitoring should foremost be conducted by the contractor, who has control of what is happening in the adjacent construction site. A second line of monitoring can be undertaken by the Technical Advisor, or whoever performs the weekly Environmental Site Inspections on behalf of Metrolinx. Because of the complexity of the urban environment and the sensitivity of remnant woodlots monitoring is to be completed by a Registered Urban Forester who demonstrates experience managing trees as well as the associated biotic and abiotic components in small communities and the interstitial areas between woodlots and urban surroundings with the ability to:

- identify tree and shrub species,
- assess condition of trees and shrubs (health),
- identify factors contributing to poor health,
- trace poor health to onsite construction, and
- provide recommendations for mitigation.

Monitoring Reporting

Monitoring shall include an annual assessment of changes to health of woodland/forest edges and where applicable forest interior, including the monitoring and reporting of:

- General health
- Sunscald
- Windthrow
- Desiccation
- Potential root or branch damage
- The presence of chlorosis
- Mortality / dieback
- Evidence of pests or diseases
- Soil moisture
  - Seasonal data
  - Soil moisture weekly data
  - Record of watering
- Recommendations
- Mitigations
  - Short term
  - Long term

Monitoring the edge plantings can provide an indication of the health and conditions of the interior woodlot. For example, if edge plantings are dying due to drying out, it may be an indication of changes to surface water runoff due to adjacent construction practices. Replacement plantings of all dead or very poor condition plantings is required each spring during active construction with yearly monitoring and maintenance to continue for five years post construction. Notes collected on monitoring of edges to be included in weekly Erosion and Sediment Control reporting during active construction and ensure surface water flows are maintained through monitoring of plant health.

Monitoring Timelines

Depending on construction phases, additional monitoring, recommendations and mitigations will vary with some guidance below.

- Preconstruction assessment of existing conditions
- Seasonal monitoring for plant condition, IVM and replacement
- Weekly edge observations and moisture data conducted during active construction during ESC weekly monitoring and reporting

Active Construction Mitigations

- Look for mortality, evidence of pests, disease, desiccation, sunscald, loss of herbaceous coverage, soil moisture Too dry/ too wet, sediment deposition; example mitigations provided below:
    - *identify the cause of mortality/health decline based on construction activities on site*
    - *identify duration of activity and if mitigation is needed*
    - *If too much water, redirect water to storm, sanitary, or use pea gravel bags along edge*
    - *If too little water, truck water from off site to water the edges in the short term*
    - *If construction the construction schedule necessitates a long-term impact to water availability to the woodland/forest, changes to the construction sequencing should be explored to find a long-term solution*
    - *Indirect observation of rilling (indicates concentrated flows, erosion in woodlot or edge)*
    - ESC measures, a sediment release or grading blocking sheet flow of water into the woodland
    -

Post construction

- Look for concentrated flows vs sheet flow and obvious signs of rilling resulting in the need for regrading

Triggers

Development of triggers linked to observations and appropriate mitigation based on above:

- Mature, established woodland or forest trees exhibit signs of deteriorating health, particularly in the late summer/early fall.
- Newly planted edges exhibit signs of deteriorating health at any time of the year.
- Signs of deteriorating health:
    - Sunscald
    - Windthrow
    - Desiccation
    - Potential root or branch damage

- The presence of chlorosis
- Mortality / dieback
- Evidence of pests or diseases

Presence of the above in vegetation adjacent to construction activities should trigger a response from the contractor, including examining the construction practices and if any changes can be made to activities or schedule to decrease the apparent impacts to the adjacent woodland or forest.

Examples of a site-based trigger could include comparison of the health of the woodlot with nearby, comparable woodlots.

Maintenance (Watering, IVM)

The maintenance of the edge plantings is to be conducted by the installer who has warranty over the health of the plants. Ultimately, the Contractor performing construction adjacent to the woodland or forest is responsible for the survival of the edge plantings. In addition to the maintenance outlined in Appendix I the following applies:

- Temporary irrigation system to be installed or watering program shall be conducted twice weekly during the months of May to October for the first two years after planting when the planting location receives less than 25 mm of rain per 7-day period measured Monday to Sunday. Watering is provided to ensure plants have adequate water to establish as their root systems develop.
- Invasive Plant Species shall continue to be removed and managed (as per project IVM Plan or Ontario Invasive Plant Council recommendations) during active construction and post construction period.
- Replacement of all plants for the first 5 years after planting with a minimum of 80% coverage at end of construction.

Refer to **Appendix C** for root protection and pruning to be completed prior to any exaction or construction.

Additional Resources though not exhaustive will enhance edge management and mitigation:

- For Erosion and Sediment Control follow TRCA's Erosion and Sediment Control Guide for Urban Construction 2019.
- For Wetland Water balance follow TRCA's Wetland Water Balance Risk Evaluation
- For wildlife encounters refer to the Ontario Species at Risk Handling Manual

APPENDIX G: EVALUATION OF IMPACTS, REPLACEMENT, RESTORATION AND REUSE IMPLEMENTATION FLOWCHARTS

Field Work, Initial Reports, Plans and other Documents

- Identify potential DNA through desktop exercise prior to field work
- Invitation to Indigenous communities to participate in field work as applicable
- Identify/confirm DNA, SAR, other significant trees and lumber quality trees during field work
- Identify sensitive features and proposed tree removals, injuries and vegetation reuse opportunities based on initial design
- Provide recomendations to reduce impacts through Mitigation Memo
- Prepare Natural Environment Report, IVM Plan and Integrated Arborist Report following Metrolinx Integrated Arborist Report Template*
- Identify mitigation measures and BMPs (e.g. timing windows, pruning and translocation methodology, etc.)
- Prepare high-level Landscape and/or Restoration Plans based on initial compensation calculations

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Engagement with Indigenous communities and Stakeholders

- Circulate applicable Reports, Plans and other documents with Indigenous communities and Stakeholders
- Identify bio-culturally significant species, DNA and other trees of interest based on IK/TEK and stakeholders feedback
- Identify concerns and feedback including sensitive features and specific trees to be avoided
- Provide feedback and recommendations to Landscape and/or Restoration Plans

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Re-evaluation of Environmental Impacts and Report, Plan and Document Revision

- Additional and/or confirmatory site investigations are conducted as required
- Assess and adjust the design following the mitigation hierarchy and Mitigation Memo as well as feedback received
- Revise Natural Environment Report and Integrated Arborist Report to incorporate design changes and address feedback
- Prepare more detailed Landscape and/or Restoration Plans based on initial feedback
- Develop replacement commitments for both vegetation and natural heritage feature loss.
- Start permit application(s) process as applicable (e.g. tree removal permit, SAR permit, conservation authority VPR, etc.)
- Initiate communications with local residents and acquire Permissions to Enter (if applicable)

↔

Engagement with Indigenous communities and Stakeholders

- Circulate applicable revised Reports, Plans and other documents with Indigenous communities and Stakeholders
- Confirm the changes address concerns and feedback. Feedback may result in further revisions in previous step
- If all concerns cannot be addressed, discuss alternatives with Indigenous communities and Stakeholders
- Identify vegetation reuse and tree end use opportunities where removal of bio-culturally significant, SAR, and other significant trees cannot be avoided

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Implementation (Removals and Restoration)

- Acquire all applicable permitting as required (e.g. tree removal permit, SAR permit, conservation authority VPR, etc.)
- Conduct on-site and off-site restoration plantings and habitat creation for permanent loss before or in parallel with tree removals (where possible) - See Restoration Implementation Flowchart (Appendix C)
- Conduct tree removals, injuries, translocations, and pruning following Integrated Arborist Report and permit requirements
- Conduct applicable vegetation reuse: seed collection, plant rescue, tree end use preparation, etc.
- IVM begins in construction and continues in operations
- Conduct maintenance and monitoring and fulfill warranty requirements of plantings as per the Landscape and/or Restoration Plan

TRPAP/ 10% Design → 30-60% Design Stages → 90-100% Design/ Construction

* Please refer to most up to date Metrolinx Integrated Arborist Report Template for tree inventory, arborist report and restoration plan requirements.

Figure G-1 : Evaluation of Impacts, Restoration and Reuse Engagement and Consultation Flowchart

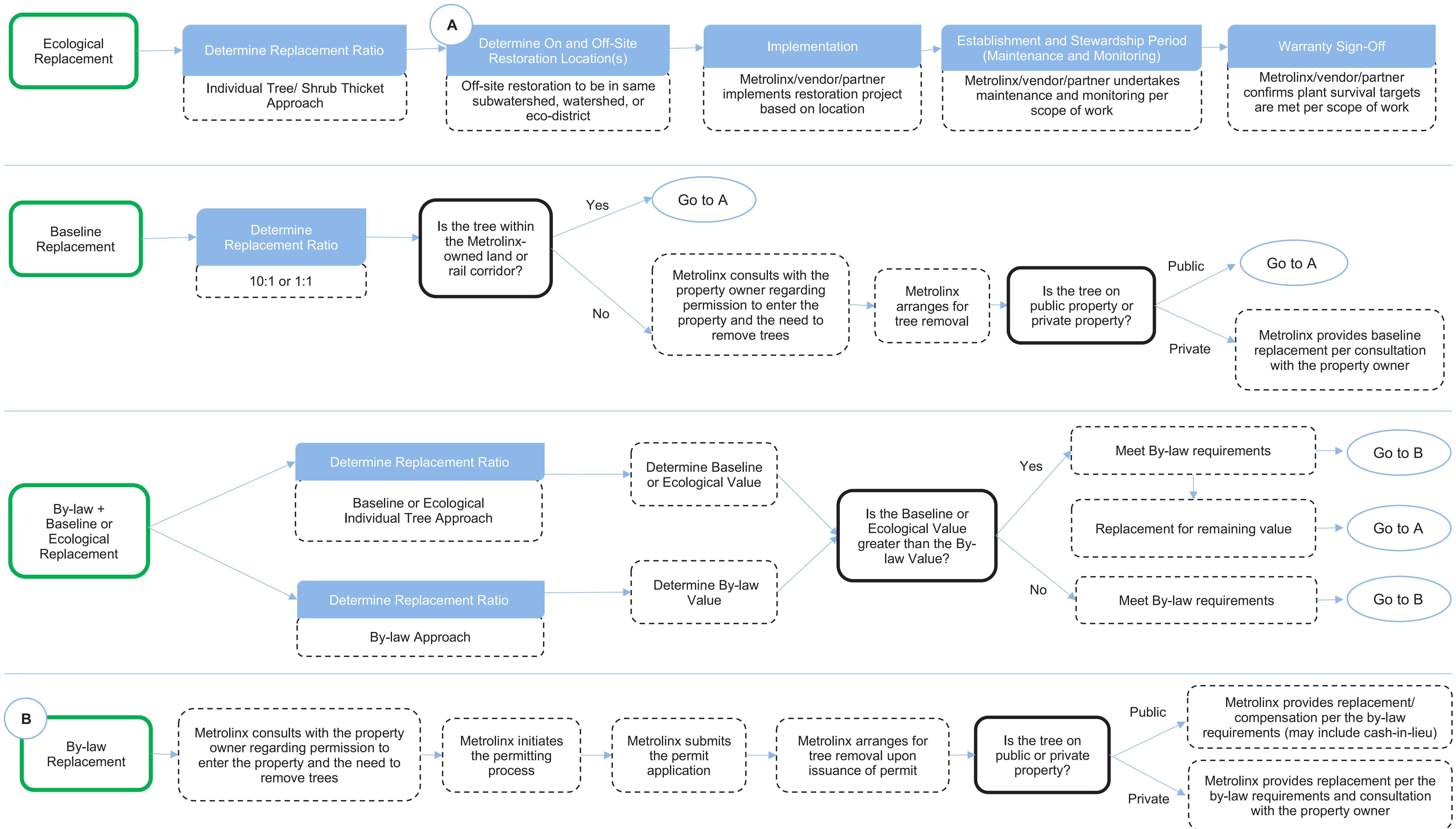

Figure G-2: Tree Replacement and Restoration Implementation Flowchart

APPENDIX H: GENERAL PRINCIPLES OF IMPLEMENTING RESTORATION & ECOLOGICAL RESTORATION BUDGET ITEMS

Compensation through ecological restoration should involve the following components or considerations and be included in restoration and landscape plans. Therefore, restoration plans including specifications relating to careful native plant selection, healthy soils, IVM, watering, planting maintenance and monitoring following the Guideline should be included within contract documents.

Considerations for planting location and siting:

- Engagement and consultation with Indigenous communities;
- Proximity to tree removals (preference is for plantings to be in the same municipality and sub-watershed or watershed where feasible);
- Contiguous to the existing natural system;
- Land ownership and designation to preserve conservation indefinitely;
- Land availability;
- Identification of impacts to adjacent property owners and ability to provide robust native tree and shrub buffer for natural screening;
- Planting of appropriate native species for access, layover and ROW areas;
- Ecosystem connectivity;
- Ecosystem configuration; and
- Accessible to Indigenous communities.

Ecosystem Type Considerations:

- Restoration to be based on on-site, existing conditions; historic vegetation communities and restoration potential (e.g. vegetation communities based on Ecological Land Classification (ELC), recognizing that the impacted ELC may not reflect the natural community type that was historically present); and environmental conditions (soil type, drainage, exposure and condition) of the restoration location.
- Consideration must be given to the succession of plantings and their tolerance to current conditions when selecting the ultimate community type. For example, re-creation of the original shady-tolerant community may be the ultimate goal, but species tolerant of the current conditions (i.e. extreme sun) would more appropriate. A focus on pioneering species, with a source of late-succession/shade-tolerant species associated with the late successional ELC should be used, and/or late succession and shade-tolerant species associated can be added in for year 1,3 and 5 replacement plantings after more suitable conditions have been created.
- Applicable wildlife surveys pre-construction (or pre-restoration if off-site) and post restoration to assess wildlife usage of the habitat. For example, breeding bird, bat acoustic or mammal surveys for forested and meadow or edge sites, amphibian surveys for wetlands etc.

Vegetation Planting Considerations:

- Ecosystem or vegetation community type to be restored to be reflective of removals where possible.
- Tree and shrub replacement will be provided through ecological restoration, such as the creation or enhancement of habitat through the planting of trees and shrubs.
- Plant material will be native species to southern Ontario (request native species planting list from Metrolinx, **Appendices I and J**) with consideration for regional genetics (southern Ontario seed source or local seed source if applicable).
- Local partnerships are encouraged to leverage efficiencies and bolster regional restoration initiatives.
- Tree and vegetation rescue, reuse and seed collection (See Chapter 5)
  - Smaller trees and plants (including seeds) with high probability of survival and those that are of interest to Indigenous communities should be identified and moved with adequate notice prior to construction and offered to interested Indigenous communities as a priority, to enhance restoration and maintain the genetic diversity of the vegetation on site.
  - Root pruning and seasonal requirements for survival are to be evaluated as part of Integrated Arborist Report or tree inventory.
- Opportunities to identify screening plantings along edge of ROW including implementation of dissuasive vegetation to discourage active trespassing.
- Opportunities to identify screening plantings along noise and retaining walls to discourage graffiti in the form of native vines and dissuasive vegetation.

Site preparation Considerations:

- Re-use of healthy soil material including soil decompaction and amendments.
- A Soil Amendment and Decompaction Plan shall be prepared for areas where restoration plantings will occur on-site to describe how the soil will meet appropriate soil standards for successful planting with consideration to the existing conditions as identified by the soil analysis and identify mitigation to reduce further compaction during construction to the existing soils.
    - Verification of healthy soils may be required to a minimum of one (1) meter depth.
    - Identification of soil remediation decompaction and amendments required to meet healthy soil standards in restoration areas and as prescribed in any municipal requirements including organic matter, nutrients, and mycorrhizae application.
    - Imported or re-used soil must meet municipality's soil standards and O. Reg 153/04 based on land use, O. Reg 406/19 and/or specifications where applicable.
- Site preparation including proper Invasive Plant Species removal and management as per species-specific Ontario Invasive Plant Council Best Management Practices and applicable project IVM plans where applicable.

Restoration and Landscape Plan development:

- Engagement with Indigenous communities on restoration/landscape plans to support Aboriginal and Treaty rights and ensure inclusion of two-eyed seeing and Indigenous knowledge.
- Restoration plans (including Landscape Plans) should be developed prior to tree removals and should include GIS mapping.
  - Off-site and adjacent to site replacement plantings should be implemented before, in parallel or immediately following removals in order of priority.
  - On-site restoration is to occur as construction progresses. Areas to be planted after temporary construction works should be restored within the same growing season as final grading.
- Inclusion of species list (native only searchable excel to be provided by Metrolinx, **Appendices I and J**) and planting locations, including size of plantings.

Considerations for habitat features:

- All ecological restoration plans should include a minimum of 1 habitat structure per hectare of habitat type
- Various habitat structures are acceptable and can be innovative based on the site selected for restoration
- Examples include: nest box (i.e. bats, birds), perching pole, woody debris, hibernacula, log tangles, rock piles, sand bar, fish crib, and salamander logs.

Considerations for climate change resilience:

- Determine the percentage of seed and/or plant stock that will be sourced outside of the applicable ecodistrict and seed zone of the planting area for the purpose of facilitating assisted population migration.
  - Ecodistricts are ecosystem boundaries distinguished by geology, substrate, vegetation material and microclimate.
  - To prioritize use of stock sourced from locally adapted populations, this Guideline recommends targeting a maximum of 20% of stock sourced outside of the applicable ecodistrict or seed zone. The actual target percentage shall be determined on a case-by-case basis dependent on restoration habitat type, species susceptibility to climate change, species rarity and other variables.
- Seed and plant stock sourcing locations outside of the applicable ecodistrict or seed zone shall be determined following the guidance in the Ontario Tree Seed Transfer Policy (MNRF, 2020) and the associated online tool: https://public.tableau.com/app/profile/larlo/viz/SeedSourceOntario/Intro.
- Species should be selected based on current plant hardiness zones as well as projected plant hardiness depicted by Canadian Forest Service's species-specific models and maps online tool: https://www.planthardiness.gc.ca/?m=23&lang=e
  - As part of restoration planning, it is recommended that a target percentage of species that are projected to be suitable for the site in various Representative Concentration Pathway (RCP) emission

scenarios is established to guide species selection. For example, developing a species list that meets both scenarios:

  - Scenario 1: Target planting up to 25% of species whose projected ranges overlap the restoration site for the 2071-2100 period and RCP8.5[1] high emission scenario, which assumes continued increases in greenhouse gas emissions.
  - Scenario 2: Target planting at least 75% of species whose projected ranges overlap the restoration site for the 2071-2100 period and RCP2.6[2] low emission scenario, which assumes greenhouse gas emissions will be rapidly reduced.

- Adjust the implementation of planting, maintenance and monitoring based on yearly differences in temperature, precipitation, and length of the growing season. This could include, but is not limited to, extending the planting window, increasing the watering frequency, increasing monitoring visits, and adjusting timing of invasive species management.
- Further improvements to restoration planning and adaptive management shall be employed as climate change research continues to progress.

Considerations for the establishment and stewardship period, including monitoring and maintenance:

- Restoration warranty for plantings shall be five years (for on-site restoration); a longer period if required by the relevant municipality, region or conservation authority; or 10 years (for off-site). Monitoring and reporting shall be conducted in years one (1), three (3), five (5), seven (7) and ten (10) respective to restoration warranty length.
- Deer fence and/or other herbivore protection installation such as small mammal trunk guard if applicable.
- Mulching is to be applied to each individual plant (though should not touch stems) and is not to be installed broadscale in beds to allow for native seeds to grow in and between shrubs and trees.
- To identify and measure the success of the restoration projects:
  - A minimum of, five- or 10-years post-planting monitoring and replacement is required for all naturalized plantings; landscaping and municipal ROW plantings may be less depending on landowner requirements;
  - Replacement costs should be built into project budgets. A minimum of 20% infill plantings must be included in off-site restoration

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[1] RCP8.5 is the highest baseline emission scenario used in climate models where emissions are projected to continue to rise, and leading to an increase in radiative forcing to 8.5 W/m^2 in 2100. Refer to the Canadian Climate Data and Scenarios (CCDS) site for more information.

[2] RCP2.5 is the low emission scenario typically used in climate models where emission projections decrease as a result of active mitigation, leading to radiative forcing peaking at 3 W/m^2 prior to declining to 2.6 W/m^2 in 2100. Refer to the Canadian Climate Data and Scenarios (CCDS) site for more information.

budgets, increased to 50% infill if space to achieve full baseline and/or ecological replacement requirement could not be met.
  - Monitoring events to take place throughout the 5- or 10-year period such as in years 1, 3 and 5 OR 2, 4, 7, and 10.
  - As part of edge planting maintenance and monitoring, retained trees that are in natural areas adjacent to areas of impact will be maintained and monitored for 5 years.
  - Monitoring events to be recorded through individual reports.
  - Reporting may be subject to review and acceptance by Indigenous communities, municipalities and/or regulatory agencies pending permit requirements and obligations.
  - Monitoring includes biological surveys that are appropriate for the habitat type prior to planting and at various stages post planting to assess changes in biodiversity and presence of bio-indicator species.
  - Acceptance at end of monitoring period may be subject to walkthrough and acceptance by municipalities and/ or regulatory agencies pending permit requirements and obligations.
- Temporary irrigation system to be installed or watering program shall be conducted twice weekly during the months of May to October for the first two years after planting when the planting location receives less than 25 mm of rain per 7-day period measured Monday to Sunday. Watering is provided to ensure plants have adequate water to establish as their root systems develop;
  - Retained trees that were injured, pruned or transplanted shall be maintained through watering, application of mulch and/or fertilizer as required and monitored;
- Invasive Plant Species shall continue to be removed and managed during the Restoration Warranty period;
- Edge management requirements if within a Designated Natural Area (**Appendix F**);
- Monitoring plans for on-site, adjacent and off-site restoration areas shall include wildlife bio-indicator species as biological endpoints. Wildlife surveys are to be selected based on the ecotype of the area restored. The bio-indicator species provided are examples and should be determined by the discretion of the Biologist overseeing the monitoring program and the restoration objectives.
  - Breeding Bird Surveys are applicable to all ecotypes restored and should be included in every restoration monitoring plan. Surveys to be conducted following the protocol outlined in Ontario Breeding Bird Atlas Guide for Participants (OBBA). Bio-indicators vary based on ecotype, and the relative abundance and diversity of species detected can indicate the quality of habitat re-created or improved through restoration, such as:
    - Meadow – Eastern Meadowlark, Bobolink, Grasshopper Sparrow
    - Forest (interior) – Ovenbird, Thrush sp.

        - Forest (edge) – Eastern Pheobe
        - Wetland – Sedge Wren, American Bittern
    - Aquatic surveys are applicable for aquatic, wetland or marsh restoration.
        - Aquatic Habitat Assessments using modified Ontario Stream Assessment Protocol specifically to target the presence of fish and aquatic macroinvertebrates.
        - Breeding amphibian surveys following the protocol outlined in the Marsh Monitoring program (Bird Studies Canada, 2009).
        - Turtle basking surveys following the protocol outlined in Survey Protocol for Blanding's Turtle in Ontario (MNRF, 2015).
    - Where bat targeted habitat or structures are created, Bat Habitat and Acoustic Surveys to follow the guidelines outlined in the MNRF's Survey Protocol for Species at Risk Bats within Treed Habitats (2017). Bio-indicator species in forested and forest edge habitats include Eastern Red Bat, Big Brown Bat.
    - Small mammal surveys may be applicable to all ecotypes restored and should be included in restoration monitoring plan especially when access to a network of ecosystems is interrupted by the planned transit project.
    - Insect observations may be intentional, or incidental depending on the restoration project. For example, if a native wildflower and grass meadow is the focus of restoration, insect surveys may be included in the assessment of the success. Insect bio-indicators include butterflies and moths (e.g. Monarch, Red Admiral, Cabbage White, Pale Beauty) and a variety of native bees (e.g. sweat bee, bumble bee).
- For on-site and adjacent restoration areas within a Designated Natural Area, wildlife surveys as described above, but at a minimum breeding bird survey, to be completed in year five (5) of monitoring and included in the final monitoring report. If wildlife surveys for existing conditions are not captured in the project's pre-construction environmental reports, a Biologist shall conduct wildlife surveys within Designated Natural Areas prior to construction start.
- For off-site restoration, wildlife surveys as described above, but at a minimum breeding bird surveys are recommended, must be completed prior to planting or by the end of year one (1) of monitoring as well as year five (5) and ten (10) of monitoring with results included in the final monitoring report.
- The restoration warranty period, post-planting maintenance and monitoring for each planting and restoration area initiates at the time planting occurs.
- Every monitoring event should include a monitoring report to document maintenance success, needs and success of plantings. Post planting monitoring shall be conducted between May and end of June of each year post planting. The monitoring reports shall include:
    - Key map showing planting locations;

  - Summary of monitoring data;
  - Date and time of visit;
  - Weather at time of visit and brief summary of weather starting in early April with average precipitation to ensure watering is occurring;
  - Survey methods – survey effort including duration and timing for visual monitoring and sampling method; tree photo points to be identified year one and same georeferenced photo point to be used in each report from same direction. Minimum photopoints to be one (1) per 500 square meters.
  - Other incidental relevant observations (e.g. loss due to rodents, vandalism or human disturbance nearby, wildlife activity, any changes to surrounding landscape since installation);
  - Wildlife survey results;
  - Figure showing all components above in relation to the location;
  - Watering record documenting number of times during the year plantings were watered including the dates watering was completed;
  - Summary of maintenance activities related to deer/ herbivore fence;
  - Summary of monitoring findings, assessment findings and recommendations for any changes for future years (if necessary);
  - Condition of tree protection and any repairs required to protect plantings for the next year;
  - Recommendations for invasive species management and documentation of management;
  - Assessment of trees pruned, injured or transplanted during Construction. If there are tree mortalities, must be replaced as per appropriate ratios as set out in the Guideline.
  - Requirements and schedule for post planting monitoring reports; and
  - Photo appendix should contain photos with clear labels of two to three georeferenced photo points in each report with photos taken in each cardinal direction to assess growth and vegetative coverage over time;
- If any plantings die during the monitoring period, plant material shall be replaced before October 15 or the first frost of the same monitoring year. If maintenance or monitoring was not conducted, restoration warranty restarts each replacement planting extending the maintenance and monitoring period to the same duration as initial restoration warranty period at the installers own cost. The biennial monitoring report shall continue to be prepared and submitted until the extended restoration warranty period is complete.
- If all maintenance and monitoring was completed, each dead planting must still be replaced before October 15 or the first frost of the same monitoring year, however, the restoration warranty period does not extend.
- Restoration warranty inspection and sign-off at the end of the specified period must be completed by a Metrolinx Representative and Municipality if required.

Delivery, Storage and Handling Considerations:

- No plant shall be harvested or transported from the time of bud break until the newly formed leaves are fully developed and matured. Any plant to be planted after the emergence of leaves, shall be harvested prior to bud break and stored in a partially shaded area protected from wind and extreme weather exposure. Watering of plant material is to be completed daily until plant material is installed.
- To ensure plant material is in best condition for successful restoration delivery is to comply with the following
    - Protect plant material from frost, excessive heat, wind and sun during delivery.
    - Protect plant material from damage during transportation:
- When delivery distance is less than 30 km and vehicle travels at speeds under 80 km/h, tie tarpaulins around plants or over vehicle box.
- When delivery distance exceeds 30 km or vehicle travels at speeds over 80 km/h, use enclosed vehicle where practical.
- Storage and Handling Requirements:
    - Immediately store and protect plant material which will not be installed within one (1) hour.
    - Plants must be handled by the root ball or container, and under no circumstances shall plants be dragged or pulled by the trunk or foliage.
- Protect stored plant material from frost, wind and sun to ensure planting success as follows:
    - For pots and containers, maintain moisture level in containers.
    - For balled and burlapped and wire basket root balls, place to protect branches from damage. Maintain moisture level in root zones.
- Bulk materials:
    - Do not deliver or place soils and soil amendments in frozen, wet, or muddy conditions.
    - Provide protection including tarps, plastic or matting between all bulk materials and any finished surfaces sufficient to protect the material.
    - Provide erosion-control and dust control measures to prevent erosion or displacement of bulk materials, including airborne dust particles. Use water only for dust control.
- Substitutions
    - Supply and install plant material as specified on the approved Landscape or restoration Plans. Substitutions of size, species may require engagement with Indigenous communities, municipality or other local community.
- Planting Season
    - Trees shall be planted in the spring following ground thaw prior to May 15, or in the fall between leaf-drop after September 15 and before ground freeze up. A watering and maintenance regime must be submitted at the time of request by Metrolinx for any plantings installed outside these windows.

