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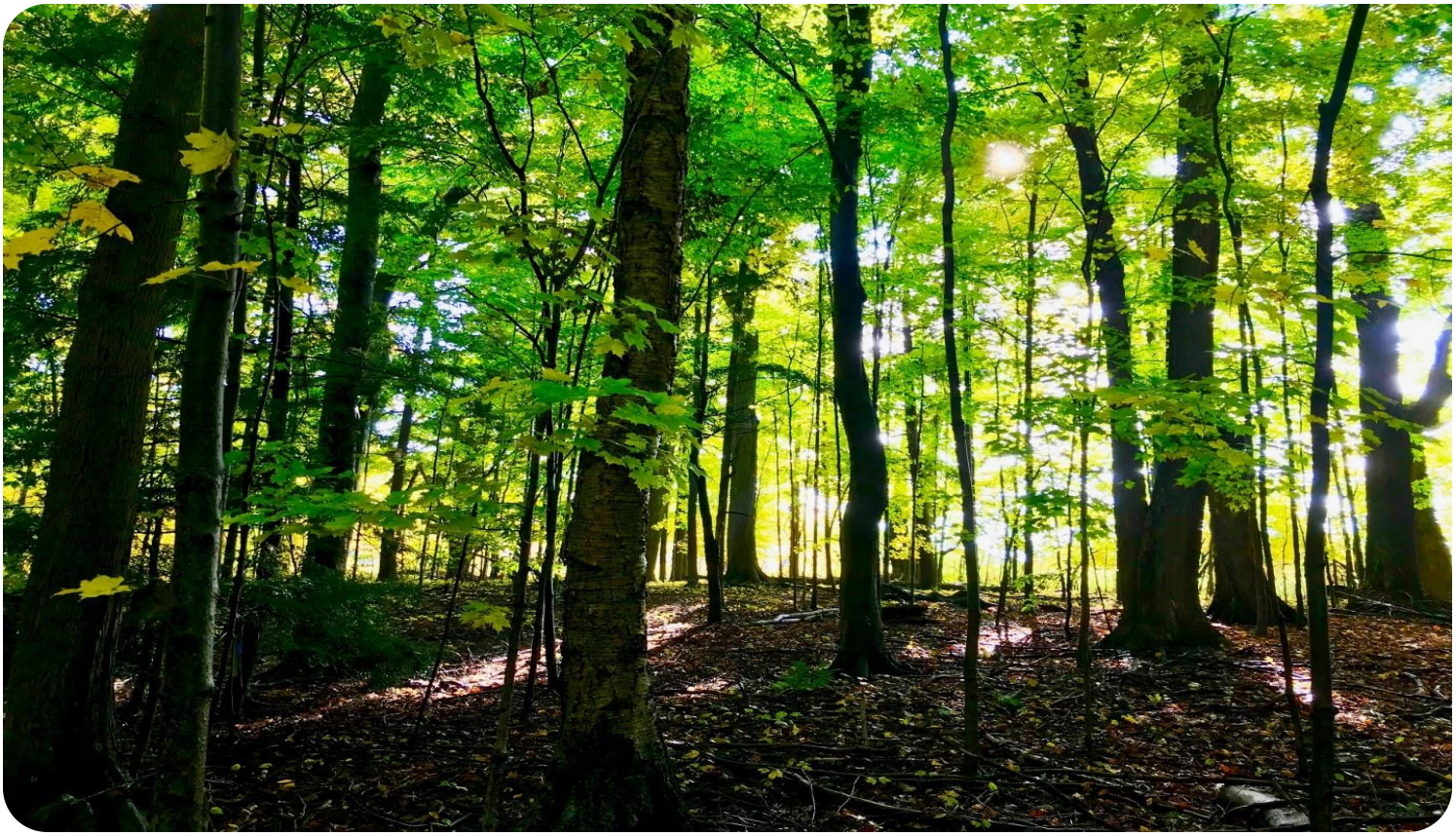

Ecosystem Offsetting Guidelines

Prepared by: Credit Valley Conservation

March 13, 2020

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This document contains material directly from Toronto and Region Conservation Authority's *Guideline for Determining Ecosystem Compensation* (June 2018). CVC would like to thank TRCA staff for all their hard work on the development of their guideline. This document is as consistent as possible with TRCA's guideline; however, there are changes to speak to CVC specific policies and programs. In addition, there are a couple of new requirements or methods intended to provide more clarity and consistency between projects.

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This guideline was approved by Credit Valley Conservation's Board of Directors under Resolution 29/20 on 13 March 2020.

RESOLUTION:

WHEREAS *natural systems continue to often be adversely impacted by development and infrastructure projects throughout the Credit River watershed (and area) despite Credit Valley Conservation's (CVC) and partner municipalities' commitment to natural heritage protection and adherence to a strong provincial policy and regulatory regime; and*

WHEREAS *past approaches to ecosystem compensation have only been partially successful at replacing lost ecosystem features and functions; and*

WHEREAS *the land use planning, environmental assessment and permitting process determines when impacts from development on ecosystems are appropriate; and*

WHEREAS *CVC Watershed Planning and Regulation Policies (April 2010) recommend that "CVC will encourage all planning and permit applications to achieve an ecological gain. Where it has been demonstrated an ecological gain is not feasible, CVC will promote the principle of no net loss of ecological functions and hydrologic functions"; and*

WHEREAS *there is a lack of transparent, consistent and replicable technical guidance on determining what is required to effectively replace ecosystem losses; and*

WHEREAS *based on their expertise and experience, staff have developed a technical guideline that outlines a best practice to compensate for losses to natural features - after the decision to compensate has been made by the approval authority; and*

WHEREAS *in some instances, CVC may accept funds from development proponents to undertake compensation works on their behalf, recognizing they may not have the resources and CVC may be better positioned;*

THEREFORE BE IT RESOLVED THAT *the report entitled "Ecosystem Offsetting Guideline" be received and appended to the minutes of this meeting as Schedule "F"; and further*

THAT *the Board of Directors endorses the CVC Ecosystem Offsetting Guidelines and its implementation/distribution through CVC's Planning and Development Services processes, where appropriate*

THAT *the Board of Directors directs staff to establish a reserve to accept, track and manage cash-in-lieu payments associated with offsetting projects to support CVC's commitment to transparency and accountability;*

THAT *the Board of Directors directs staff to develop a database to track and manage offsetting projects and their associated losses; and*

THAT *the Board of Directors directs staff to provide a report annually on the application of Ecosystem Offsetting in the Credit River Watershed.*

CONTENTS

APPENDICES

FIGURES

TABLES

1 INTRODUCTION

Ecosystem offsetting is an approach to offset the adverse impacts of land use change on the natural heritage system through the creation or restoration of natural features.

Increased stress is placed on natural heritage systems and on their ability to provide the same benefits to the population as the Greater Golden Horseshoe region continues to grow. Conservation in an urban context is challenging because of the finite space available to fit all basic needs of communities, including homes, workplaces, amenities, infrastructure and natural features and areas. Issues at a larger scale, such as global climate change, add to the complexity of addressing the local challenges. These pressures should result in increased support for conservation; however, despite a strong protective policy and regulatory regime, natural features and the functions and services they provide continue to decline in some areas within the Credit River watershed and the Greater Golden Horseshoe region.

Within this context, ecosystem offsetting becomes an important tool to help ensure that the critical ecosystem functions and services lost through development and site alteration related activities are restored on the landscape for the betterment of our watershed and its communities. Credit Valley Conservation (CVC) and our municipal partners are dedicated to the protection, restoration and enhancement of the natural heritage system, its features and functions, and the valuable ecosystem services that the system provides to residents. Our agencies' ecological restoration programs and the strong environmental objectives and policies contained in municipal official plans, and in CVC's Watershed Planning and Regulation Policies, clearly demonstrate this commitment.

Compensation for the loss of natural features has been occurring in Ontario for a long time. This compensation has lacked standards or guidance. This lack of guidance has produced long negotiations, inconsistent results, and inadequate compensation for the loss of ecological features and functions. CVC has developed ecosystem offsetting guidelines to improve and streamline the approval process, clarify expectations, and achieve better ecological outcomes for the health of the Credit River Watershed. The guideline provides a consistent, fair and transparent process informed by science and best practices.

This guideline applies only after the decision to offset has been made by the approval authority. Offsetting is often applied to planning and development activities or infrastructure projects that produce losses or impacts on the natural heritage system. The application of offsetting shall be consistent with relevant provincial, municipal and other approval authority natural heritage system planning policies, legislation and regulations. Offsetting may not be appropriate or permitted

in all cases. Proponents are encouraged to consult the appropriate approval authority to discuss the applicability of ecosystem offsetting to your project. These guidelines are intended to ensure offsetting activities remain a last resort and that all efforts for protection on site have been considered before contemplating removals.

1.1 Ecosystem Offsetting and Ecological (Net) Gain

In accordance with the Provincial Policy Statement and Provincial Plans, municipal official plans contain policies for the protection of natural heritage systems, natural features and areas, lands containing natural hazards and water resources. Through the development process, there may be a need to modify, move or remove natural areas on the landscape to achieve overall planning objectives.

Where avoidance and mitigation measures are not possible or financially feasible, offsetting may be considered where the approval authority deems it possible and the plan continues to conform with federal, provincial, municipal and conservation authority requirements. In addition, natural heritage features and areas may be impacted through the construction or expansion of infrastructure through the environmental assessment process – including other development-related activities requiring permitting pursuant to Section 28 of the Conservation Authorities Act.

1.1.1 Ecosystem Offsetting

Municipalities and CVC have used compensation in the past to address unavoidable losses to the natural heritage system. Compensation frequently occurred with little or no guidance to ensure full compensation for the loss. In many cases, the goal of the compensation was to only mitigate impacts to an acceptable level. As a result, these compensation projects typically only partially replaced the lost ecosystem services they remove.

Compensation activities have also been applied inconsistently across the watershed and typically do not address risks and uncertainties associated with impacting complex ecosystems or consider cumulative impacts, climate change, time lag and other unanticipated or unmeasurable impacts.

Alternatively, ecosystem offsetting is a methodical, consistent approach in which adverse impacts on natural features are offset by the intentional restoration or creation of new features - providing positive environmental outcomes of an equivalent or greater magnitude and kind. Offsetting policies and programs have been developed in Canada (Alberta, and British Columbia), the United States and Australia, and have been generating interest in the business community through the development of the Business and Biodiversity Offset Programme (BBOP). Governments and agencies in Ontario are currently exploring, developing, or adopting offsetting approaches (City of Pickering, Toronto and Region Conservation

Authority, Lake Simcoe Region Conservation Authority, and the Province's *Considerations for the Development of a Wetland Offsetting Policy for Ontario*).

Offsetting activities are typically embedded within the mitigation hierarchy (Figure 1) where the offsetting phase of the sequence is considered only after a thorough assessment of impact avoidance, minimization and mitigation alternatives have been considered and where policy permits.

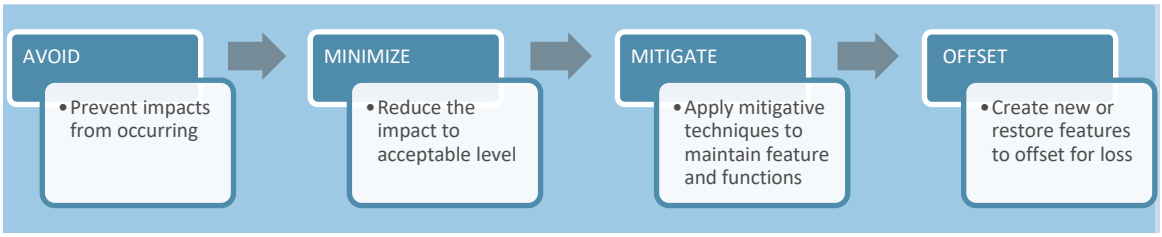


Figure 1: Mitigation hierarchy

In updating official plans and other environmental policies, some municipalities and agencies have included provisions that address limited instances where impacts to natural heritage features and areas may be permitted on condition that appropriate mitigation or offsetting be provided. Credit Valley Conservation recognizes that impacts on natural heritage features and areas, in specific circumstances, may be permitted through the planning and development processes – consistent with federal, provincial, municipal and CVC policy.

1.1.2 Ecological (Net) Gain

Credit Valley Conservation continues to use a "protection first" approach to natural heritage protection and management. The development of this guideline does in no way diminish CVC's commitment, or the commitment of its member municipalities, to the protection of the natural features, functions and services of natural heritage systems.

As planning and development activities occur throughout CVC's watersheds, we strive to ensure positive environmental outcomes by implementing the concept of ecological (net) gain:

> *"CVC will encourage all planning and permit applications to achieve an ecological gain. Where it has been demonstrated an ecological gain is not feasible, CVC will promote the principle of no net loss of ecological functions and hydrologic functions." (CVC Watershed Planning and Regulation Policies April 2010)*

Each natural area provides a specific set of ecological functions and services related to the natural area's ecological composition and structure. Offsetting programs as a principle recommend that offsetting should strive to achieve some equivalency

between the ecological conditions and functions at the development and offset site to achieve no net loss in ecological form and function, and preferably an ecological (net) gain. It is recognized that this is challenging due to the unique conditions at each site, so characteristics and functions will need to be identified and prioritized. Two priority considerations for offsetting in the Credit River watershed are to create an ecological community similar to what was lost (like-for-like) and to provide the equivalent land base. CVC also acknowledges there are some circumstances (limited) when greater ecological outcomes can be achieved by creating ecosystem components or functions different from those lost to development. The decision to deviate from "like-for-like" offsetting should be guided by large scale environmental reports and a thorough technical analysis.

Land Base Offsetting

The overall size of a natural heritage system and its features determines what ecosystem functions and services the system and the features can provide. Offsetting strives to achieve a net gain in both ecosystem form and function to offset the adverse impacts of development on the natural heritage system. A **land base offset** replaces the land removed from the natural heritage system by a development project. The land base offset is also important to provide a place for the planting of vegetation associated with the offset.

Best practice for deviating from "like-for-like" offsetting is to document the ecological justification, identify objectives, set clear measurable targets, and monitor to inform future offsets.

1.2 Setting Principles and Standards

To date, the application of compensation has resulted in some success at replacing lost natural features and the ecosystem functions they provide. However, there are several challenges, such as the limited availability of land for restoration, the risks and complexities associated with restoration, lengthy negotiations, lack of transparency, inconsistent results and, in many instances, an inability to fully replace the complex ecosystem functions of many natural heritage features and areas.

Some of these challenges are difficult, if not impossible to fully address. However, it is intended that establishing a guideline outlining principles and standards for offsetting will assist in addressing many of them. The principles and standards established in this guideline are intended to ensure offsetting activities remain a last resort and that all efforts for protection on site have been considered before

contemplating removals. Standards of practice can also help ensure that offset projects are adequately financed and successfully implemented for the long term.

