A Wetland Conservation Strategy for London:

Guidelines for Best Practices

Recommendations for the City of London and
Our Development Partners

Prepared for the City of London by the
Ecological and Environmental Planning Advisory Committee (EEPAC)

1 Introduction

Wetlands are among the most ecologically diverse and productive ecosystems in the world, rich in biodiversity, and providing habitat for many species. While wetlands cover only 1.5 percent of the Earth's surface, they account for 40 percent of the world's ecosystem services, such as water purification, sediment trapping, nutrient cycling, temperature regulation, and reducing flood and erosion risks. Although wetlands are among the most important ecosystems on the planet, they are also one of the most threatened due to human activities—urbanization, economic development, and climate change (Pattison-Williams et al., 2017). Wetland loss and degradation around the world has occurred at an alarming rate; over 64 percent of the world's wetlands have disappeared in a little over a century (Pattison-Williams et al., 2017).

Russia and Canada are home to the largest wetland areas. Canada's wetlands are diverse, consisting of marshes, bogs, fens, swamps and open water. However, approximately twenty million hectares of its wetlands have been drained for agricultural purposes since European settlement, totalling approximately a 70 percent loss from historical highs (Pattison-Williams et al., 2017). Currently, wetlands in Ontario cover 350,000 square kilometres, comprising 25 percent of all the wetlands in Canada and six percent of the world's wetlands (A Wetland Conservation Strategy, p.2). These seemingly large numbers disguise the fact much of Ontario's wetlands have been lost, and the losses have been severe in the most densely populated areas—precisely the areas that most require robust wetland policy and protection. In the 19th century, 25 percent of southern Ontario's terrestrial area (two million hectares) consisted of wetlands. By 2002, 72 percent of the wetlands in southern Ontario (1.4 million hectares) had been lost primarily due to agriculture and expanding urban and suburban development (Ducks Unlimited, p. 1). From 1982 until 2002, southern Ontario lost another 3.5 percent of its pre-settlement wetlands, equalling 70,854 hectares, at an average of 35 km2 per year, an area the size of St. Thomas (Ducks Unlimited, 2010, p.1).