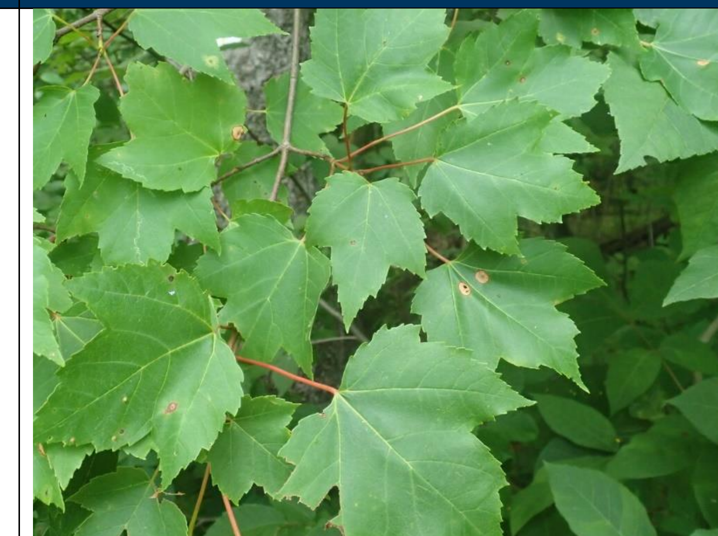
Table H-1: Treed Restoration Planting Typical Budget Items (per 1 ha)

Planning	Notes
Project Management	Identify, justify and summarize plant quantities, species, habitat features and locations, develop plan for on-site and off-site restoration including mapping, estimated area(s), soil testing, soil assessment and amendment plan; review and summary of soil, habitat features and planting plans, installation, monitoring, maintenance, replacement and final acceptance
Site Preparation	**Notes**
Equipment	Includes as applicable: X days of equipment time for decompaction, tilling, grading, mowing, seeding, and safety equipment (Truck, trailer, tractor, tractor implements, ATV, excavator, machinery to conduct mowing, aeration and/or scarification/ Air spading [pneumatic excavation or loosening])
Materials	TRCA (50 kg) cover crop and (15-30kg) native seed mix, soil amendments
Labour	Plan, design and implementation/construction
Contingency	10%
Planting	**Notes**
Equipment	Includes as applicable: Truck, trailer, ATV, seed application equipment (blower truck), watering equipment and/ or irrigation system, planting, fencing, mulching and safety equipment
Materials	1950 native tree seedlings and 4,500 native shrubs, native seed, mulch, protective herbivore measures such as fencing, rodent guards, and Mycorrhizae (if applicable). Alternative to 1950 tree seedlings; 1000 tree seedlings spaced at 1.7 metres on centre and 1000 potted trees spaced at 2.45 metres on centre.
Labour	Plan, design, installation, watering and IVM application
Contingency	10%
Plant Replacement	Replacement of material with 100% replacement of die-back after year 1,
Habitat Features	**Notes**
Equipment	Includes as applicable: X days of equipment time for minor grading and structure installation. (Truck, trailer, tractor, tractor implements, ATV, excavator and safety equipment)
Materials	X numbers of days to install minimum one habitat feature per planting including: Snag, brush pile, Bird boxes, bat boxes, sandy areas for turtle nesting, hibernaculum, root wad for fish coverage, riffle- pool sequencing where applicable.) •Wood piles: 11 large downed wood piles per hectare, 100 feet apart https://www.nnrg.org/habitat-piles/ https://www.surrey.ca/sites/default/files/media/documents/BiodiversityDesignGuidelines_HabitatStructures.pdf

	•Hibernacula 1 per hectare https://www.torontozoo.com/adoptapond/habitat/hibernacula •Deep water wetland refugia (frogs / fish) •Stream banks Root wads overhang natural creek channels and vegetated stream banks http://adoptastream.ca/sites/default/files/Root%20Wads%202014.pdf
Labour	Plan design and installation
Contingency	10%
Maintenance & Monitoring	**Notes**
Equipment	Includes as applicable: Truck, trailer, ATV, watering equipment, tractor with implements, herbicide application equipment, monitoring equipment, and safety equipment
Maintenance	Watering program temporary irrigation system to be installed or watering program shall be conducted twice weekly during the months of May to October for the first two years after planting when the planting location receives less than 25 mm of rain per 7-day period measured Monday to Sunday. Watering is provided to ensure plants have adequate water to establish as their root systems develop; or implementation irrigation system, herbivore protection repairs, repairs to habitat features, X days of IVM/ Invasive species management, planting warranty (on-site is 2 years) or percent coverage (80% by end of year 5 with replacements in year 1 and 3) In the first year during establishment, it is recommended to include a mow in august of first year form weed pressure is observed to suppress the weeds that will come up quickly prior to the slow germinating native species. This cut is typically a high cut at around 6-10" in mid August or a bit earlier, pending weed growth timing. For pollinator areas/ meadows, maintenance mowing can be completed every 3-4 years on a portion of the site with the goal to reduce the biomass on the landscape to allow native vegetation to continue to thrive. Maintenance mows or burns are typically done early spring or late fall to reduce impacts to pollinators.
Labour	Plan, monitor and implement
Monitoring	3 visits (year 1, 3 and 5) with reporting, wildlife monitoring (e.g. breeding bird surveys, bat acoustic surveys, passive mammal surveys) pre-restoration and at 5-year mark to assess restoration success, or more frequent monitoring for habitat features if required (e.g. may be yearly for bat boxes)
Labour	Plan, monitor and implement
Plant Replacement	Replace dead plantings to 100% after year 1, at year 3 and ensure 80% percent coverage by end of year 5

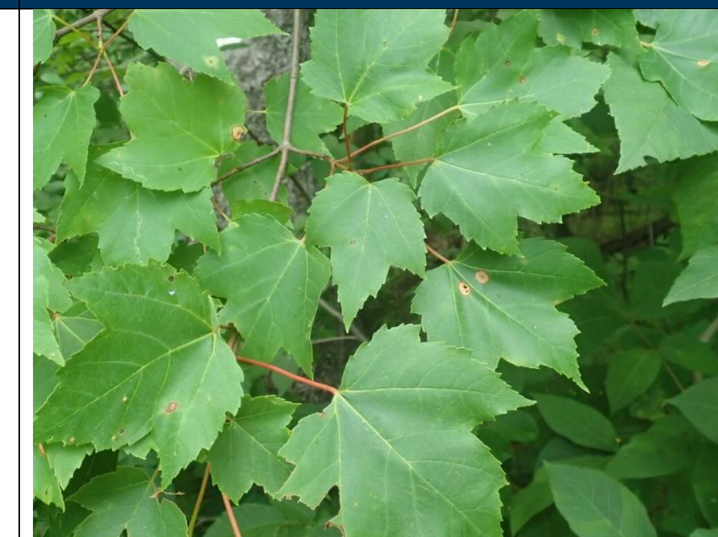
APPENDIX I: RECOMMENDED TREE, SHRUB AND VINE SPECIES LIST

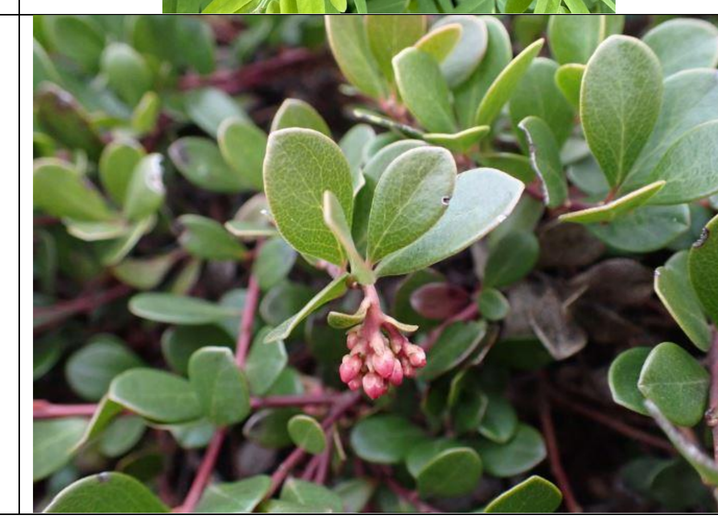
Table I-1: Recommended Tree, Shrub and Vine Species List

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Red Maple *Acer rubrum*	15 m	Full Sun	Average to Wet	Yes				✓	
Silver Maple *Acer saccharinum*	15 m	Shade tolerant, full sun preferred	Moist	Yes				✓	

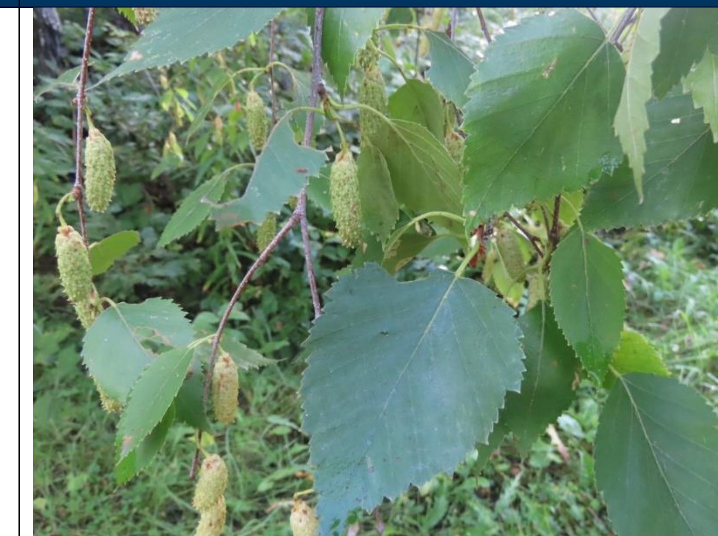
Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Mountain Maple *Acer spicatum*	3 - 5 m	Part Sun	Moist	No			✓	✓	
Striped Maple *Acer pensylvanicum*	Up to 10 m	Full to Part Sun	Moist	No				✓	

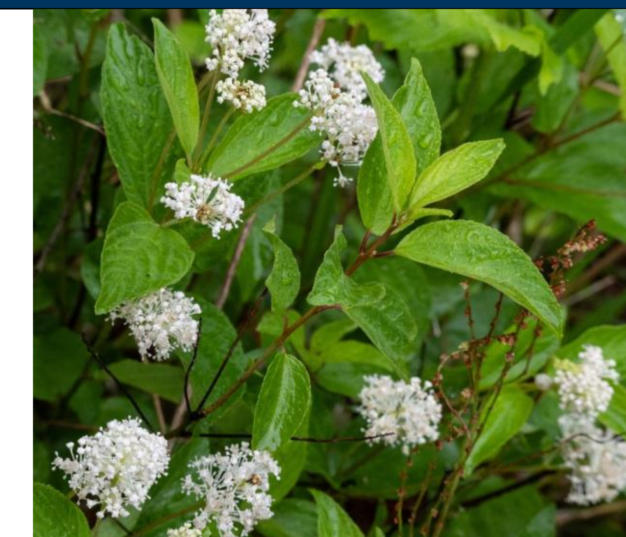
Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Sugar Maple *Acer saccharum*	20 m	Full Sun	Average to Moist	Yes				✓	
Speckled Alder *Alnus rugosa*	4 - 8 m	Full to Part Sun	Wet to Moist	No			✓	✓	

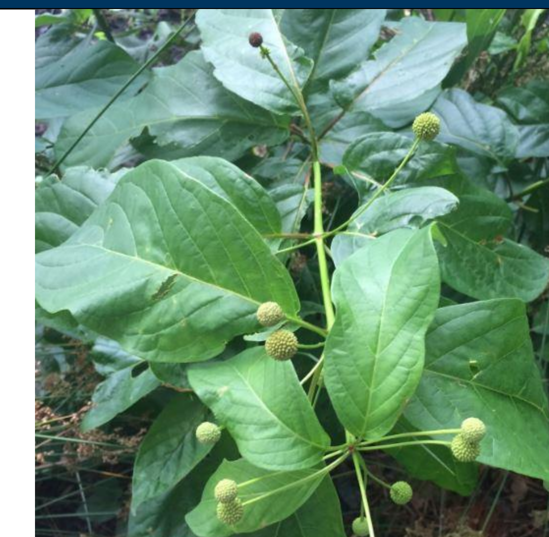
Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Green Alder *Alnus viridus ssp. Crispa*	Up to 3 m	Full to Part Sun	Wet to Moist	No		✓	✓	✓	
Serviceberry *Amelanchier sp.*	3 – 9 m	Full to Part Sun	Moist	No				✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
False Indigo *Amorpha fruticose*	5 - 6 m	Full Sun	Tolerates Poor, Dry, Sandy	Yes			✓	✓	
Bearberry *Arctostaphylos uva-ursi*	Less than 1 m	Full to Part Sun	Dry to Moist, Acidic, Sandy	Yes	✓	✓	✓	✓	

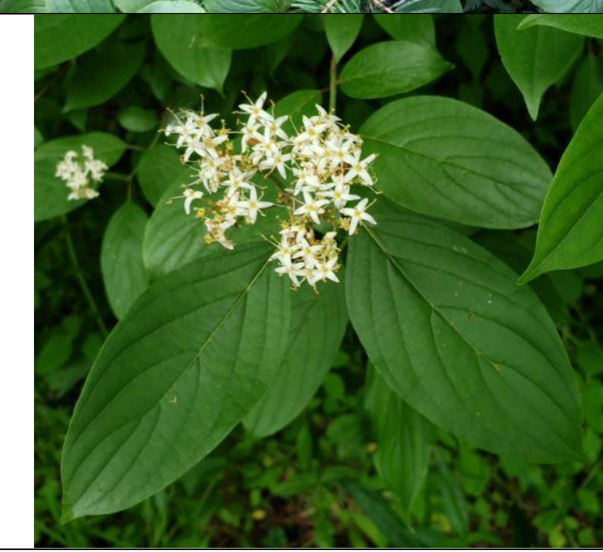
Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Red Chokecherry *Aronia arbutifolia ‘Brilliantissima*	2 m	Full Sun	Dry to Wet	Yes		✓	✓	✓	
Black Chokeberry *Aronia melanocarpa*	2 - 2.5 m	Full Sun	Dry to Wet	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
White Birch *Betula papyrifera*	13 m	Full and Part Sun	Average to Moist	No				✓	
Blue-Beech *Carpinus caroliniana*	Up to 8 m	Full Sun to Shade	Dry to Wet	No			✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
New Jersey-tea *Ceanothus americanus*	Up to 3 m	Full to Part Sun	Well Drained	Yes		✓	✓	✓	
Common Hackberry *Celtis occidentalis*	20 m	Full Sun	Dry to Wet	Yes				✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Buttonbush *Cephalanthus occidentalis*	Up to 6 m	Full to Part Sun	Moist to Wet	Yes			✓	✓	
Eastern Redbud *Cercis canadensis*	Up to 10 m	Full to Part Sun	Moist	Yes				✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Sweet Fern *Comptonia peregrina*	Up to 1 m	Full to Part Sun	Dry to Average, Sandy Acidic	No	✓	✓	✓	✓	
Alternate Leaved Dogwood *Cornus alternifolia*	4 - 6 m	Full to Part Sun	Moist, Well-Drained, Acidic	No			✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Bunchberry *Cornus canadensis*	Less than 1 m	Full Sun to Shade	Moist, Well-Drained, Acidic	No	✓	✓	✓	✓	
Pale Dogwood or Silky Dogwood *Cornus obliqua*	2 - 3 m	Full to Part Sun	Wet to Moist	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Gray Dogwood *Cornus racemosa*	Up to 2.5 m	Full Sun to Shade	Dry to Wet	Yes		✓	✓	✓	
Round-leaved Dogwood *Cornus rugosa*	Up to 3 m	Full to Part Sun	Moist	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Red Osier Dogwood *Cornus sericea* or *Cornus stonolifera*	2 - 3 m	Full to Part Sun	Dry to Wet	Yes		✓	✓	✓	
Beaked Hazelnut *Corylus cornuta*	3 - 4 m	Full to Part Sun	Moist	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Cockspur Hawthorn *Crataegus crus-galli*	Up to 9 m	Full Sun	Dry to Moist	Yes				✓	
Washington Hawthorn *Crataegus phaenopyrum*	9 m	Full Sun	Dry to Moist	Yes				✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Dotted Hawthorn *Crataegus punctata*	Up to 8 m	Full Sun	Dry to Moist	Yes			✓	✓	
Bush Honeysuckle *Diervilla lonicera*	Less than 1 m	Full to Part Sun	Dry to Moist	Yes	✓	✓	✓	✓	
Leatherwood *Dirca palustris*	Up to 2 m	Part Sun to Shade	Moist to Wet	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Silverberry *Elaeagnus commutata*	0.5 to 3 m	Full Sun or Partial Shade	Moist	No		✓	✓	✓	
Trailing Arbutus *Epigaea repens*	Less than 1 m	Part Sun to Shade	Moist and Acidic	No	✓	✓	✓	✓	

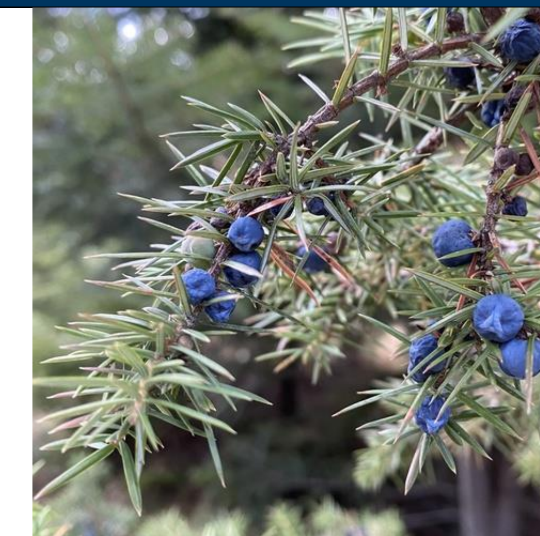
Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Running Strawberry Bush *Euonymus obovatus*	Less than 1 m	Shade	Moist and Rich	No	✓	✓	✓	✓	
American Beech *Fagus grandifolia*	30 m	Full Sun	Moist	No				✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Eastern Teaberry or Wintergreen *Gaultheria procumbens*	Less than 1 m	Full Sun to Shade	Moist, Acidic, and Well-Drained	No	✓	✓	✓	✓	
Black Huckleberry *Gaylussiacia baccata*	Up to 1 m	Partial Shade	Acidic, Loose and Well-Drained	No	✓	✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Kentucky Coffee Tree *Gymnocladus dioicus*	17 m	Full Sun	Dry to Moist	Yes				✓	
American Witch-hazel *Hamamelis virginiana*	4.5 - 6 m	Full Sun to Shade	Average to Wet, acidic	Yes			✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Kalm's St. John's Wort *Hypericum kalmianum*	Up to 1 m	Full to Part Sun	Dry to Average	Yes	✓	✓	✓	✓	
Shrubby St. John's Wort *Hypericum prolificum*	Up to 1.5 m	Full to Part Sun	Dry to Average	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Black Holly or Common Winterberry *Ilex verticillata*	3 - 6 m	Full to Part Sun	Moist to Wet, Acidic	No			✓	✓	
Black Walnut *Juglans nigra*	18 m	Full Sun	Dry to Moist	Yes				✓	

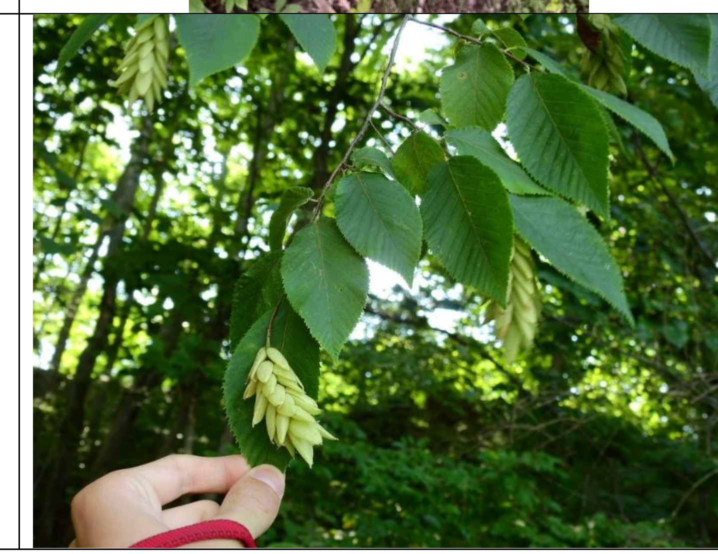
Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Common Juniper *Juniperus communis*	Up to 1.5 m	Full Sun	Dry to Moist	Yes		✓	✓	✓	
Eastern Red Cedar *Juniperus virginiana*	10 m	Full Sun	Dry to Moist	Yes				✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Spicebush *Lindera benzoin*	Up to 3 m	Full sun to Shade	Average to Moist	Yes		✓	✓	✓	
Canada Fly Honeysuckle *Lonicera canadensis*	Up to 1.5 m	Part Sun to Shade	Dry to Moist	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Cucumber Magnolia Tree *Magnolia acuminata*	15 m	Full Sun to Partial Shade	Moist	No				✓	
Sweet Crab Apple *Malus coronaria*	7 - 9 m	Full Sun	Moist, Acidic and Well-Drained	No				✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Partridge-berry *Mitchella repens*	Less than 1 m	Shade	Moist, Rich and Well-Drained	No	✓	✓	✓	✓	
Sweet Gale *Myrica gale*	Up to 1 m	Full Sun	Average to Wet	Yes	✓	✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Bayberry *Myrica pensylvanica*	2 m	Full Sun to Partial Sun	Average to Moist	No		✓	✓	✓	
Mountain Holly *Nemopanthus mucronatus*	Up to 3 m	Full to Part Sun	Moist	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Sourgum *Nyssa sylvatica*	9 m to 15 m	Full Sun or Partial Sun	Moist	Yes				✓	
Ironwood *Ostrya virginiana*	12 m	Full Sun to Partial Shade	Dry to Moist	Yes				✓	

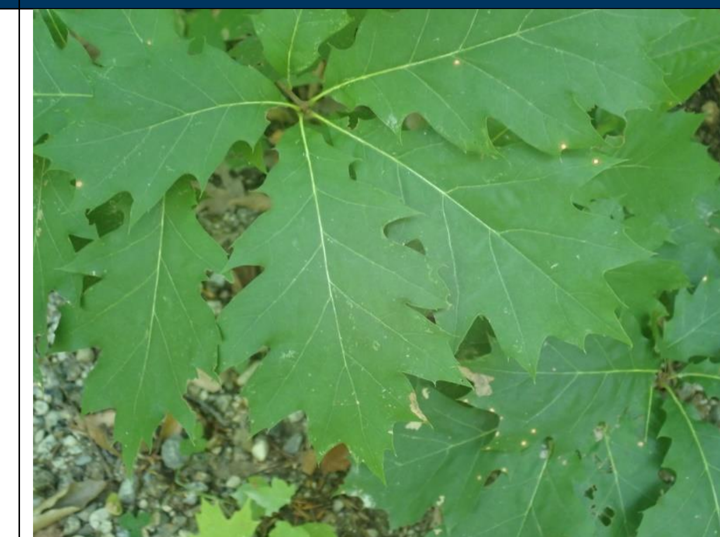
Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Woodbine *Parthenocissus inserta*	10 m	Full Sun, Part Sun or Full Shade	Wet or Dry site	Yes				✓	
Ninebark *Physocarpus opulifolius*	Up to 3 m	Full to Part Sun	Dry to Moist	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Shrubby Cinquefoil *Potentilla fruticosa*	1 m	Full to Part Sun	Dry to Wet	Yes	✓	✓	✓	✓	
Hop Tree *Ptelea trifoliata*	6 - 8 m	Full Sun to Shade	Moist	No			✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Canada Plum *Prunus nigra*	Up to 10 m	Part Sun to Shade	Rich, Moist	No				✓	
Sand Cherry *Prunus pumila*	1 m	Full to Part Sun	Dry to Average	Yes	✓	✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Black Cherry *Prunus serotina*	15 to 22 m	Full Sun and Partial Sun	Moist	Yes				✓	
Chokecherry *Prunus virginiana*	6 - 9 m	Full Sun	Average to Moist	Yes				✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Burr Oak *Quercus macrocarpa*	24 m	Full Sun	Dry to Moist	Yes				✓	
Pin Oak *Quercus palustris*	25 m	Full Sun	Average to Wet	Yes				✓	

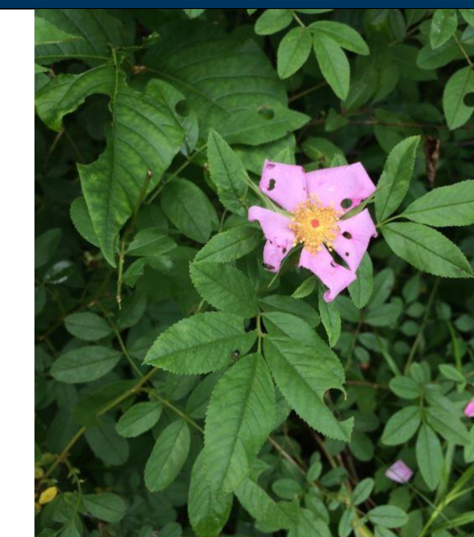
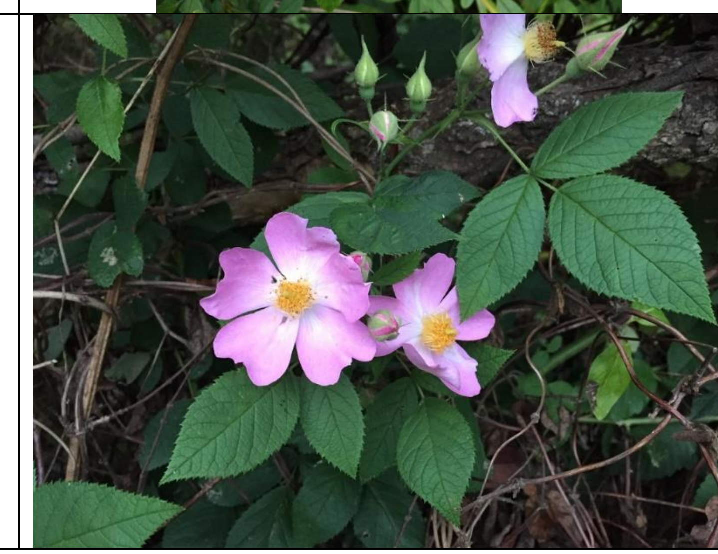
Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Red Oak *Quercus rubra*	21 m	Full Sun	Average to Moist	Yes				✓	
Fragrant Sumac *Rhus aromatica*	Up to 1.5 m	Full Sun to Shade	Dry to Moist	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Staghorn Sumac *Rhus typhina*	3 - 6 m	Full to Part Sun	Dry to Moist	Yes		✓	✓	✓	
Wild Black Currant *Ribes americanum*	1 m	Full to Part Sun	Moist to Wet	No	✓	✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Prickly Gooseberry *Ribes cynosbati*	1 m	Full to Part Sun	Average to Moist, Rich	No	✓	✓	✓	✓	
Smooth Gooseberry *Ribes hirtellum*	1 m	Full Sun	Moist to Wet	No	✓	✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Skunk Currant *Ribes glandulosum*	1 m	Part Sun to Shade	Moist to Wet	No	✓	✓	✓	✓	
Red Currant *Ribes triste*	1 m	Full Sun to Shade	Moist to Wet	No	✓	✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Prickly Wild Rose *Rosa acicularis*	1 m	Full to Part Sun	Dry to Moist	No	✓	✓	✓	✓	
Smooth Rose *Rosa blanda*	Up to 1.5 m	Full to Part Sun	Dry to Moist	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Swamp Rose *Rosa palustris*	Up to 1.5 m	Full Sun	Moist	No		✓	✓	✓	
Prairie Rose *Rosa setigera*	Up to 1.5 m	Full to Part Sun	Dry to Moist	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Allegheny Blackberry *Rubus allegheniensis*	Up to 2 m	Full to Part Sun	Dry to Moist	Yes		✓	✓	✓	
Wild Red Raspberry *Rubus idaeus ssp. strigosus*	Up to 1.5 m	Full Sun to Full Shade	Dry to Moist	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Black Raspberry *Rubus occidentalis*	1 - 2 m	Full Sun to Full Shade	Dry to Moist	Yes		✓	✓	✓	
Purple-flowering Raspberry *Rubus odoratus*	1 - 1.5 m	Full to Part Sun	Dry to Moist	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Dewberry *Rubus pubescens*	Less than 1 m	Full Sun to Full Shade	Dry to Moist	No	✓	✓	✓	✓	
Bebb's Willow *Salix bebbiana*	1 - 6 m	Full to Part Sun	Moist to Wet	Yes			✓	✓	