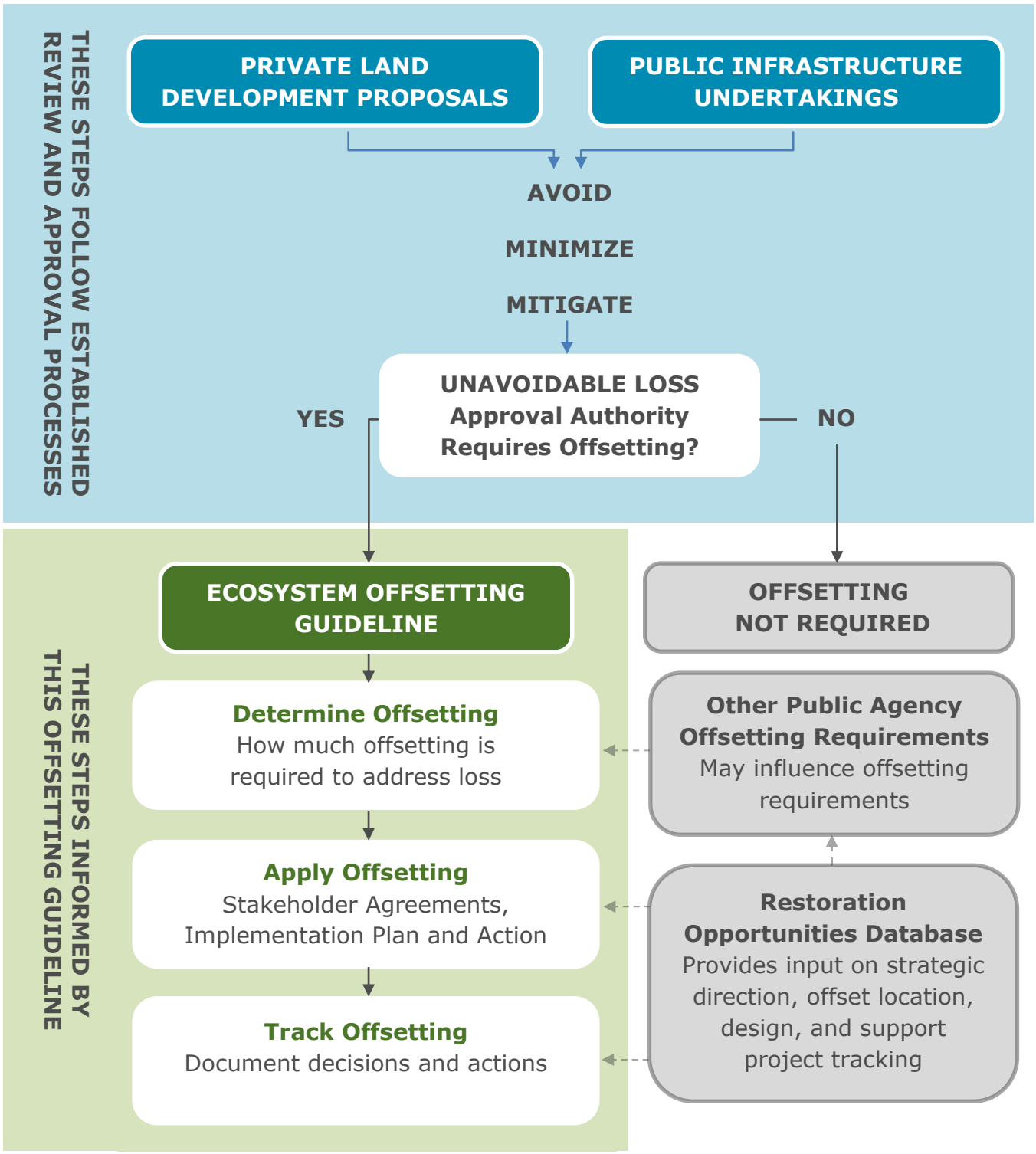
1.3 Municipal and Other Public Agency Adaptation

It is recognized that each municipality has its own unique goals, objectives and policy approaches to ecosystem offsetting. This guideline outlines the key principles and methods needed for improved ecosystem offsetting outcomes, while recognizing municipalities or other public agencies may wish to adapt them to their own needs and/or circumstances.

1.4 Plan Review and Approval Processes

Figure 2 illustrates where ecosystem offsetting fits within the existing plan review and approval processes. In addition, the figure illustrates how this guideline may be a tool for use only after the decision to permit impacts to natural heritage systems, features and areas has been made. It should be noted that CVC's Watershed Planning and Regulation Policies recommends that works within, or modifications to the natural heritage system, features and areas take place at the appropriate stage of the planning and development processes and is supported by an approved environmental assessment, comprehensive environmental study or technical report, as appropriate.

As indicated by the box on the lower left in Figure 2, this guideline has been organized to address each technical aspect of the offsetting approach, from determining what is required to replace the impacted ecosystem, to strategic application of offsetting, to monitoring and tracking outcomes.



Adopted from TRCA, 2018.

Figure 2: Offset and review and approval processes

1.5 Purpose and Scope of the Guideline

The purpose of this Guideline is to guide how to determine the total amount of offsetting required to replace lost or altered ecosystems in a repeatable and transparent manner after it has been decided that offsetting is required through the land use planning or environmental assessment process. As previously stated, offsetting may not be appropriate or permitted under specific policies, legislation and regulations. The Guideline is written to assist planners, ecologists, landscape architects, landowners, other practitioners and interested parties in understanding how CVC recommends approaching offsetting for ecosystem losses. Promoting strategic and effective implementation of offsetting, the Guideline 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.

Ecosystem Structure, Functions and Services

This Guideline determines requirements for replacing the structure and the land base of a natural feature lost to development or infrastructure. Once established and over time, the restored ecosystem structure provides renewed ecosystem functions, which provides the foundation for the provision of ecosystem services. There are a number of risks and uncertainties associated with attempting to replace complex ecosystems. The re-establishment of similar ecosystem functions and associated services is far from certain and can take a significant amount of time. Adhering to the standards in this Guideline (along with long term protection, management, and the passage of time) can lead to the replacement of similar ecosystem functions and services.

1.5.1 What the Guideline Is Not

The Guideline does not provide guidance on when removals are appropriate with associated offsetting. Rather, this determination is made through the planning, environmental assessment or permit processes, and guided by policy addressing offsetting, where such policy exists.

This Guideline does not replace, or in any way negate the requirements of other legislation applicable to impacts to species or ecosystems at the municipal, provincial or federal levels. Protection, and ideally enhancement of the existing natural system remains a primary goal of natural heritage systems planning. The intent of this Guideline is not to weaken this goal or diminish the ability to protect ecosystems in situ.

The Guideline is not suggesting any modifications to the existing planning, environmental assessment or permitting processes leading up to the decision to allow ecological impacts with offsetting. However, the decision will be better informed by the information in the Guideline given that it articulates what is warranted when the decision is made.

This Guideline does not directly address offsetting for aquatic ecosystems, nor does it determine offsetting requirements for stormwater management. Indirectly, this guideline will help offset natural features that contribute to the health and function of aquatic ecosystems. CVC does have other guidelines that are related to hydrologic offsetting and the mitigation hierarchy, including the *Water Balance Guidelines for the Protection of Natural Features* in CVC's Stormwater Management Criteria (2012), and CVC's *Evaluation, Classification and Management of Headwater Drainage Features Guidelines* (2014). The Department of Fisheries and Oceans' *Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act* (2019) also guides measures to offset impacts to fisheries. In the coming years, CVC will work with other conservation authorities and stakeholders to determine the need for aquatic ecosystem offsetting guidelines.

1.6 Role of Municipalities, CVC and Proponents in Ecosystem Offsetting

1.6.1 Municipalities

Municipalities are the approval authorities under the Planning Act and may or may not have official plan policies, by-laws, or other mechanisms for requiring offsetting or other forms of ecosystem replacements. As approval authorities, municipalities can refuse or approve impacts to natural features as part of a Planning Act application. Once that decision has been made, municipalities share with CVC the assessment of offsetting projects proposed by private development proponents.

As proponents of their municipal infrastructure projects, municipalities may put forward their offsetting projects to replace lost ecosystem structure as described in Section 2.3. Section 2.2.2 of this Guideline speaks to municipal infrastructure projects and special considerations for the lost land base. For all municipal projects affecting CVC Regulated Areas and/or CVC owned or managed lands, municipalities and CVC routinely work together to achieve provincial, municipal and CVC shared objectives for natural heritage systems planning and sustainable communities.

1.6.2 Credit Valley Conservation

As a conservation authority, CVC is a public commenting body under the planning and environmental assessment (EA) processes (delegated by the Province to represent the provincial interest in managing natural hazards) - acting as a resource management agency and service provider to approval authorities through service agreements and/or memorandums of understanding. In its regulatory role,

CVC is the decision-maker for permits issued under section 28 of the Conservation Authorities Act, as well as a landowner and proponent when undertaking works requiring planning and development approvals.

In participating in the review of development applications under the Planning Act and reports under the Environmental Assessment Act, CVC ensures that applicants and approval authorities are aware of any regulatory requirements, where applicable. Further, CVC assists in the coordination of these applications to avoid conflict and unnecessary delay or duplication in the planning and permitting processes. As a proponent of its own projects, CVC may put forward its own offsetting projects to replace lost ecosystem structure and land base.

1.6.3 Private Proponents

As a proponent of private development directed to offset for an impact through the above-noted processes, landowners must be willing to provide and implement an offset project that will adequately address the loss of the impacted ecosystem. The implementation plan must be designed, installed, monitored and maintained in accordance with any conditions or agreements established between the proponent and the public agencies.

1.7 Guideline Applicability

This guideline may be applied to natural heritage features (e.g., forests, woodlands, wetlands, thickets and meadows) and areas within the natural heritage system, or other features that have been determined by the approval authority to require ecosystem offsetting through the review of applications for planning, infrastructure or CVC permitting processes. Restoration or enhancement areas that fall within the natural heritage system, that may not already contain natural heritage features or areas, can also have the land base portion of the guideline applied if determined to require offsetting.

1.7.1 Exceptions

The application of offsetting is determined by the appropriate approval authority and shall be consistent with all applicable policies and exemptions. This guideline is not intended to be applied to small, isolated and/or low functioning natural features or areas where it has been determined their protection can be mitigated and/or is not necessary to meet environmental protection goals and objectives.

Ecosystem offsetting will not be applied to applications that facilitate permitted agricultural uses or the construction of accessory structures (e.g. garages) or a single-family dwelling on an existing lot of record.

1.7.2 Green Infrastructure

Offsetting requirements determined through the use of this Guideline should be applied to the re-establishment of natural ecosystems and not used to install or otherwise improve engineered green infrastructure or community amenities. The Guideline does not apply to individual trees located in parks or along roadsides not associated with natural features.

1.7.3 Other Compensation or Offsetting Programs

For impacts to individual park, yard or street trees, municipalities may have by-laws containing provisions for tree replacements. CVC will continue to support the application of these municipal mechanisms by providing technical guidance in their application, coordinating with municipal staff to avoid duplication, and assist in the development of new or updated by-laws as needed. In this way, the two separate processes of the guideline and individual tree replacement programs work together for a comprehensive approach to restoring losses.

Another mechanism for restoring lost habitat is the Ministry of Environment, Conservation and Parks' (MECP) Overall Benefit Permit (OBP) process under the *Endangered Species Act*. Where an OBP is required, CVC defers to MECP for their requirements under their species-specific permit process. However, there may be cases where a portion of the impact on habitat is offset through one mechanism while the remaining impact is offset through a different mechanism. For example, off-setting required through the *Endangered Species Act* may address impacts to one particular species but may not offset for all of the lost structure and function provided by the impacted ecosystem. In these cases, determining what is required to offset for the remaining impact can be accomplished through the Guideline.

This Guideline does not contain provisions for determining offsetting requirements for the loss of fish habitat and defers to provincial and federal ministries (e.g., Fisheries and Oceans Canada) that direct compensation for impacts to aquatic species and their habitat. For direction on addressing any type of alteration, restoration or removal of a headwater drainage feature, the Evaluation, Classification and Management of Headwater Drainage Features Guideline (TRCA and CVC, 2014) should be used.

1.8 CVC's Principles of Ecosystem Offsetting

The following principles represent the framework and express the intent of this guideline:

1. Consideration for offsetting may only be applicable where it is consistent with the appropriate legislation, regulations and supporting policies and guidelines.

2. Offsetting must follow the mitigation hierarchy of Avoid, Minimize, Mitigate, then Offset. Offsetting should only be applied after a detailed analysis has determined that avoidance, minimization and mitigation of loss is not possible or feasible.

3. The offsetting process should be transparent ensuring accountability of all parties involved.

4. The offsetting process should be consistent and replicable.

5. Offsetting activities should target an ecological (net) gain. Where determined to not be feasible, they should ensure no-net-loss and fully replace the same level of lost ecosystem structure and function in proximity to where the loss occurs.

6. Offsetting should be directed to on-the-ground ecosystem restoration and be informed by strategic watershed and restoration planning.

7. Implementation of offsetting activities should be completed promptly so ecosystem functions are re-established as soon as possible after (or even before) losses occur.

8. The offsetting process should use an adaptive management approach incorporating monitoring, tracking and evaluation to gauge success and inform improvements.

This guide does recognize that there are limits to offsetting and recommends that decision-makers avoid using offsetting to justify the removal of features that are difficult or impossible to replicate due to their complexity, vulnerability, and sensitivity (e.g. bogs and fens). Offsetting for these features is unlikely to replace the functions lost, nor demonstrate a no net loss. Decision-makers should consider this during the planning process and avoid impacts to or losses of these features whenever possible.

2 COMPONENTS OF AN OFFSETTING PROJECT

The offsetting process and the application of this guideline begins with the decision by the approval authority to require offsetting as a condition for the removal of natural features or impacts to the natural heritage system. Figure 3 illustrates the Ecosystem Offsetting Process and directs the user through the various steps in the process and to its location in the guideline.

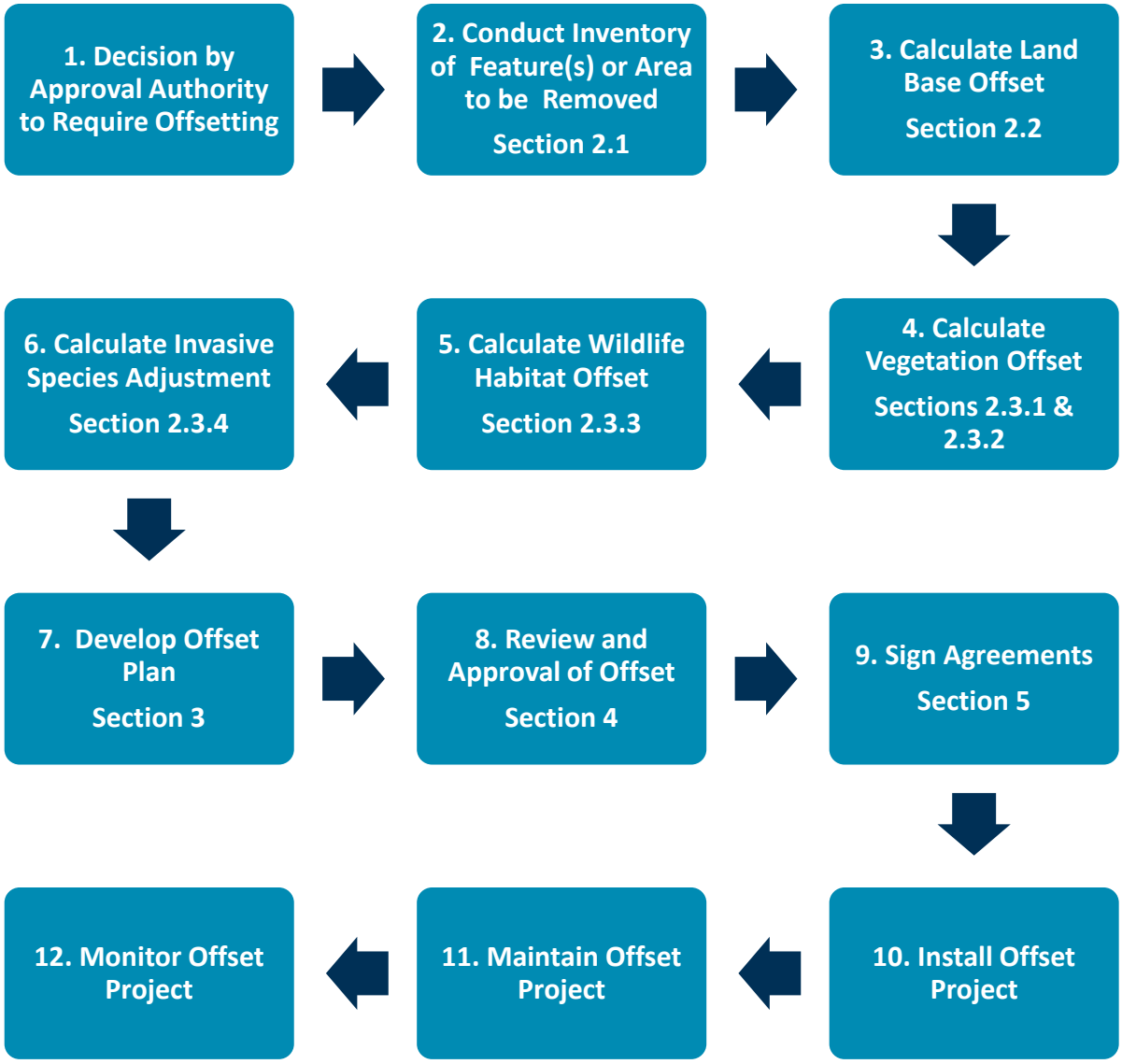


Figure 3: Ecosystem Offsetting Process

Section 2 of the guideline provides direction for the inventory and documentation of the ecological structure, composition and function of the natural feature/area(s) being removed and calculating the amount of land and vegetation that is required to offset that loss.