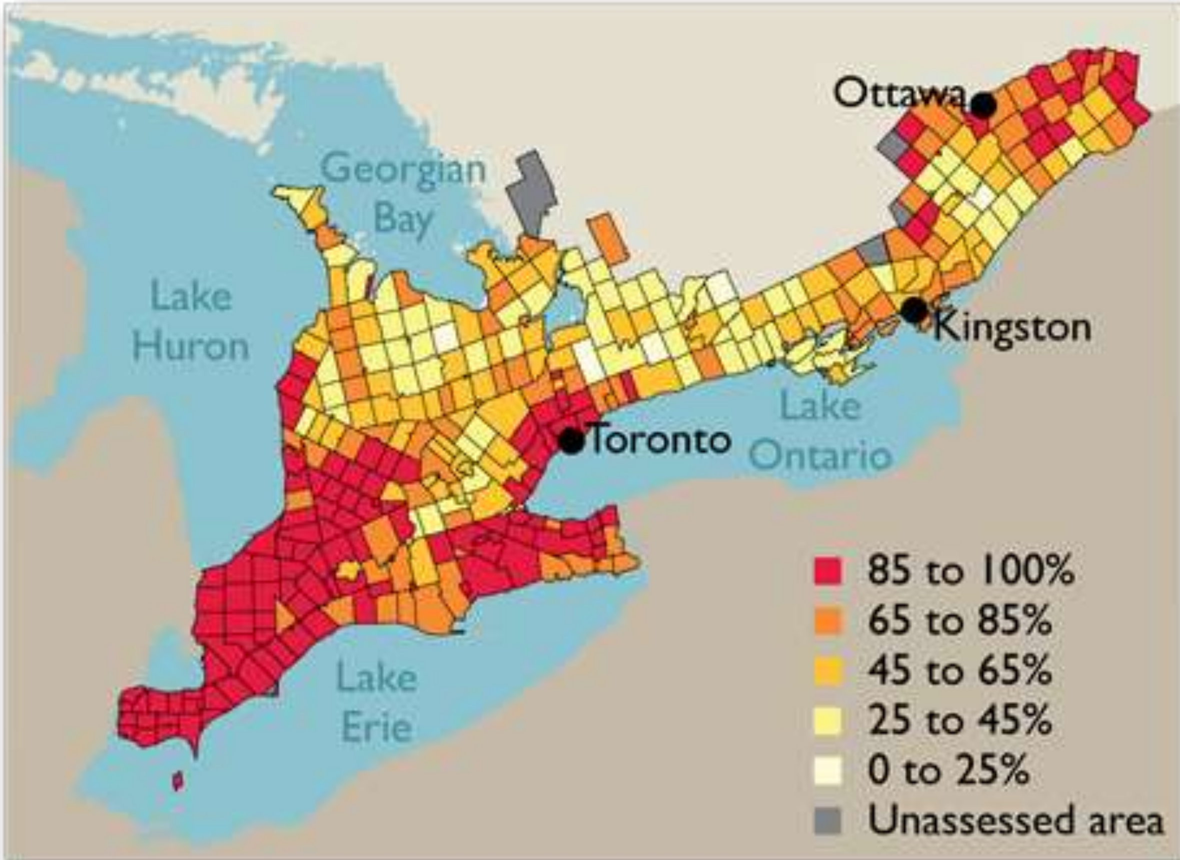

Figure 1. Wetland losses in southern Ontario (1880-2002). In southwestern Ontario, the loss of wetlands has been the most dramatic, with over 85 percent of the areas originally covered in wetlands converted to other uses.

Until recently, our understanding of wetlands — and the services and functions they provide — was limited. Wetlands are often considered insect-infested wastelands, and as such land use policies have not — and still do not— prioritize their conservation. Since they are not currently valued by the market system and financial incentives to protect them are lacking, wetlands have been, and are continuously, drained and/or filled in for roads, agricultural use, housing developments, new shopping complexes, or to serve as waste sites.

2 Definitions

2.1 Types of Wetlands

- **Bog** — A wetland with acidic soils that may or may not have trees, with waterlogged soils — fed solely by precipitation — that tend to accumulate peat and is associated with low productivity. They are often very old, perhaps thousands of years. Bogs often have a low diversity of species. Rare in southern Ontario.

- **Fen** — A wetland dominated by grasses, sedges and rushes that may or may not have trees, with waterlogged soils that tend to accumulate peat. Fens are fed by groundwater and surface water runoff, and are associated with low productivity. Rare in southern Ontario.
- **Marsh** — A wetland without trees, associated with flowing water, and tends to be highly productive. Dominated by non-woody plants such as cattails, rushes, pond lilies and submerged plants.
- **Swamp** — A wetland with trees, associated with flowing water, and tends to be highly productive.
- **Wetland** — An ecosystem which is seasonally or permanently covered in standing water or saturated with water for a least part of the year, or where the water table is close to or at the surface, such that vegetation has adapted for growth in saturated conditions.

2.2 Ecology and Development Terms

- **Additionality** — To what degree does an offsetting project generate new and additional contributions to biodiversity conservation/wetland conservation.
- **Biodiversity Offsetting** — Compensating (or attempting to compensate) for losses of biodiversity at an impact site by either creating ecologically equivalent gains or credits at an in-site or off-site location. The purpose of biodiversity offsetting is to incur no-net loss of biodiversity.
- **Invasive species** — a non-native species that outcompetes native species and becomes a nuisance or threat to ecosystems.
- **LID** — [Low Impact Development] Land planning and engineering design approach considering conservation and on-site nature protection to manage stormwater runoff as part of green infrastructure.
- **Mitigation banking** — The developer purchases offset credits from a wetland bank, that is, an area that has been previously restored, created, enhanced or preserved and set aside by a third party, and certified for compensation. The banker is responsible for the success of the compensation project.
- **Mitigation Hierarchy** — A tool used in biodiversity offsetting to minimize the harm that occurs due to a project. The preference should be given first to avoiding negative impacts, then to minimizing impacts at a project site, followed by restoration/rehabilitation and finally, offsetting biodiversity losses that cannot be avoided.
- **Rehabilitation/Creation/Re-creation** — Bringing back once-existing wetlands
- **Restoration** — Bringing back areas degraded through actions such as in-filling, changes in drainage patterns, sedimentation, vegetation removal, and pollution.
- **Urban Heat Island Effect** — When an urban or metropolitan area is significantly warmer than rural areas due both to human activities and the built environment.
- **Wetland Offsetting** — Compensation for the negative impacts of development through the restoration or creation of new wetlands to achieve no-net-loss or a net environmental gain.