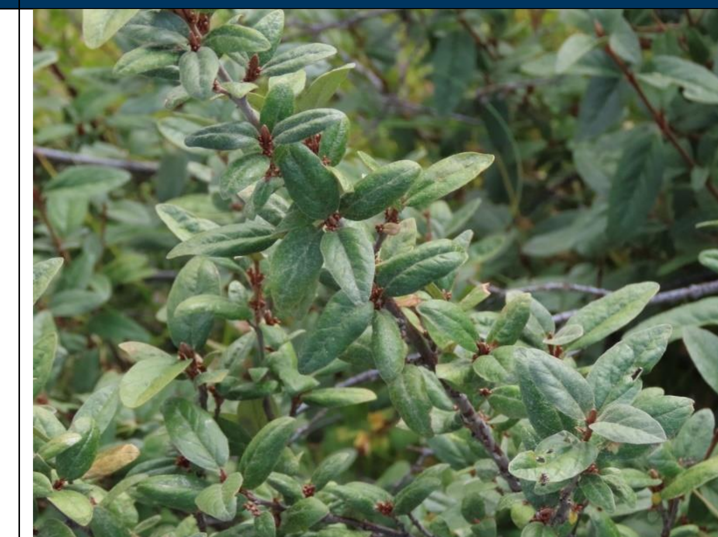
Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Sage-leaved or Hoary Willow *Salix candida*	2 - 3 m	Full to Part Sun	Moist to Wet	No		✓	✓	✓	
Pussy Willow *Salix discolor*	2 - 6 m	Full to Part Sun	Moderately Dry to Wet	Yes			✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Heart-leaved Willow *Salix eriocephala*	3 - 4 m	Full Sun	Dry to Wet	Yes		✓	✓	✓	
Sandbar Willow *Salix exigua*	3 - 6 m	Full Sun	Dry to Wet	Yes			✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Upland Willow *Salix humilis*	1 - 3 m	Full Sun	Dry to Wet	Yes		✓	✓	✓	
Shining Willow *Salix lucida*	3 - 6 m	Full Sun	Moist to Wet	Yes			✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Slender Willow *Salix petiolaris*	3 - 4 m	Full to Part Sun	Moist	Yes		✓	✓	✓	
Common Elderberry *Sambucus canadensis*	3 - 4 m	Full to Part Sun	Moist	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Red Elderberry *Sambucus racemosa*	Up to 4 m	Full to Part Sun	Moist	Yes		✓	✓	✓	
Black Elderberry *Sambucus nigra*	Up to 2 m	Full to Part Sun	Moist	Yes		✓	✓	✓	

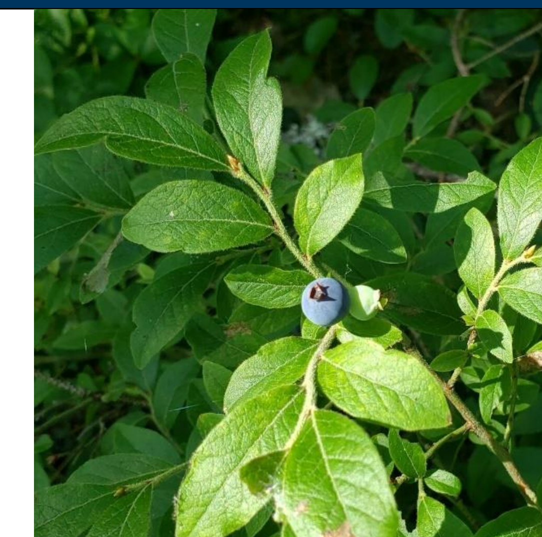
Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Buffalo Berry *Shepherdia canadensis*	Up to 2 m	Full to Part Sun	Dry to Moist	No		✓	✓	✓	
American Mountain Ash *Sorbus americana*	Up to 10 m	Full Sun	Dry to Moist	Yes				✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Showy Mountain Ash *Sorbus decora*	Up to 10 m	Full Sun	Dry to Moist	Yes				✓	
Narrow-leaved Meadowsweet *Spiraea alba*	1.5 - 2 m	Full to Part Sun	Moist	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Steeplebush *Spiraea latifolia*	1 to 2 m	Full Sun to Part Shade	Moist	No		✓	✓	✓	
Broad-leaved Meadowsweet *Spiraea tomentosa*	1.5 m	Full to Part Sun	Moist	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
American Bladdernut *Staphylea trifolia*	3 - 5 m	Full to Part Shade	Moist	No			✓	✓	
Common Snowberry *Symphoricarpos albus*	0.5 - 2 m	Full to Part Sun	Dry to Moist	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Canadian Yew *Taxus canadensis*	Less than 2 m	Full to Part Shade	Moist	No		✓	✓	✓	
Eastern White Cedar *Thuja occidentalis*	12 m	Full to Part Sun	Moist	No				✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Low Sweet Blueberry *Vaccinium angustifolium*	Less than 2 m	Full to Part Sun	Moderately Dry to Moist	No		✓	✓	✓	
Velvet-leaf Blueberry *Vaccinium myrtilliodes*	Up to 1 m	Full to Part Sun	Moderately Dry to Moist	No	✓	✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
One-leaved Bilberry *Vaccinium ovalifolium*	Up to 1 m	Full to Part Sun	Moist	No	✓	✓	✓	✓	
Maple-leaved Viburnum *Viburnum acerifolium*	Less than 2 m	Full to Part Sun	Dry to Moist	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Common Hobblebush *Viburnum alnifolium*	Up to 2 m	Full Sun to Full Shade	Moist	Yes		✓	✓	✓	
Northern Wild Raisin *Viburnum cassinoides*	Up to 1 m	Full to Part Sun	Moderately Dry to Moist	Yes	✓	✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Arrowwood *Viburnum dentatum*	2 m	Full Sun to Part Sun	Average to Moist	Yes		✓	✓	✓	
Mooseberry *Viburnum edule*	Less than 2 m	Full Sun to Full Shade	Moist	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Nannyberry *Viburnum lentago*	Up to 6 m	Full Sun to Full Shade	Dry to Moist	Yes			✓	✓	
Possumhaw *Viburnum nudum*	3 - 4 m	Full to Part Sun	Moist	No		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Downy Arrow-wood *Viburnum rafinesquianum*	Up to 1.5 m	Full to Part Shade	Dry to Moist	Yes		✓	✓	✓	
Highbush Cranberry *Viburnum trilobum*	3 - 4 m	Full to Part Sun	Moderately Dry to Moist	Yes		✓	✓	✓	

Species Name	Height (m)	Sun Exposure	Soil Preference	Street and Urban Tolerant? (Yes/No)	Zone 2 (Non-Electrified and Guideways) and Zone 3 (Electrified) Up to 1.4 m tall	Zone 3 (Non-Electrified and Guideways) and Zone 4 (Electrified) Up to 4m Tall	Zone 4 (Non-Electrified and Guideways) and Zone 5 (Electrified) Up to 8m Tall	Zone 5 (Non-Electrified and Guideways) Greater than 8m Tall	Photos
Prickly Ash *Zanthoxylum americanum*	Up to 10 m	Full to Part Sun	Dry to Moist	Yes				✓	

APPENDIX J:
RECOMMENDED SEED MIXES

Native Seeding

- The recommended native seed mixes shall be determined based on existing site conditions and pre-disturbance or desired Ecological Land Classification (ELC) community, where possible.
- Approved nurse crop and native seed mixes can be found in the TRCA Seed Mix Guideline V.2.0 (January 2022) found at the following link.
- Native seed mixes should be applied at the specified rate described in TRCA Seed Mix Guideline ranging from 25 to 29 kg/ha.
- Seed mixes may be customized based on guidance from a qualified biologist or landscape architect with expertise in ecological restoration but suggest selecting the appropriate mix from the TRCA Guideline to ensure availability.
- Nurse crop consisting of annual species shall be added to the native seed mix to establish quick vegetative cover and applied at a rate of 30Kg/ha).
    - Annual species suggested for best cover include Oats (Avena sativa), Annual Rye (Lolium multiflorum), and Winter Wheat (Triticum aestivum)
    - Select cover crop based on time of year of application.
- Application method:
    - Native seed mix rates shall be adjusted as needed based on application method with a preference for Terraseeding™ with tackifier added as needed, especially on slopes.
    - Pneumatic seeding (Terraseeding™) is composed of composted organic soils and seed and is applied via a Blower Truck. Pneumatic application often results in higher germination rate as seed is insulated by warm and damp soil resulting. Blowing in soil, compost and seed also has added benefit of a smooth and even finished product with no fine grading required, serves as an erosion and sediment control until annual seed establishes, increases water saturation capacity of soil and improves plant rooting system
    - Tackifiers (also known as soil binders) are included in hydroseeding and Terraseeding™ applications to promote adhesion among soil particles or mulch materials. Tackifiers improve soil stabilization by reducing water and wind driven erosion protecting seedbeds by holding the product to the soil surface and preventing movement. This is a temporary measure, designed to prevent short-term (e.g., two to four weeks) erosion during seed germination and early growth for permanent stabilization. They are effective for a wide range of soil, slope, temperature, and rainfall conditions.
- Maintenance:
    - Assess growth in Spring and Fall of years 1 & 2 and determine whether seed is well established with good coverage (>80%), re-apply in next growing season if required.
    - In the first year during establishment, it is recommended to include an August mow if weed pressure is observed to suppress the weeds prior to the slow germinating native species. This cut is typically a high cut at around 6-10" in mid-August or a bit earlier, pending weed growth timing.
    - For pollinator areas/ meadows, maintenance mowing required every 3 to 4 years on a portion of the site with the goal to reduce the biomass on the landscape to allow native vegetation to continue to thrive. Maintenance mows or burns are typically done early spring or late fall to reduce impacts to pollinators.

Table J-1: TRCA Seed Mix Recommendations

Seed Mix Recommendations	
Existing Community	**Seed Mix**
Shallow Marsh (MAS)	TRCA Frugal Wet Mix (TRCA-SW-1)
Meadow Marsh (MAM)	TRCA Wet Meadow Mix (TRCA-SW-6)
Cultural Meadow (CUM)*	TRCA Butterfly Meadow (TRCA-SD-6)
Woodland (CUW, FOD, SW)	TRCA Swamp Mix (TRCA-SC-2)/TRCA Upland Slope Mix (TRCA-SD-3)
Cultural Meadow (CUM)* with heavy invasive pressure	TRCA Resilient Area Meadow Mix (TRCA-SD-4)
Woodland (CUW, FOD, SW) with shade, slopes and/or compacted mixed soils	TRCA Difficult Site Mix (TRCA-SC-1)

*May also be referred to as ME, MEM, MEG, and MEF (from the 2008 ELC)

Table J-2: Example Seed Mix (TRCA Seed Mix Guideline, 2022)

TRCA Difficult Site Mix (TRCA-SC-1) Shady, sloped, compacted, mixed soils mix		
Common Name	**Scientific Name**	**% of Mix**
Big bluestem	Andropogon gerardii	15%
Virginia wild rye	Elymus virginicus	15%
Little bluestem	Schizachyrium scoparium	15%
Silky Wild Rye*	Elymus villosus	15%
Riverbank rye	Elymus riparius	15%
Green coneflower*	Rudbeckia laciniata	2%
Showy tick-trefoil	Desmodium canadense	3%
Wild Columbine	Aquilegia canadensis	1%
Wild bergamot	Monarda fistulosa	3%
Golden Alexander	Zizia aurea	2%
Bee Balm*	Monarda didyma	1%
Great St.John's Wort*	Hypericum ascyron	1%
Yellow Hyssop*	Agastache nepetoides	1%
New Jersey Tea*	Ceanothus americanus	1%
Oxeye	Heliopsis helianthoides	2%
Evening primrose	Oenothera biennis	2%
Foxglove beardtongue	Penstemon digitalis	2%
Hairy beardtongue*	Penstemon hirsutus	1%
Virginia mountain mint*	Pycnanthemum virginianum	2%
White vervain*	Verbena urticifolia	1%
Minimum recommended ratio of 28.37 Kg/ha		

Successful Seeding Chcklist

Soil Preparation (Refer to **Appendix D** for details)

- ✓ Identify minimum topsoil depth
- ✓ Identify method and depth of uncompacted soil depth (topsoil + subsoil)
- ✓ Identify soil quality amendments (for example, minimum percentage of organic matter; pH; etc.)
- ✓ Confirm any invasive species management pre-seed application required and timing

Seed Mixes

Identify seed mixes based on local soil, moisture, light conditions, and adjacent vegetation communities. If different seed mixes are proposed in different areas, this should be specified in the drawings or described landscape plan. Include:

- ✓ Species (scientific name and common name)
- ✓ Percentage composition for each species in the mix
- ✓ Specify proposed nurse crop to be applied with the native seed mix
- ✓ Tackifiers
- ✓ Additional notes for best management practices

Seed Mix Application

- ✓ Specify application rate in Kg/ ha (native seed mix and nurse crop)
- ✓ Specify application method (preferred application is pneumatic (Terraseeding™)
- ✓ Confirm depth of blown in material (minimum 50mm)
- ✓ Provide proposed timing for application
- ✓ Provide proposed maintenance activities and schedule (e.g., watering /mowing)

APPENDIX K: IMPLEMENTATION FRAMEWORK AND FLOWCHART FOR INTEGRATED VEGETATION MANAGEMENT

Metrolinx’s IVM program has been adapted from the framework conceptualized by scholars Nowak and Ballard (2005). It is presented in five (5) steps and should be interpreted as a cyclical and adaptive framework (**Figure K-1**). A detailed flowchart for IVM is provided at the end of this framework.

In principle, IVM will allow for the long-term flexibility needed to (re)adjust to the changes expected to take place on Metrolinx-owned-lands, the rail corridors, guideways and restoration areas, particularly following engagement with Indigenous communities on IVM Plans. Over the implementation period, it is anticipated that managerial, operational, and environmental conditions will change. This framework will allow Metrolinx to react and respond as appropriate.

Following this approach, it is expected Metrolinx will move through each step on an as-needed basis, continually cycling through the five (5) step process. Once IVM Step No. 5 has been applied, IVM managers are expected to reassess the effectiveness of the program and potentially reapply or readjust the framework starting at Step No. 1, as necessary. Accordingly, IVM Plans are to document these decisions and be updated to suit site conditions, objectives, and project needs.

This implementation framework is intended to guide an IVM program/plan for managing vegetation within Metrolinx’s-owned-lands, restoration areas, the electrified and non-electrified rail corridors, and along guideways.

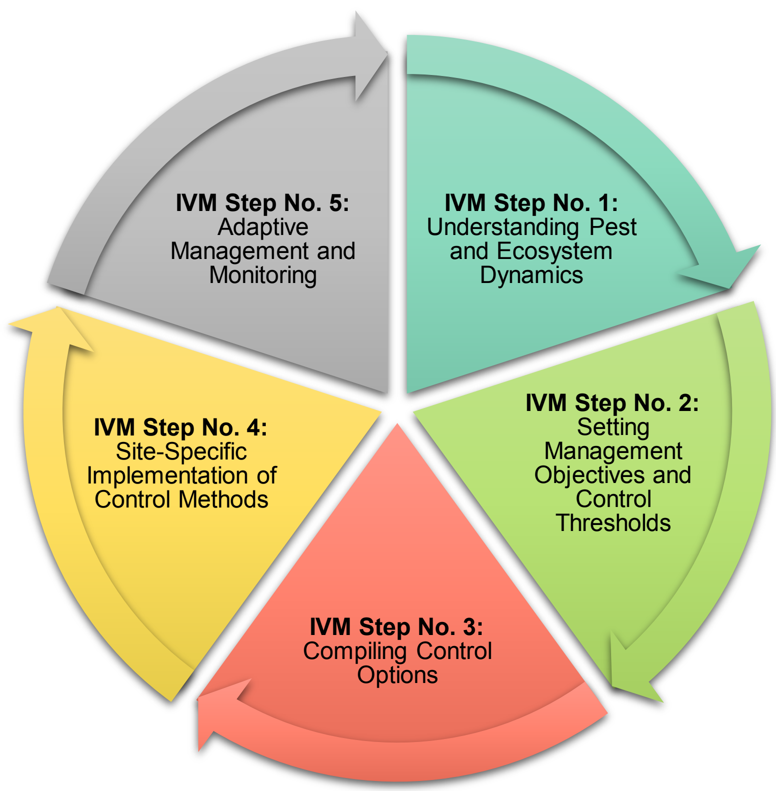


Figure K-11: Cyclical Steps of Integrated Vegetation Management

1.1.1 IVM Step No. 1: Understanding Pest and Ecosystem Dynamics

Goal

Develop and maintain a comprehensive understanding of the existing ecological conditions within project areas including Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas.

Objectives

- Undertake an inventory of vegetation conditions;
- Monitor plant community composition and structure; and
- Monitor the presence of incompatible and compatible species within and adjacent to the rail corridors, guideways, restoration areas and Metrolinx-owned-lands.

The first step in conducting IVM is to develop a working knowledge of the vegetation in the managed system. This information enables managers to determine if existing vegetation is compatible and can be retained, or if it is incompatible (e.g. height or invasive) and requires management. Thus, this IVM framework begins with the collection of data to document and assess the condition, including the location, quantity, and character of vegetation.

Throughout implementation, Metrolinx will need to frequently revisit this step to fully capture an understanding of the local ecology. This is especially important given that Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas will be moving through various construction, managerial, and ecological phases that will result in changes to existing conditions. This inventory will be maintained by completing monitoring as part of the program's monitoring of managed sites at a justifiable interval (e.g. biennial), prior to implementation of control methods.

This section details monitoring events that will take place throughout implementation in order to maintain an understanding of the ever-changing ecosystem dynamics.

1.1.1.1 Initial Inventory

Initial inventory will be part of natural heritage studies and will include documentation of existing vegetation and conditions within and immediately adjacent to Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas. This includes an inventory of vegetation species and complete ELC vegetation community type, which should be performed with a biologist present, covering multiple seasons, including soil coring (with horizon analysis), with the initial inventory in order to capture all flora species. Detailed information on data collection required for woody vegetation that will also enable the implementation of the vegetation replacement and tree end use is provided in **Appendix B.** Initial inventories should be completed by qualified biologists/specialists via on-foot field surveys, according to an agreed upon schedule in the contract (**Figure K-2**). Previous project experience has shown that aerial and high-rail vehicle or train surveys do not provide sufficient detail for organizing IVM work. For larger scale projects and corridor maintenance, additional information on existing conditions will include:

- Delineation of vegetation types within the inventory limits in accordance with the *Ecological Land Classification for Southern Ontario* (ELC) system;
- A list of all vascular plant species for each type of vegetation community and estimated percent cover;
- Soil coring with horizon analysis;
- Identification and delineation of incompatible (e.g. invasive species) herbaceous vegetation;
- Identification and delineation of conditions which may compromise the establishment of compatible vegetation (e.g. contaminated soil, steep slopes, rocky or thin soil, etc.). and
- Evaluation of future climate conditions that could impact the compatibility of vegetation, such as increasing intensity and frequency of rainfall, drought, wind, and extreme temperatures.

Figure K-22: Qualified Professional Completing Initial Vegetation Surveys

1.1.1.2 Vegetation Monitoring – Prior to Control Implementation

Throughout implementation of the IVM program, changes in distribution and abundance of plant species will inevitably occur as a result of management efforts. Vegetation monitoring, completed prior to implementation of control methods and on an interval in keeping with restoration needs, will serve to maintain an up-to-date record of existing ecological conditions within the given site. Monitoring is intended to evaluate the effectiveness of IVM control methods that have been implemented and is discussed as part of Step 5.

Monitoring prior to implementation of control methods will include confirming and augmenting data collected during the initial inventory and/or previous monitoring events in addition to the following:

- Delineation of areas represented by compatible plant species that can be retained and may require protection;
- Delineation of areas represented by incompatible and invasive plant species that may require management (including problematic vegetation encroachments);
- The presence of dead, dying, and imminently hazardous trees (posing an immediate risk to health and safety);
- Identification of tree branches or vines close to OCS poles and any associated electrical structures;
- Access restrictions to the rail corridors caused by the presence of incompatible species;
- The location of trees or brush compromising site security and creating safety issues for employees/ passengers (tripping, slipping, or health hazards);
- Breaches, or potential breaches, to control thresholds;
- Width of the rail corridor edge (especially relative to the 7 m vegetation clearance zone);
- Assessment of function of existing vegetation, including visual screening and opportunities for replacement of screening with native vegetation of the appropriate height;
- Terrain characteristics that help determine the appropriate work method, such as steep slopes;
- Terrain characteristics such as topographical features, eroded or erosion-prone areas or evidence of extreme weather events, bare-ground areas, and hazards such as large rocks and stumps;
- Special conditions such as incompatible land use issues, property encroachments and other concerns;
- Update to changes in conditions such as vegetation communities, access locations/information, etc.; and
- Incidental observations of wildlife and wildlife habitat.

Monitoring findings will be compared against management objectives and control thresholds established as part of Step 2 and will inform the course of action that will be taken to manage vegetation within the entirety or select parts of the area for that year.

1.1.2 IVM Step No. 2: Setting Management Objectives and Tolerance Levels

Goal

Minimize, to the greatest extent possible, the percentage of incompatible vegetation within Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas to ensure that biodiversity and safety are upheld.

Objectives

- Set control thresholds that aim to minimize and prevent the establishment of incompatible species.
- Enable required vegetation removal while retaining compatible vegetation.

Once an understanding of the ecosystem has been established, it is used to inform management objectives and tolerance levels within Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas. Consistent with Metrolinx's focus on providing safe and reliable service, key management objectives for IVM are to:

- Prioritize worker and operational safety;
- Maintain reliable GO train service by minimizing disruption caused by fallen trees, tree limbs, and debris;
- Protect rail infrastructure;
- Support ecological restoration projects; and
- Reduce the spread of invasive species.

Tolerance levels are determined based on the existing vegetation and its alignment with management objectives. Tolerance levels can be quantified by control thresholds, which provide a measurement tool for determining whether action (i.e. control methods) are required to manage vegetation. In general, vegetation that exceeds a control threshold requires a management action or decision.

The following sections present further discussion on determining control thresholds and defining compatible and incompatible vegetation. They provide clear guidance on how to measure the existing vegetation within Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas against control thresholds to determine if management is needed.

1.1.2.1 Key Determinants of Control Thresholds

Control thresholds identified in the Guideline have been determined based on a review of rail corridor and guideway IVM plans as well as ecological, operational, and safety considerations. They have been established to address electrified, non-electrified rail infrastructure and guideways as discussed in **Section 6.1**.

In this IVM framework, control thresholds have been developed to manage the level of vegetative height and surface cover (expressed as a percentage of the total area) that can be tolerated before safety and integrity are compromised. Beyond these levels, vegetation becomes incompatible and may pose risks to operation and infrastructure and thus, requires control methods to be implemented. Control thresholds related to invasive species management should be site specific and based on best management practices.

1.1.2.2 Compatible and Incompatible Vegetation

Defining compatible and incompatible vegetation is an important component of this step. For the purposes of the IVM program, compatible vegetation is defined as vegetation that can exist without interfering with rail operations and safety as well as native species in zone 3, 4, 5, or outside the rail corridors. Conversely, incompatible vegetation includes vegetation that presents a potential risk to safe and reliable rail service includes, not limited to:

- Vegetation breaching threshold tolerance levels (in height and/or density);
- Hazard trees;
- Hazardous vegetation; and
- Invasive species.

1.1.2.2.1 VEGETATION HEIGHT AND DENSITY

Vegetation height and density are characteristics that can be measured and compared against control thresholds. Height and density control thresholds will vary depending on the location within Metrolinx-owned-lands, the rail corridors, and guideways relative to the road, rail, or guideway infrastructure.

Height tolerance is largely based on the existing or potential height of vegetation relative to its proximity to infrastructure. Plant species that grow tall enough to potentially interfere with infrastructure are considered incompatible. A strict tolerance applies to the OCS and electrified infrastructure within the vegetation clearance area, given the risk of damage and subsequent possibility of electrical fire.

Density of vegetation is measured as the percentage of the total area that can be tolerated before safety and integrity are compromised and this determines whether the amount of vegetation present is enough to require management. Vegetation present at a high density near infrastructure is considered incompatible and will warrant proper management. For example, the ballast area demands a stricter tolerance to prevent damage to sensitive rail infrastructure and derailment.

1.1.2.2.2 HAZARD TREES

Trees where the rail line, electrification, or guideway infrastructure is within the potential fall zone should be assessed for risk. A hazard tree can generally be defined as a tree with structural defects likely to cause the failure of all or part of the tree and is at risk of causing damage or injury to life or property. Risk is related to the chance that the tree could potentially strike a target if left untreated, thus a tree is only considered hazardous when it poses a risk to life or property. It is important to note that not all dead trees are hazardous. Rather, they can provide many ecological benefits by creating habitat for wildlife such as birds, bats, and insects, and cycling nutrients back into the earth and ecosystem. Dead trees should be retained wherever deemed to be not imminently hazardous. To that end, only trees that are considered imminently hazardous should be removed, with the principles of avoidance and minimization being considered at all times.

Detailed information on the assessment of hazard trees is provided in **Appendix B**.

1.1.2.2.3 HAZARDOUS VEGETATION

Hazardous or noxious vegetation includes species that may pose serious health and safety issues (such as blindness or poisoning) to employees or members of the public due to this vegetation growing in unsuitable locations. Examples of hazardous plant species include Giant Hogweed (*Heracleum mantegazzianum*) and Water Hemlock (*Cicuta maculata*). Expectations around hazardous vegetation management will be site or project specific and the health/safety risks associated.

1.1.2.2.4 INVASIVE SPECIES

The management of vegetation within Metrolinx owned lands, the rail corridors, guideways, and restoration areas are important not only for safety, but also for the control of invasive plant species (Bordadegua, 2017), particularly as linear infrastructure is known for being a vector of invasive species. For the purposes of this IVM, invasive plant species are non-native species that may threaten the biodiversity and ecological integrity of the ecosystem within Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas.

Invasive species tend to be fast-growing; have high dispersal/reproduction capabilities; phenotypic plasticity (the ability to alter one's growth form to suit current conditions); tolerant of a wide range of environmental conditions; and are difficult to control once established. This IVM framework applies a strict tolerance level intended to control the presence of invasive species within and near Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas to the greatest extent possible. A key component of IVM is to avoid creating suitable conditions for dispersal and establishment of non-native or non-desirable species, especially during construction and maintenance activities (Bordadegua, 2017). To minimize the introduction and spread of non-native and invasive species, the Clean Equipment Protocol for Industry (Halloran et al., 2013, updated 2016) will be implemented. Disposal of invasive species shall be conducted in a manner that prevents dispersal of plant materials seeds and rhizomes including soils etc. and if applicable complies with *Invasive Species Act* and BMPs.

Throughout IVM implementation, invasive species will be managed in accordance with all relevant federal and provincial regulations and the latest research, particularly by making use of BMPs by the Ontario Invasive Plant Council (OIPC). It is likely that site-specific or species-specific IVMs will be needed to effectively manage invasive species in some cases. Over time, IVM plans will require updating to capture and adjust to any legislative changes, changes in climate conditions, invasive species of concern, or scientific/practitioner/IK or TEK understanding accordingly.

Relevant regulations that apply to the spread of invasive species include the federal *Plant Protection Act* and *Seeds Act* as well as the provincial *Invasive Species Act* and *Weed Control Act*.

While the *Invasive Species Act* does not set out obligations to remove already established invasive plant communities, this IVM framework has been developed with the intent of controlling invasive plant species to the extent possible. The provincial *Invasive Species Act* prohibits activities that will result in the further establishment or movement of prohibited or restricted invasive species. This includes but isn't limited to four restricted species that may be found on Metrolinx land, including: Black Dog-strangling Vine (*Cynanchum louiseae*), Dog-strangling Vine (*Cynanchum rossicum*), Japanese Knotweed (*Reynoutria japonica* var. *japonica*), and European Common Reed (*Phragmites australis* ssp. *Australis*). Non-site specific BMPs for each of these species are drafted and regularly updated by the OIPC and should be referenced as part of vegetation management wherever these species are present.

Outside of the federal and provincial realm, there are a number of non-regulated woody and herbaceous invasive species considered to be threats within local, regional, and Conservation Authority jurisdictions. To understand current impacts and invasive species of concern to local municipalities and conservation authorities, research is required. Up to date strategies to reference include the Toronto and Region Conservation Authority's (TRCA) Invasive Species Management Strategy; Credit Valley Conservation's (CVC) Invasive Species Strategy; and Central Lake Ontario Conservation Authority's (CLOCA) Updated Invasive Species Management Strategy. As the climate changes, invasive species are expected to become more widespread, both within regions and crossing climate zones. Invasive vegetation that will flourish in future climate conditions must be considered in IVM.

This information as well as the presence and abundance of invasive species will be used to inform IVM plans and project management actions. Action decisions should include the following considerations where possible:

- OIPC recommended BMPs
- The consequence of not managing;
- The invasiveness of the species;
- The potential safety, economic, and ecological impacts likely to be caused by its spread;
- Site characteristics – including adjacent land uses and proximity to environmental sensitive areas;
- Expected future climate conditions;
- Indigenous Knowledge (inclusive of TEK) and
- Species composition and percent coverage on-site as well as in the adjacent landscape.