2.1 Inventory and Assessment Requirements for Ecosystem Offsetting

As ecosystem offsetting strives to achieve a no net loss and preferably an ecological (net) gain, it is essential to have a qualified expert (e.g. ecologist, biologist or forester) conduct a detailed inventory of the natural features and areas to be removed, and their associated functions. The information collected under this section will be used to calculate the amount of offsetting required, guide the design of the offset, and compare the offset to the lost to ensure that there is an ecological (net) gain in ecosystem composition, structure and functions.

In the interest of saving time, the percent cover of the vegetation layers (i.e. canopy trees, sub-canopy trees, tall shrubs, low shrubs, forb and graminoid, floating–leaved aquatic, free-floating aquatic plants, submergent plants, and open water can be estimated based on field observations. Aerial photography can be used to assist with estimations where appropriate, but field surveys are still necessary. These estimations of vegetation cover shall be verified by qualified municipal or conservation authority staff (i.e. ecologist, biologist, or forester).

If cover estimates are disputed, a more quantitative approach, such as the Ontario Ministry of Natural Resources' Vegetation Sampling Protocol (VSP) (Puric-Mladenovic et al., 2010), can be used to resolve the disagreement. The VSP uses a fixed-area method for sampling vegetation types that is practical, easy, and replicable while being scientifically rigorous.

Information required for <u>each</u> vegetation type/community within the feature that is proposed to be removed or impacted:

a. Mapping of the vegetation type's boundaries;
b. Mapping of the proposed area of removal;
c. Classification of community to vegetation type (or Ecosite);
d. Estimation of percent cover (refer to Appendix C of Ecological Land Classification for Southern Ontario (Lee *et al.* 1997) for guidance) and height for each vegetation layer present. Vegetation layers (Table 1) include *canopy trees, sub-canopy trees, tall shrubs, low shrubs, forb, graminoid, floating–leaved aquatic, free-floating aquatic plants, submergent plants, and open water*;
e. List of four most abundant species in each vegetation layer;
f. Complete plant species list with abundance codes for each species in each vegetation layer;

g. Percent cover of each vegetation layer occupied by invasive species, and the percent cover (i.e. None, ≤ 50%, or > 50%) of that vegetation that is high-threat' invasive species
h. Soil classification (texture, moisture, depth of organics);
i. For each treed vegetation type with greater than 35% canopy cover that is going to be removed or impacted, conduct wedge prism sweeps according to the ELC (refer to Appendix D of ELC for guidance), including
    - Basal area of living trees by species;
    - Basal area of dead trees;
j. For each treed vegetation type with less than 35% canopy cover, linear feature or edge, provide a tree inventory plan illustrating the location and diameter of the trees [greater than 5 cm diameter at breast height (dbh)] to be removed;
k. The abundance of downed wood using transects (Appendix G) or plots;
l. Evidence of wildlife habitat structures (cavities trees, dens, nests, hibernacula, roosts, vernal pools, etc.) (Appendix H);
m. Bathymetry/topography for wetlands;
n. Hydrologic characterization for wetlands;
o. Identification of associated watercourses;
p. Identification of hydrologically connected wetlands and watercourses; and
q. An assessment of the natural area's relationship to the natural heritage system. Suggested natural area metrics – size, shape, contribution to interior habitat, proximity or connectedness, matrix quality, patch habitat/species diversity.

Table 1: Definitions and Descriptions of Vegetation Layers

Vegetation Layer	Definition/Description
Canopy Trees	Trees greater than six meters in height whose leaves and branches receive direct sunlight.
Sub-Canopy Trees	Trees greater than six meters in height whose leaves and branches do not receive direct sunlight due to the canopy trees.
Saplings and Tall Shrubs	Trees and shrubs between one and six meters in height
Seedling and Low Shrubs	Trees and shrubs less than one meter in height
Forbs and Graminoids	Forbs are non-woody, broad-leaved plants that are not a graminoid. Graminoids are grass-like, narrow-leaved monocot plants including grasses and sedges
Emergent Plants	Plants that have a photosynthetic surface extending above the normal water level (Lee et al. 1997). Includes cattails, rushes, pickerelweed, bur-reeds, sweet flag, water plantain.
Floating–Leaved Aquatic Plants	Rooted wetland plants with leaves that float on the surface of the water, includes water-lilies, pondweeds, water-shield, etc.
Free-Floating Aquatic Plants	Non-rooted wetland plants that float on the surface of the water, includes duckweeds, watermeals, aquatic liverworts.
Submergent Plants	Wetland plants that normally lie entirely beneath the water, includes coontails, water-milfoils, bladderworts, stonewort.
Open Water	Aquatic communities in permanent water that is generally greater than two meters deep and total vegetation cover is less than 25 per cent (Lee et al. 1997).
Tree	A woody plant usually with a single main stem and capable, under the right conditions, of reaching heights of several meters or more (Lee et al. 1997), examples include Sugar Maple, Eastern White Cedar, ashes, oaks, American Beech, poplars, and birches.
Shrub	A perennial plant often with a multiple woody stem base, examples include Red-osier Dogwood, raspberries, Chokecherry, shrub willows, viburnums, sumacs

Additionally, some information may be extracted from existing comprehensive environmental studies (e.g. EIS, EIR, EIA, etc.); however, additional surveys may be required to gather information specific to the feature or area being removed as determined by the approval authority. Proponents shall consult with the approval authority to determine the scope of the study before study commencement.

2.2 Maintaining the Land Base & Natural Heritage System Form

The overall size of a natural heritage system and its features determines what ecosystem functions and services the system and the features can provide. Larger natural heritage systems are generally more biologically diverse, provide greater levels of ecosystem functions and are better able to withstand the stresses of urbanization and climate change. It is therefore critical to ensure that any losses to the land area of the natural heritage system due to removals be addressed by adding new lands back into the natural heritage system such that the overall physical extent of the natural heritage system is not reduced.

Lands added back into the natural heritage system must be configured in such a way as to improve the overall ecological function of the natural heritage system. Additional direction on land base configuration is provided in Section 3.0.

When replicating the land base for off-site projects, there are two important considerations:

- The offset lands should be located as close as possible to the location of the loss to help ensure the restored ecosystem functions and services remain accessible to the local community. For more guidance see Section 3.1.1. Methods of calculating the land value must consider the cost of securing or acquiring land within the same municipality and sub-watershed as the land removed.
- Secondly, lands secured for offsetting should be located outside of (but connected to) the identified natural heritage system of the municipality so that they can ultimately be added to the system to make up the loss. Securing or purchasing land for offsetting that is already identified as part of the natural heritage system would result in a net loss to the overall area of the natural heritage system.

2.2.1 Land Base Offsets for Development Projects

Approval authorities may require development projects to offset the loss of area of the natural heritage system. Development projects are activities resulting in the creation of a new lot, a change in land use, or the construction of buildings and structures requiring approval under the Planning Act (MMAH, 2014). In addition, development projects may also include activities requiring approvals under other pieces of legislation including, but not limited to, the Conservation Authorities Act

and the Aggregate Resources Act. These projects should, at a minimum, replace the land base removed at a one to one ratio.

Land Base Offsetting

Land removed from the natural heritage system should be offset at a 1:1 ratio.

In other words, one hectare of land removed should be offset by adding one hectare back into the natural heritage system, either on the same site or on another site.

For the purposes of this guideline, development projects do not include activities undertaken by public authorities that create or maintain infrastructure as authorized under an environmental assessment process. For this guideline, there are two approaches to addressing the land base of an offset associated with infrastructure projects. One for public infrastructure projects (2.2.2), and the other for private infrastructure (2.2.3).

2.2.2 Land Base Offsets for Public Infrastructure Projects (Authorized under an Environmental Assessment)

Infrastructure projects are completed by several different public agencies/proponents making a standard approach to land base offsetting difficult. CVC will work with municipal and other public agency partners undertaking infrastructure works to help ensure the land base component of offsetting is appropriately considered. Where municipalities or other agencies have established conservation land acquisition programs, the land base component of offsetting will be addressed comprehensively and not on a project by project basis. Where no conservation land acquisition program is established or the number of projects in the area is limited (e.g. Metrolinx, MTO etc.), land base offsetting should be considered on a project by project basis.

Both investments in infrastructure and the protection of natural heritage systems contribute to the public good. The environmental assessment process for public projects helps to ensure investments in infrastructure minimize impacts to natural features and the functions they provide. However, when impacts cannot be eliminated, offsetting action should be taken to ensure the public benefits provided by the natural heritage system are not diminished.

The requirements for an offsetting project as outlined in the guideline represent the best available practice for the restoration of lost features and for "adding back" to the natural heritage system. In its roles as a public commenting body under the planning and environmental processes, as a regulator, and at times as a landowner,

CVC routinely works with infrastructure providers to seek offsetting to the extent feasible for lost features due to infrastructure projects (new or upgrades) that cannot avoid natural areas, or are already located within them.

The guideline provides guidance to further aid in these review and approval processes by providing a rationale as to why the land base of the natural heritage system is critical to its continued function. The full land base requirements determined by the guideline for a feature lost to infrastructure may not be achievable given that municipalities typically own right-of-way lands sized only to accommodate the infrastructure itself with little surplus land remaining, (see Municipal Infrastructure diagrammatic example in Appendix). In these cases, the land area removed from the natural heritage system from all municipal infrastructure projects can be tracked by CVC and the municipality and compiled together so that cumulative losses to the land base of the natural heritage system can be quantified. Municipalities and CVC can work together to understand how these cumulative losses are impacting the function of the natural heritage system and explore avenues to offset these losses through existing municipal land acquisition and ecological restoration programs or other means.

2.2.3 Land Base for Private Infrastructure Projects

Since private utility companies do not have public conservation land securement programs to offset the losses associated with their activities, this Guideline encourages environmental assessments for private infrastructure projects (e.g. projects carried out by private utility, pipeline and telecommunication companies, etc.) to consider following the same offsetting approach as other types of private development.

Single infrastructure projects that involve the removal of large portions (multiple hectares) of the natural heritage system, or when CVC-owned lands are impacted, may warrant discussions regarding compensating land base on a case-by-case basis.

2.3 Replicating Ecosystem Structure and NHS Function

Ecosystems are complex and dynamic systems. Regardless of the approach to determining the level of offsetting required, attempts to replace lost ecosystem structure and functions will fall short in many instances, at least in the short term. Understanding this limitation, the Guideline establishes an approach that attempts to replicate, to the extent possible and without significant delay or lag time, the same ecosystem structure and associated level of ecosystem functions that are to be lost.

The ability to re-establish generally the same structure in a reasonable time frame is in part dependent on the type of ecosystem being restored. Some functions of

some ecosystem types such as cultural meadows and some marshes can be established relatively quickly since their rate of vegetation growth does not have a significant lag time. This is not to suggest that these ecosystem types are less complex or less important than others, or that restoration of these ecosystems is without risk and uncertainty. It simply recognizes that the vegetation in non-treed ecosystems can be established relatively quickly.

It takes much longer to re-establish treed ecosystems due to their long developmental periods and the limited potential to plant fully grown trees. This Guideline attempts to partially address this issue by prescribing that the loss of a mature forest requires replacement with a larger, young forest.

2.3.1 Offsetting for Trees in Forests, Woodlands and Swamp Communities (with Greater than 35% Tree Cover)

This Guideline uses basal area to establish ecosystem restoration replacement ratios (in hectares) for forests, woodlands, and swamps with greater than 35% tree cover. Basal area is a standard forestry measurement, included in the Ecological Land Classification for Southern Ontario and is a widely used standard practice easily determined using simple equipment (See

Appendix : Calculating Basal Area).

A wedge prism will not be an effective approach in sparsely treed communities (i.e. tree cover less than 35%). This Guideline uses a different approach to assess tree cover in sparsely treed communities (e.g. savannahs, meadows, thickets, some swamps, etc.), go to Section 2.3.2.

For linear infrastructure projects (e.g. roads, pipelines, etc.) where access to the entire vegetation community may not be possible, go to Section 2.3.2.

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 (1.3 m) and expressed as a unit of land area (m^2/ha). In general terms, older and higher functioning treed ecosystems will have a greater basal area. Basal area also loosely equates to and can be used as a surrogate for, biomass of the canopy and sub-canopy trees within a treed ecosystem. Biomass, in turn, correlates to some of the ecosystem functions and services (e.g. carbon sequestration, water management) that a treed ecosystem can provide. Therefore, attempting to re-establish the same basal area in the newly restored treed ecosystem as was lost, helps, in part, to ensure that the same level of some ecosystem functions is maintained.

The objective for treed ecosystems is to re-establish the same level of basal area within 10 years of implementing the offset project. Toronto and Region Conservation Authority has advised that based on the survival and growth rates of their previous restoration projects, it is typical to achieve a basal area of 5 m^2/ha at the 10-year mark. Therefore, as an example, to achieve basal area equivalency at the 10-year mark (5m^2/ha) for an impacted site with an average basal area of 25 m^2/ha, a 5:1 restoration ratio must be used. In other words, 5 hectares of new habitat must be restored for every one hectare removed. For this guideline, the trees to be planted are branched whips at a minimum height of 1.5 – 2.5m. Table 2 (below) is used to determine the offsetting ratios for various basal area categories.

Steps 1 to 5 that follow outline the procedure for calculating replacement ratios.

Table 2: Offset ratios based on the basal area of the impacted site

	Basal area range (m^2/ha)	Average basal area (m^2/ha)	Lag time factor – Basal area of 10-year-old restoration site (m^2/ha)	Offset Ratio
1	0 – 10	5	5	1:1
2	10.1 – 20	15	5	3:1
3	20.1 – 30	25	5	5:1
4	30.1 -50+	40	5	8:1

Procedure for Determining Replacement Ratios with Basal Area

1. Determine the vegetation type(s) for the area being impacted using the Ecological Land Classification for Southern Ontario (ELC) system. If more than one ecosystem type is being impacted, then the vegetation type must be determined for each.
2. Determine the amount (in hectares) of each vegetation type being removed.
3. Determine the basal area for each woodland vegetation type being impacted. (See: Calculating Basal Area). In narrow linear features (less than 30 m wide) or edges of features, a tree inventory plan illustrating the location and diameter of the trees [greater than 5 cm diameter at breast height (dbh)] to be removed is required.
4. Using Table 2, determine the offset ratio for each forest or woodland vegetation type being removed
5. Based on the amount of each vegetation type being removed and the offset ratio for each, determine the total size of the restoration required for each vegetation type.
6. Go to Section 2.3.2 to calculate the offset for the woodland's understory.