1.1.2.3 Incidental Observations and Ad Hoc Management

In some instances, ad hoc management (actions that are carried out as needed), may be triggered by the following:

- Vegetation interfering with access to railway and guideway equipment;
- Vegetation compromising site security or causing safety issues for employees or passengers (such as tripping, slipping, or health hazards);

- Vegetation compromising, or potentially compromising, communication and signal installations and yard and station grounds; or
- Any problematic vegetation that has been identified from an adjacent property owner, Indigenous communities, stakeholder or an employee complaint.

In these instances, it may not be possible to determine whether management is needed based on the common indicators of vegetation height or surface cover. Instead, determining the need for action will be based on factors such as the likelihood of harm to property, people or ecology.

1.1.2.4 Summary

Control thresholds are an important part of the management decision-making process for IVM. They provide a proactive means to address incompatible species that, if left untreated, would otherwise come to harm operations and infrastructure. Ensuring that these thresholds are maintained will reduce the associated risks and costs, thus promoting in the long-term protection of infrastructure integrity and investment and the provision of a safe, reliable transportation network.

In order to achieve these benefits of IVM, the following is recommended:

- Appropriate action is taken before thresholds are breached;
- Necessary action is applied in a timely manner, informed by risk considerations;
- Vegetation is maintained in accordance with the control thresholds established and applicable regulations;
- Control thresholds are not breached, particularly so within the 7 m vegetation clearance zone (represented in Zones 1, 2, and 3);
- Invasive species, imminently hazardous trees and hazardous vegetation are handled in accordance with this framework and opportunities for appropriate native vegetation planting identified with consideration of future climate conditions;
- Any problematic or other incompatible vegetation is removed if posing a hazard to safety, ecology, or rail operability; and
- Responsibility for removal and maintenance is assumed for vegetation within any newly identified areas requiring integrated management.

In addition, it is recommended that removals or other control actions are applied according to BMPs and are not implemented before a control threshold has been breached.

The intent of the integrated approach is to encourage a managed environment that is compatible with rail operations and project objectives. In order to allow for the growth of a compatible plant community, control methods must be avoided unless the control threshold is exceeded. If controls are over-applied, this may compromise the health of compatible vegetation, the local ecosystem and IVM objectives.

1.1.3 IVM Step No. 3: Compiling Vegetation Control Options

1.1.3.1 Chemical Control Methods

Chemical control should be minimized as much as possible to reduce known and unknown environmental and cultural impacts. When applied following Best Management Practices (BMPs, including those from OIPC), chemical treatments can effectively control incompatible vegetation (BCRC, 2012), particularly if they are applied in combination with other methods or selectively, using advanced application technologies and appropriate timing. **Figure K-3** below demonstrates the chemical control method possible along the rail corridors.

Figure K-33: Herbicide Application along Metrolinx Lakeshore West Corridor, 2023

Other vegetation control methods may simply address the symptoms of overgrowth, whereas herbicides can treat the root cause by killing the plant as a whole. This is an important consideration to be made when weighing control options for areas of the rail corridors where there is a zero to low tolerance for vegetation.

1.1.3.1.1 CHEMICAL CONTROL WITHIN METROLINX-OWNED-LANDS

Across Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas, herbicides/chemical controls may be used in response to control threshold breaches and ad hoc events following BMPs. They may also be required for:

- Vegetation control in areas where non-chemical methods are not feasible or practical due to accessibility issues;
- The control of the presence and re-growth of woody vegetation where mechanical methods are not effective, safe or practical;

- The control of noxious and invasive plants where cultural or mechanical methods are not effective, safe, or practical; and
- Instances where no feasible non-chemical control alternative is available (e.g. Zones 1 and 2, “no growth” zones).

1.1.3.1.2 HERBICIDE SELECTION

Choosing which herbicide to apply in response to IVM needs is dependent on target species; time of year; stage of plant growth; site-specific considerations and sensitives; soil moisture before, during, and after application; precipitation (rain or snow); and temperatures of soil and air before and throughout chemical treatment. Herbicide selection may also consider the use of the product with the least adverse non-target impacts available that will achieve the necessary control.

The proper BMPs and subject matter experts (e.g., pesticide application licensed professionals, or qualified invasive species management practitioners, etc.) should be consulted prior to herbicide selection to ensure all factors have been considered. Time of year should be regarded as an important factor given the need to consider when certain active ingredients in herbicides are effective, dangerous, or when they are rendered unusable. Environmental impacts are another important factor to consider in herbicide selection. It is important to consider how to achieve vegetation management goals with the least harm or risk to the local environment. Where chemicals are used, the timing window and target species outlined in **Table K-1** should be considered.

In addition to timing windows, details on the persistence and selectivity of active ingredients have also been listed in **Table K-1**. Persistence, as defined in the context of IVM, refers to non-residual ingredients (chemicals that work at the time of treatment and remain active for only a short while thereafter) and residual ingredients (chemicals that remain effective where they are applied for some length of time). Generally, for areas like Zone 1 (which are operationally demanding) and areas such as those surrounding OCS poles (which are susceptible to risk), residual herbicides may be used to ensure long-lasting effectiveness. Beyond this, residual herbicides should be avoided to reduce non-target and environmental impacts.

Table K-11: Herbicide Selection

Active Ingredient*	Persistence	Selectivity	Timing	Target Species
20-25% Glyphosate (diluted in water)	Non-residual	Non-selective	Spring/Summer/Fall**	Herbaceous species
10% Glyphosate	Non-residual	Non-selective	Spring/Summer/Fall**	Herbaceous species
Triclopyr*	Non-residual	Selective	Year round**	Herbaceous and woody species
Picloram	Residual	Selective	Summer**	Herbaceous and woody species
Imazapyr	Residual	Non-Selective	Spring/Summer/Fall**	Herbaceous and woody species

* The active ingredients provided have been determined based on their proven ability to treat vegetative species that are known to occur within Metrolinx-owned-lands. BMPs and subject matter experts should be consulted before herbicide(s) selection and treatment.
** When working with pesticides/herbicides, follow all label instructions, regulations and when working with invasive species, BMPs and subject matter experts should be consulted before herbicide(s) selection and treatment.

Non-selective herbicides are those which can effectively treat a broad range of vegetation, whereas selective herbicides are those that inhibit the growth of a target species, while leaving other plants unaffected. Where noxious weeds and invasive species are a concern, a selective control is the optimal choice. Selective herbicides should be used where target vegetation is surrounded by compatible plants and in any instance where surrounding plants need to be protected. Within highly utilized and risk-prone areas, it is recommended that non-selective products be considered to reduce invasive species presence.

It is understood that surfactants are used in the application of herbicides to increase efficacy. The selection of surfactant should be done in consultation with BMPs and subject matter experts in order to reduce hazards to the environment. In particular, surfactants should not be used in proximity to wetlands or waterbodies as they have been shown to be environmentally hazardous.

Limitations

The use of herbicides is associated with known environmental and social impacts and challenges. Despite their importance in maintaining a safe corridor, it is recommended that the extent of known impacts or hazards from herbicides be avoided or mitigated. This may be accomplished by utilizing precise application tools (discussed below), selecting appropriate herbicides/surfactants, applying the appropriate ratio of active chemical ingredients, and following the operational requirements on herbicide use outlined below, stipulated on product labels and in all applicable regulations and BMPs (including those from the OIPC).

1.1.3.1.3 OPERATIONAL INFORMATION

Personnel involved in the handling and application of herbicides must do so in accordance with Metrolinx protocols and policies and, at minimum, must adhere to the following:

1. Herbicides must be applied in accordance with applicable regulations including the federal *Pest Control Products Act*, the *Ontario Pesticides Act*, application BMPs (including OIPC BMPs where applicable) and *Ontario Regulation 63/09* and in accordance will all label directions.
2. Prior to use, personnel are to ensure that they have the most current label consistent with the information detailed on the Pest Management Regulatory Agency search product label website: http://pr-rp.hc-sc.gc.ca/ls-re/index-eng.php.
3. All supervisory personnel applying chemicals shall have valid applicator's licenses. Copies of such licenses shall be provided to Metrolinx. A maximum of three trainees/employees can work under a supervisor's license at one time. Direct supervision is required for anyone working under their supervisors' applicator license.
4. Herbicide application shall be performed in keeping with the associated Integrated Vegetation Management Plan.

1.1.3.2 Mechanical and Manual Control Methods

Mechanical and manual methods can be used to cut or remove vegetation on-site, and efficacy is often increased by combining with other control approaches. Mechanical and manual controls are regarded in rail corridor and guideway management as important tools for addressing imminently problematic vegetation and are one of the most effective methods where time and risk are major concerns. **Figure K-4** demonstrates mechanical control method along the rail corridors.

Figure K-44: Mechanical Control (Chainsaw) of Incompatible Vegetation along Metrolinx Corridor, 2023

The mechanical methods outlined in this framework include tree removal, mowing and pruning (refer to **Section 6.2.4.2**). Determining which of these controls should be used will be dependent on such factors as terrain, safety, and economic considerations/feasibility, in consultation with BMPs and subject matter experts.

Limitations

When used in isolation from cultural or chemical approaches, mechanical controls may be limited in their ability to reduce the presence of incompatible vegetation over the long-term. Given that the reduction in incompatible vegetation is an important IVM objective, use of mechanical control methods should be considered in combination with other methods.

1.1.3.3 Cultural Control Methods

Cultural controls involve the introduction of specific plants, ground covers, soil amendments or mulches to control vegetation growth. They are used in rail corridor and guideway management as a means of creating a vegetative community compatible with the requirements of railway and guideway safety as well as the social and environmental values important to Metrolinx. They include such means of control as the retention and replanting of compatible native vegetation, seeding, and use of mulch. Monitoring these controlled areas is necessary to ensure incompatible vegetation has been managed and plantings are maintained.

These control options represent an important non-chemical means of preventing the establishment of incompatible vegetation. Moreover, they are essential tools for:

- Providing a safe and an aesthetically pleasing rail corridor;
- Enhancing wildlife habitat;
- Preventing the loss of and promoting biodiversity;
- Establishing pollinator habitats and promoting native pollinator species;
- Reducing the cost of vegetation management;
- Reducing the need of chemical control; and
- Helping to reduce the presence of tall growing vegetation by planting species that out-compete for light, space, and nutrients.

Metrolinx-owned-lands, rail corridors, guideways, restoration areas have the potential to provide habitats and functional connectivity for plants and wildlife. Management practices that involve small-scale revegetation have been recommended to help increase these positive effects of railway corridors (Bordadegua, 2017) and other land types.

Cultural control methods such as native planting or seeding are recommended in Zones 3, 4 and 5 (where located within the rail corridors) and Zones 1g to 4g (where located adjacent to the elevated guideways). They offer a proactive means of management; for example, they can be used to prevent the establishment of invasive species. .

Limitations

While effective as a preventative measure, cultural controls should not be regarded as a reactive means of addressing immediately hazardous or problematic vegetation. Where a breach of threshold demands a timely response, chemical or mechanical methods should be implemented. Cultural controls, however, are encouraged as a preventative or subsequent measure – whereby, as discussed above, soil amendments such as ballast gravel or native seeding, etc. is used preventatively or following the implementation of a reactive control method.

1.1.3.4 Mixed Method/Combined Approach

As noted, the effectiveness of each method is potentially more effective when chemical, cultural, and mechanical vegetation control methods are used in combination. Thus, the framework endorses the use of a mixed-methods approach, whereby a combination of methods are used to control incompatible vegetation.

In action, the mixed method approach may take place as follows:

Example 1: For the removal of an imminently hazardous, invasive tree within Zone 4 of the Metrolinx rail corridors:

1. Mechanical controls would be used to remove an identified imminently hazardous tree as timely as possible.
2. Up to 30 days following mechanical control implementation, chemical treatments are used to treat the cut stump using the one of the herbicides recommended for use under the IVM plan.
3. The area would then be subsequently seeded with low-grow native species.

Example 2: For the large-scale removal of vegetation, e.g., prior to the construction of new rail corridors, within Zone 3 of the Metrolinx rail corridors:

1. Where vegetation is being removed at a large-scale, mechanical techniques (e.g. mowing, tree removals) will be used.
2. Following control method(s), cleared ground will be seeded with low-grow native species.
3. Mulch will then be applied to serve as a protective cover over disturbed soils.

The mixed control method approach allows for the opportunity to create a IVM action plan which best:

- Maximizes cost-effectiveness and efficacy;
- Creates a self-sustaining native vegetation community;
- Improves worker safety;
- Reduces environmental and landscape alteration and impacts;
- Promotes a healthier, more functional ELC vegetative community within Metrolinx-owned-lands; and
- Reduces the dependence on herbicides and chemical controls.

1.1.3.5 Selection Criteria

Determining which method, or combination of methods should be used of mechanical, chemical, or cultural control options hinges on a number of considerations/ constraints:

- Vegetation cover and height relative to control thresholds;
- Site characteristics, including the proximity to a Designated Natural Area or other feature requiring protection;
- Timing of control method;
- Composition of vegetation present;
- Type and abundance of invasive, incompatible, and/or noxious species;
- The consequences of not implementing treatment;
- Potential impact to safety, site security, and biodiversity;
- Urgency or risk level of the hazardous vegetation present;
- Public concerns;
- Cost effectiveness;
- Efficacy of previously implemented control options;
- The possibility of adverse impacts to surrounding land, workers, and bystanders; and
- Other factors which are generally used in IVM approaches to justify, evaluate, and determine method(s) chosen for the management of vegetation within the rail corridors and road ROWs and land management.

Vegetation management zones (VMZ) are described in the Compatible and Incompatible Vegetation section (Section 6.2.2). **Table K-2**, and **Table K-3** provide a summary of the zones for electrified corridors, non-electrified corridors, elevated guideways, and raised guideways respectively, along with their respective control thresholds and suitable management treatment options for each zone. The IVM manager will have to determine which option or combination of options will most appropriately meet IVM objectives based on the selection criteria above.

Table K-2: VMZs and Management Control Options for Electrified and Non-Electrified Corridors

Zone	Location/Description	Target Vegetation	Control Threshold	Control Options
Zone 1	Ballast area (which includes the main track, siding, back track and storage track)	No growth zone	3% cover	Chemical AND Cultural
Zone 1	2.9 m clearance from the track centerline [for electrified corridors: extending to the Overhead Contact System (OCS)]	No growth zone	3% cover	Chemical AND Mechanical AND Cultural

Zone	Location/Description	Target Vegetation	Control Threshold	Control Options
Zone 2	**Non-Electrified:** 1.6 m maintenance zone starting immediately adjacent to the Exclusion Zone infrastructure **Electrified:** 2.5 m clearance from the Overhead Contact System (OCS) and electrified infrastructure	**Non-Electrified:** Low growth zone comprised of non-woody vegetation. **Electrified:** No growth zone	20% cover 0.5 m or less in height OR 10% cover 0.5 m to 1.4 m in height (**Non-electrified**)	Chemical AND Mechanical AND Cultural
Zone 3	**Non-Electrified:** 5.5 m area (between 4.5 and 10 m from the track centerline) outside of the vegetation clearance zone where management is not required but future plantings should be limited. **Electrified**: 1.6 m maintenance zone starting immediately adjacent to the Exclusion Zone infrastructure	**Non-Electrified:** Medium growth zone comprised of shrubs and non-woody species that grow up to 4 m above track when mature. **Electrified:** Low growth zone comprised of non-woody vegetation. Electrified:	Non-electrified: N/A **Electrified:** 10% cover 1.4 m or more in height	Chemical AND Mechanical AND Cultural

Zone	Location/Description	Target Vegetation	Control Threshold	Control Options
Zone 4	**Non-electrified:** 3.5 m area (between 10 and 13.5 m from the track centerline) outside of the vegetation clearance zone where management is not required but future plantings should be limited. **Electrified:** 5.5 m area (between 7 and 12.5 m from the track centerline) outside of the vegetation clearance zone where management is not required but future plantings should be limited.	**Non-electrified:** Tall growth zone comprised of trees, shrubs, and non-woody species that grow up to 8 m above track when mature. **Electrified:** Medium growth zone comprised of shrubs and non-woody species that grow up to 4 m high when mature.	N/A	Chemical AND Mechanical AND Cultural
Electrified Zone 5	3.5 m area (between 12.5 and 16 m from the track centerline) outside of the vegetation clearance zone where management is not required but future plantings should be limited.	Tall growth zone comprised of trees, shrubs, and non-woody species that grow up to 8 m high when mature.	N/A	Chemical AND Mechanical AND Cultural
All	Invasive species	Minimize presence	0% tolerance within 30m of DNA, >30m of DNA species specific	Chemical AND Mechanical AND Cultural
All	Hazard tree(s)	Minimize presence	0% tolerance level if imminently hazardous	Chemical AND Mechanical

Zone	Location/Description	Target Vegetation	Control Threshold	Control Options
All	Hazardous vegetation	Minimize presence	0% tolerance level	Chemical AND Mechanical AND Cultural

Table K-3: VMZs and Management Control Options for Elevated Guideways

Zone	Location/Description	Target Vegetation	Control Threshold	Control Options
Zone 0g	Air space 1m offset from elevated guideway structure (i.e. from pier and parapet)	No vegetation breach	20%	Mechanical
Zone 1g (below guideway)	Area under the guideway structure between Zone 0g, the finished grade and within the dripline of the parapet	Low growth zone comprised of non-woody vegetation (pier) and/or shrubs (no pier)	N/A	Mechanical AND Cultural AND Chemical (pier only)
Zone 1g (adjacent guideway)	Area between the dripline of the parapet structure and a 1 m horizontal offset from the parapet outside of Zone 0g	Low or medium growth zone comprised of shrubs and non-woody species that will not grow to breach Zone 0g when mature	N/A	Mechanical AND Cultural
Zone 2g	1.6 m area (between 1 m and 2.6 m horizontally from the dripline of the parapet structure) plus a 1.4 m vertical offset area from the top of parapet	Medium or tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 1.4 m vertical offset from the top of parapet	N/A	Mechanical AND Cultural
Zone 3g	5.5 m area (between 2.6 m and 8.1 m horizontally from the dripline of the parapet structure) plus a 4.0 m vertical offset area from the top of parapet	Tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 4.0 m vertical offset from the top of parapet	N/A	Mechanical AND Cultural

Zone	Location/Description	Target Vegetation	Control Threshold	Control Options
Zone 4g	3.5 m area (between 8.1 m and 11.6 m horizontally from the dripline of the parapet structure) plus an 8.0 m vertical offset area from the top of parapet	Tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 8.0 m vertical offset from the top of parapet	N/A	Mechanical AND Cultural
All	Invasive species	Minimize presence	0% tolerance within 30m of DNA, >30m of DNA species specific	Chemical AND Mechanical AND Cultural
All	Hazard tree(s)	Minimize presence	0% tolerance level	Mechanical AND Chemical
All	Hazardous vegetation	Minimize presence	0% tolerance level	Chemical AND Mechanical AND Cultural

Table K-4: VMZs and Management Control Options for Raised Guideways

Zone	Location/Description	Target Vegetation	Control Threshold	Control Options
Zone 1w	Space between finished grade and height of the adjacent noise barrier	No vegetation breach	20%	Mechanical
Zone 2w	Area between the noise barrier and a 3.0m horizontal offset from the noise barrier, and from the grade up to the height of the noise barrier	No vegetation breach within the 3.0m radius of the Auto Transformer Feeder (ATF) wire. No tree trunks within 3.0m offset from the noise barrier	20%	Mechanical AND Cultural

Zone	Location/Description	Target Vegetation	Control Threshold	Control Options
Zone 3w	1.6 m area (between 3 m and 5.6 m horizontally from the noise barrier) plus a 1.4 m vertical offset from top for noise barrier	Medium or tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 1.4 m vertical offset from the top of noise barrier	N/A	Mechanical AND Cultural
Zone 4w	5.5 m area (between 5.6 m and 10.1 m horizontally from the noise barrier) plus a 4.0 m vertical offset from top for noise barrier	Medium or tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 4.0 m vertical offset from the top of noise barrier	N/A	Mechanical AND Cultural
Zone 5w	3.5 m area (between 10.1 m and 13.6 m horizontally from the noise barrier) plus a 8.0 m vertical offset from top for noise barrier	Tall growth zone comprised of trees, shrubs, and non-woody species that will not grow past the 8.0 m vertical offset from the top of noise barrier	N/A	Mechanical AND Cultural
All	Invasive species	Minimize presence	0% tolerance within 30m of DNA, >30m of DNA species specific	Chemical AND Mechanical AND Cultural
All	Hazard tree(s)	Minimize presence	0% tolerance level	Mechanical AND Chemical
All	Hazardous vegetation	Minimize presence	0% tolerance level	Chemical AND Mechanical AND Cultural

1.1.4 IVM Step No. 4: Site-Specific Implementation of Control Methods

Goal

Apply a control action that is tailored to varying site conditions, needs, and sensitivities. The selected option should aim to represent a balance between meeting IVM targets/objectives while considering indirect and direct impacts to the environment and society.

All applicable regulations and Health and Safety considerations need to be thoroughly understood, planned for, and hazards mitigated before implementation of control methods begins.

Objectives

Adhere to the selection criteria/decision-making process to determine which potential control type and method (e.g. pruning, mowing, foliar chemical application, seeding, etc.) best addresses management objectives and constraints, (e.g. site conditions, environmental sensitivities, timing windows etc.).

Once a control option has been determined, the next step will be to decide on the application approach to be used to apply the chemical, mechanical and/or cultural control(s). Each method of control comes with a host of application options in terms of the techniques and technologies that can be used for application. Determining which approach to take hinges on a variety of species-specific and site-specific sensitives, constraints, and conditions that will need to be accounted for.

This section overviews the application techniques and technologies that may be used to implement control methods. It provides a summary of the benefits and limitations of application options and gives recommendations on which approach should be taken. The sections below summarize the decision-making process to be followed to ensure that the most suitable, cost-effective, and environmentally compatible control method(s) is applied within Metrolinx-owned-lands, the rail corridors, guideways and restoration areas.

1.1.4.1 Chemical Techniques and Application Technologies

The advancement in herbicide application techniques and technologies has allowed IVM professionals to apply chemicals more precisely and efficiently resulting in a reduction in the volume of herbicide needed to treat incompatible species. The most effective treatment application approach available, which reduces the total volume of herbicide used should be implemented where deemed necessary. Chemical control methods should be developed with Subject Matter Experts and align with regulations, label instructions, industry standards and BMPs.

Chemical control can be used to:

- Prevent vegetation growth in non-growth zones;
- To target incompatible vegetation that has breached its control threshold;

For the treatment of vegetation by foliar or basal bark/stem applications (to prevent re-sprouting)

Application technologies include:

- Foliar/stem applications
- Soil applications (for no-growth zones)
- Cut surface (where re-sprouting is likely)

Furthermore, caution, planning and appropriate consultation or engagement must be exercised if:

- Used within areas at risk of erosion or sediment movement caused by heavy precipitation or a high-water table, as they may be washed or move off-site; or
- Application is needed adjacent or within an environmentally sensitive area; or
- If a targeted species is considered bio-culturally significant or a Species at Risk; or
- If a targeted species is adjacent to desirable plants, wildlife and habitats, bio-culturally significant species or Species at Risk.

1.1.4.2 Mechanical Techniques

For mechanical application options, recommended methods include pruning, mowing, and tree removal.

1.1.4.2.1 PRUNING AND TREE REMOVALS

Within Metrolinx-owned-lands, the rail corridors and guideways, tree removal may be implemented:

- For the removal of hazard trees that pose a risk of falling within Metrolinx-owned-lands, rail corridors or guideway.
- For the removal of trees that have breached the control threshold or that have been deemed necessary as an immediate hazard within the 7 m vegetation clearance zone; and
- For the removal of trees necessary for construction.

Within Metrolinx-owned-lands, the rail corridors and guideways, pruning should be used to address vegetation (namely branches) encroaching into Zone 1, 2 or 3 (rail corridors) or Zone 0g (guideways) and in other cases where complete tree removal is not required. The frequency of trimming will be based on the assessment results considering conditions collected during monitoring events.

Tree removal and woody vegetation pruning must be undertaken by qualified personnel under the oversight of an Arborist with knowledge and experience in proper arboricultural techniques. This will ensure works are effective and does not lead to unnecessary damage of a tree or infrastructure. For the removal of trees in environmental sensitive areas, when complying with multiple timing windows, removal by hand may be required.

Caution must be exercised with this treatment considering:

- Vegetation removal and pruning should only be conducted outside the bird nesting season (generally April 1 to August 31 in southern Ontario but can include shoulder months) to avoid disruption of migratory birds and habitat. Applicable municipal by-laws should also be reviewed and applied as several municipalities prohibit removals during this season;
- Vegetation removal or pruning shall not damage or destroy a nest of species listed under Schedule 1 of the MBR, under the MBCA, at any time of year until the nest has been abandoned, registered, and the designated time period has passed per the regulations. Nest sweeps for birds listed under Schedule 1 should be conducted by a qualified biologist prior to tree removals;
- Although not all species of birds are protected under the MBCA, Metrolinx recognizes the ecological value of other species and caution should be used when removing or pruning vegetation near these species and their habitat;
- Tree removal and pruning should only occur outside of the active bat roosting season (generally April 1 to October 1) where potential bat habitat has been identified;
- Permits may be required for boundary trees and public/ private owned trees that are overhanging Metrolinx-owned-lands, rail corridors or guideways that will be pruned or injured to an extent that is considered as a removal by the municipality;
- Where SAR trees or habitat were identified nearby, additional mitigation measures shall be followed as prescribed in an approved permit, authorization or letter of advice as applicable;
- To minimize soil disturbance during tree removal, trees should be cut above the soil and grubbing should be avoided; and
- Pruning of oak trees should not occur from April to November to prevent potentially exposing the tree to Oak Wilt. If oak trees must be pruned during this window, such as if damage to an oak tree has occurred (accidental or weather related), wounds will be covered with commercial tree paint.

Refer to **Appendix E** for the bird nest survey and protocol details.

1.1.4.2.2 MOWING

Mowing involves the cutting of vegetation using track-mounted or wheel heavy-duty flail or rotary cutters. Within Metrolinx-owned-lands, the rail corridors and guideways, mowing may be used:

- For the removal of incompatible vegetation less than 20 cm in height within Zones 1-3 within the rail corridors and Zone 1g of the guideways;
- To maintain requirements where alternative methods have proven ineffective, or in areas with high densities of conifers;

- In circumstances where removal is required immediately; or
- For the cutting of vegetation in areas where it is desirable for Metrolinx-owned-lands, rail corridors and guideways to be left at a short length, e.g., adjacent to public parks.

Caution must be exercised considering the following:

- Mowing should only be conducted outside the bird nesting season (generally April 1 to August 31 in southern Ontario but can include shoulder months) to avoid disruption of migratory birds and habitat;
- Mowing shall not damage or destroy a nest of species listed under Schedule 1 of the MBR, under the MBCA, at any time of year until the nest has been abandoned, registered, and the designated time period has passed per the regulations. Nest sweeps for birds listed under Schedule 1 should be conducted by a qualified biologist prior to mowing;
- Although not all species of birds are protected under the MBCA, Metrolinx recognizes the ecological value of other species and caution should be used when mowing near these species and their habitat; and
- Where mowing is planned in areas with considerable pollinator habitat and compatible species, particularly in the late summer and on a large scale, we should consider scheduling this work to occur in the dormant season/winter to reduce insect mortality. Mowing during the late summer will lead to significant reduction of plants that provide food (i.e., nectar, pollen, foliage, and seeds) and habitat for insects and birds, as well as killing pollinator larvae on host plants, such as milkweed.

Refer to **Appendix E** for the bird nest survey and protocol details.

1.1.4.3 Cultural Techniques

Cultural control methods include retaining existing low ground cover, as well as seeding, mulching, soil amendments and planting. The most effective cultural method for a given area will be largely dependent on location and site-specific conditions. Within Zone 3, the retention of existing low ground cover, mulching and seeding are recommended. Where suitable, planting of native trees and shrubs within Zones 4 and 5 may be undertaken.

1.1.4.3.1 RETAINING EXISTING LOW GROUND COVER

To the greatest extent possible, existing, compatible ground cover should remain undisturbed. Retention of existing compatible vegetation will benefit IVM as it helps prevent the establishment of incompatible or invasive species, resulting in a reduced need for the implementation of mechanical and chemical controls.

1.1.4.3.2 ON-SITE RESTORATION

Ecological restoration is the process of assisting the recovery of a site that has been degraded, damaged, or destroyed through construction activities. Restoration includes all works required to return a site to its original or an improved healthy state. Restoration on- and off-site should improve ecological function (processes), integrity (species composition and community structure), and sustainability (resistance to disturbance and resilience). On a typical site in the GTHA, restoration involves creating healthy soils, controlling invasive species, seeding native herbaceous species, planting native trees and shrubs that reflect the surrounding or adjacent vegetation communities, and returning ecosystem composition and structure to a more natural state. This process strives to improve the biological diversity of degraded landscapes, increase the populations and distribution of rare and endangered species, and enhance landscape connectivity. These practices will also support resilience to changing climate conditions.