In some instances, there may be particular ecosystem functions (e.g. wildlife habitat, topographic, or hydrologic features and functions) provided by the impacted ecosystem that are identified and required through the planning or infrastructure review process to be addressed as part of the restoration implementation. These conditions may influence the ecosystem restoration requirements. Additional information is provided in Section 3 regarding project-specific requirements.

Dead and Dying Trees

For the purposes of the Offsetting Guideline, dead trees are included in the basal area calculations. Dead trees contribute to the function of forested ecosystems in important ways and therefore should be considered in assessing the feature that is being lost. This in turn informs the restoration requirements to replace the lost feature. This is particularly relevant at this time, given that a number of ash trees are dying due to the Emerald Ash Borer.

2.3.2 Offsetting for Woodland Understory Vegetation, and Vegetation in Communities with Less than 35% Tree Cover

The understory of a woodland (forests, cultural woodlands and treed swamps) contains tree saplings, shrubs, seedlings herbaceous vegetation, logs, and fine

woody material that contribute to the ecological and hydrological functions and services provided by our woodlands. The understory represents the future of our woodlands and contributes to the maintenance of biodiversity, soil development, hydrologic functions, and the air quality and climate regulation values associated with woodlands. To achieve a no net loss and preferably an ecological (net) gain, offsetting should account for these components, structures, and functions of a woodland.

Communities with less than 35% tree cover include sparsely treed swamps, shrub swamps, marshes, shrublands (thickets), prairies (including tallgrass savannah and woodlands), meadows, rocklands, bluffs, and beaches. Their functions are defined by the dominance of shrubs, grasses, herbaceous vegetation with some sparse tree cover.

Most of the vegetation associated with communities can be restored without significant issues associated with a time lag (i.e. how long it takes to grow mature trees and the conditions capable of sustaining the flora and fauna associated with mature treed communities). However, a compensation ratio is still used to offset the loss of the larger trees and their services in these communities.

The approach for inventorying trees in communities with less than 35 per cent tree cover is different because, as previously stated, the wedge prism is not an effective method where tree cover is scattered or sparse. For these sparsely treed communities, a tree inventory plan illustrating the location and diameter of the trees greater than 5 cm diameter at breast height (dbh) to be removed is required. A tree inventory plan illustrating the location and diameter of the trees [greater than 5 cm diameter at breast height (dbh)] to be removed should be used in narrow linear features (less than 30 m wide), or edges of features. This plan will provide a count of trees that can be organized into different size classes and placed into Table 3 to calculate the required offset for the loss of those trees. These offsetting ratios were developed based on the i-Tree-Eco analysis model developed by the USDA Forestry Service to help provide relevant, empirical values for some ecosystem services based on tree diameter; these include carbon sequestration and pollution removal.

Table 3: Form for calculating offset for replacing larger trees in sparsely treed vegetation communities based on diameter at breast height (dbh)

DBH Range (cm)	Count	Offsetting Ratio	Offset Required
>5 – 10		1:1	
10.1 – 20		1:3	
20.1 – 30		1:10	
30.1 – 40		1:15	
40.1 – 50		1:20	
50.1 – 60		1:30	
60.1 – 70		1:40	

70.1 +		1:50	
		Total	

Calculating the amount of offsetting required for the woodland understory and non-forest community vegetation relies on the information collected under the Section 2.1 Inventory and Assessment section of this guideline. Section 3.1.1.10 guides the planting of trees to offset for vegetation communities with less than 35% tree canopy cover.

The approach for calculating the amount of vegetation offsetting required for the loss of a forest's understory, or the non-tree component of non-forested communities is based on the following calculation:

Per cent cover of layer at the impact site (e.g. tall shrubs)	X	Area Removed (ha)	X	Recommended Planting Density (#/ha)

Appendix provides area percentage charts to assist in estimating the per cent cover for each vegetation layer.

The recommended planting densities are based on advice from CVC's Ecosystem Restoration Program and through discussions with Foresters from the Ontario Ministry of Natural Resources and Forestry. Table 4 provides a form for calculating the offset requirements for woodland understory and vegetation in non-woodland communities.

Table 4: Form for calculating offset requirements for woodland understory and vegetation in non-woodland communities (except trees > 5cm dbh)

Layer	Cover %	Recommended Planting Density (units per hectare)	Total Area Removed (ha)	Required Offset
	A	B	C	(A x B) x C
Trees (<5cm dbh)		1200		
White Cedar (<5cm dbh)		4350 [a]		
Tall shrubs		2750		
Low shrubs		11000		
Graminoids and Forbs		25 kg		
Emergent		110,000		
Floating–leaved aquatic		110,000		
Free-floating		N/A		
Submergent		110,000		
Open water		N/A		

[a] *Based-on planting density of 1.5 metres on centre.*

2.3.3 Habitat Features and Structures

Natural features and areas provide habitat for our local plants, animals and other organisms and contribute to the health and function of our watershed and ecosystem. These habitats are where they find adequate amounts of food, water, shelter, and space needed to sustain their populations. It is recommended that the impact site be assessed for wildlife habitat features and attempt to replicate these habitat features based on their abundance and distribution at the impact site.

Habitat features of the impact site should have been identified in Section 2.1 Inventory and Assessment, including:

- Cavity trees
- Rock piles
- Basking logs
- Vernal Pools
- Standing water
- Seepage or high water table
- Dead standing trees
- Mast trees (nut-producing)

Appendix H provides a list of references for documents that can assist with the identification of wildlife habitat features and structures.

2.3.4 Considerations for Offset Adjustments for Invasive Species

Invasive species are generally non-native plant, animal or pest species that outcompete native species for resources and dominate space. They may directly kill other species, introduce disease or hybridize with native species. Threats posed by invasive species are now considered one of the most serious threats to global biodiversity, as recognized by the UN Convention on Biological Diversity, the International Union for Conservation of Nature, the Invasive Alien Species Strategy for Canada, and the Ontario Biodiversity Strategy. (CVC, 2018a)

While invasive species pose a significant threat to biodiversity and the health of our environment, they can also provide some important ecological functions and services (e.g. habitat for native species, natural hazard regulation, water cycling, carbon, and nutrient sequestration) particularly in urban areas where there is little remaining natural vegetation.

To recognize the positive functions and the adverse impacts of invasive species, this guideline is adopting a portion of the Habitat-Hectare Approach used in Australia as an offsetting tool (Parkes *et al.* 2003). Offset projects will receive a deduction based on the per cent cover of invasive species at the impact site, and the per cent of that amount that are identified as high threat invasive species. High threat invasive species are those species identified by Donna Havinga and the Ontario Invasive Plants Working Group's Sustaining Biodiversity: A Strategic Plan for

Managing Invasive Plants in Southern Ontario. (2000) as Category 1 or 2 invasive species (Appendix)

To calculate the offset adjustment for invasive species. Based on the data collection record:

1. For each vegetation layer identify the percentage of the area to be removed that is covered by invasive species based on the data collection record (Section 2.1);
2. For each vegetation layer identify the percentage of those invasive species (Step 1) that are high-threat' invasive species (Appendix A);
3. Identify the discount (Table 5) for that vegetation layer based attributes of Step 1 and 2;
4. Subtract the discount from the required offset for the associated strata. An example application is provided in Table 6.

Table 5: Offsetting Discount for Percentage of High Threat Invasive Species by Vegetation Layer

Per cent cover of invasive species of the area to be removed	Per cent of invasive species cover that is 'high-threat' invasive species		
	None	**≤ 50%**	**> 50%**
	Discount on Only Vegetation Offset		
> 50%	-11 %	-13 %	-15 %
25–50%	-7 %	-9 %	-11 %
5–25%	-4 %	-6 %	-7 %
< 5%	0 %	-2 %	-4 %

Modified from Parkes *et al.* 2003

Table 6: Example of Offsetting Adjustment for Percentage of High Threat Invasive Species by Vegetation Layer

Layer	Invasive Species Cover (%)	High Threat Invasive Species (%)	Offset Discount by Strata	Before Discount Offset	Final Offset
Canopy trees	0	None	0	0	0
Sub-canopy	15	≤ 50%	-6 %	641	603
Tall shrubs	50	> 50%	-11 %	4450	3961
Low shrubs	0	None	0	0	0
Graminoids and Forbs	45	> 50%	-11 %	40 kg	36
Emergent	0	None	0	0	0
Floating–leaved aquatic	0	None	0	0	0
Free-floating	0	None	0	0	0
Submergent	0	None	0	0	0
Open water	0	None	0	0	0

CVC has developed other tools to suggest approaches to addressing common issues associated with the calculation and implementation of an offset. These tools can be found in Appendix B: The Offset Tool Box. The application of these tools is considered **optional**.

3 OFFSET DESIGN AND PLANNING

Section 2 guided the documentation of the ecological structure, composition and function of the natural feature/area(s) being removed, and the calculation of the amount of land and vegetation that is required to offset that loss. Offset designers and planners should use that information to design an ecosystem creation or restoration project that replicates the ecological structure, composition and function of the natural feature/area(s) removed by the development project. Figure 4 illustrates the progress through the Ecosystem Offsetting Process thus far.

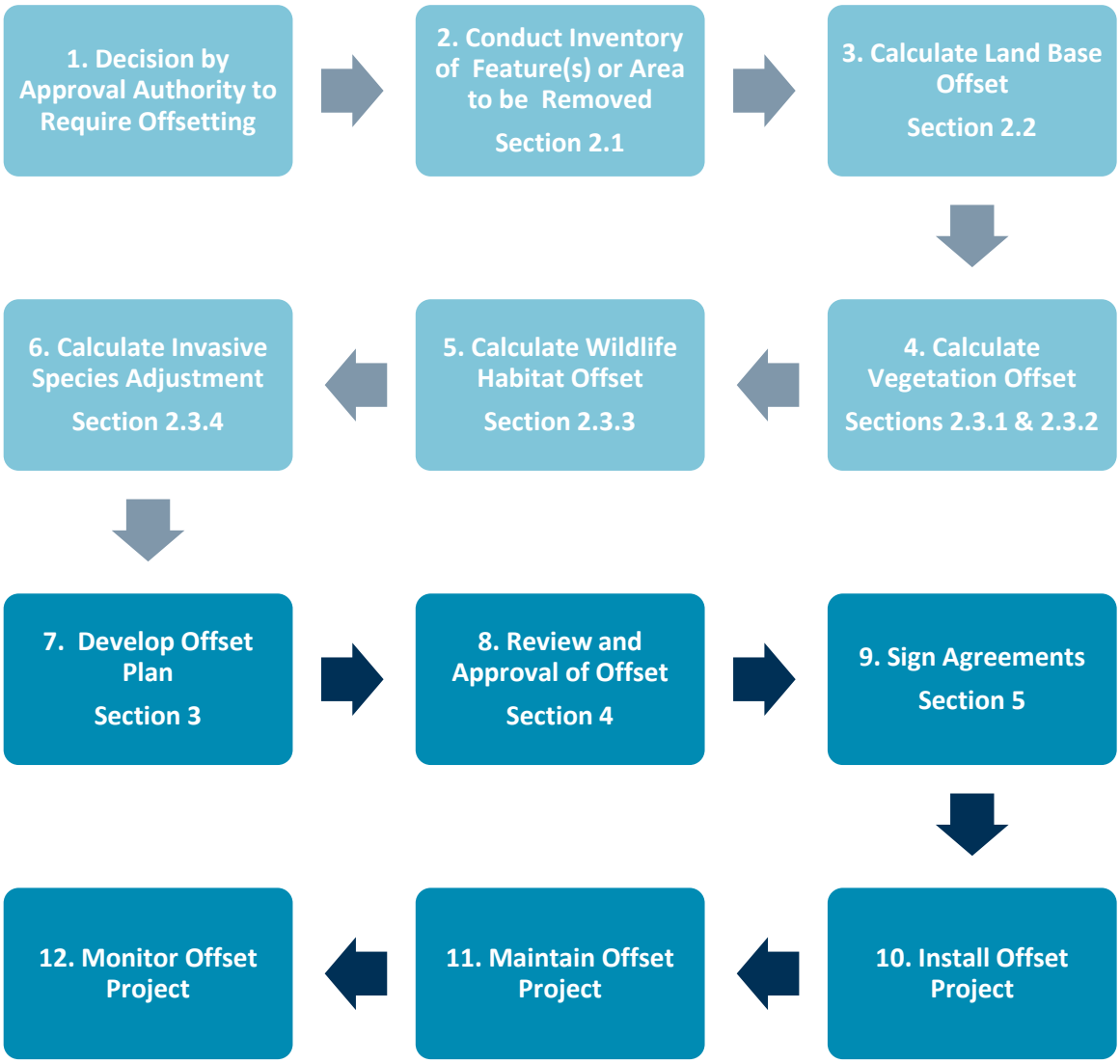


Figure 4: Progress in the Ecosystem Offsetting Process

Section 3 provides suggestions and considerations to help offset designers and planners ensure that the design of an offset adequately replaces the form and function of the lost feature and adheres to the ecosystem offsetting principles.

The guideline provides two approaches to the offset design and implementation process, including:

- a proponent led design and implementation approach, and
- a cash-in-lieu approach for CVC to lead the offset design and implementation.

This cash-in-lieu option helps proponents that may not have the resources to implement offsetting without support.

3.1 Developing an Offsetting Plan

Documentation is essential to successfully designing and implementing an ecological offset project, demonstrating no net loss and an ecological (net) gain, and providing transparency. As such, an offset plan report is required for each offset project. The report shall document the losses to the natural heritage system associated with the development, include calculations of offset requirements, clearly define goals, measurable ecological objectives and targets, and provide an implementation plan including maintenance and monitoring timelines and methods. This report will enable decision-makers to use adaptive environmental management approaches to ensure that we learn from our experiences (i.e. what works and does not work). This approach will provide transparency, improve project outcomes, and produce efficiencies in offset implementation and management.

It is recommended that approval agencies update their Environmental Impact Study (EIS) Guidelines to outline the data required to support the design, implementation and monitoring for implementation of the mitigation hierarchy, in particular, ecosystem offsetting as appropriate.

For each offsetting project, the specific actions proposed to address the required offset must be documented in a report by those implementing the work (or an agent acting on their behalf). The report must document how the offset:

- Adheres to Ecosystem Offsetting Principles (Section 1.8);
- Provides a record and characterization of the features being removed (Section 2.1)
- Replaces the land base (Section 2.2);
- Replaces the lost vegetation communities/type(s) (Section 2.1);
- Adequately compensates for mature trees (Section 2.3.1);
- Replaces understory and shrubs and herbaceous vegetation (Section 2.3.2);

- Replaces the habitat features and functions (2.3.3);
- Provides equal natural heritage system function (2.1.1 and 3.1.1)

In addition, the report must document the following:

- A description of the impacted ecosystem based on the information collected under the guidance of Section 2.1;
- Rationale for the removal of the natural features or area;
- A brief description of the proposed offset location(s) and a rationale for their selection;
- A proposed work plan;
- Detailed design drawings;
- Material costs;
- Equipment and labour costs;
- Construction phasing plan;
- Maintenance and monitoring plan and costs; and
- Any other relevant details as required through agreements between the proponent and the approval authority based on site-specific/file-specific circumstances.

Ultimately, the documentation must show that projects are designed to take advantage of existing site conditions and will provide the agreed to deliverables.