1.1.4.3.3 NATIVE SEEDING

Native seeding can inhibit incompatible vegetation establishment and promote the establishment of a native plant community and natural regeneration.

Seeding typically includes application of a nurse crop as well as a native species seed mix with a high percentage of grass and legume species. The nurse crop will provide fast, temporary (typically annual species) cover to suppress undesirable vegetation while the native seed mix (typically perennial species) becomes established. Species that are commonly used as nurse crops include Virginia Wild Rye (*Elymus virginicus*), Canada Wild Rye (*Elymus canadensis*), Common Oat (*Avena sativa*) and Buckwheat (*Fagopyrum esculetnum*). Nurse crop species should be selected with consideration to avoid aggressive, invasive or non-native species such as White Clover (*Melilotus albus*) and Annual Rye (*Lolium multiflorum*) which is not recommended for use, as it can inhibit the growth of other species (Conservation Halton, 2017; CVC, 2013). Nurse crops should be applied at a rate of 22 kg/ha; however, the application rate and best management practices recommended by the seed supplier should be considered.

The recommended native seed mixes include species that will be compatible with the long-term objectives of IVM within Metrolinx-owned-lands, the rail corridors, guideways and restoration areas. Site-specific native seed mix recommendations are provided in the Guideline based on the existing site conditions, particularly the local soil (including texture, fertility, pH, and organic matter content), moisture, and light conditions. Species should be compatible and complementary to the existing and immediately adjacent vegetation communities of the site following disturbance.

TRCA has developed a number of seed mixes suitable for restoration projects within the GTHA (TRCA, 2022). These seed mixes were designed to be used in a variety of soil and moisture conditions. As such, the recommended native seed mixes include those developed by TRCA. Seed mixes should be applied at the specified rate of 22-25 kg/ha and application method should reflect site conditions (adjusted as necessary to suit application method).

The recommended native seed mix for areas within Zone 3-5 have been determined based on existing site conditions. **Table K-4** provides a summary of suitable seed mixes based on the pre-disturbance ELC vegetation community identified. **Appendix F** contains a list of southern Ontario native species in each mix.

Metrolinx is also committed to engaging with Indigenous communities on seed mixes and seed sourcing for project-specific IVM restoration programs.

Table K-4: Seed Mix Recommendations

Existing Community	Seed Mix
Shallow Marsh (MAS)	TRCA Frugal Wet Mix (TRCA-SW-1)
Meadow Marsh (MAM)	TRCA Wet Meadow Mix (TRCA-SW-6)
Cultural Meadow (CUM)*	TRCA Butterfly Meadow (TRCA-SD-6)
Wooded (CUW, FO, SW)	TRCA Swamp Mix (TRCA-SC-2)
Cultural Meadow (CUM)* with heavy invasive pressure	TRCA Resilient Area Meadow Mix
Woodland (CUW, FO, SW) with shade, slopes and/or compacted mixed soils	TRCA Difficult Site Mix (TRCA-SC-1)

* May also be referred to as ME, MEM, MEG, and MEF (per the 2008 ELC)

Seeding application methods can include dry seeding, wet broadcast seeding, hydroseeding and Terraseeding™. The most appropriate application method will be based on site conditions such as soil, hydrology, and slope, as well as logistical issues such as access and equipment. In general, Terraseeding™ is recommended where feasible. Seeds that require cold stratification for successful germination should be pre-stratified or seeded in fall. Note seeds can be purchase already cold stratified. Where dry seeding or wet broadcast seeding are implemented, the soil should be rolled after seeding or the seed should be otherwise pressed into the soil to ensure there is good contact at the seed/soil interface.

1.1.4.3.4 MULCHING

Woody material (e.g., branches, stems, leaves, etc.) cut as part of IVM activities has the potential to be used as mulch within Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas. Over time, mulch slowly decomposes and provides nutrients and organic matter to plants, and improves soil aeration and structure, nutrient holding capacity, and moisture retention (GOERT, 2012). The repurposing of mulch has the potential to provide a number of benefits; for example, it can:

- Serve as a protective cover over disturbed soils by reducing erosion;
- Prevent soil from forming a crust;
- Improve soil structure, texture, and porosity;
- Provide nutrients to plants;
- Conserve soil moisture;

- Mitigate greenhouse gas emissions;
- Moderate soil temperatures; and
- Improve native plant establishment in urban and disturbed environments.

Despite these benefits, caution must be exercised with this approach. Mulch shall not be applied within Zones 1 or 2. Material to be used as mulch can be applied:

- A minimum of 3 m from any active rail; and
- A minimum of 30 m from any watercourses and drainage systems (Network Rail, 2018).

The application of mulch should be considered as part of ongoing monitoring to ensure that it is not lending to the establishment of incompatible plant species (e.g. from fragments in the mulch). Use of chips cut from invasive tree species, such as Tree of Heaven (*Ailanthus altissima*), is not recommended to be spread in areas where the species are not present as the chips might include viable seed or other material that may lead to plant growth (GOERT, 2012). It should be noted, however, that where invasive tree species already exist and seeds are already present in the soil seed-bank, little benefit will be gained by attempting to separate the chips from these species from already infested areas.

Within Metrolinx-owned-lands, the rail corridors, guideways, and restoration areas, mulch should be applied according to the desired outcome of the area of application. Where mulch is being applied for the purpose of inhibiting plant growth, a thicker layer is appropriate (up to a maximum of 10 cm depth). Where mulch is being applied for the purpose of protecting seeded areas, a thin layer 1 to 4 cm in depth should be applied, leaving some areas bare. A thin, scattered application will allow growth and establishment of compatible plants. Leaving some areas free of mulch provides the added benefit of retaining ground nesting habitat for bees and other pollinators (GOERT, 2012).

Mulch is best applied during the spring, after the soil has begun to dry, or in the fall when the soil is no longer dry from the summer. However, for efficiency, mulch should generally be applied during and immediately following tree removals, when tree waste will be chipped in place and spread to nearby areas as needed.

1.1.4.3.5 SOIL AMENDMENTS

Utilizing soil amendments in restoration sites and in the ROW can assist in fulfilling the objectives of the applicable IVM program for a given site or zone in the ROW.

To promote the establishment of plant communities and natural regeneration, soil amendments can include the addition of organic fertilizers and soil conditioners to improve the physical and chemical properties of the soil. Therefore, cultural control methods may promote plant growth; help to sustain native vegetation cover; reduce long-term erosion; and also works to increase soil water retention. Soil amendments can be especially valuable in areas where vegetation has been removed through various vegetation management practices such as chemical control, where the soil quality may have degraded. Soil amendments are recommended to restore/ enhance the topsoil layer quality prior to replanting the disturbed area. The addition of fertilizer, compost or other organic matter and aeration of the soil can all act as soil amendments to help bring valuable nutrients back to the soil and promote the regeneration of native soil and plant communities. Improved soils should match the nutrient levels of those in the local region. Soil restoration processes that use a high volume of compost as the organic amendment, require strict guidelines around compost quality. This is to ensure a high-quality product is selected which will allow shrubs, trees and other plants to successfully establish in their new environment without additional stressors due to the compost quality (Vineland, 2021).

To deter plant growth, soil amendments such as gravel or mulch can be applied. This is particularly important for use in Zones 1 and 2 where plant growth is a safety hazard. Track ballast comprised of crushed stones thus serves multiple purposes as it bears the compression load and provides stability to the rail track while also suppressing vegetation growth.

Soils can be appropriately amended, and then planted with native restorative and compatible vegetation as appropriate. Monitoring the soil conditions and plantings is important after amendments have been utilized.

Soil amendments are best applied in late spring when the soils are not too wet, or in early fall prior to frost.

1.1.4.3.6 PLANTING

For electrified corridors, planting may take place within Zones 4 and 5. For non-electrified corridors, planting may take place within non-electrified Zone 3 and non-electrified Zone 4 and Guideways. Where planting is deemed appropriate it is recommended that vegetation be composed of native species that will not exceed 4 m in height at maturity within Zone 4 and non-electrified Zone 3, or 8 m in height within Zone 5 and non-electrified Zone 4. A list of recommended species is provided in **Appendix G.**

Dense plantings of appropriate native trees, shrubs and ground flora per zone described above shall be undertaken as soon as possible following vegetation removals to minimize the areas available for aggressive non-native and invasive, disturbance tolerant species and mitigate their spread. An IVM plan should be in place to immediately mitigate the spread of invasive and/or non-native plant species. A monitoring plan is to be developed to assess that the newly planted material survives and fulfils the intended ecological function and to ensure that the inadvertent spread of invasive and/or non-native plant species is appropriately managed.

1.1.4.4 Selection Criteria and Best Practices

In determining which application method to use for chemical, mechanical or cultural controls, the following should be considered:

- Location and size of the area requiring management;

- Site conditions including slope and aspect, drainage, edge habitat, soil type;
- Existing/adjacent vegetation – species, composition, and density;
- Previous management (successes and failures);
- Proximity to Designated Natural Areas or other features requiring protection;
- Adjacent land uses (e.g. residential); and
- Work schedule, funds and timeline requirements.

After control methods are utilized for vegetation management, edge plantings in particular require more effort for monitoring and maintenance. In larger habitats, there is a smaller percentage of area affected by the edge; this allows flora and fauna to thrive both within the landscape and along the edges. In smaller habitats, it is more likely for conditions at the edge to threaten the stability of individual habitats making it difficult, if not impossible, for many plants and animals to survive. There may be increased risk for predation, degraded soil quality, and decreased moisture levels at edges; edge habitats must therefore be properly restored and monitored to mitigate impacts to these habitats.

1.1.4.4.1 SITE-SPECIFIC MANAGEMENT – PROTECTION OF ENVIRONMENTALLY SENSITIVE AREAS

Environmentally sensitive areas, including DNAs, exist within and adjacent to the Metrolinx-owned-lands, the rail corridors and guideways where IVM treatments may be required. Prior to control method implementation, the boundaries of the management area shall be delineated in the field to confirm management area boundaries and protection of environmentally sensitive areas or other features requiring protection. In order to protect environmentally sensitive areas, avoidance and mitigation measures shall be incorporated into all IVM implementation plans and activities to the greatest extent possible.

The Ontario Invasive Plant Council provides and regularly updates BMPs for invasive plants, including the four restricted species in Ontario discussed in **Section 6.2.2.2.4 – Invasive Species**. BMPs provide information intended to prioritize avoidance and mitigation of impacts to environmentally sensitive areas. The OIPC BMPs can be found online.

The application of herbicides should always adhere to applicable regulations, BMPs and label instructions. Caution should be applied when handling herbicides, particularly within the context of parks, environmentally significant features or species, protected areas and landscapes of cultural significance, where, prior to the use of chemical methods, Indigenous communities, municipalities, Ontario Parks, Parks Canada, and conservation authorities will need to be notified.

1.1.4.4.2 PROTECTING WILDLIFE

The IVM methods described in the Guideline can place local wildlife at risk if mitigation measures are not implemented. Wildlife such as reptiles, amphibians and mammals should be provided with adequate escape routes from the work area (if contained). This can include small spaces beneath a fence, or natural gaps caused by uneven terrain. If intentionally created, these escape routes should direct wildlife to the next available habitat surrounding any given work site. Once clearing operations have been completed, any wildlife escape routes should be closed off to reduce the risk of wildlife returning to the site. Tree removals and vegetation clearing will follow applicable regulations and occur outside the breeding bird window and bat roosting window (if potential roosting habitat was identified) and with a survey to ensure that no wildlife are impacted; this should include consideration of ground nesting birds, bio-culturally significant species and SAR. Survey results are valid for 48 hours only within simple habitats. Where regulations do not prohibit clearing during these windows, tree and vegetation removals will occur outside of these windows where possible. Daily site inspections are to be completed within the active construction site to ensure no wildlife is present prior to any works starting.

1.1.4.4.3 SITE MANAGEMENT

All personnel involved with IVM approaches and other related activities should be briefed about wildlife protection measures at the outset of the project to ensure site management measures are understood and properly implemented. The briefing should include an overview of the mitigation measures in place on-site, as well as general instructions on the steps to follow if wildlife is encountered during routine daily work. It should also include information on any SAR that may be present, and instruction on what to do if a SAR is seen within the project site. It is recommended that a laminated handout summarizing key information on wildlife protection be present on-site at all times and distributed for reference by personnel. The handout should include information such as general provisions on encounters and handling of non-SAR, SAR identification and protocol as well as contact information for MNRF, MECP, wildlife rehabilitators and/or project biologist(s). Handling of SAR may only be performed by a biologist or environmental monitor that is both qualified and trained following the Ontario Species at Risk Handling Manual: For *Endangered Species Act* Authorization Holders prepared by the MNRF and authorized to do so under a SAR permit or as otherwise approved by the MECP. Although on-site activities generally discourage wildlife from entering the work area during the day, they may be drawn to the site at night or on weekends, especially if sources of food, water or shelter are present. Therefore, the site should be managed in a way which eliminates the potential for attracting wildlife (e.g. prompt garbage removal, proper site drainage, containment of excess materials and stockpiles of vegetation, etc.).

While all personnel need to be aware of the wildlife protection measures, one or more people should be specifically tasked with: 1) ensuring that mitigation measures are properly implemented by conducting regular inspections, and 2) monitoring to ensure proper function and integrity of mitigation measures (e.g. site containment, habitat compensation, work site cleanliness, etc.). Retaining a project biologist with a minimum of five years of experience is a requirement for most projects in order to properly manage wildlife conflicts as well as mitigation measures on a periodic basis. The qualified biologist retained will be responsible for the creation of a project specific Environmental Management Plan (EMP), which shall outline the protocol, guidelines and mitigation measures to follow during vegetation clearing/construction in order to reduce impacts to wildlife as effectively as possible.

1.1.5 IVM Step No. 5: Adaptive Management and Monitoring

Goal

Allow for ongoing improvement to the IVM based on learned experiences and to meet new objectives and conditions.

Objectives

- Monitor and evaluate the success of the IVM program and plan.
- Adjust and revise IVM plan to allow for ongoing improvements based on field observations and learned experiences.

The final step of IVM, post-implementation monitoring, will be undertaken to evaluate the success of implemented approaches. This monitoring and evaluation will work to inform adaptive management needs, providing guidance for future work. This adaptive management approach allows ongoing improvement to the established IVM plan based on learned experiences. It also allows the IVM plan to be revised as needed to meet new objectives and conditions. The following section details the methodology of the monitoring and management approach that will be followed at this stage. It also outlines a framework for ongoing documenting and reporting.

1.1.5.1 Vegetation Monitoring – Post-Implementation Methodology

As outlined in IVM Step No. 1 (see **Section 6.2.1**), the vegetation monitoring program involves a post-implementation monitoring event. The intent is to provide information on the efficacy of management efforts. Post-implementation monitoring should be undertaken when the effects of implementation are anticipated to be evident – which can range from between one (1) week to six (6) months following implementation, depending on what control method(s) was used. These visual investigations must be carried out by qualified specialists. The method of undertaking post-implementation monitoring may involve field and high-rail vehicle or train surveys or other suitable approaches. For example, where more general information is required to evaluate efficacy of control methods, remote sensing (Landsat 8) may enable treated areas to be monitored roughly twice monthly at a lower cost. Use of remote sensing would require some level of ground-truthing.

Where chemical, cultural and/or mechanical approaches have been applied, monitoring shall be undertaken to capture the following:

- Plant species composition, distribution, and density;
- Any evident environmental impacts from implementation;
- The presence/persistence of the targeted incompatible or invasive vegetative species;

- The presence/persistence of dead, dying, and imminently hazardous trees (posing an immediate risk to health and safety);
- Residual access problems to Metrolinx-owned-lands, the rail corridors and guideways caused by the presence of incompatible species;
- Residual vegetation encroachments;
- The location of trees or brush compromising site security and creating safety issues for employees (tripping, slipping, or health hazards);
- Percentage of target plants alive/dead following implementation;
- Soil quality after the addition of cultural soil amendments, as applicable;
- General efficacy of the approach and evidence of the establishment of a more compatible plant community; and
- Presence and abundance of pollinator or rare plants.

Generally, for evaluating control approaches, information/ findings gathered from monitoring will be used to determine:

- The state of the target vegetation;
- Efficacy of control approach;
- Need for additional control;
- The success in meeting IVM Plan objectives; and
- Adverse effects that may be the result of the control approach.

Evaluating control method effectiveness consists of undertaking inspections on a regular basis, recording results, and comparing progress at an appropriate cadence. The following criteria are relied upon within this IVM as appropriate measures of success:

- An increase in compatible species;
- A decrease in incompatible/invasive species;
- A decrease in vegetation issues identified as part of monitoring, incidental observations or as identified by a concerned adjacent property owner, members of the public or Indigenous communities;
- Successful ecological restoration and native plantings (80% survival); and
- A decrease in service disruptions and/or operational challenges attributed to vegetation.

1.1.5.2 Adaptive Management

Successful IVM plans are consistently implemented over a series of years and annually adjusted as necessary based on field observations. Post-implementation monitoring evaluation will determine what adjustments are needed, if any, to better meet safety needs, IVM program compliance, changing climate or environmental conditions, and IVM objectives for the following year. If it is determined that more effective control methods are necessary, this should trigger an investigation into what alternative control method or application technology can be used in the future. For areas where control options are limited (i.e. Zone 1 or ballast areas), changes in herbicide active ingredients and application frequencies (for example, to limit plants from developing herbicide resistance) can and should be considered.

As the program progresses and maintenance is expected to become less demanding, alternative methods will be explored as part of adaptive management to reduce environmental impacts and necessary program resources. Furthermore, emerging technologies and efficiencies may present more effective and environmentally conscious methods of conducting management or monitoring. For example, there may be future opportunities to integrate vegetation monitoring into other ongoing monitoring of the rail corridors (i.e. for track maintenance). The methods and/or frequency of monitoring will be re-evaluated as Metrolinx owned lands, the rail corridors, guideways and restoration areas are adaptively managed and maintenance is expected to become less demanding.

1.1.5.3 Reporting

Reporting will consist of maintaining an up-to-date GIS database, annual reports as well as a five-year review of the IVM framework.

1.1.5.3.1 GIS DATABASE

Maintaining up-to-date information on Metrolinx-owned-lands, the rail corridors, and guideways through the use of a GIS database will enable IVM managers to:

- Forecast work;
- Determine where to focus actions;
- Prioritize workflows;
- Allocate budget;
- Minimize inefficiencies;
- Track interactions with Indigenous communities, residents and adjacent landowners;
- Apply data to create long-term work strategies to meet operational goals;
- Ensure proactive work orders are issued; and
- Ensure rapid response to events that may compromise the integrity of the electrical and rail infrastructure.

The GIS database should include at minimum:

- Centreline data consistent with the current status of Metrolinx –owned-lands, the rail corridors and guideways or with work planned for the upcoming year so that IVM can be adjusted as necessary;
- VMZs and associated information including management objectives, control thresholds, recommended control options and compatible plant species;
- Metrolinx-owned-lands, rail corridor and guideway limits.
- Adjacent property information such as Property Identification Number (PIN);
- DNAs and protection requirements;
- ELC information;
- Tree data (location, species, size, tree protection zone, existing or removed, etc.);

    - Information on implemented IVM approaches within a delineated area (e.g. date of seeding, seed mix used, application method); and
    - Information on planned IVM approaches within a delineated area (e.g. schedule for herbicide application, type of herbicide, application method).

1.1.5.3.2 REPORTING

An IVM Plan report following post-implementation evaluation will be finalized at an appropriate cadence and will include (at minimum):

- Name, position title, organization association (if not Metrolinx) and contact information of the person(s) who conducted the pre-implementation monitoring;
  - The results of pre-implementation monitoring;
  - Plans for IVM implementation;
  - Name, position title, organization association (if not Metrolinx) and contact information of the person(s) who conducted the control method applications;
  - Documentation of all areas treated including:
    - Initial condition prior to implementation;
    - Location (including size);
    - Control method option(s) applied (including details, e.g. active substance and dosage for chemical treatment);
    - Application method(s); and
    - Date(s) of implementation.
  - Name, position title, organization association (if not Metrolinx) and contact information of the person(s) who conducted the post-implementation monitoring;
  - The results of post-implementation monitoring;
  - An evaluation of the efficacy of applied IVM approaches and methods;
    - Identification of any and all issues including but not limited to:
    - Adverse impacts of control methods(s); and
    - Complaints.
  - A record of the applicable Environmental Management Plans, consultation issues, landowner agreements, contracts;
    - Recommendations for adjustments to the IVM program for the following year;
    - Cost estimates for the following year’s implementation of IVM;
    - Photographs; and
    - Field notes.

1.1.5.3.3 FIVE-YEAR REVIEW

A five-year review of the IVM framework is recommended to ensure up-to-date information on the following components:

- Legislation;
    - Best management practices;
    - Technological advances;
    - Indigenous Knowledge;.
    - Lean management principles;
    - Metrolinx strategic plans;
    - Metrolinx Sustainability Guidelines;
    - Lessons learned and,
    - Changing climate conditions.

The five-year review should incorporate any changes based on lessons learned and adaptive management implemented. This will include an assessment of the cost and results over time.

IVM Step No. 1: Understanding Pest and Ecosystem Dynamics

Develop and maintain a comprehensive understanding of the existing ecological conditions within Metrolinx Owned Lands, rail corridor, guideways, and restoration areas.

- Undertake an inventory of vegetation conditions.
- Monitor plant community composition and structure.
- Monitor the presence of incompatible and compatible species within and adjacent to Metrolinx Owned Lands, rail corridor, guideways, and restoration areas

Use existing ecological conditions to inform management objectives and identify control thresholds

Evaluate existing ecological conditions against management objectives and control thresholds

IVM Step No. 2: Setting Management Objectives and Tolerance Thresholds

Minimize the percentage of incompatible vegetation within Metrolinx Owned Lands, rail corridor, guideways, and restoration areas to ensure that biodiversity and safety are upheld.

- Set control thresholds that aim to minimize and prevent the establishment of incompatible species.
- Enable required vegetation removal while retaining compatible vegetation.

Where incompatible vegetation is identified, proceed to IVM Step No. 3

IVM Step No. 3: Compiling Vegetation Control Options

Develop a treatment method that meets the needs of ecological, economic, and cultural concerns of rights holders and stakeholders.

- Develop a treatment approach that will most effectively meet site-specific conditions and vegetation composition (chemical, mechanical, cultural or a mixed method approach) for Metrolinx Owned Lands, rail corridor, guideways, and restoration areas.
- Develop a treatment approach that encourages the establishment of a compatible, self-sustaining vegetative cover which, over the long-term, becomes less dependent on treatments.

Once a control option has been determined, proceed to IVM Step No. 4.

IVM Step No. 4: Site-Specific Implementation of Control Methods

Apply a control action that is tailored to varying site conditions, needs, and sensitivities. The selected option should aim to represent a balance between meeting IVM targets/objectives while considering indirect and direct impacts to the environment, society, and cost.

- Adhere to the selection criteria/decision-making process to determine which potential control type and technology (pruning, mowing, foliar chemical application, seeding, etc.) best addresses management constraints, i.e., site conditions, environmental sensitivities, timing windows etc.

Following implementation of treatments, proceed to IVM Step No. 5.

IVM Step No. 5: Adaptive Management and Monitoring

Allow for ongoing improvement to the IVM based on learned experiences and meet new objectives and conditions.

- Monitor and evaluate the success of the program on a yearly basis and prepare a monitoring report
- Adjust and revise IVM to allow for ongoing improvements based on field observations and learned experiences.
- Offsite restoration sites may require additional monitoring and maintenance efforts including hand weeding, vegetation replacements and focused eradication of invasive species until a successful coverage rate of 80% is achieved.

Carry revised approaches to IVM Step No. 1

APPENDIX L: TREE END USE

1 IDENTIFICATION OF INTEREST

Trees that are removed from the project site are to be re-used in compliance with the Tree End Use section of the Metrolinx Vegetation Guideline. This may be accomplished through distribution to end use partners as lumber, restoration habitat, mulch, furniture or other forms as requested. Suggested end use may also include give aways of firewood and/ or invasive species free mulch/ chips.

The Arborist will assess and recommend potential tree end use options based on the tree's bio-cultural significance and Indigenous community feedback, the tree's suitability for lumber, community asks and any applicable TPAP/TRPAP/EA commitments.

Indigenous communities feedback and requests relating to tree end use could include, but are not limited to:

- Specific tree species requested for end use
- Distribution of wood to proximate communities (e.g. Urban Indigenous communities, Indigenous friendship centres, etc.)
- Requested forms (e.g. stumps) and sizes that wood should be prepared for transport
- Tree inspection details (e.g. absence of invasives plant material or diseases)

Coordination of tree storage, inspection, delivery or pick up is the responsibility of contractor removing the trees.

Documentation of suggested tree end use should be submitted to Metrolinx for review prior to implementation and updated at end of project.

Where a value of materials given away can be assessed and counted toward a community benefit activity, it shall be reported to Metrolinx.

Potential tree end use partners will be reviewed and approved by Metrolinx on an as-needed basis to ensure that partners meet goals from a financial and liability standpoint. Potential partners include:

- Indigenous communities;
- Conservation Authorities;
- Community groups;
- Municipalities;
- NGO's and foundations focused on enhancing urban trees and parks;
- Events related to urban tree enhancement (e.g. tree planting) and repurposing;
- Wood products and services – Sawmills, Companies/Artists dedicated to Carving, Woodturning, Furniture and Wood Products; and
- Wood products and services - Other Organizations (Firewood, Paper Mill, Purchasers/Users of Bulk Wood, NGO);

Tracking and documentation of tree end use is the responsibility of the contractor and should be distributed in the order of priority as identified in **Section 5**:

- Bio-culturally significant trees to Indigenous communities or other wood they have stated an interest in reuse
- Trees used for restoration habitat projects:
    - Native trees 30 to 50 DBH with main leader 3 meter or greater in length
    - Root wads
    - Native Thickets and branches to create brush piles for habitat and source of organic matter adjacent to site
- Lumber quality trees are identified based on the tree species (**Table L-1**), size (> 15 cm DBH), tree condition, and straight trunk at least 3 m long with no large branches (greater than 5 cm diameter) with no visible defects
- Mulch used on-site and for edge management to prevent soil compaction
- Local community requests (e.g. Park bench, fences, gates, etc.)
- Mulch/ chip give-away (where invasive species were not present)
- Firewood give-away
- Waste disposal (e.g. EAB ash trees, Oak infected with Oak wilt, etc.)

Table L-1: Lumber Quality Tree Species (Hilts and Mitchell, 2009)

Category 1	Category 2	Category 3
Black Walnut	Basswood	Aspen
Black Cherry	Tulip Poplar	Beech
Red Oak*	Yellow Birch	Hop Hornbeam
White Oak*	White Birch	Hemlock
White Ash**	Red Maple	White Cedar
Sugar Maple	White Pine	Butternut
	Red Pine	Hickory
	White Spruce	Elm

* Re-use of Oaks subject to CFIA directives
** See **Section 5** regarding removal of Ash trees

2 EQUIPMENT REQUIREMENTS

Mulching or chipping trees will be carried out using mulchers or chippers. Mulchers cut and chop or grind vegetation into particles that are usually left on-site as mulch. Mulchers can reduce limbs, tops, and cut material to shredded particles that are left on the ground and can better hold runoff and degrade more quickly back into the soil than larger material. Chippers can chip the tree to uniform size. Equipment such as graders will be needed to spread out mulch on-site and ensure it does not exceed the maximum depth of 10 cm within the rail ROW.

During removal of lumber quality trees, it is important to minimize any impact from felling the trees as this can cause internal checking and damage to the tree's trunk.

Lumber quality trees can be removed and cut into sawlog length using a harvester. The harvester is capable of felling, de-limbing, and bucking a tree to a desired length;

however, the harvester's capability is limited by the size of the tree. where needed, hand tools such as chainsaws can be used.

Once the stems have been bucked into a series of log lengths, a grapple truck/skidder is required to sort the logs and stack them into piles. Once enough logs of a specific sort have been accumulated, they can be loaded onto a truck and transported to their destination.

A bucket truck and pruning equipment as well as staff trained to apply proper pruning techniques (identified by the International Society of Arboriculture and Landscape Ontario) will be required for pruning trees.

Uneven terrain is common within the rail corridors and typical tree removal equipment such as mulchers or chippers may not be able to access all areas where vegetation removal is occurring. The use of hi-rail equipment may be required in some isolated areas, especially if there are no suitable access points or where terrain prevents retrieval of debris.