3.1.1 Offset Design and Planning Considerations

Once the appropriate amount of offsetting has been determined and agreed to by the parties involved, the next step is the development and execution of a land securement (if applicable) and ecosystem restoration implementation plan. The execution of the plan will be dependent on the location of the offset and who will complete the works. However, regardless of these, some fundamental considerations apply, including project-specific information, ecosystem restoration principles, and broader CVC or municipal program direction. In addition to the guidelines outlined herein (Section 3.1), CVC has developed several tools to help identify potential restoration sites (e.g. CVC's Restoration Opportunities Database) and guide ecosystem restoration decision making, as referenced in Section 3.1.1.14 of the Guideline.

Offsetting activities should result in a reinvestment into local ecosystem restoration and the lands required for those works and should be guided by strategic watershed and/or natural heritage system management and restoration planning documents and priorities. Offset actions should be directed to new projects (or extensions of existing projects) that require investment and resources.

The following provides considerations to help offset designers and planners improve their design, implementation and outcomes of their ecosystem offsetting project.

3.1.2 Natural Heritage System Function

A natural heritage system (NHS) is a system of connected or to be connected green and natural areas that provide ecological functions over the longer term and to enable the movement of species across the landscape (Ontario Ministry of Natural Resources, 2010). The primary objectives of the natural heritage system are to protect, restore, or enhance the ecological and hydrological health and function of the Credit River watershed.

The natural heritage system assessment and metrics produced under Section 2.1 will help planners and designers understand the relationship of the feature to the system. That assessment should have identified the function of the natural area within the context of the NHS (e.g. core, corridor, steppingstone, buffer) and its metrics (Table 8). Offset designers and planners should use these metrics to ensure that the offset provides equal or greater quality function within the natural heritage system.

Offsetting should strive to provide at least an equivalent quality and quantity in both form and function. The size of the offset should not be compromised for improved function, as the size of the natural heritage system is critical to the function of the system. Ecosystem form and function are both important, and both need to be addressed adequately in the design of the offset.

Table 7: Natural Heritage System Metrics and their use in Ecosystem Offsetting

Metric	Impact of Removal	Suggested Remedies for Consideration
Size	Reduces the size of remaining natural area Or Reduces the amount of natural vegetation cover in the catchment or subwatershed	• Add offset back to the remaining natural area in a different location, • Add to another higher functioning natural area within the same catchment or subwatershed, or • Consider increasing compensation ratio
Shape	Negatively affects the shape of the remaining natural area	• Use the offset to improve the shape of the remaining natural area in a different location, or • Improve the shape of another higher functioning natural area, • Consider increasing compensation ratio
Interior habitat Habitat that is 100 meters from the edge	Reduces the amount of interior habitat	• Use the offset in a different location to restore the interior habitat of the same natural area • Use the offset to increase the interior habitat of another higher functioning natural area, or • Consider increasing compensation ratio
Proximity to other natural areas	Increases the distance between the natural area to other natural areas	• Reduce the distance between these natural areas in a different location • Improve the proximity or connectivity of another higher functioning natural area, or • Consider increasing compensation ratio
Corridor	Negatively affects a corridor or linkage within the provincial, regional or local natural heritage system	• Improve the quality of the same corridor in a different location • Improve the quality of a different but similar corridor

Metric	Impact of Removal	Suggested Remedies for Consideration
		• Improve the quality of a higher priority corridor • Construct an eco-passage, or • Consider increasing compensation ratio
Proximity and relationship to hydrologic features or areas	Negatively affects associated wetland, watercourse, recharge area, discharge area, or floodplain	• Use the offset to restore or enhance the same hydrologic feature or area • Use the offset to restore or enhance a different, but similar hydrologic feature or area in the same catchment or subwatershed, or • Consider increasing compensation ratio
Matrix quality	Negatively affects the matrix quality for the remaining or adjacent natural areas	• Locate the offset within 2 km of the loss, preferably towards the NHS • Improve the proximity or connectivity of the remaining or adjacent natural areas, or • Consider increasing compensation ratio
Habitat and species diversity	Reduces the diversity of the habitats or species of the remaining or adjacent natural areas	• Use the offset in a different location to restore the habitat and/or species diversity of the same natural area, • Use the offset to restore the habitat and/or species diversity of a different higher functioning natural area, or • Consider increasing compensation ratio

3.1.3 Ecosystem Configuration

Ecosystem restoration should be configured in such a way as to improve the size and shape of the natural heritage system, improving both the local ecosystem function and the larger natural heritage system as a whole. Newly restored ecosystems must also be situated to help ensure they are protected from the effects of adjacent land use

3.1.4 Ecosystem Connectivity

When determining the location of restoration areas and land securement, ecosystem connectivity must be considered and maximized to the extent possible; for example, where east-west connectivity could enhance cross-watershed functions.

3.1.5 Location of Offset

Offset projects may be located on-site, off-site, or a combination of both.

On-site	Offset occurs on the same site that the ecosystem impact is taking place;
Off-site	Offset occurs in a different location from where the impact is taking place.

On-site offsetting is preferred as it is in proximity to where the loss occurs; it also removes the complexity of finding new lands in proximity to the loss. Some options to consider allowing on-site offsetting are to adjust alignment (straightening) of rear lot lines, filling in gaps and edges of natural areas, and naturalizing corridors and buffers.

3.1.6 Proximity to Loss

The location of the offset project (both land securement and ecosystem restoration) should be within the same geographic area as the ecosystem that was removed (same neighbourhood, subwatershed, or municipality). This helps to ensure that the restored ecosystem functions and services contribute to the same area. For those circumstances where land acquisition is part of the required offset, the lands to be acquired and the land to be restored do not need to be on the same site. There may be instances where previously identified and secured lands can be restored to address the ecosystem restoration component of the offset and separate lands acquired to address the land base offset component. However, they should both be located within the same geographic area (ideally in the same neighbourhood or subwatershed) as the impacted site. The appropriateness of the location for ecosystem restoration may also be influenced by the requirement to restore a particular ecosystem type or to achieve a specific natural heritage objective.

3.1.7 Land Availability

In highly urbanized watersheds adding lands to the natural heritage system may not always be feasible due to the limited availability of land. In these cases, the municipality, CVC, and the proponent may consider working together to find lands that are perhaps within the natural heritage system but need restoration to compensate for permitted losses. However, this should be the exception to the rule,

given that this scenario would result in a net loss in the amount of land within the natural heritage system. Alternatively, lands can be secured outside of the impacted municipality but within the upper portion of the same watershed, helping to ensure that the downstream municipality will benefit from many of the ecosystem services in the long term.

3.1.8 Land Ownership and Designation

Lands secured for offsetting should be placed in public ownership and designated and zoned in an environmental protection category. They should also be in proximity and preferably contiguous to currently held public lands and be accessible, enabling their effective long-term protection and management.

3.1.9 Ecosystem Type

In most instances, it will be appropriate to restore the same ecosystem type as was lost, e.g., restoring a forest for losing a forest. However, there may be other cases where this is not achievable due to the specific site conditions of the restoration location, or not desirable based on strategic restoration priorities. Site conditions including soil type, drainage, exposure and aspect will dictate which ecosystem types are suitable for a particular location. Additional guidance to help refine the restoration goals and ecosystem type to be restored can be based on the type of restoration that best achieves the natural heritage system strategies and municipal objectives. There may also be site-specific/file-specific circumstances that dictate special technical direction that deviates from a typical “like for like” approach. Nevertheless, in all cases, the type of feature to be restored will be guided by CVC, provincial and municipal natural heritage objectives, restoration programs and strategic ecosystem management priorities.

3.1.10 Project-Specific Requirements

Some offset projects may have specific requirements and deliverables associated with them as part of the offset agreement. These could include restoration of a particular ecosystem type or the need to re-use soil or woody material or perform a plant rescue from the lost ecosystem. In addition, the impacted ecosystem may have been providing a particular function that warrants consideration in the design and implementation of the restoration works. For example, habitat for a particular species or group of species may need to be incorporated into restoration projects to help address the loss of this habitat as a result of the ecosystem removal. These requirements must be adhered to, planned for, and documented through implementation.

3.1.11 Planting trees in communities with less than 35 per cent tree cover

The approach used in Section 2.3.1 (for determining the appropriate offset for larger trees in communities with less than 35 per cent tree cover) uses compensation ratios based on the diameter at breast height of the trees removed. This offset requirement will likely produce more trees than what should be planted at the offsetting site to replicate the feature that was lost (e.g. savannah to replace a savannah). This Guideline recommends planting the approximately the same number of trees (1:1 or 1.5:1) at the offset site as were removed from the impact site to replicate the composition and structure of the lost feature. Over planting the offset site could produce a different community type than what was intended or desired. If there is residual plant material not used at the offset site, then it should be redirected to be incorporated into other natural area restoration projects (see illustrative examples of on-site and off-site offsetting in Appendix) to make up for the functions and services lost to the development.

Frequently, sparsely treed or successional vegetation communities are treated as poor quality woodlands. However, these communities have their unique values and support a unique group of plants, animals and functions. A healthy, functioning natural heritage system should have a diversity of vegetation types and ages. In addition, the successional process helps to build soils and modify site conditions that sustain healthier forests in the long-term. As such, this guideline encourages offset designers to consider replacing what was lost as opposed to converting the offset into forests.

3.1.12 Use of Understory Vegetation

When creating new natural features as part of an offset, the environmental conditions at the offset site are likely going to be hostile (e.g. too much sun, wind, frost, etc.) to the plants typically associated with a forest understory.

As such, this Guideline recommends using the understory vegetation required for an offset to restore older reforestation projects by underplanting plantations, or to help repair damage from invasive species, Emerald Ash Borer, and poor land-use practices or encroachments.

There are other instances and restoration techniques that would allow the understory vegetation to be planted at the same location and time as the trees and shrubs (e.g. planting herbaceous vegetation in sparsely treed swamp).

3.1.13 Ecological (Net) Gain

The principles of offsetting state the offset projects should target an ecological (net) gain. This section offers some suggestions for planners and designers to consider in the design of their project to help achieve an ecological (net) gain.

- Increasing the size of the offset;
- Improving the quality habitat of the offset beyond what is required;
- Improving ecological connectivity or linkages to other natural areas and the natural heritage system;
- Securing other lands beyond those required;
- Connecting the offset to other (different) habitat types to improve habitat and biological diversity;
- Addressing ecosystem stressors outside of those produced by the development;
- Supporting long-term management of the offset beyond what is required under a condition of approval;
- Combining the offset with other restoration projects;
- Implementing measures to protect the function and condition of the offset (e.g. invasive species management, vegetated buffers, hydrologic restoration, fencing, boardwalks).

3.1.14 Ecosystem Restoration Guidelines and Tools

CVC has developed guidelines and tools that can help with the design and implementation of ecosystem offsetting projects, including:

- Healthy Soil Guidelines for Natural Heritage Systems;
- Credit River Watershed Natural Heritage System;
- CVC Fish and Wildlife Crossing Guidelines;
- Plant Selection Guideline – Species List for Planting Plants within the Credit River Watershed;
- Ecological Restoration Strategy and Guidelines [Draft];
- Restoration Cost Calculation Tool [Draft]; and
- Restoration Opportunities Database [Draft].

These draft guidelines and tools will be finalized available shortly.

3.1.15 Restoration Services

CVC has expertise and programs that can help advise, design or implement offset projects, including:

- Reforestation and Naturalization Services;
- Wetland and Stream Management Services;
- Invasive Species Management Services;
- Native Grassland and Habitat Restoration Services;
- Ecological Monitoring Program;
- Land Securement Services; and
- Restoration Performance Monitoring Services.

3.1.16 Offset Implementer

The offset may be installed by:

- The proponent and contractors;
- CVC's Restoration and Management Services;
- Other public agencies (municipalities, provincial or federal); or,
- Non-government organizations (e.g. Ducks Unlimited Canada, Trout Unlimited Canada)

The implementer of the project is responsible for ensuring that the offset project is planned, designed, implemented, monitored and maintained according to approved restoration guidelines and offset requirements stated in the applicable agreements. Roles, responsibilities and timelines should be clearly defined through agreements (see Section 5) between the agency requiring the offset, the proponent, and the implementer.

3.1.17 Considerations for Monitoring and Maintenance

Monitoring outcomes are a critical component of the offsetting process. Regardless of who is implementing the work, it is the responsibility of the implementer to undertake the monitoring and any required remedial actions. The key to achieving the goals of the agreed-upon offsetting plan is ensuring the success of the individual project, which in turn will help guide the improvement of the overall offsetting program over time.

Monitoring should be undertaken at the 1, 3, and 5-year points after construction and or planting is complete, to allow for early detection and correction of any planting or construction failures. Documentation should be uploaded into the CVC Restoration Opportunities Database if implemented by CVC, or provided to the public agency overseeing proponent-led implementation for review.

Monitoring and maintenance of forest offset projects will take longer – the proponent should pay for long term monitoring and maintenance (e.g. thinning if applicable).

Monitoring and maintenance will typically be the responsibility of those undertaking the restoration work. This responsibility will be confirmed and documented as part of the agreements outlined in Section 5. Monitoring reports will be written to document project results. Where projects are not functioning as designed and approved, investigations will be undertaken to understand why. Further, modifications may be required to ensure that the project is successful; the need for these can be stipulated in an agreement and assured through securities held by the public agencies (see Section 5 Agreements). Monitoring and maintenance often

constitutes a learning process that can inform future offsetting decisions and implementation plans.

As a standard best management practice, a 25% planting replacement cost should be built into all project budgets regardless of who is implementing the work. This planting replacement is informed by the experience of the conservation authority and reflects typical restoration replanting rates.

3.1.18 Contingency

The plan shall include a fund to address unforeseen issues that may develop during the implementation of the offset project. Contingency is typically 10 percent of the project's value (excluding the land base costs).

4 OFFSET DESIGN REVIEW AND APPROVAL

CVC Planning and Development Services, with input from the affected municipality(ies) and other relevant agencies, will use the following guidelines to inform and review the design of the proposed offset:

- Ecological Offset Report and Plan;
- Healthy Soil Guidelines for Natural Heritage Systems;
- Credit River Watershed Natural Heritage System;
- CVC Fish and Wildlife Crossing Guidelines;
- Plant Selection Guideline – Species List for Planting Plants within the Credit River Watershed;
- Ecological Restoration Strategy and Guidelines [Draft];
- Restoration Cost Calculation Tool [Draft]; and
- Restoration Opportunities Database [Draft].

As per the usual plan review process, all comments from the CVC technical review team will be conveyed to the proponent by the CVC Planner on the file.

In the instances that the proponent or another public agency will be undertaking the offset project, the approval authority will review the proposed offset project to ensure the intent of the guideline is being adhered to and the quality of the restoration plan is acceptable.

5 AGREEMENTS

Agreements are required after the approval authority has approved the offsetting plan. Agreements will differ from situation to situation, dependent on the offsetting approach applied and on which party will undertake the implementation. Examples of agreements may be within:

- the conditions of draft plan approval for a subdivision,
- a site plan agreement, or
- the commitments of an Environmental Assessment.

Alternatively, there may be a stand-alone agreement for the offset plan signed by all the parties (proponent, municipality and conservation authority). The parties involved in offsetting decisions will ultimately determine the terms and conditions of any subsequent legal agreements. The following are factors to be considered when contemplating agreements:

- Agreements of conditional approval should cite that current costs to restore and current land values (at the time of receipt of the funds) should be used in calculating the offset funds.
- Offsetting funds transferred to a public agency must be applied to the installation of the agreed-upon ecosystem type, including land acquisition (when applicable), helping to ensure the funds are directed to the replacement of lost ecosystem functions and services.
- Funds (when being transferred to a public agency) should be received before the removal of features.
- A timeline for implementation may be determined to ensure the ecosystem is replaced as soon as possible and ideally before the impact occurs.
- If the proponent implements offset actions, a security should be held until the warranty's expiration. Warranty periods will vary but should be consistent with the determined monitoring period. Security amounts and holding periods will also vary depending on perceived risks and the complexity of restoration actions. Phased release of securities may be negotiated depending on the nature of the project to ensure development applicants undertake the required offset work.
- If upon review by the senior leadership of the agency issuing the approval it is found that an agreement is not being followed, the proponent will be provided with written notice to bring the project into compliance by a specified date.
- If the project is not brought into compliance by the specified date, the proponent will be advised in writing and the agency staff may cash the security and use the funds to undertake the necessary work. This ensures

that the appropriate funding is available should the applicant fail to undertake or complete the agreed-upon offset.

In addition to the considerations listed above, there may be circumstances that warrant additional measures to help reduce risk to an acceptable level. The following provides some possible actions:

- Requiring greater financial securities to support possible mitigation measures and contingencies;
- Requiring financial securities to be held for longer periods to ensure the establishment of newly restored ecosystems;
- Increasing the size of the ecosystem required to be restored; and
- Using CVC to undertake ecosystem restoration, land securement, monitoring and any remedial works required.

5.1 Agreements and Public Agencies as Proponents

Securities/letters of credit are generally not applied where the proponent is another public agency such as a municipality. As per current practice, CVC and the public proponent will work together, transparently and consistently, to agree on the best approach to implementing offsetting that meets the principles of the Guideline. Nonetheless, if implementation is being undertaken by a public agency, that agency (municipality, CVC or other) accepts responsibility for the effective implementation and monitoring of the offset works, unless otherwise arranged between agencies. For example, in the case of public-private partnerships, securities may be required.

5.2 Cash-in-Lieu

When an impacted feature cannot be offset on-site and another parcel of land is not readily available off-site, to compensate for the lost land base associated with the impact, the proponent should provide cash-in-lieu that accounts for acquiring land elsewhere to add back to the natural heritage system. The value of purchasing a comparable parcel of land to add to the natural heritage system elsewhere can be determined either through recent comparable sales data (i.e., similarly designated and zoned development parcels with no pre-existing encumbrances, located within 2km of the subject site) by an appraisal or as negotiated where parcels of similar characteristics may already be targeted for acquisition.

Other methods of calculating land costs could be supported, subject to the satisfaction of CVC and/or the appropriate approval authority. In any case, the fair market value of the development site should be determined using generally accepted appraisal principles. Appraisal costs and other fees associated with determining land base replacement costs will be the responsibility of the proponent.

In the instances that CVC or another public agency implements an offset project, private proponents provide funds to CVC or the public agency instead of undertaking the offset project themselves. The amount of the cash-in-lieu is based on the cost to restore the impacted ecosystem's structure (Section 2.3), replace the land base (Section 2.2), and to monitor and maintain the project according to the conditions of the permit and/or agreement.

5.3 Transparency and Accountability

As part of our commitment to transparency and accountability, CVC will establish a financial reserve to manage and track funds associated with offset projects and a database to track the location and status of those projects. Staff will provide a report to the Board of Directors every three years on the application of offsetting in the Credit River watershed.

6 CONCLUSIONS AND RECOMMENDATIONS

This Ecosystem Offsetting Guideline presents a consistent approach for replacing natural features lost to development, site alteration, or infrastructure projects after the decision to offset has been made by the appropriate approval authority.

The Guideline provides an approach to natural heritage system planning and management that provides flexibility while meeting provincial and municipal planning policy requirements. This approach can produce better development and ecological outcomes if all of the guidelines are followed.

The successful implementation of these guidelines will require a collaboration between the proponent and an integrated team of planners, ecologists, restoration specialists and other technical experts depending on the nature of the offset project. These Guidelines should be updated as CVC, municipalities and proponents gain more experience from the design, implementation and monitoring of offset projects. Other tools and products will be produced to improve the efficiency and effectiveness of offsetting projects in the future.

7 GLOSSARY

Conservation Banking	A conservation bank is a parcel of land managed for its conservation values. In exchange for permanently protecting the land, the bank owner is allowed to sell credits to parties who need them to satisfy legal requirements for compensating for the environmental impacts of development projects. (Carroll et al. 2008)
Ecological (Net) Gain	a working principle by which CVC strives to build upon natural features and areas requiring protection under CVC, municipal or provincial policy, and enhances or restores the ecological functions and hydrologic functions of the natural heritage system in both the short term and long term as a result of the approval of an application. Enhancements or restoration may include, but are not limited to, on-site and off-site works that will result in one or more of the following: a) increases in the spatial extent of the natural heritage system; b) increases in biological and habitat diversity; c) enhancement or restoration of ecological functions and hydrological functions; d) enhancement or restoration of wildlife habitat; e) enhancement of natural succession; f) creation of wetlands, water systems or woodlands; g) enhancement or restoration of riparian corridors; h) enhancement or restoration of groundwater features; and i) establishment, enhancement or restoration of linkages between natural features and areas. (Credit Valley Conservation, 2010)
Ecological Land Classification System for Southern Ontario	The Ministry of Natural Resources and Forestry's Southern Ontario system of classification of lands from an ecological perspective; an approach that attempts to identify and classify ecologically similar areas; published in 1998, and as may be updated from time to time.
Ecological Restoration	The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. - Society for Ecological Restoration

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 socio-economic interactions.
Ecosystem goods and services	The benefits to humans and other species, provided by nature.
Ecosystem structure	The biotic (living) and abiotic (non-living) form and composition (e.g. dominant plant species, size of vegetation, soil type and topography) of ecosystems that give each ecosystem its definition and function.
Green infrastructure	Natural vegetation, vegetative technologies, soil in volumes and qualities adequate to sustain vegetation and absorb water, and supportive green technologies that replicate ecosystem functions and that collectively provide society with a multitude of environmental, social and economic benefits.
Headwater Drainage Features	Ill-defined, non-permanently flowing drainage features that may not have defined bed or banks; they are zero-order intermittent and ephemeral channels, swales and rivulets, but do not include rills or furrows. Headwater drainage features that have been assessed through CVC's Evaluation, Classification and Management of Headwater Drainage Features Guideline, as "protection" and "conservation" are subject to CVC's Regulation; those assessed as "mitigation" may be subject to CVC's Regulation.
Invasive plants	Non-native floral species which displace native species, dominate ecosystems and impact ecological integrity and ecosystem services for humans.
Lag Time	In the context of this Guideline, lag time refers to the time required for a newly restored ecosystem to reach a similar level of function as the impacted ecosystem it is attempting to replace.
Land Base Offset	Land that is provided by a development proponent as an offset to replace the land removed from the natural heritage system by a development project. The land can be provided on the same site or a different site as where the development is to occur. Land is replaced at a one to one ratio; in other words, the replacement

	area is equal to the area removed by the development.
Low shrubs	*Rubus sp*. (Raspberry), *Spiraea alba* (Narrow-leaved Meadowsweet), *Clematis virginiana* (Virgins Bower), *Cornus canadensis* (Bunchberry), *Euonymous obovatus* (Running Strawberry Bush), *Menispermum canadense* (Canada Moonseed Vine), *Rhamnus alnifolia* (Alder-leaved Buckthorn), *Ribes americanum* (Wild Black Currant), *Ribes cynosbati* (Prickly Gooseberry), *Ribes triste* (Swamp Red Currant), *Rubus pubescens* (Dwarf Raspberry), *Vitis riparia* (Riverbank Grape/Frost Grape). All other shrubs are considered tall shrubs for this document.
Market Value	The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress. (Appraisal Institute of Canada)
Mitigate	The prevention, modification or alleviation of negative effects on the environment. It also includes any action with the intent to enhance beneficial effects.
Mitigation Hierarchy	Avoid, minimize, mitigate, compensate (offset).
Natural Cover	The land occupied by naturally and culturally occurring native or non-native vegetation that is not characterized as agricultural or urban land uses.
Natural Heritage System	Natural heritage system means "a system made up of natural heritage features and areas, and linkages 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 indigenous species, and ecosystems. These systems can include natural heritage features and areas, federal and provincial parks and conservation reserves, other natural heritage features, lands that have been restored or have the potential to be restored to a natural state, areas that support

	hydrologic functions, and working landscapes that enable ecological functions to continue." (OMMAH, 2014)
No-Net-Loss	A working principle by which CVC strives to balance unavoidable negative impacts on the natural heritage system with replacement of those ecological functions and hydrologic functions on a project-by-project basis so that further reductions to the natural heritage system may be avoided. (Credit Valley Conservation, 2010)
Vegetation Type/ Vegetation Community	An ecosystem as described by its vegetation composition and form. For example, an oak-maple forest. The level of mapping detail for the "Vegetation Type" is defined by the Ecological Land Classification System for Southern Ontario.

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Appendices

Appendix A: Considerations for Offset Adjustments for Invasive Species

Section 2.3.4 provided an approach to recognize both the positive functions and the adverse impacts of invasive species on the ecosystem. This approach provides offset deductions based on the per cent cover of invasive species at the impact site, and the per cent of that amount that are identified as high threat invasive species. High threat invasive species are those species identified by Donna Havinga and the Ontario Invasive Plants Working Group's Sustaining Biodiversity: A Strategic Plan for Managing Invasive Plants in Southern Ontario (2000) as Category 1 or 2 invasive species (below).

High Threat Invasive Species for Adjusting Offset Calculations

Category 1 — Species that exclude all other species and dominate sites indefinitely. They are the top priority for control, but control may be difficult. Plants in this category are a threat to natural areas wherever they occur because they tend to disperse widely (for example, through transport by birds or water).

Scientific Name	Common Name	Effect on Natural Area
*Acer negundo**	Manitoba maple	invades all habitat types
Aegopodium podagraria	Goutweed	dominates forest understorey
Alliaria petiolate	Garlic mustard	dominates forest herb layer
Alnus glutinosa	Black alder	dominates wetlands
Butomus umbellatus	Flowering rush	dominates open marshes
Cirsium arvense	Canada thistle	dominates meadows/prairies and forest edges
Coronilla varia	Crown vetch	dominates meadows
Cynanchum nigrum	Black swallow-wort	dominates meadows and forest edges
Cynanchum rossicum	Pale swallow-wort	dominates meadows and forest edges
Elaeagnus umbellate	Autumn olive	dominates forest edges
Glyceria maxima	Rough manna grass	dominates wet meadows
Hesperis matronalis	Dames rocket	dominates open forest understorey and meadows
Hydrocharis morsus-ranae	European frog-bit	dominates open water habitats
Impatiens glandulifera	Himalayan balsam	dominates forests and wet meadows
Lonicera japonica	Japanese honeysuckle	dominates forest understorey
Lonicera maackii	Amur honeysuckle	invades meadows and forest edges
Lonicera morrow	Morrow's honeysuckle	invades meadows and forest edges

Lonicera tatarica	Tartarian honeysuckle	invades meadows and forest edges
Lonicera xylosteum	Euro. fly honeysuckle	invades meadows and forest edges
Lythrum salicaria	Purple loosestrife	dominates wetlands
Morus alba	White mulberry	hybridizes with rare *M. rubra*
Myriophyllum spicatum	Eurasian watermilfoil	dominates open water habitats
Nymphoides peltatum	Floating heart	dominates open water habitats
*Phragmites australis**	Common reed	dominates wetlands and wet meadows
Potamogeton crispus	Curly pondweed	dominates open water habitats in SW Ontario
Rhamnus cathartica	Common buckthorn	dominates forest understorey/ meadows and prairies
Rhamnus frangula	Glossy buckthorn	dominates wetlands
Rosa multiflora	Multiflora rose	dominates forest edges

** hardy native species that can become invasive given certain conditions*

Category 2 — Species that are highly invasive but tend to dominate only certain niches or do not spread rapidly from major concentrations. Many spreads by vegetative means or seeds that drop close to the parent plant. Most persist in dense populations for long periods. Control where necessary and limit their spread into other areas.

Scientific Name	Common Name	Effect on Natural Area
Acer platanoides	Norway maple	dominates forest canopy
Acer pseudoplatanus	Sycamore maple	dominates forest canopy
Ailanthus altissima	Tree of Heaven	dominates early successional forest
Betula pendula	European birch	dominates open wetlands
Celastrus orbiculatus	Oriental bittersweet	now more common than native C. scandens
Galium mollugo	White bedstraw	invades meadows
Lotus corniculatus	Bird-foot trefoil	dominates meadows and prairies
Lysimachia nummularia	Moneywort	dominates wet forest understorey
Melilotus alba	White sweet clover	dominates meadows and prairies
Melilotus officinalis	Yellow sweet clover	dominates meadows and prairies
Pinus sylvestris	Scots pine	invades meadows
Poa pratensis	Kentucky bluegrass	dominates prairies
Polygonum cuspidatum	Japanese knotweed	dominates wet meadows and moist forests
Populus alba	White poplar	invades meadows

Robinia pseudo-acacia	Black locust	invades meadows
Scilla siberica	Scilla	dominates forest understorey
Syringa vulgaris	Lilac	dominates shallow limestone areas
Ulmus pumila	Siberian elm	invades prairies
Vicia cracca	Cow vetch	dominates meadows and prairies
Vinca minor	Periwinkle	dominates forest understorey

Havinga, D. and the Ontario Invasive Plants Working Group. 2000. Sustaining Biodiversity: A Strategic Plan for Managing Invasive Plants in Southern Ontario. Society for Ecological Restoration – Ontario Chapter. http://chapter.ser.org/ontario/files/2012/08/Sustaining-Biodiversity.pdf Accessed 12 October 2018.

Appendix B: Offsetting Tool Box

The following tools are not a formal part of this Ecosystem Offsetting Guideline. These tools have been developed to offer suggested approaches to address soil conditions, ecological net gain, and ecological services issues that may relate to an offset project. The application of these tools is optional and can be adjusted to meet the needs of an offset project.

1. Soil and Microtopography Recommendation

Offsetting projects are most likely to be implemented on lands previously used for other land-use practices that can produce problems with soil compaction, loss of organic matter, loss of microtopography, and alteration of site hydrology and soil moisture. These impacts on the soil can significantly affect the eventual species richness, diversity and evenness of the restored site.

As a result, this guideline recommends that decision-makers consider incorporating topsoil, leaf litter, and coarse woody debris from the impact site to the offset site to help to address limiting factors associated with the soils. Adding this organic material will also inoculate the site with mycorrhiza fungi, mould, bacteria and invertebrates that are critical to supporting nutrient cycling and soil development and maintenance processes. This approach will also create habitat structure and microtopography to assist in the restoration and maintenance of biodiversity and hydrologic characteristics associated with restoring the ecosystem.

Other practices to help improve soil health can and should be considered when reviewing offsetting plans or determining the required costs.

2. Suggested approach to achieving an Ecological (Net) Gain

The objective of a net gain is that the development leaves the natural environment in a better condition than before the development started (Figure A-1). A net gain should be pursued to address adverse residual and cumulative impacts, inherent risks and uncertainties, and our incomplete understanding of ecosystem functions and services.

The activities to achieve a net gain must produce a measurable and quantifiable ecological net gain in terms of their improvement to the ecological composition, structure and function of the natural heritage system.