3 STORAGE STRATEGY

Before wood products can be delivered to end users, a practical and efficient method of wood storage will need to be identified. The wood storage method will depend on the type, volume, and duration of storage. Metrolinx prefers that lumber quality trees are stored on Metrolinx property prior to distribution to end users, where possible.

Ideally, designated temporary wood storage areas will be created within Metrolinx property near access points where there is sufficient space to store both sawlogs and wood chips. Designated temporary storage areas are required to have enough space to allow chipping, sorting sawlogs and any other necessary wood processing.

In cases where Species at Risk (SAR) and their habitat are identified within swales, waterbodies, or wetlands within the project study area, stockpile locations shall not be within proximity to the waterbody or wetland. Stockpiles will be required to be located at least 50 m from the waterbody or wetland; however, up-to-date correspondence with Indigenous communities and relevant agencies shall be undertaken to ensure adequate notification and protection.

Wood (from non-invasive trees) requiring disposal due to insufficient space on site for chipping or insufficient offsite opportunities shall be stockpiled at off-site locations. As per OPSS 180, the off-site location must comply with the following distance separation requirements:

- A minimum of 2 m above the level of ground water;
- A minimum of 30 m from waterbodies and top of slope;
- A minimum of 100 m from any water wells; and
- A minimum of 100 m from residences.

Stockpiling of wood chips on-site shall not exceed three (3) months duration and shall be avoided to the greatest extent possible so as not to create a fire hazard and to prevent reducing the quality of the wood chips (re: due to mold and insects). In cases where wood chips are piled, compliance with Ontario Fire Code (OFC) (*O.Reg. 213/07*) Section 3.2.3 (Outdoor Storage of Wood Chips), Article 3.2.3.6 regarding outdoor storage spacing is required, as follows:

(1) Space shall be maintained between chip piles and exposing structures, yard equipment or stock equal to

(a) Twice the pile height for combustible stock or buildings, or

(b) The pile height for non-combustible buildings and equipment.

(2) Despite Sentence (1), space between chip piles and exposing structures, yard equipment or stock shall not be less than 9 m.

Mulch or wood chips may be spread within the 9 m buffer areas surrounding wood chip stockpiles on-site, providing these areas are within Metrolinx property. Spreading wood chips or mulch on-site requires Metrolinx approval.

Wood chips shall not be left on-site where there is a risk to property, assets, or the operational railway. Any remaining chipped material shall be a minimum of 3 m from any operational rail line and chipped material shall be spread evenly to a depth no greater than 10 cm. Cut wood material that has been stacked in piles shall not be left on slopes with a gradient steeper than or equal to 33 degrees, since cut and stacked material can move over time and present a hazard.

The OFC indicates the storage area for wood chips must satisfy the following conditions:

- Surface of the ground should be well drained and level, solid ground or paved with asphalt, concrete or other hard surface material;
- Weeds, grass and similar vegetation shall be removed from the area;
- Portable open flame weed burners shall not be used in chip storage areas;
- Piles of wood chips shall not exceed 18 m in height, 90 m in width and 150 m in length unless temporary water pipes with hose connections are laid on the top surface of the pile;
- The area is fenced, has fire department access, smoking is prohibited, and fire extinguishing provisions are available;
- The maximum storage period for these wood chip piles should be no longer than 3 months;
- Compaction of the pile should be avoided; and
- The piles should be periodically wetted down, especially during dry conditions, to minimize the possibility of a surface fire.

Additionally, the following recommendations (Ministry of the Solicitor General, 2019) should be followed to reduce the risk of fire:

- Check piles periodically for any signs of hotspots, smouldering or unusual odour that could indicate the on-set of a fire;
- Keep other combustible materials away from wood chip piles;
- Eliminate any ignition sources near the wood chip piles; and
- Prepare a pre-fire plan.

A transportation plan should be developed in conjunction with end users to minimize the storage time of wood residues.

4 RAIL CORRIDOR ACCESS REQUIREMENTS

For project on the rail ROW, only certain types of access points allow access for tree removal equipment and hauling trucks. Potential types of access points include vehicular access points, level crossings, and train stations. Tree removal access points will need to be identified as part of transportation plans. It should be noted that some access points may only exist on one side of the railway. Temporary access points may need to be identified if there are no suitable existing access points to complete the required tree removals or pruning.

The use of hi-rail vehicle access may be required in some isolated areas. If hi-rail is required, it would need to be loaded onto a decommissioned “dead” rail track from the nearest GO Station and track protection would need to be implemented.

5 TRANSPORTATION

Transporting wood chips requires a trailer that can safely carry chips without losing material while being loaded and unloaded. Open top trailers are used where chips will be loaded either by a chipper or grinder with a conveyor capable of pushing the chips over the top of the trailer, or by a loader capable of dumping loads of chips over the top of the trailer. The load capacity of a standard size dumping tuck is 7.8 tons for one load.

Full-length logs can be transported by stinger-steer log trailers or fixed length log trailers. Where only log length material is being transported, a straight truck with a trailer may be used. The standard size logging truck can carry 40 m^3 of sawlogs.

Trees will be transported from the on-site storage areas to loading, inspection and storage areas. It is expected that the tree end user will haul the wood residues to an approved off-site waste facility and will provide appropriate documentation in the form of a bill of lading for non-hazardous materials or waste manifestos for hazardous (CFIA-regulated) material. This will require coordination with the tree end user to confirm capacity of equipment and preferred size of logs, root wads, branches for transport.

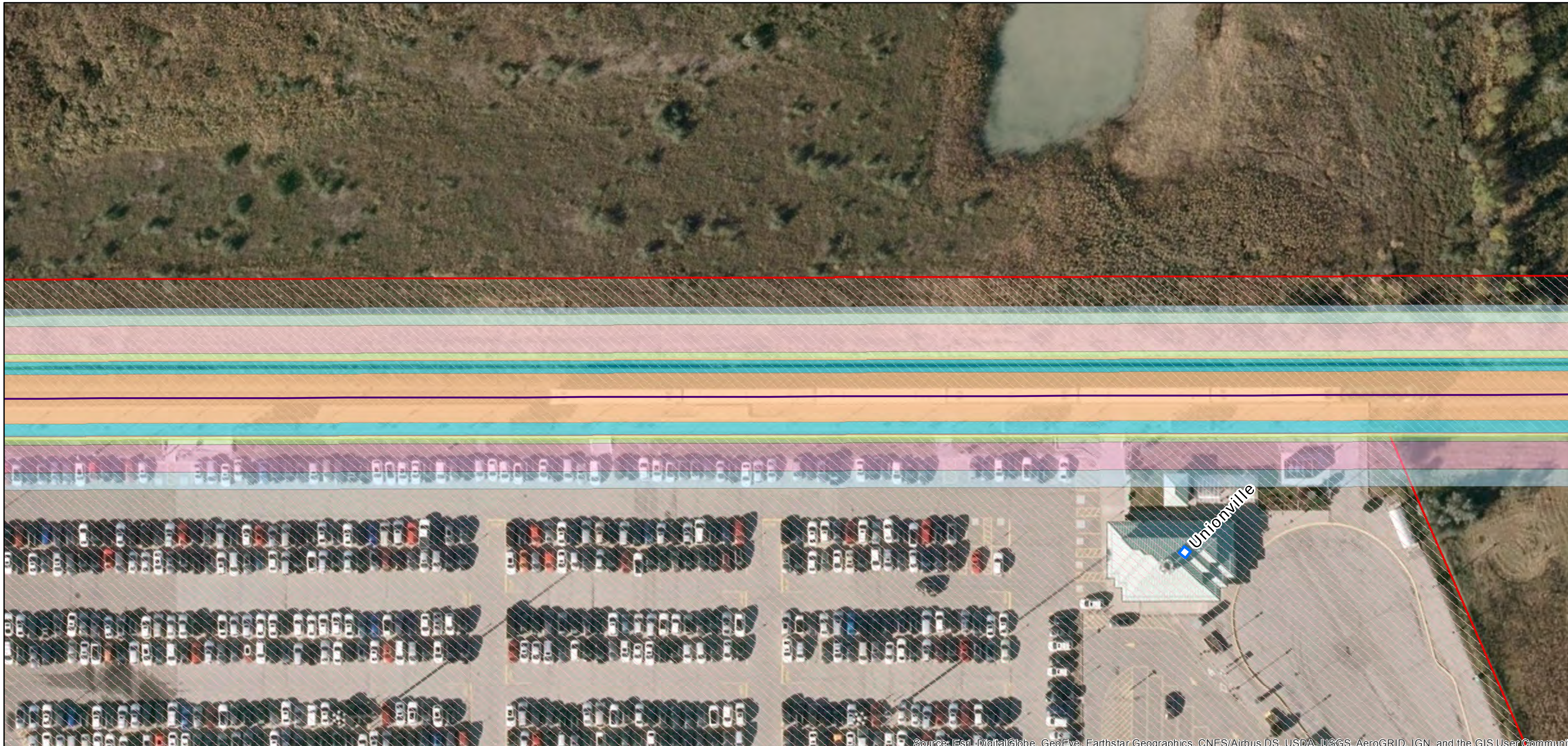
APPENDIX M: VEGETATION MANAGEMENT ZONES FOR RAIL CORRIDOR

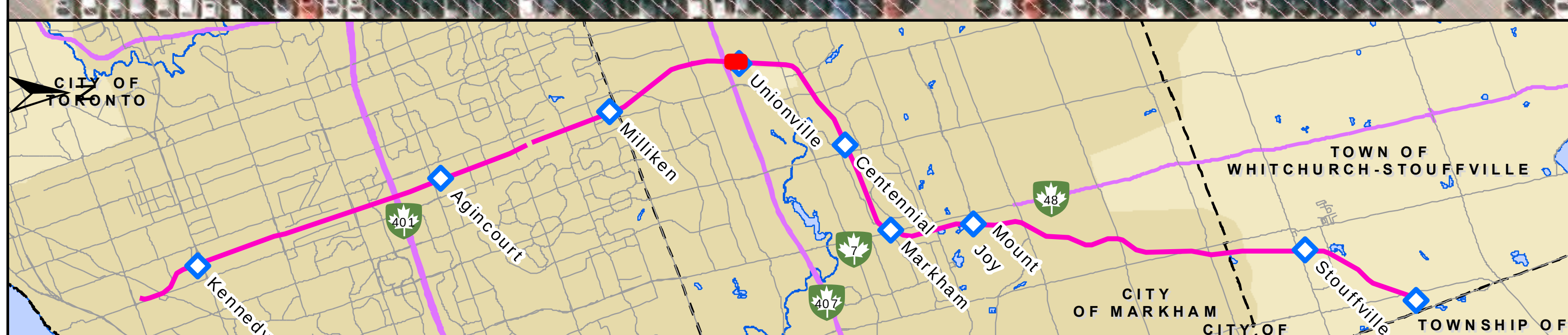
VEGETATION REMOVAL ZONE GUIDELINES FOR ELECTRIFIED CORRIDORS

VEGETATION REMOVAL ZONE GUIDELINES FOR ELECTRIFIED CORRIDORS

VEGETATION REMOVAL ZONE GUIDELINES FOR ELECTRIFIED CORRIDORS

MORRISON HERSHFIELD





Legend

Track Layout	Zone
Future Track Centreline	Zone 1
Track Centreline	Zone 2
Go Station Platforms	Zone 3
Metrolinx Properties	Zone 4
Other Property Owned	Zone 5

METROLINX

MORRISON HERSHFIELD

Drawn By:	Checked By:	ISSUE
ES	XX	

0 5 10 15 20 25
Meters

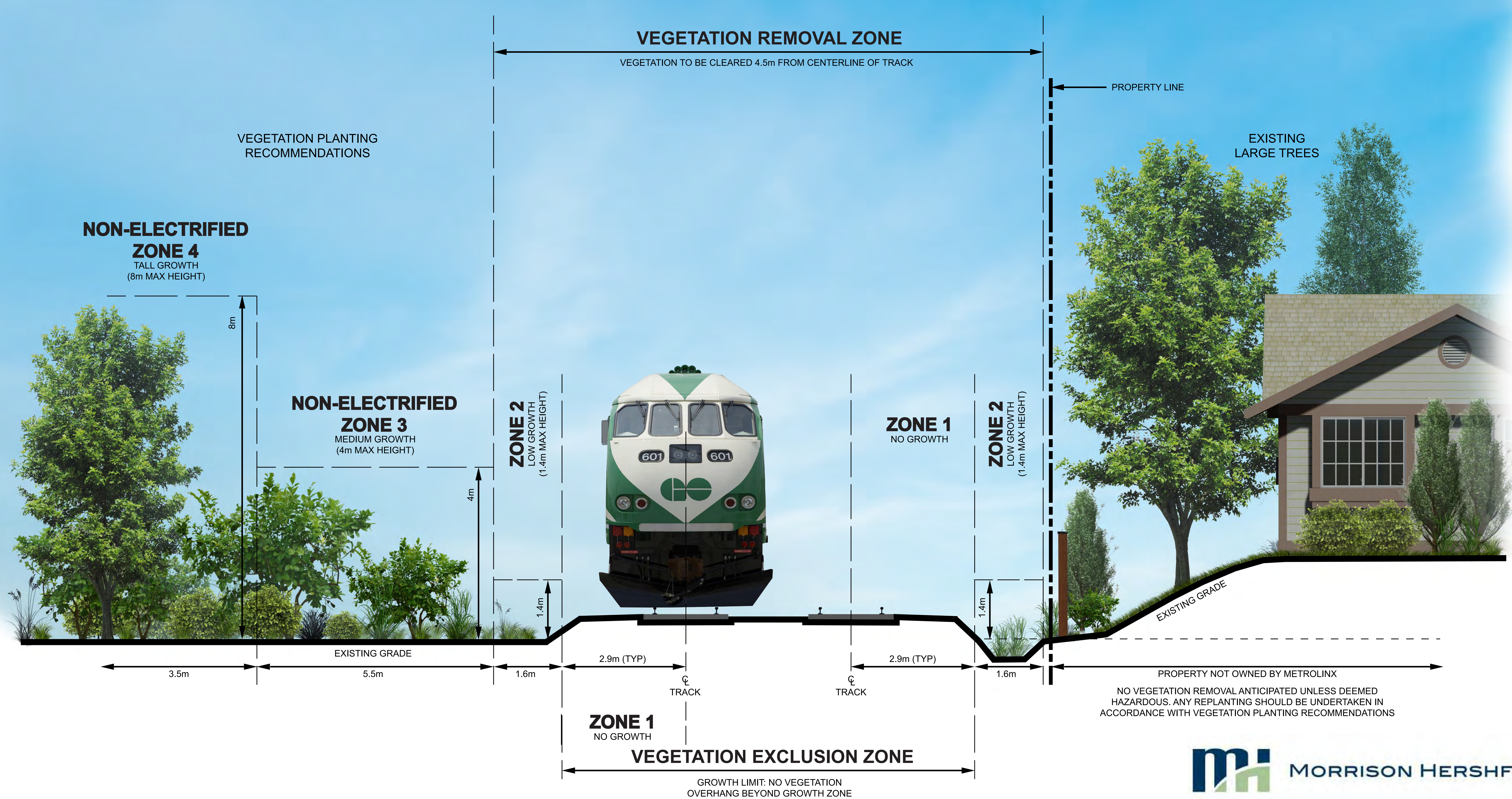
N

Integrated Vegetation Management for Electrified Corridors Program GO Rail Network

Figure 51

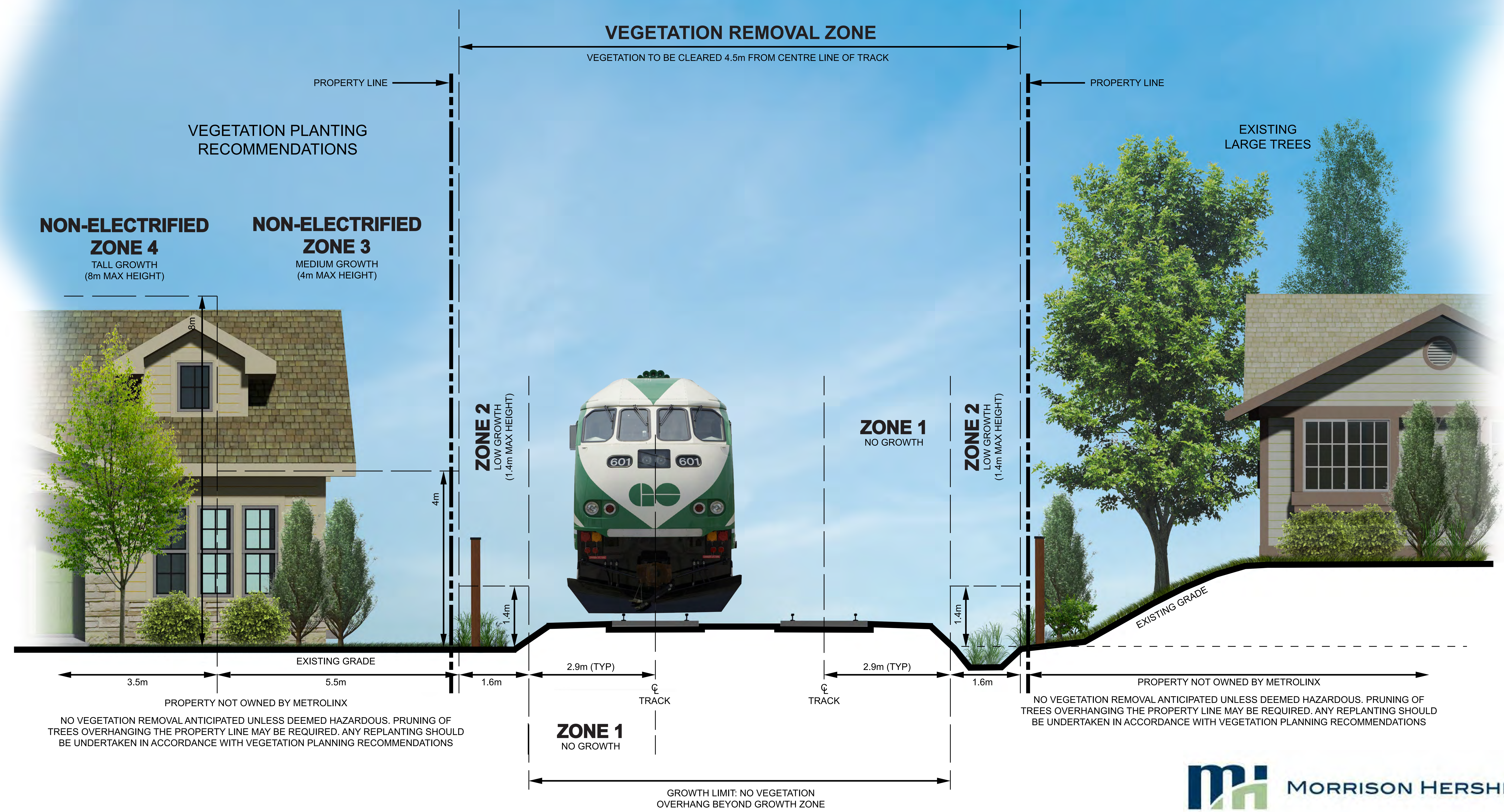
VEGETATION REMOVAL ZONE GUIDELINES
FOR NON-ELECTRIFIED CORRIDORS
VEGETATION REMOVAL ZONE
VEGETATION TO BE CLEARED APPROXIMATELY 4.5m FROM CENTERLINE OF TRACK
VEGETATION PLANTING RECOMMENDATIONS
VEGETATION PLANTING RECOMMENDATIONS
NON-ELECTRIFIED ZONE 4
TALL GROWTH (8m MAX HEIGHT)
NON-ELECTRIFIED ZONE 3
MEDIUM GROWTH (4m MAX HEIGHT)
ZONE 2
LOW GROWTH (1.4m MAX HEIGHT)
ZONE 1
NO GROWTH
ZONE 2
LOW GROWTH (1.4m MAX HEIGHT)
NON-ELECTRIFIED ZONE 3
MEDIUM GROWTH (4m MAX HEIGHT)
NON-ELECTRIFIED ZONE 4
TALL GROWTH (8m MAX HEIGHT)
8m
4m
1.4m
1.4m
4m
8m
601
601
EXISTING GRADE
EXISTING GRADE
3.5m
5.5m
1.6m
2.9m (TYP)
℄ TRACK
℄ TRACK
2.9m (TYP)
1.6m
5.5m
3.5m
NO VEGETATION REMOVAL ANTICIPATED UNLESS DEEMED HAZARDOUS. PRUNING OF TREES OVERHANGING THE PROPERTY LINE MAY BE REQUIRED. ANY REPLANTING SHOULD BE UNDERTAKEN IN ACCORDANCE WITH VEGETATION PLANTING RECOMMENDATIONS
NO VEGETATION REMOVAL ANTICIPATED UNLESS DEEMED HAZARDOUS. PRUNING OF TREES OVERHANGING THE PROPERTY LINE MAY BE REQUIRED. ANY REPLANTING SHOULD BE UNDERTAKEN IN ACCORDANCE WITH VEGETATION PLANTING RECOMMENDATIONS
ZONE 1
NO GROWTH
GROWTH LIMIT: NO VEGETATION OVERHANG BEYOND GROWTH ZONE
MORRISON HERSHFIELD

VEGETATION REMOVAL ZONE GUIDELINES FOR NON-ELECTRIFIED CORRIDORS



MORRISON HERSHFIELD

VEGETATION REMOVAL ZONE GUIDELINES FOR NON-ELECTRIFIED CORRIDORS



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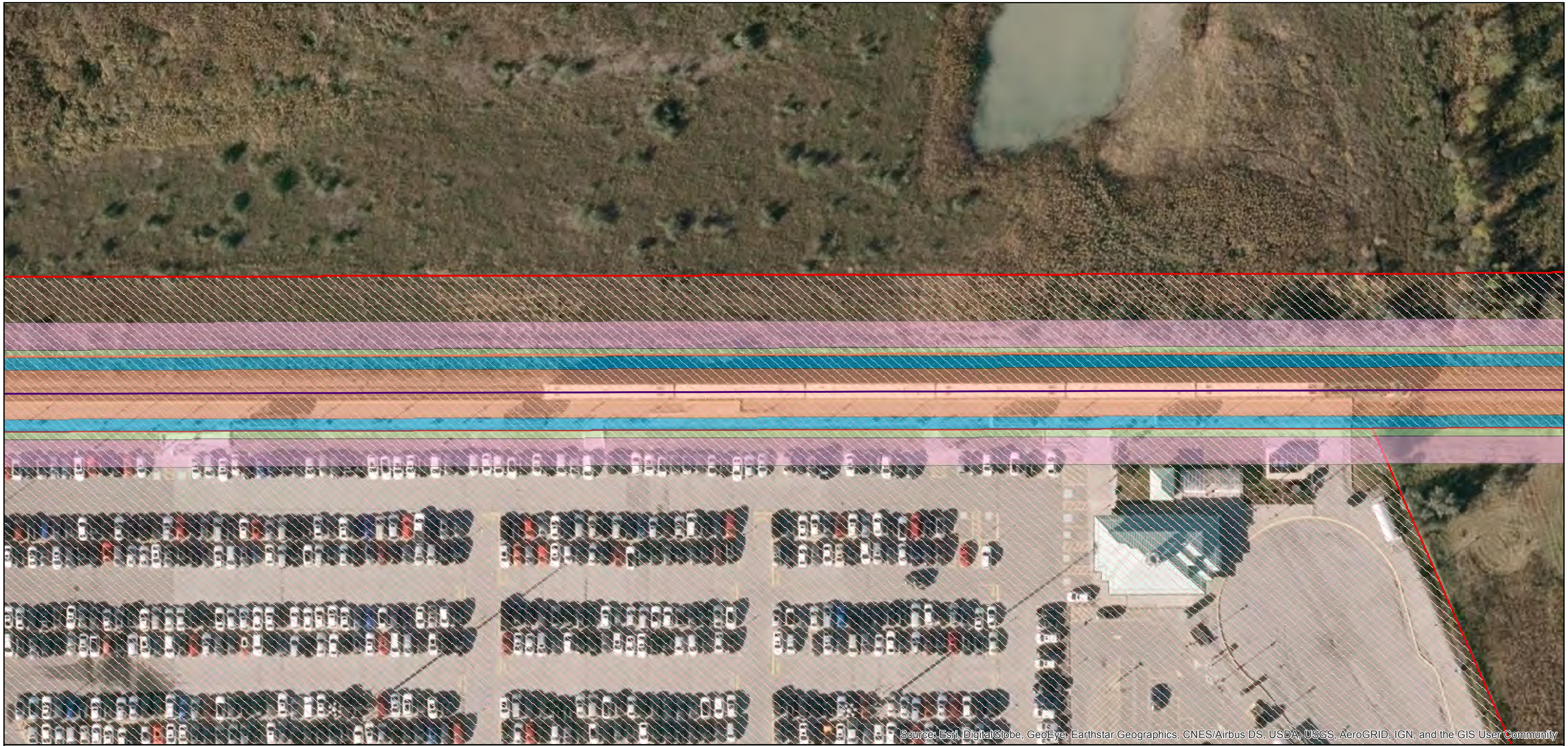

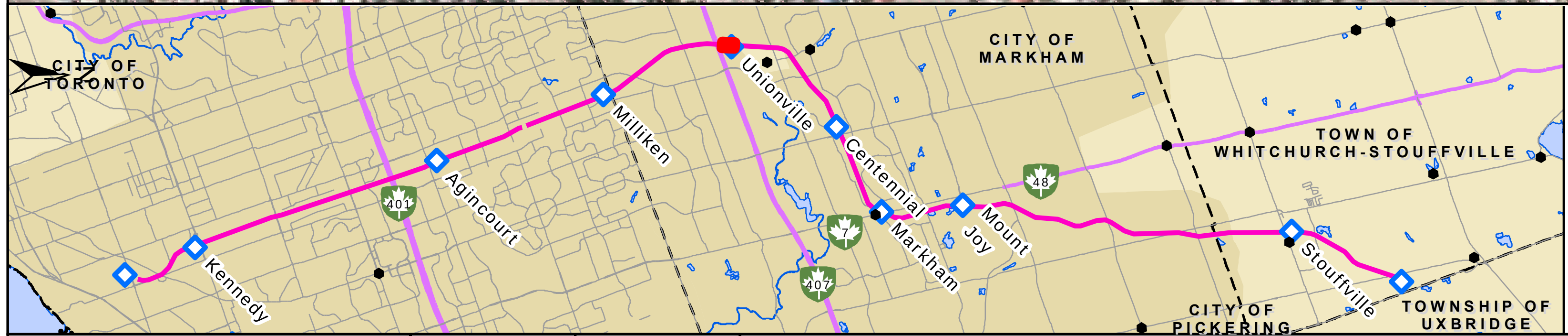

Legend

Track Layout
- Future Track Centreline
- Track Centreline
- Go Station Platforms
- Metrolinx Properties
- Other Property Owned

Zone
- Zone 1
- Zone 2
- Non-Electrified Zone 3
- Non-Electrified Zone 4

METROLINX

MORRISON HERSHFIELD

Drawn By: ES

Checked By: XX

0 5 10 15 20 25
Meters

ISSUE

Integrated Vegetation Management for Non-Electrified Corridors Program GO Rail Network

Figure 51

APPENDIX N: Vegetation Management Zones for Elevated Guideways

Planting Guidelines (Pier)

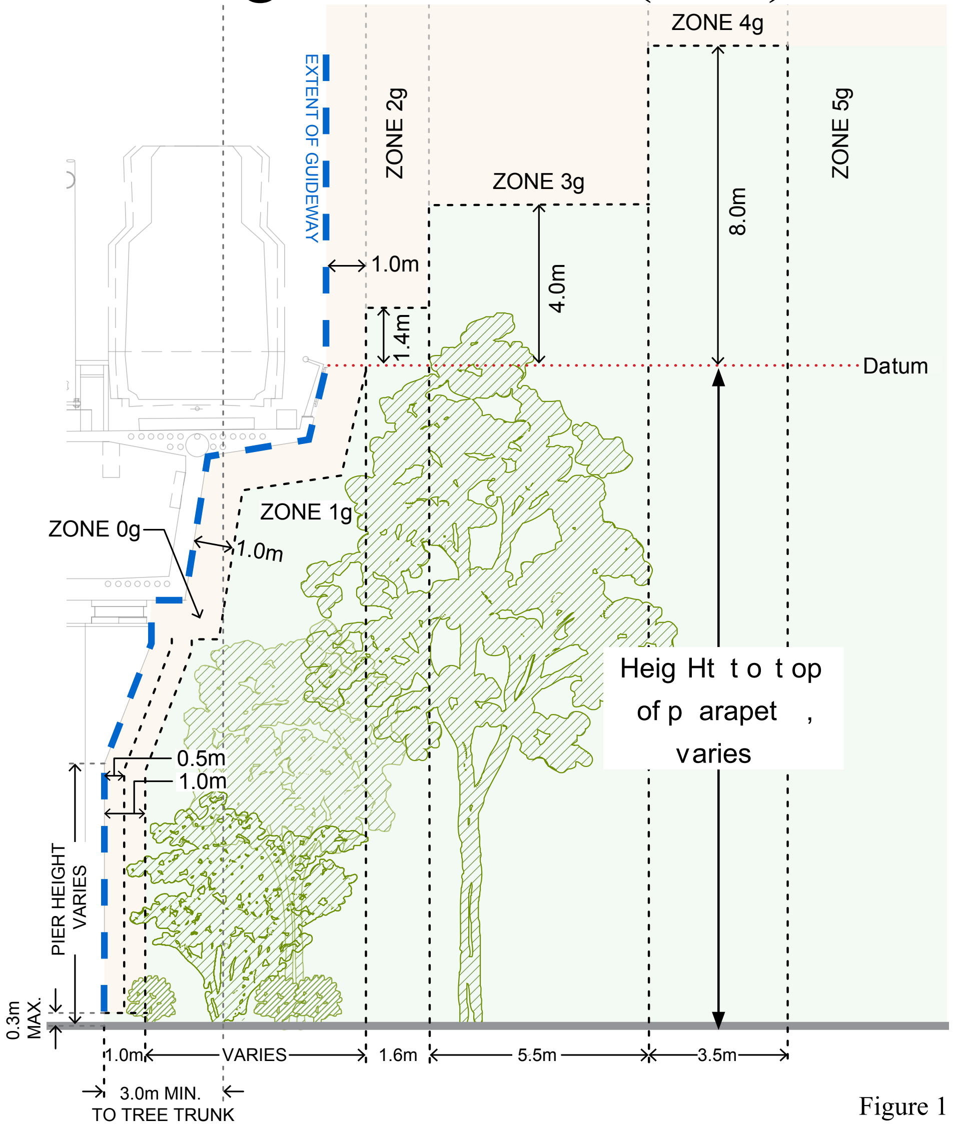

Figure 1

The cross-section in Figure 1 uses the principles from the Metrolinx Vegetation Guideline's vegetation clearance zones for the electrified rail corridor and applies them to create Vegetation Management Zones dependant on the guideway structure height. This section is applicable wherever the guideway is elevated at a pier.

As seen in Figure 1, the parameters of Zone 1g can vary widely based on the shape of the guideway structure. Refer to page 3 for specific Planting Guidelines in Zone 1g. Note that the Zone boundaries apply to the approximate anticipated horizontal spread of the tree/plant canopy. Zones shall be rectangular, based on section cuts of the guideway as seen in Figure 1:

Table 1

Zone	Y-Axis (Vertical)	X-Axis (Horizontal)
0g	1m offset from elevated guideway structure. • plant material with a maximum mature height of 0.3m.	Space created between: • a 1m offset from the elevated guideway structure to canopy dripline of tree, and • a 0.5m offset from the Pier to elevated guideway structure to dripline of shrub.
1g	Space between finished grade and a 1m offset from the elevated guideway structure.	Space created between: • a 1m offset from the elevated guideway structure, and • a 1m offset from the dripline of the parapet structure.
2g	Space between finished grade and the outside vertical limit of the parapet, plus 1.4m.	Space created by: • a 1m offset from the dripline of parapet structure, plus • a 1.6m offset from this point away from the guideway.
3g	Space between finished grade and the outside vertical limit of the parapet, plus 4.0m.	Space created by: • 2.6m offset perpendicular from the dripline of the outisde vertical limit of the parapet, plus • a 5.5m offset from this point away from the guideway.
4g	Space between finished grade and the outside vertical limit of the parapet, plus 8.0m.	Space created by: • 8.1m offset perpendicular from the drippline of the outside vertical limit of the parapet, plus • 3.5m offset from this point away from the guideway.
5g	No vertical limit.	Any space beyond a 11.6m offset perpendicular from the dripline of the outside vertical limit of the parapet.
0g-5g	Zone dependent, see notes per zone.	Space created between: • a 3m minimum offset from any vertical structure (Pier or retaining wall) to tree trunk for maintenance access.

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Planting Guidelines (No Pier)

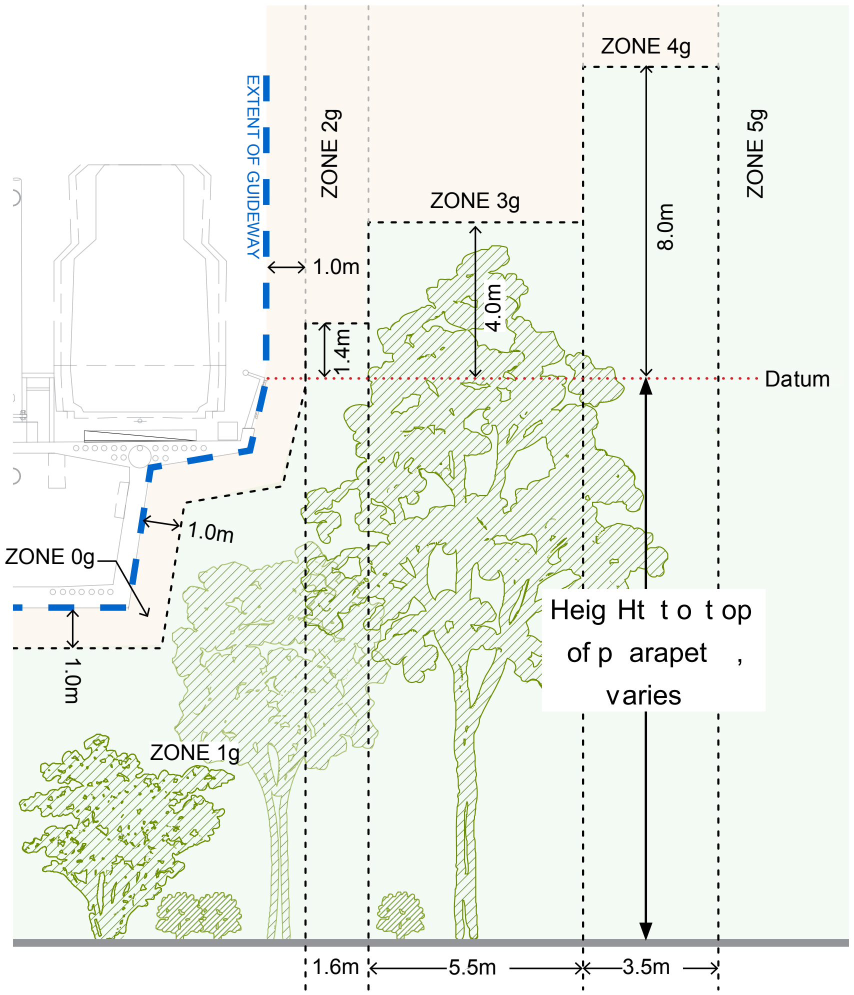

Figure 2

The cross-section shown in Figure 2 is applicable wherever the guideway is elevated.

In this condition, Zones 2g and up remain the same as when a pier is present, however Zones 0g and 1g can now include area directly below the guideway structure, where a pier is not present. Additionally, as seen in Figure 2, the parameters of Zone 1g can vary widely based on the shape of the guideway structure. Refer to page 4 for specific Planting Guidelines in Zone 1g. Note that the Zone boundaries apply to the approximate anticipated horizontal spread of the tree/plant canopy.

Table 2

Zone	Y-Axis (Vertical)	X-Axis (Horizontal)
0g	1.0m minimum offset from elevated guideway structure to canopy dripline of tree.	Space created between the guideway structure and a 1.0m offset perpendicular from said structure.
1g	Space between finished grade and 1.0m offset from structure.	Space created between: • a 1.0m offset from the pier / structure, and • a 1.0m offset perpendicular from the dripline of the outside vertical limit of the parapet.
2g	Space between finished grade and the outside vertical limit of the parapet, plus 1.4m.	Space created by: • 1.0m offset perpendicular from the dripline of the outside vertical limit of the parapet, plus • a 1.6m offset from this point away from the guideway.
3g	Space between finished grade and the outside vertical limit of the parapet, plus 4.0m.	Space created by: • 2.6m offset perpendicular from the dripline of the outisde vertical limit of the parapet, plus • a 5.5m offset from this point away from the guideway.
4g	Space between finished grade and the outside vertical limit of the parapet, plus 8.0m.	Space created by: • 8.1m offset perpendicular from the drippline of the outside vertical limit of the parapet, plus • 3.5m offset from this point away from the guideway.
5g	No vertical limit.	Any space beyond a 11.6m offset perpendicular from the dripline of the outside vertical limit of the parapet.

Trees to be planted in a municipal R.O.W. should adhere to the standards set out by the municipality, to the extent possible while adhering to these Guidelines.

If the elevated guideway/parapet is of a sufficient height, large shade trees are permitted in Zones 2g, 3g, 4g, 5g, and beyond. Additionally, large trees which respond well to heavy pruning can be pruned to fit in these Zones.

Planting Guidelines - Planting in Zone 1g (Pier)

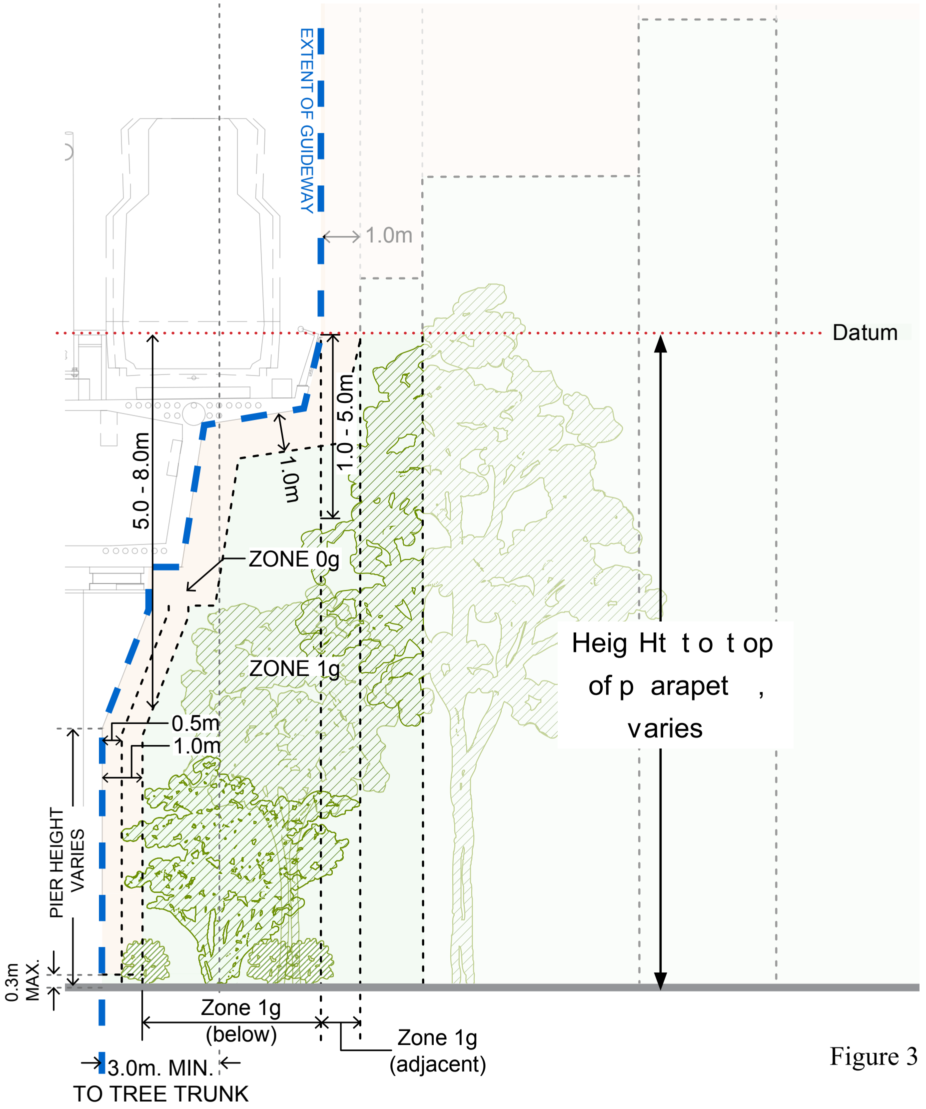

Figure 3

The cross-section shows how to determine appropriate planting height in Zone 1g, where there is a 6.6m pier present, same principles to be applied at various pier heights.

The dividing line between Zone 1g below the guideway, and Zone 1g adjacent to the guideway, is the dripline of the outside vertical limit of the parapet, as seen in Figure 3.

Table 3, below, outlines how to determine the range of planting heights recommended in these zones.

Table 3

Zone	Planting Height
1g (below guideway)	Space between finished grade and a 5.0 to 8.0m offset down from the height of the outside vertical limit of the parapet.
1g (adjacent to guideway)	Space between finished grade and a 1.0 to 5.0m offset down from the height of the outside vertical limit of the parapet.

Due to the use of offset ranges in Zone 1g it can be expected that there will be branch encroachment into Zone 0g. When determining whether to use the low or the high end of the recommended offset, consider that all encroachment into Zone 0g will likely be pruned. Tree species and heights in Zone 1g should therefore be considered carefully based on this assumption.

Low planting is permitted in Zone 0g adjacent to the piers. Plant material in this area shall have a maximum mature height of 300mm.

Planting Guidelines - Planting in Zone 1g (No Pier)

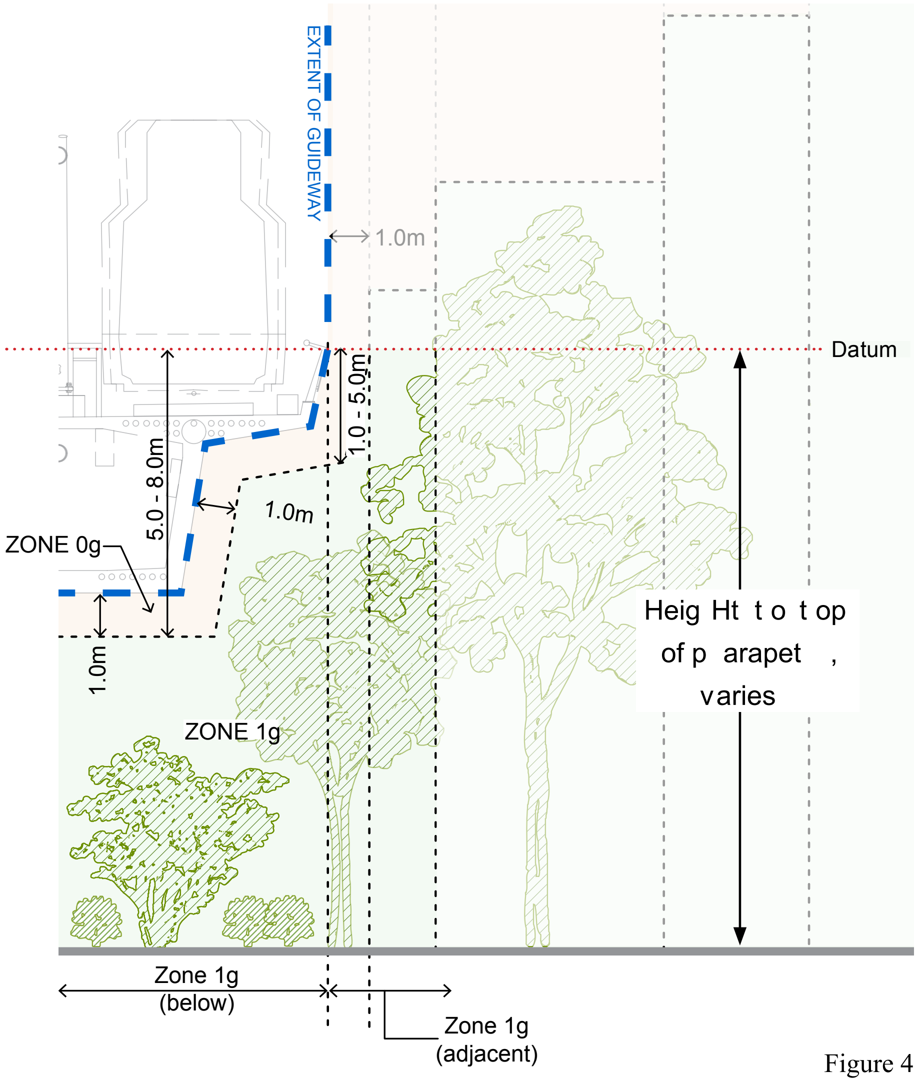

Figure 4

This cross-section shows how to determine appropriate planting height in Zone 1g, where there is no pier present.

The dividing line between Zone 1g below the guideway, and Zone 1g ajacent to the guideway, is the dripline of the outside vertical limit of the parapet, as seen in Figure 4.

Table 4, below, outlines how to determine the range of planting heights recommended in these zones. Zone 1g adjacent to the guideway remains the same as when a pier is present.

Table 4

Zone	Planting Height
1g (below guideway)	Space between finished grade and a 5.0 to 8.0m offset down from the height of the outside vertical limit of the parapet. Note that where the offset is perfectly horizontal, directly under the guideway structure, a 1.0m offset from the bottom of the structure should be used to ensure that pruning of these trees is not required, as that pruning would likely result in unwanted trimming of the tree's leader.
1g (adjacent to guideway)	Space between finished grade and a 1.0 to 5.0m offset down from the height of the outside vertical limit of the parapet.

Due to the use of offset ranges in Zone 1g, it can be expected that there will be branch encroachment into Zone 0g. When determining whether to use the low or the high end of the recommended offset, consider that all encroachment into Zone 0g will likely be pruned. Tree species and heights in Zone 1g should therefore be considered carefully based on this assumption.

Pruning Guidelines (Pier)

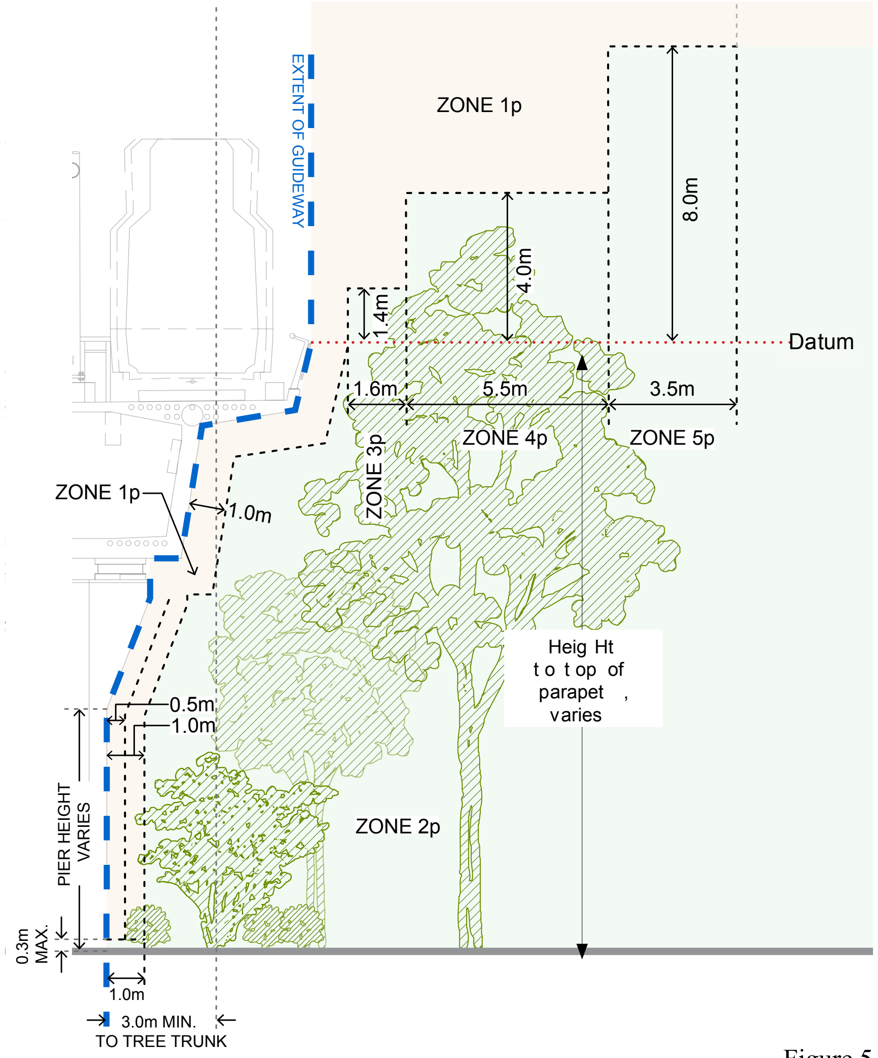

Figure 5

This cross-section uses the parameters outlined in the Planting Guidelines on page 1 to indicate limits of pruning for an elevated guideway where there is a 6.6m pier, same principles to be applied at various pier heights.

Table 5

Zone	Y-Axis (Vertical)	X-Axis (Horizontal)	Prune?
1p	1.0m offset from elevated guideway.	Space created between: • a 1.0m minimum offset from elevated guideway structure to dripline of tree, and • a 0.5m minimum offset from Pier and elevated guideway structure to dripline of shrub	All Vegetation*
2p	Space below height of the dripline of the outside vertical limit of the parapet structure.	Space beyond: • the 1.0 offset perpendicular from the guideway structure, and • includes a 3.0m minimum offset from any vertical structure (Pier or retaining wall) to tree trunk for maintenance access.	No
3p	Space between height of the dripline of the outside vertical limit of the parpet, and a 1.4m offset from said point.	Space created by: • a 1.0m offset perpendicular from the dripline of the outside vertical limit of the parapet, plus • a 1.6m offset from this point away from the guideway.	No
4p	Space between height of the dripline of the outside vertical limit of the parapet, and a 4.0m offset from said point.	Space created by: • a 2.6m offset perpendicular from the dripline of the outside vertical limit of the parapet, plus • a 5.5m offset from this point away from the guideway.	No
5p	Space between height of the dripline of the outside vertical limit of the parapet, and an 8.0m offset from said point.	Space created by: • a 8.1m offset perpendicular from the dripline of the outside vertical limit of the parapet, plus • a 3.5m offset from this point away from the guideway.	No

All vegetation which encroaches on Zone 1p shall be pruned to facilitate inspection. Any pruning of vegetation should be reviewed and undertaken by an Arborist certified in the province/territory in which the work is occuring.

*As low planting is permitted in Zone 1p adjacent to the piers, plant material in this area should be pruned to facilitate inspection on foot.

Pruning Guidelines (No Pier)

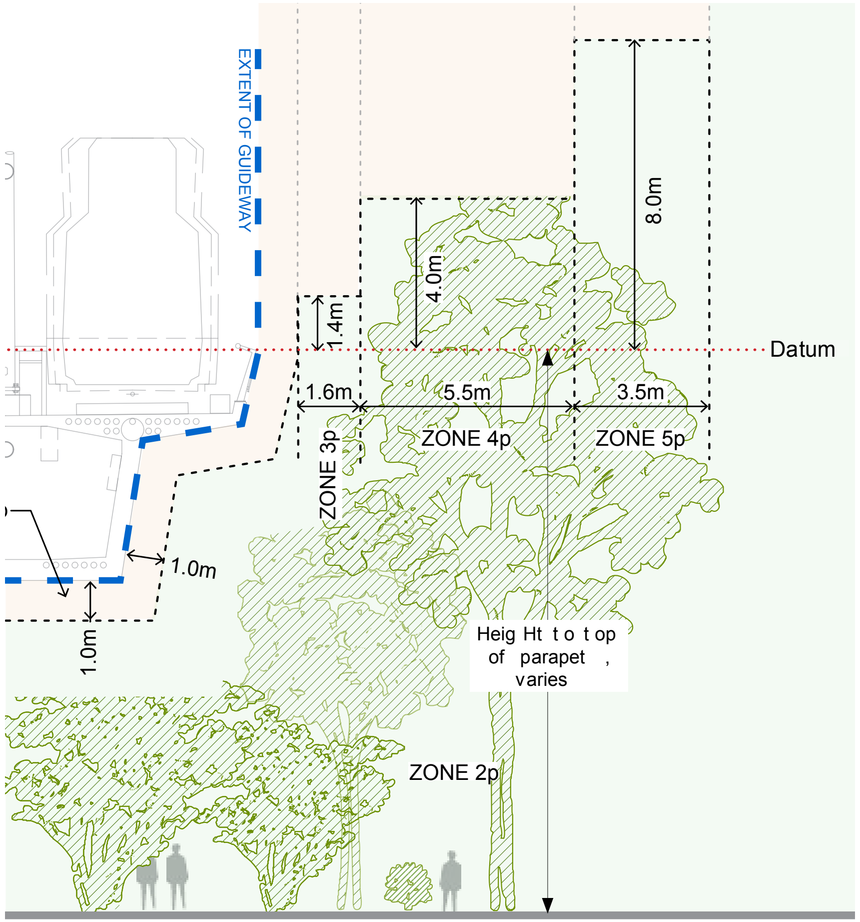

Figure 6

This cross-section uses the parameters outlined in the Planting Guidelines on page 2 to indicate limits of pruning for an elevated guideway where there is no pier.

Table 6

Zone	Y-Axis (Vertical)	X-Axis (Horizontal)	Prune?
1p	1.0m offset from elevated guideway.	Space created between the guideway structure and a 1.0m offset perpendicular from said structure.	All Vegetation*
2p	Space below height of the dripline of the outside vertical limit of the parapet structure.	Space beyond the 1.0m offset perpendicular from the guideway structure.	No
3p	Space between height of the dripline of the outside vertical limit of the parpet, and a 1.4m offset from said point.	Space created by: • a 1.0m offset perpendicular from the dripline of the outside vertical limit of the parapet, plus • a 1.6m offset from this point away from the guideway.	No
4p	Space between height of the dripline of the outside vertical limit of the parapet, and a 4.0m offset from said point.	Space created by: • a 2.6m offset perpendicular from the dripline of the outside vertical limit of the parapet, plus • a 5.5m offset from this point away from the guideway.	No
5p	Space between height of the dripline of the outside vertical limit of the parapet, and an 8.0m offset from said point.	Space created by: • a 8.1m offset perpendicular from the dripline of the outside vertical limit of the parapet, plus • a 3.5m offset from this point away from the guideway.	No

All vegetation which encroaches on Zone 1p shall be pruned to facilitate inspection. Any pruning of vegetation should be reviewed and undertaken by an Arborist certified in the province/territory in which the work is occuring.

*As low planting is permitted in Zone 1p adjacent to the piers, plant material in this area should be pruned to facilitate inspection on foot.

How to Apply Planting Guidelines to Varying Conditions

This cross-section is a sample applying the Elevated Guideway Vegetation Management Zones, as seen previously in Figures 1 and 2 and outlined in Tables 1 and 2, to a sample section of an elevated guideway where there is no pier (right cross-section) and where there is a single 6.6m pier supporting a single guideway structure (left cross-section), same principles to be applied at various pier and guideway heights.