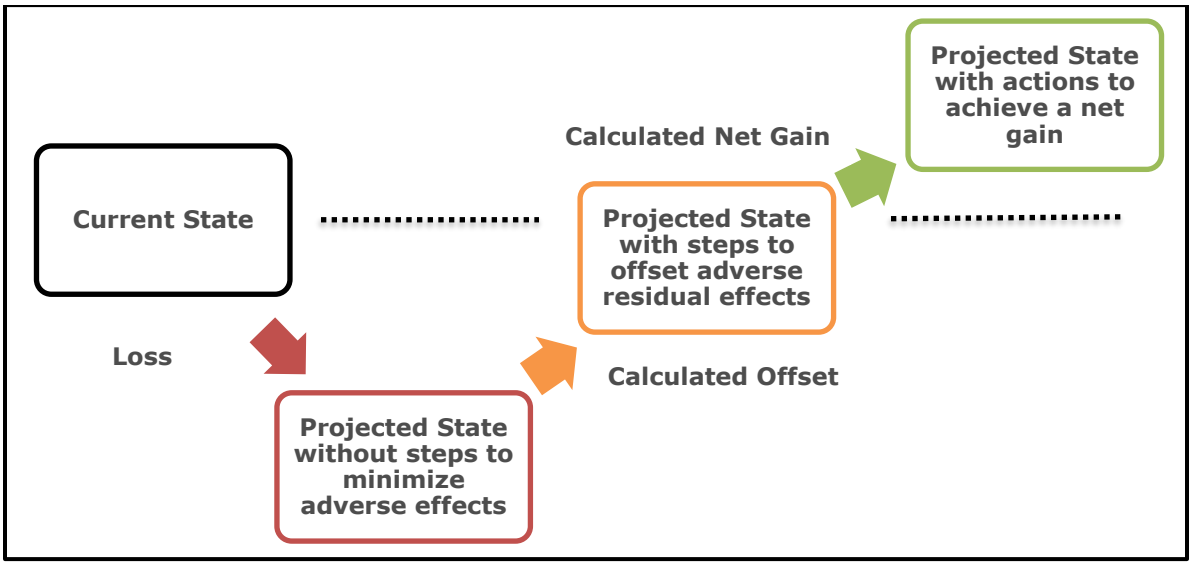
This tool recommends an approach that calculates the required vegetation, labour and materials (i.e. soil, wood chips, stakes, tree guards, etc.) offset for the loss of produced by the development and simply adds 10 percent to the total offset. Ten

percent was selected simply because it is large enough to produce a measurable effect, and not too large as to be unreasonable.

There is no additional offsetting required for the land-based offset (i.e. land base is still 1:1).

Surplus offset vegetation and materials that cannot be applied to the development site will be used in other restoration projects in the municipality or watershed. CVC or municipal restoration or land management programs may be able to assist in the implementation of these surplus offsets.

Figure A-1. Net Ecological Gain Concept



Other approaches that can demonstrate a measurable and quantifiable long-term ecological net gain are appropriate if approved by the agency requiring the offset as a condition of their plan approval or permit.

3. Off-site Offsets and the Loss of Ecological Services

This tool is an optional approach intended to address losses that cannot be offset near the site where the loss occurred, and where it has been determined by the permitting agency that the proposed offsetting plan produces unacceptable residual impacts on the local community or subwatershed.

In most cases, on-site offsetting is the preferred option as it is in proximity to where the loss occurs; it also removes the complexity of finding new lands in proximity to the loss. On-site offsetting should be explored as a priority option before contemplating off-site options. Ideally, the implementation guidance in

Section 3 should be adhered to when determining the appropriateness of on-site offset.

If on-site restoration is not possible, offsetting should be pursued within the same neighbourhood and subwatershed. As last resort, offsets shall occur within the same municipality and watershed (i.e. Credit River watershed). When the offset is located off-site, the municipality may require an Ecological Services Surcharge to mitigate the social impact of the loss on the community.

The Ecological Services Surcharge is calculated based on a percentage of the vegetation component of the offset (Table A-). This surcharge (or its monetary equivalent) will remain with the impacted community and should be used to mitigate the loss of ecological services and quality of life impacts on the local community. Some ideas for applying this surcharge include planting natural vegetation in parks, community centres or near schools, street tree replacement, invasive species management, low impact development projects and or repairing damage to other natural features and areas in the community.

Land base replacement value is not used in calculating the Ecological Service Surcharge.

Table A-1. Ecological Services Surcharge.

Offset Location relative to Loss Location	Ecological Service Surcharge Additional Percent of Required Vegetation Offset
Off-Site - Same Neighbourhood[1] and Catchment[2]	10%
Off-Site - Different Neighbourhood[1] and Catchment[2]	20%
Off-Site - Different Municipality or Subwatershed[3]	50%

[1] *Neighbourhood boundaries determined by the impacted municipality*
[2] *Catchment determined by the Conservation Authority*
[3] *Subwatershed determined by the Conservation Authority*

The values of Ecological Services Surcharge in Table A- are suggested to encourage proponents to address the losses on their properties or locally to avoid or minimize impacts to the community being impacted by the loss. These values can be negotiated between the proponent and the approval agency requiring the offset.

Appendix C: Calculating Basal Area

General guidance on how to perform the basal area calculation can be sought from the Ecological Land Classification for Southern Ontario Field Guide or the Ontario Tree Marking Guide. The following recommendations are provided to standardize the collection and submission of basal area calculations related to CVC's Ecosystem Offsetting.

Please consult with CVC staff before deviating from the ideal data collection recommendations.

- Basal area should be collected from the contiguous ecosystem type (Ecological Land Classification polygon) from which the unavoidable loss or impact to natural feature has been identified.
- Use a BAF 2 metric prism.
- Use fixed area plots in circumstances where the prism provides less accuracy (such as in young plantations or dense hardwood stands where it is not possible to distinguish individual stems).
    - In these circumstances circular plots are recommended; for a 200 m^2 plot the plot radius is 7.99 m.
- A minimum of 3 plots (either prism sweeps or fixed area plots) should be taken within the ecosystem type impacted, with a minimum sample size of 10% coverage.
- Ideally, plots are to be located 40 meters from an edge of the polygon to avoid edge bias. At minimum plots should be located so that they do not solely include the edge of the ecosystem type.
- Ideally, there should be a minimum of 80 meters between sweeps/plots.
- Where appropriate a grid pattern should be used and marked in the office before field data collection.
- The centre of each sweep/plot should be marked on the ground and recorded with GPS, for staff verification, if necessary. This information should be mapped and provided with the data collection sheets to CVC staff.
- Basal area to be recorded by tree species. All dead trees are to be included in the basal area calculation.
- Diameter measurements are to be recorded for all borderline trees. A plot radius table can be used to determine whether the tree is in a plot. A Plot Radius Factor Table can be found in Appendix D of the Ontario Tree Marking Guide.

References:

Lee, H.T., W.D. Bakawsky, J.Reily, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and Its Application. Ontario Ministry of Natural Resources, Southcentral science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

OMNR. 2004. Ontario Tree Marking Guide, Version 1.1. Ont. Min. Nat. Resour. Queen's Printer for Ontario. Toronto. p. 252

Basal Area Collection Form

ECOSYSTEM TYPE CHARACTERISTICS	SITE:
	Ecosystem Type:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
DEAD							
TOTAL							100
BASAL AREA (BA)							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM

Adapted from the Ecological Land Classification for Southern Ontario (Lee et al, 1998)

Appendix D: Individual Tree Replacement Table

When the basal area approach is not suitable for determining offsetting, as may be the case with individual trees where no municipal tree by-laws apply, tree replacement ratios can be a helpful tool. The following provides information on tree replacement ratios as well as typical costing when planting individual trees.

The data collected as part of municipal Urban Forest Studies conducted by TRCA and the i-Tree-Eco analysis model developed by the U.S.D.A. Forestry Service help to provide CVC-relevant, empirical values for some ecosystem services based on tree diameter; these include carbon sequestration and pollution removal. The i-Tree-Eco data, the basal area information used for natural feature offset as well as current municipal tree by-law requirements were all used to inform the suggested tree replacement ratios outlined in Table D-1 below. In general, older or more significant trees are replaced at higher ratios than smaller ones.

Table D-1: Replication Tree (Planting) Ratio by Diameter at Breast Height (DBH)

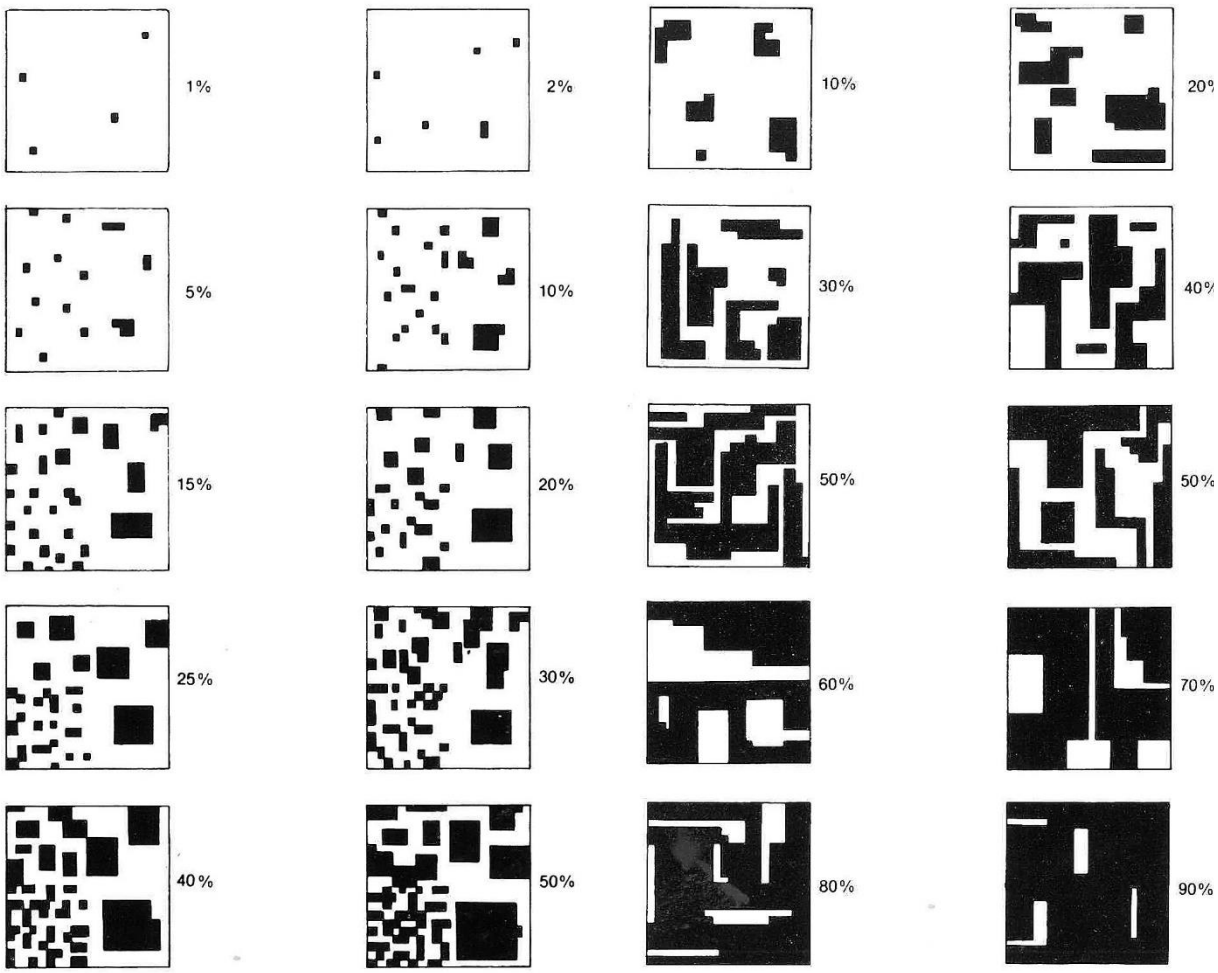
	DBH Range (cm)	Replication Ratio
1	0 – 10	1:1
2	10.1 – 20	1:3
3	20.1 – 30	1:10
4	30.1 – 40	1:15
5	40.1 – 50	1:20
6	50.1 – 60	1:30
7	60.1 – 70	1:40
8	70.1 +	1:50

Improved efficiency would be achieved if a large number of trees would be implemented under one contract. For this Guideline, the following assumptions were made:

1. Replacement of individual trees will have a replacement requirement of minimum 60 mm wire basket calliper tree;
2. Costing will include maintenance and monitoring with a minimum 2-year warranty; and
3. Costing is based on typical industry standards and planting within parkland settings.

Costs associated with these plantings are subject to market changes for fuel, materials, etc., and are therefore not listed. For the most current costs, please contact CVC staff.

Appendix E: Area Percentage Charts

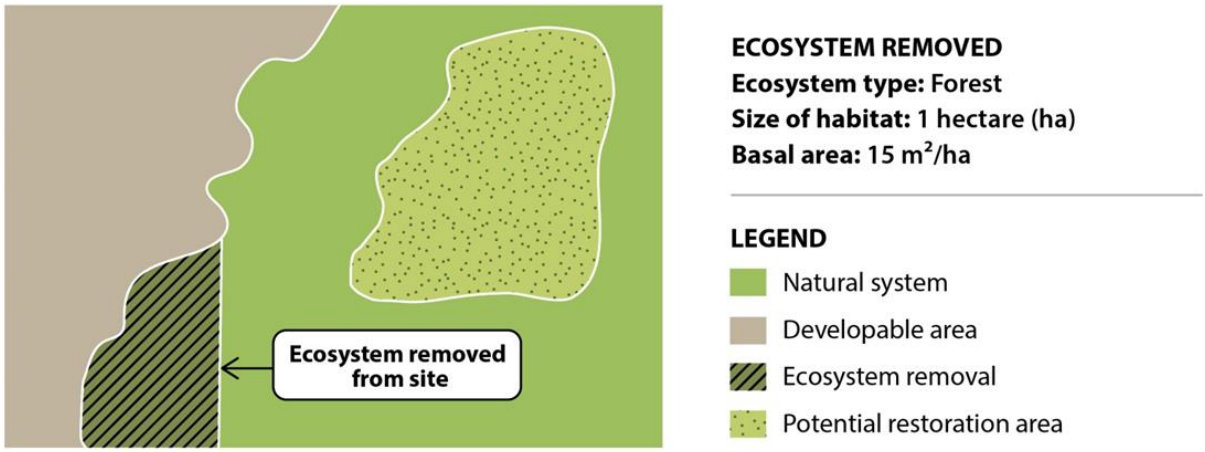


Adopted from Denholm, K. A., L. W. Schut, and D. E. Irvine. 1993. Field manual for describing soils in Ontario, 4th ed. Ontario Centre for Soil Resource Evaluation. Guelph: Land Resource Science, University of Guelph.

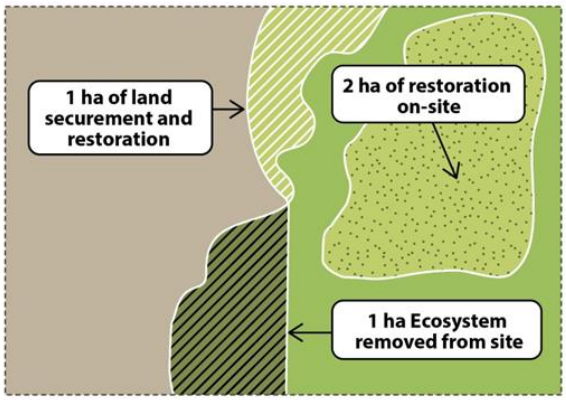
Appendix F: Offsetting Examples

Simple examples are provided in this appendix that helps to illustrate the application of the offsetting approaches described within the Guideline. The examples are not meant to exclude other options of offsetting but to demonstrate some of the more common scenarios.