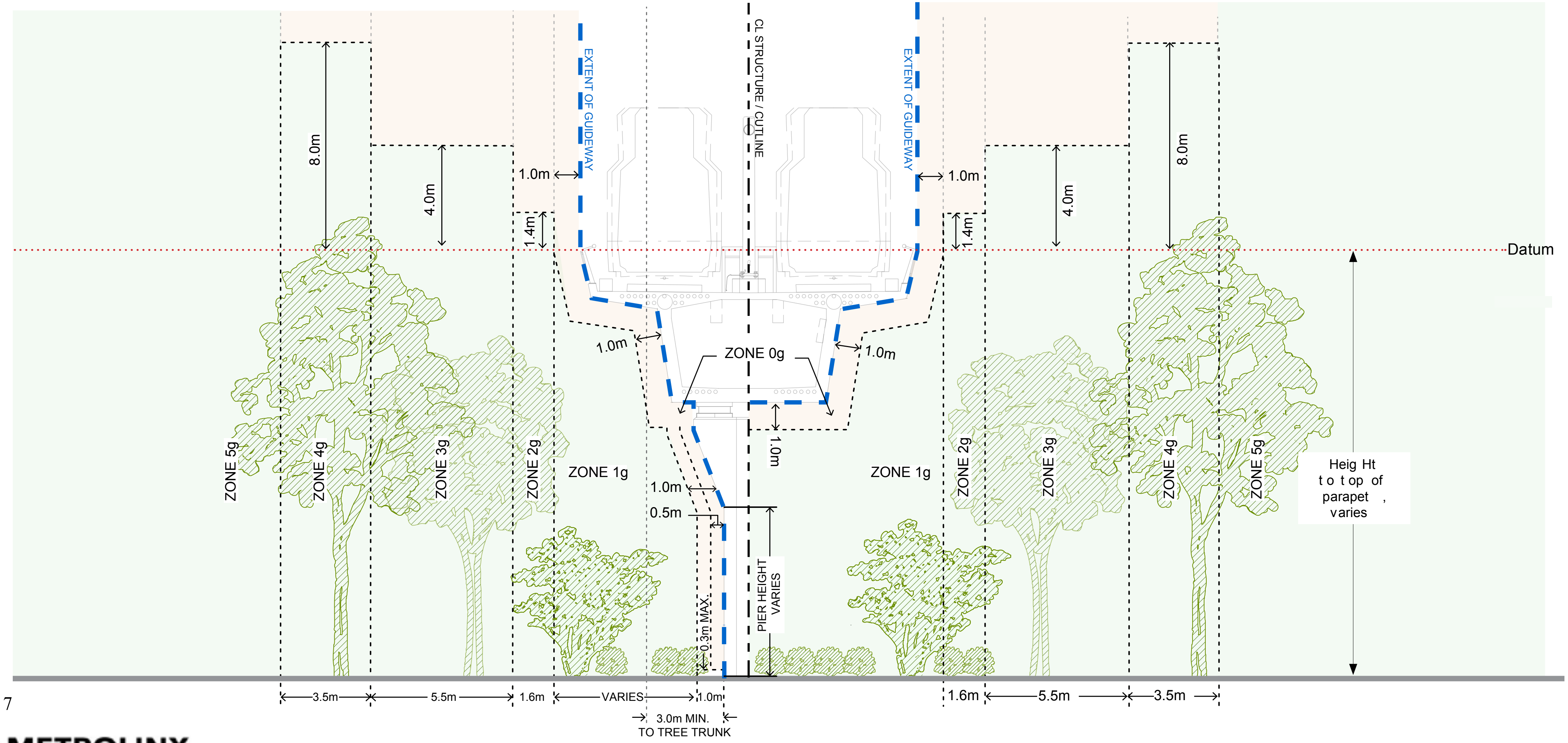

Figure 7

Planting Guidelines

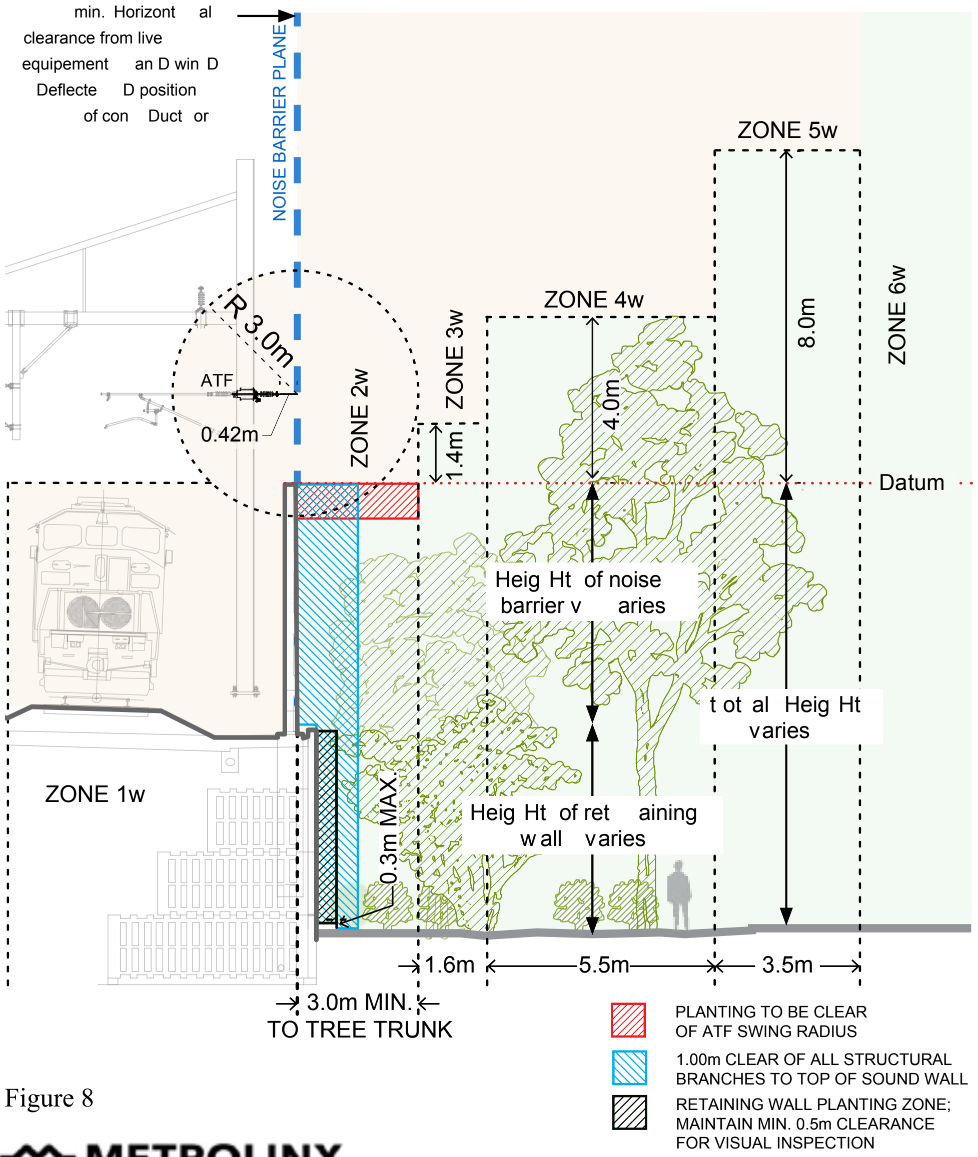

Figure 8

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The cross-section in Figure 8 uses the principles from the Metrolinx Vegetation Guideline's vegetation clearance zones for the electrified rail corridor and applies them to create wall height-dependant, and Auto Transformer Feeder (ATF) location*-dependant Vegetation Management Zones. This section is applicable where there is a retaining wall with a noise barrier on top. Outlined in Figure 8, the datum can relate to different elements of the guideway. The datum should adjust to the most effective location to prevent leaves and debris from falling on to the guideway.

Note that the Zone boundaries apply to the approximate anticipated horizontal spread of the tree/plant canopy. Zones shall be rectangular, based on section cuts of the wall as seen in Figure 8:

Table 7

Zone	Y-Axis (Vertical)	X-Axis (Horizontal)
1w	Space between finished grade and height of the adjacent noise barrier.	Space created between: • track centreline, and • the noise barrier.
2w	Space between finished grade and height of the adjacent noise barrier. If applicable, remove any vertical space which intersects the 3.0m radius of the ATF wire*.	Space created between: • the noise barrier, and • 3m offset perpendicular from the noise barrier, and • 3m minumum offset to trunk of tree.
3w	Space between finished grade and the height of the adjacent noise barrier, plus 1.4m. If applicable, remove any vertical space which intersects the 3.0m radius of the ATF wire*.	Space created by: • 3m offset perpendicular from the noise barrier, plus • 1.6m offset from this point away from the wall.
4w	Space between finished grade and height of the adjacent noise barrier, plus 4.0m.	Space created by: • 4.6m offset perpendicular from the noise barrier, plus • 5.5m offset from this point away from the wall.
5w	Space between finished grade and the height of the adjacent noise barrier, plus 8.0m.	Space created by: • 10.1m offset perpendicular from the noise barrier, plus • 3.5m offset from this point away from the wall.
6w	No vertical limit.	Any space beyond a 13.6m offset perpendicular from the noise barrier.

For planting requirements within the Retaining Wall Planting Zone, refer to page 10.

Trees to be planted in a municipal R.O.W. should adhere to the standards set out by the municipality, to the extent possible while adhering to these Guidelines.
If the raised guideway/noise barrier is of a sufficient height, large shade trees are permitted in Zones 2w, 3w, 4w, 5w, and beyond. Additionally, large trees which respond well to heavy pruning can be pruned to fit in these Zones.

*The ATF location is dependent on the location of the Overhead Catenary System (OCS) poles and should be confirmed with a track engineer.

Pruning Guidelines

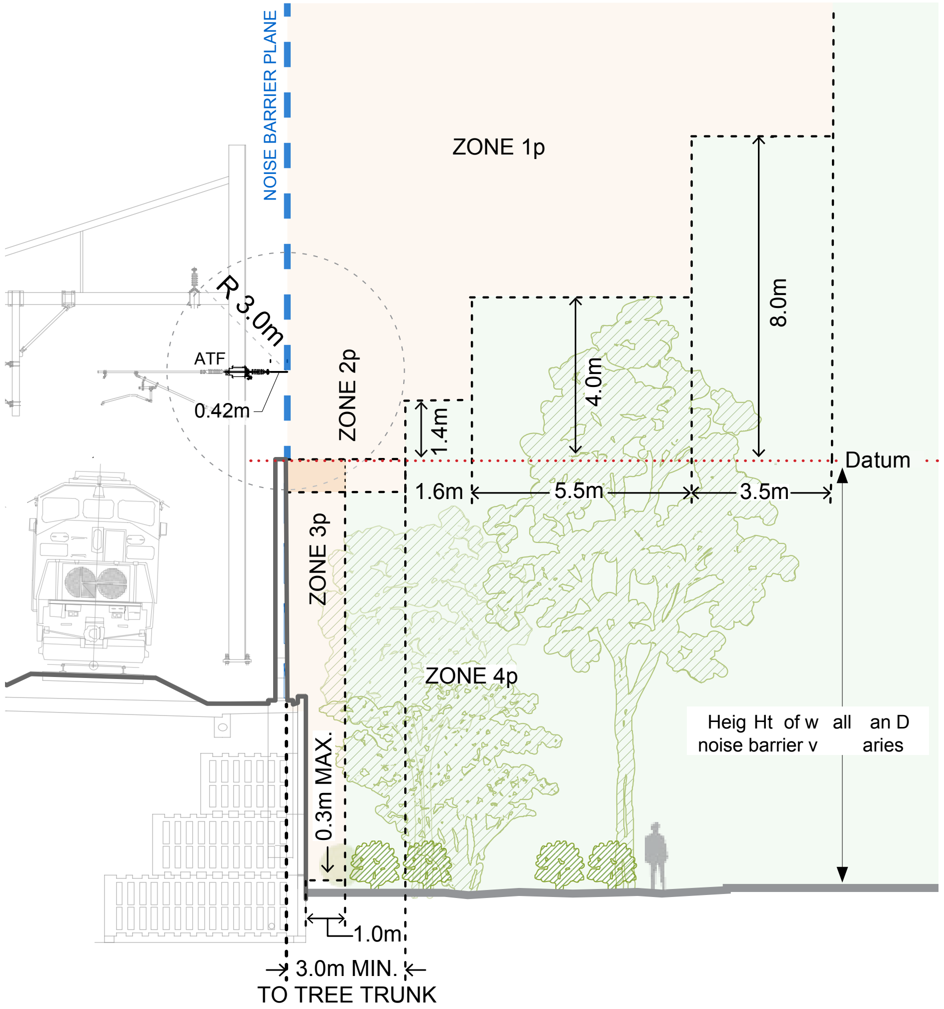

Figure 9

This cross-section shows how pruning should be approached where the guideway is raised with a retaining wall, as seen in Figure 9 and specified in Table 8 below:

Table 8

Zone	Y-Axis (Vertical)	X-Axis (Horizontal)	Prune?
1p	Space above height of the adjacent noise barrier and vertical steps as defined by planting zones (Fig. 8; Table 7).	Space between the face of the noise barrier and each step-out as defined by planting zones (Fig.8; Table 7).	All Vegetation
2p	Space within the 3.0m radius of the ATF wire.	Space beyond the outside face of the adjacent noise barrier and within the 3.0m radius of the ATF wire.	All Vegetation
3p	Space below height of the adjacent noise barrier.	Space created by a 1.0m offset perpendicular from the face of the noise barrier	Structural Branches
4p	Space below the height noise barrier, plus vertical stepping above the noise barrier as per vegetation planting zones. Refer to Figure 8 and Table 7.	Space beyond a 1.0m offset perpendicular from the face of the noise barrier.	No

The 1.0m directly adjacent to a retaining wall shall be clear of all structural branches to the top of the noise barrier in order to prevent climbing. Additionally, any plant material that encroaches into a 0.50m offset, at a minimum, from the face of the retaining wall will be pruned to facilitate inspection. Refer to page 10 for other potential required clear spaces, depending on planting locations. Any pruning of vegetation should be reviewed and undertaken by an Arborist certified in the province/territory in which the work is occuring.

Inspection and Safety Requirements for Retaining Walls

While methods to determine Zones 3w to 6w remain the same regardless of the height of the wall, Zone 2w contains the Retaining Wall Planting Zone, which has particular requirements based on the need for visual inspection of retaining walls.

Note that in general, all species selections in Zone 2w are required to be non-climbable, or pruned as such, due to proximity to the wall. As indicated in Figures 1 to 6, the 1.0m directly adjacent to the wall shall be clear of all structural branches to the top of the wall, regardless of the planting strategy being employed in the Retaining Wall Planting Zone.

Design should respect the best practices of Crime Prevention Through Environmental Design (CPTED). For example, continuous barriers are not recommended as they can have a negative impact on the Natural Surveillance and Access Control principles defined by CPTED, resulting in safety and maintenance concerns.

The Retaining Wall Planting Zone rules outlined below take into consideration various methods of access to and maintenance of the retaining walls, and aim to create a general framework for planting which will still allow for creativity and site-specific applications.

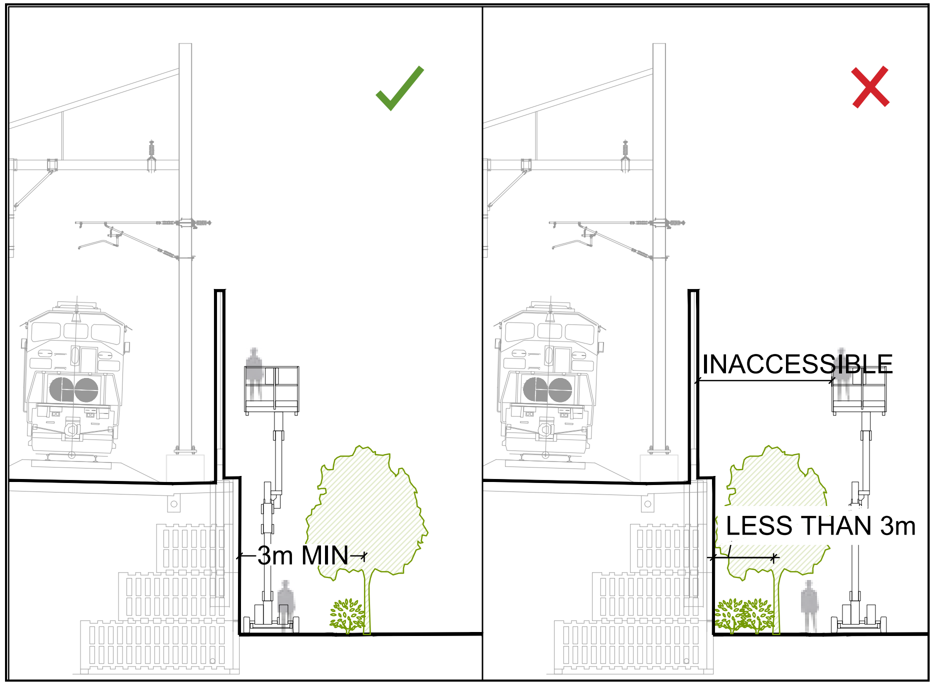

Figure 10

Five Rules for Retaining Wall Planting Zones

1. All tree trunks must be located past a minimum 3.0m offset from the face of the wall.
2. Every exposed surface of the wall must be accessible for visual and physical inspection.
   a) For walls below 1.8m in height, by a person standing at grade.
   b) For walls above 1.8m height, via machinery (scissor lift, cherry-picker, etc.), as needed.
3. The wall must be accessible for inspection from Metrolinx property, or via an access/maintenance agreement with adjacent property owners.
4. No planting over 0.5m in height is permitted between the face of the wall, and a 0.5m offset from the wall. Plant material in this area will be pruned to facilitate inspection.
5. Planting within the intended maintenance access route must not prevent access by foot or via machinery as needed, depending on the height of the wall. Appropriate planting could include low grasses and hardy perennials or groundcovers.

APPENDIX O: INTEGRATED VEGETATION MANAGEMENT PLAN TEMPLATE

This is an example template for an **Integrated Vegetation Management Plan**. This document can be customized to suit project specific and/ or site-specific needs, whether for a particular project, location, ecosystem, or target vegetation.

Integrated Vegetation Management Plan

1. Introduction

- Project Description:
  - Briefly describe the project scope and construction activities that will be taking place and the general area.
- Purpose of the Plan:
  - Briefly outline the purpose/objective of the Integrated Vegetation Management (IVM) plan, which is to manage and reduce the impact of invasive species on native ecosystems, biodiversity, and restoration areas; and manage and reduce the impact incompatible and noxious plants have on Metrolinx operations/project, communities, and human activities.
- Scope:
  - Define the geographic area and ecosystems where the plan will be implemented (e.g., a forest, wetland, or urban area) described with the ELC ecosite code, including mapping. These details can be found in the associated natural heritage reports.
- Stakeholders and Partners:
  - List key Indigenous communities and stakeholders, such as local government agencies, conservation authorities, researchers, nature stewards and the community.

2. Background Information

- The definitions below should be included in the IVM Plan:

Invasive plants are non-native trees, shrubs, and herbaceous plants that are introduced to an area and cause harm to the environment, economy, or society. Non-native species aren't automatically considered invasive species just because they come from a different area of the world – they must also cause negative environmental, economic, or social impacts. Invasive species may also include species native to Ontario that have been introduced to a new geographic region due to human activity.

Noxious plants are plants that are harmful, poisonous, or very unpleasant to humans, wildlife, livestock, or pets.

Incompatible vegetation includes vegetation that conflicts with project designs, rail row-of-way (ROW) and guideways management zones and poses an imminent hazard to operations. Please note that vegetation can only be determined to be incompatible with project designs after application of the mitigation hierarchy.

- Overview of invasive, incompatible and noxious Species:
    - Provide a description of the invasive, incompatible and noxious species present in the area, if known, including scientific and common names (pull information from associated natural heritage reports).
    - For invasive species, explain their origins, pathways of introduction, and current distribution.
    - Ensure any potential additional invasive or noxious plants, if known, that may not currently be present but that have a likelihood of being established on site as a result of construction activities are considered.
- Impacts of invasive, incompatible and noxious species:
    - Explain the environmental, economic, and social impacts of the invasive species, incompatible and noxious plants, such as competition with native species, alteration of habitats, and threats to Metrolinx projects including restoration onsite.
    - Indicate that invasive and noxious plant species require more management due to their physiological characteristics and therefore this IVM Plan will focus more on invasive and noxious plants.
- Regulatory framework:
    - Summarize applicable national, provincial, or local regulations or policies related to invasive or noxious species management, not limited to:
        - Federal Plant Protection Act and Seeds Act
        - Provincial Invasive Species Act
        - Provincial Weed Control Act
        - Provincial Pesticides Act
        - Federal Pest Control Products Act

3. Objectives

Objectives are to be determined with the Metrolinx environmental project team. The objective of IVM Plans could include eliminating or having less than 5% coverage of invasive or noxious plants in the project area, and/ or maintaining 0% of incompatible plant in the project area. Cooperation with adjacent landowners to initiate invasive/ noxious plant management may also be applicable. The IVM Plan should enable required vegetation removal while retaining native or compatible vegetation.

- Short-Term Objectives (e.g. during construction):
    - Identify specific goals to be achieved in the short term as per current conditions or project needs (e.g., early detection, eradication of small populations).
    - EXAMPLE: all newly detected invasive/noxious plants will be managed within 1 month
    - EXAMPLE: all incompatible vegetation in project footprint will be removed as per associated arborist report.
- Long-Term Objectives (e.g. restoration, maintenance and monitoring):
    - Outline long-term goals, such as sustainable management, prevention of further spread, protection of disturbed areas and restoration of affected habitats as per project conditions or project needs. Consideration of future

restoration will require treatment starting the year 1-5 years prior to plantings taking place.
    - EXAMPLE: During maintenance/restoration works invasive/noxious species are minimized in size (less 5% coverage of project area)
- Measurable Outcomes:
    - Define how success will be measured for each objective (e.g., reduction in population size to 5%).

4. Survey and Monitoring

- Baseline Data Collection:
    - Review and summarize results of associated natural heritage reports and Integrated Arborist report for site information.
    - Methods described to assess the current distribution and abundance of invasive/ incompatible/ noxious species.
    - Use of site surveys, and potentially remote sensing/imagery, and/or citizen science data to collect baseline information.
    - Inclusive of mapping species on site, with % coverage as needed and vectors for invasive species to spread.
    - Provide photos of the species and affected areas as applicable.
    - Report all invasive species by either 1) Calling the Invading Species Hotline at 1-800-563-7711 or 2) inputting on EDDMapS website/app.
- Ongoing Monitoring:
    - Monitor and evaluate the success of the program on a yearly basis and prepare a monitoring report.
    - Outline the process for regular monitoring of invasive and noxious species populations and effectiveness of management efforts.
    - Tools and technologies (e.g., GPS mapping, camera traps) to be used in monitoring efforts.
    - Inclusive of mapping species on site, with % coverage as needed and vectors for invasive species to spread.
    - Report all newly discovered invasive species by either 1) Calling the Invading Species Hotline at 1-800-563-7711 or 2) inputting on EDDMapS website/app.

5. Management Strategies

Develop a treatment method that meets the needs of ecological, economic, and cultural concerns of Metrolinx, Indigenous communities and stakeholders using industry standards and best management practices. The treatment approach should encourage the establishment of native, compatible, self-sustaining vegetative cover which, over the long-term, becomes less dependent on treatments. The selected option(s) should aim to represent a balance between meeting IVM targets/objectives while considering indirect and direct impacts to the environment, society, and cost.

All invasive and noxious plant species observations within the Works limits during construction must be documented, monitored and managed with proposed species-specific management and removal action(s) in the IVM Plan and Monthly Environmental

Report. Species specific strategies can be combined where defensible. Noxious or phototoxic plant contact and injury mitigation should be considered from a site safety perspective.

Incompatible species also require documentation and management. Management plans for incompatible woody species can be combined (e.g. removal, protection etc. as described in associated arborist reports.) Considerations for tree end use, seed collection or other harvesting should be included in this Plan and available for Indigenous community and stakeholder input.

- Prevention:
    - Measures to prevent the introduction or spread of invasive and noxious species (e.g. regular monitoring novel/ restoration/planting sites, quarantine protocols, controlling pathways like transportation, contractor education).
    - Equipment sanitation methods described in the Clean Equipment Protocol for Industry (Halloran et al., 2016; as amended from time to time)
- Control:
    - Maintenance and warranty period to maintain less than 5% coverage of invasive and noxious species.
    - Description of how incompatible species will be managed and whether tree end use, seed collection or harvesting will be included as per engagement with Indigenous communities and stakeholders.
    - Methods for eliminating invasive and noxious species from specific areas (e.g., chemical treatments, cultural control, biological control, mechanical/manual removal). Reference Ontario Invasive Plant Council resources for the appropriate recommended control strategies or invasive species.
        - Physical Control:
            - Strategies like manual removal (e.g., digging, cutting), fencing, or burning.
        - Chemical Control:
            - Use of herbicides, pesticides, or other chemicals, with consideration of environmental safety and non-target species.
            - This control option is least preferred (due to environmental risks) and should only be selected when approved by Metrolinx.
            - A rationale should be included for how chemical control was selected and how each, individual chemical was selected including any applicable surfactants and additives.
        - Biological Control:
            - Introduction of natural predators or competitors to reduce invasive species populations (with careful monitoring).
        - Cultural Control:
            - Habitat manipulation, such as changing land use practices, soil remediation or promoting native plant growth.
    - The associated vegetation control method selection process/protocol and proposed control method(s) to be included for Metrolinx approval.

    - Ongoing efforts to manage invasive and noxious species populations at sustainable levels (e.g., pesticides, habitat modification, mechanical/manual control).
    - Highlight any significant presence of invasive, incompatible or noxious species that requires specific consideration for management i.e. *Phragmites australis.*

Example: Implementation of the proposed action(s) to manage and remove the invasive and/or noxious plants must occur prior to works initiating where possible or on a different timeframe approved by Metrolinx; and continuing removal and management of invasive and noxious plant species during and after Construction including on-site restoration/landscaping planting, maintenance and monitoring.

- Disposal:
    - Methods to safely and legally dispose of all invasive and noxious species.
- Restoration:
    - Plans to restore ecosystems impacted by invasive/noxious species, including reintroducing native species and habitat as appropriate.
- Monitoring and Evaluation:
    - Describe how the effectiveness of the management plan will be evaluated, including the collection of monitoring data and analysis of trends.
    - Monitoring the site for the presence and spread of invasive species and noxious plants during weekly environmental inspections.
    - Siting response plans for newly identified outbreaks with flow chart for communications with timelines.
- Reporting:
    - Define how progress/management plan updates, siting response plans and Annual Post-Planting Monitoring Report will be reported to Metrolinx, or as applicable Indigenous communities, stakeholders, the public, and funding bodies, including frequency and format of reports. Note: EPA RP and EPA IR will need to support decision of who is engaged and how.
- Contingency Plans:
    - Outline contingency plans for addressing unforeseen challenges, including adaptive management strategies.
    - Adjust and revise the IVM Plan to allow for ongoing improvements based on field observations and learned experiences.

6. Communications and Education

- Communication Plan to be included and contractor to support Metrolinx lead communications.
- Identify communication needs associated with vegetation management and include leads and supports – EPA / EPA RP or TA will identify communication needs for contractor.
- Communication needs may include:
    - Where chemical control options are being considered (the local councillor may need to be notified).

    - Where large street/park trees are proposed for removal, which may impact the local community.
- Public Engagement:
    - Strategies to engage nature stewards, Indigenous communities, local communities in invasive, incompatible and noxious species management (e.g., volunteer programs, awareness campaigns) where applicable. This includes provisions to respond to invasive, incompatible and noxious species management inquiries.
- Training and Education:
    - Educating project contractor employees, Indigenous communities, stakeholders, landowners, and the public about identifying, reporting, and managing invasive, incompatible and noxious species where applicable.
    - Metrolinx to support development of education material for contractor training/education.
- Collaboration:
    - Communication plan to out line adjacent landowners' cooperation for more effective response to invasive, incompatible and noxious species challenges and management.
- Personnel and Expertise:
    - List key personnel and their roles, not limited to: Field staff, contractor (including employees), Metrolinx (including EPA RP), adjacent landowners, applicable Indigenous communities, local community groups, city councillor, applicable conservation authority and technical experts/advisors.

7. Timeline and Milestones

- Short-Term Activities:
    - Provide a timeline for immediate actions within the first year or two (e.g., surveys, early intervention).
- Long-Term Activities:
    - Outline activities and checkpoints for the next 5-10 years, such as adaptive management, restoration and maintenance/monitoring.
- Milestones and Reviews:
    - Set specific, measurable milestones to track progress over time and adjust the plan as necessary.

8. Risk Management

- Potential Risks:
    - Identify risks associated with the proposed management strategies – especially with the use of chemical control options and potential impacts to human health, environment, biodiversity, wildlife and DNAs (e.g. wetlands, waterbodies).
    - Identify potential risks to the success of the management plan and sensitive receptors (e.g. unintended consequences of control methods, poor identification/monitoring, Indigenous community considerations).
- Mitigation Measures

- Identify mitigation measures to be implemented with the associated, identified risks for example:
  - It should be clear how chemical controls are to be isolated on site and not impact non-target species or move off site.
  - Create a chemical control schedule which avoids time periods when species at risk may be breeding/emerging.
  - Do not use chemical control in sensitive areas (DNA's, wetlands, groundwater recharge areas etc.) or areas with a high water table – instead use alternative strategies.
  - Where chemical control is applied within 120m of a waterbody, water quality to be monitored.
  - Restoration post chemical application will include soil testing to inform appropriate remediation.
- Continuous improvement/Contingency Plans:
  - Outline contingency plans for addressing unforeseen challenges, including adaptive management strategies.
  - Describe corrective actions that will be implemented if control measures are not successful.

9. Conclusion

- Summarize the goals of the invasive, incompatible and noxious species management plan and emphasize the importance of continued collaboration, monitoring, and adaptation to achieve long-term success.

Appendices

- Appendix A: Species List
  - A comprehensive list of invasive, incompatible and noxious species captured in the IVM plan and targeted by the management plan, with scientific names, descriptions, and known distributions.
- Appendix B: Maps and Data
  - Maps of the area with invasive, incompatible and noxious species distribution, monitoring sites, and areas of concern.
  - Maps to be updated annually at a minimum and support management decisions.
- Appendix C: Photo log
  - Photos that do not fit within main body of the Plan can be placed in a photolog.
- Appendix D: References
  - A list of relevant research papers, reports, best management practices and guidance documents consulted for the development of the plan.