DESCRIPTION OF THE IMPACTED SITE AND ECOSYSTEM PROPOSED TO BE REMOVED



OPTION 1 - ON-SITE COMPENSATION



ECOSYSTEM STRUCTURE

Basal area of 15 m^2/ha equates to a replacement ratio of 1:3. Total size of ecosystem restoration required = 1 ha x 3 = 3 ha

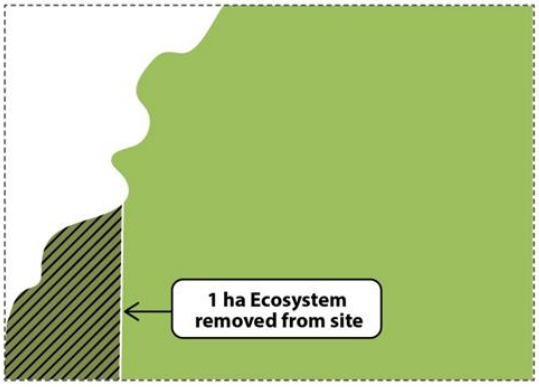
One hectare of restoration can occur on site within the area required to compensate for the lost land base. The remaining two hectares of restoration can occur within the potential restoration area on site.

LAND BASE

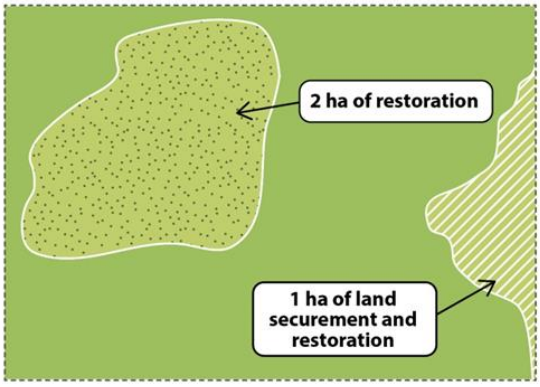
Ratio = 1:1 = one ha removed from the natural system = one hectare added back on the same site *(as illustrated in light green hatching)*

OPTION 2 - OFF-SITE COMPENSATION WITH AGENCY-LED IMPLEMENTATION

DEVELOPMENT SITE



OFF-SITE LOCATION



ECOSYSTEM STRUCTURE

Basal area of 15 m^2/ha equates to a replacement ratio of 1:3. Total size of ecosystem restoration required = 1 ha x 3 = 3 ha. If cash-in-lieu option is being used, funds transferred to implementation agency depends on the cost to restore 3 ha of habitat. Cost to restore can be obtained on request.

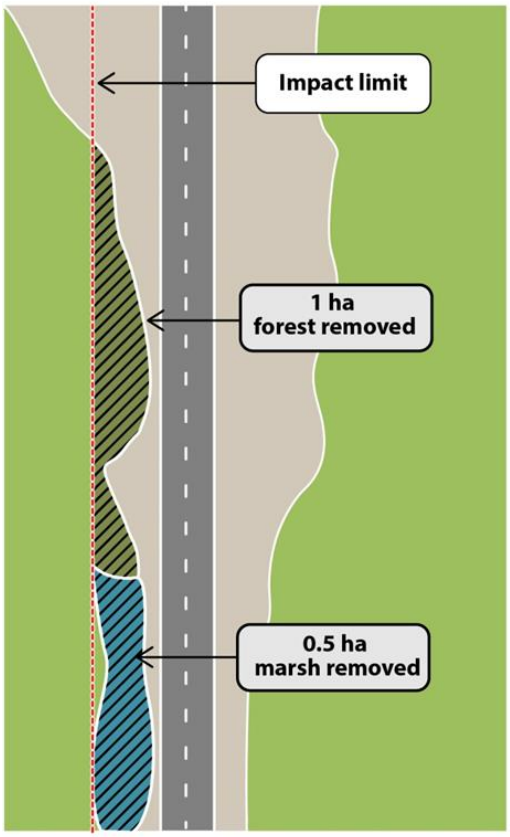
LAND BASE

Ratio = 1:1 = one ha removed from the natural system = one hectare added back off-site. If cash-in-lieu option is being used, land value of one ha determined using guidance from Section 2.2.

TOTAL COST UNDER CASH-IN-LIEU

The total funds to be transferred is the sum of the cost to restore three hectares of habitat and land value for one hectare of land.

MUNICIPAL INFRASTRUCTURE EXAMPLE



ECOSYSTEM REMOVED

Ecosystem type: Forest
Size of habitat: 1 hectare (ha)
Basal area: 15 m^2/hectare

Ecosystem type: Marsh
Size of habitat: 0.5 ha

ECOSYSTEM STRUCTURE

Forest
Assuming a forest basal area of 15 m2/ha, a 3ha:1ha replacement ratio is required. One ha of forest removed requires restoration of three ha.

Marsh
Marsh habitat is restored at a 1ha:1ha ratio. Therefore, 0.5 ha of marsh habitat must be restored to address the removal.

Restoration can occur on site to the extent possible with the remaining restoration being implemented elsewhere in proximity to the impact

LAND BASE

Land base compensation does not need to be addressed on an individual project basis. TRCA and the Municipality can track the land area removed from the natural system from all infrastructure projects and work together to explore avenues to off-set these losses through existing municipal land acquisition and ecological restoration programs or other means.

Appendix G: Method for Calculating the Volume of Downed Wood in Vegetation Communities

The purpose of this document is to provide a standardized approach to collecting Downed Woody Debris (DWD) data to support Ecosystem Offsetting.

Ecosystem offsetting is an approach to offset the adverse impacts of development on the natural heritage system through the creation or restoration of natural features. Offsetting should achieve a net gain in ecosystem function - or at least no net loss where a net gain is not feasible. As ecosystem offsetting strives to achieve an ecological (net) gain or no net loss, it is essential to have a detailed inventory of the natural area to be removed, including its features and associated functions.

Downed Woody Debris provides important ecosystem functions including water retention, nutrient cycling, soil development, carbon sequestration, erosion protection, nurse logs for young trees and important wildlife habitat for a wide range of flora and fauna (Bellhouse and Naylor 1996). Offsetting should account for the functions provided by DWD. For this method downed woody debris includes branches, portions of trees, and entire trees with a diameter greater than 7.5 centimetres (Bellhouse and Naylor 1996).

The protocols within this methodology are based on those established by Credit Valley Conservation's Integrated Watershed Monitoring Program (2018), the Ecological Monitoring and Assessment Network (Robert-Pichette and Gillespie, 1999; Sajan, 2000), those adapted from the USGS (Woodward et. al, 2009).

Equipment

Geographic Positioning System (GPS)
Compass
50-meter measuring tape
Tree callipers or diameter tape
Pigtails with flagging tape

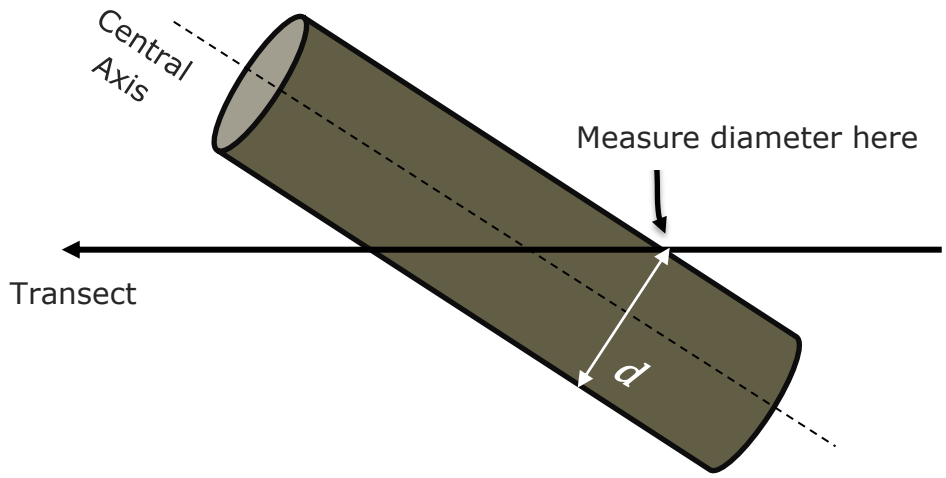
Method

This method should be applied separately to each vegetation community that is being proposed for removal and that is subject to offsetting requirements.

1. Select a representative point in the vegetation community and record the location using a GPS.
2. At that representative point, temporarily anchor the 50 m tape measure using a pigtail.
3. The surveyor runs the entire tape out in the direction of North, ensuring that the tape remains as straight as possible.

4. With the tape left laid out over the entire Downed Woody Debris transect, the surveyor begins walking along the length of the tape until the first piece of applicable downed wood is encountered. Table G-1 reviews the characteristics used to determine if a piece of downed wood is included in surveys.
5. Measure and record the diameter of the piece at the tape interaction point using callipers.

Figure G-1. Measuring the diameter of DWD along a transect.



6. If the transect crosses the end of a piece, tally only if the central axis of the log is crossed.
7. If the transect passes exactly through the end of a piece's central axis, tally every second such piece.
8. Continue along the length of the tape and repeat steps 5-7 for each additional piece encountered along the transect until the surveyor reaches the end of the transect at the 50-meter mark.
9. Repeat steps 2 through 8 along a transect that runs East from the established representative point. This method requires multiple transects to work per community being removed.

Table G-1: Characteristics used to determine if a piece of downed wood is included in surveys (Woodward et. al, 2009).

Characteristic or Situation	Include	Do Not Include
Diameter	7.5 cm or greater	< 7.5 cm
Living material	No	Yes
Roots	No	Yes
Detached bark	No	Yes
Dead stump	Fully uprooted	Fully or partially rooted
Leaning uprooted dead stem	Lean > 45 degrees from vertical	Lean ≤ 45 degrees from vertical
Supported on ground but elevated at tape intersection	The elevation height still allows for other downed wood measurements to be made accurately and safely	The elevation height does not allow for other downed wood measurements to be made accurately and safely
Submerged	Piece is not rooted and downed wood measurements can be made accurately and safely	Cannot determine if piece is rooted and/or downed wood measurements cannot be made accurately and safely

If a single piece of downed wood intersects a transect at more than one distance, treat each applicable stem or branch that crosses the tape as a separate piece of downed wood, regardless of whether or not an attached portion crosses the tape at another distance.

Calculating Volume

The volume (m^3) per hectare of DWD is based on the methods of Van Wagner (1968).

$$V = \frac{\pi^2 \, \Sigma d^2}{8L}$$

V is the volume of wood m^3/ha

d is piece diameter in centimetres

L is the length of the transect in meters

The results of this assessment provide a measurement of the volume of downed woody debris within a vegetation community. This volume measurement can be used to replicate the DWD functions for an offset project. Designers should incorporate an equal or greater amount of DWD into their offset design.

References:

Bellhouse, T. and B. Naylor. 1996. The Ecological Function of Down Woody Debris in the Forests of Central Ontario. Version 2.0 Ont. Min. Nat. Res., CRST Tech. Rpt. No 43, revised. 29pp.

Credit Valley Conservation. 2018. IWMP Reference Document: Volume 2 Data Standards and Information Management: Forest Downed Woody Debris Data Collection. Mississauga, Ontario.

Robert-Pichette, P., and L. Gillespie. 1999. Terrestrial vegetation biodiversity monitoring protocols. EMAN Occasional Paper Series, Report No. 9. Ecological Monitoring Coordinating Office, Burlington, Ontario. http://www.eman-rese.ca/eman/ecotools/protocols/terrestrial/vegetation/toc_section_3.html

Sajan, R. 2000. Community Based Tree Health Monitoring, Draft unpublished manuscript. Canadian Forest Service, Sault Ste Marie, Ontario.

Van Wagner, C.E. 1968. The Line Intersect Method in Forest Fuel Sampling. Forest Science. Vol. 14, No. 1, 1968.

Woodward, Andrea, K.M. Hutten, J.R. Boetsch, S.A. Acker, R.M. Rochefort, M.M. Bivin, and L.L. Kurth. 2009. Forest vegetation monitoring protocol for national parks in the North Coast and Cascades Network: U.S. Geological Survey Techniques and Methods 2-A8, 228 p.

Appendix H: Assessing Wildlife Habitat Features and Structures

Section 2.1 of the guideline requires the inventory and documentation of the ecological structure, composition and function of the natural feature/area being removed. Wildlife habitat features and structures are included in that requirement. Inventories of the natural features and areas being removed should document the types of wildlife habitat features and structures present and provide a characterization of each type of feature/structure. The characterization should note the feature/structure type, size, abundance, percent cover, and distribution pattern (e.g. localized or widespread). This information will be used to help design the offset project.

The following documents provide methods on identifying, inventorying and monitoring different types of wildlife habitat features and structures. These documents also offer information to be considered in the design of projects to offset the removal of wildlife habitat features and functions. In addition, these documents provide additional lists of references that may be applicable and useful.

Bird Studies Canada. 2009. Marsh Monitoring Program Participant's Handbook for Surveying Amphibians. 2009 Edition. 13 pp.

Commission for Environmental Cooperation (CEC). 2009. Monarch butterfly monitoring in North America: Overview of initiatives and protocols. Available online: http://www.mlmp.org/Resources/pdf/Monarch-Monitoring_en.pdf Accessed 25 February 2020

Environment Canada. 2013. How Much Habitat is Enough? Third Edition. Environment Canada, Toronto, Ontario.

Konze, Karl and M. McLaren. 1997. Wildlife Monitoring Programs and Inventory Techniques for Ontario. Ontario Ministry of Natural Resources. Northeast Science and Technology. Technical Manual TM-009. 139 pp.

North-South Environmental Inc., Dougan & Associates, and Sorensen Gravely Lowes. 2009. Peel-Caledon significant woodlands and significant wildlife habitat study. Report prepared for the Region of Peel and the Town of Caledon, Ontario, xi + 187 pp + app. Available online at: http://www.peelregion.ca/planning/officialplan/pdfs/Peel-CaledonSW-SWH-Study-Consultation-Summary.pdf Accessed 25 February 2020.

Ontario Breeding Bird Atlas (OBBA). 2001. Guide for Participants. Atlas Management Board, Federation of Ontario Naturalists, Federation of Ontario Naturalists, Don Mills. Available online:

https://www.birdsontario.org/atlas/download/obba_guide_en.pdf Accessed 25 February 2020

Ontario Ministry of Natural Resources. 2000. Significant Wildlife Habitat Technical Guide. 151p

Ontario Ministry of Natural Resources. 2010. Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales. Toronto: Queen's Printer for Ontario. 211 pp.

Ontario Ministry of Natural Resources. 2011. Birds and Bird Habitats: Guidelines for Wind Power Projects - First Edition. Toronto: Queen's Printer for Ontario. 32 pp.

Maine Association of Wetland Scientists Vernal Pool Technical Committee. 2014. Vernal Pool Survey Protocol.

Ministry of Natural Resources. 2011. Bats and bat habitats: guidelines for wind power projects - Second Edition. Toronto: Queen's Printer for Ontario. 24 pp. Available online: https://tethys.pnnl.gov/sites/default/files/publications/Ontario_Ministry_of_Natural_Resources_2011.pdf Accessed 25 February 2020

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Ontario Ministry of Natural Resources and Forestry. 2015. Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E. Regional Operations Division, Southern Region Resources Section. Peterborough, Ontario, Canada

Ontario Ministry of Natural Resources and Forestry. 2015. Significant Wildlife Habitat Criteria Schedules for Ecoregion 7E. Regional Operations Division, Southern Region Resources Section. Peterborough, Ontario, Canada

Ontario Ministry of Natural Resources and Forestry. 2015. Significant Wildlife Habitat References. Regional Operations Division, Southern Region Resources Section. Peterborough, Ontario, Canada.