3 Biology and Hydrogeology of Wetlands

Wetlands can range in size from very small (only a few m^2) to hundreds of km^2. Wetlands may be isolated, occur along the edges of lakes and rivers, or exist in conjunction with other natural areas such as woodlands, shrublands and native grasslands. In some cases, closely spaced wetlands related in a functional way can also form what is known as a wetland complex. In southern Ontario the average wetland is 25 hectares and the majority are swamps, dominated by trees and shrubs.

Wetland types are recognizable by their indicator and keystone species.

Table 1: Common keystone and indicator plant species in Southwestern Ontario's Wetlands

Species	Habitat Types	Habitat requirements
Broadleaf cattail *Typha latifolia*	Marshes Bogs Fens	ommon resident of the marsh environment ually one of the first species to colonize new habitats quires full sunlight eds germinate in acidic, neutral or basic pH, but only in shallow water Seeds will also germinate in low oxygen conditions Cattails can occur in sand, silt, loam and clay substrates
Small-fruited bulrush *Scirpus microcarpus*	Marshes Fens	A common resident of the marsh environment Tolerates both full-sunlight and shade Requires silty/mucky soil with a high water-holding capacity Grows best in neutral pH, but can also grow in acidic conditions
Soft maples *Acer saccharinum,* *Acer rubrum*	Swamps	Commonly found along the edges of swamps Tolerant to waterlogged soils and flooding Tolerate sun or shade and in all soil types They can thrive in acidic, neutral and basic pH conditions
Black spruce *Picea mariana*	Bogs Swamps	This species is indicative of a bog environment Also found in coniferous swamps Tolerant of highly acidic soils and is most abundant in peat bogs A pioneer species in bogs and can invade the *Sphagnum* spp. mat Grows well in a variety of soils, moisture levels and light conditions

3.1 Wetlands: Vital for species richness and abundance

While the economic benefits of wetlands tend to focus on flood control and water purification, wetlands provide other irreplaceable ecological services. One of the economically unappreciated features of wetlands is their contribution to biodiversity conservation and maintenance of the web of life. Since marshes and swamps are usually shallow enough to allow sunlight to penetrate and to allow for seasonal warming, they support high levels of photosynthetic activity, making them highly productive areas, full of diverse and abundant species. In Ontario, wetlands are biodiversity hotspots, supporting a variety of plants, birds, insects, amphibians and fish — and are particularly valuable to migratory water and shore bird species for breeding and nesting.

Wetlands are also a home to a number of Ontario's species at risk (SAR).

Table 2: Species at risk that occur in London's wetlands

Species	• Status in Ontario	• Habitat type	Habitat requirements	Threats
Eastern Ribbonsnake *Thamnophis sauritus*	• Special concern	• Marshes • Fens • Bogs • Swamps	• Found in areas with permanent water near terrestrial habitat (Harding 1997; Schribner and Weatherhead 1995) with shallow water and low, dense shoreline vegetation (Minton 1992; Cosewic 2002) • Habitat includes bare substrate near wetlands including gravel, cobble and boulders (Desroches and Leparé 2004). • Habitats used by Eastern ribbonsnakes must have a high abundance of amphibians, particularly frogs, as these are their primary food source (Carpenter 1952; Brown 1979; COSEWIC 2012).	• Their biggest threats are loss of habitat including loss of wetland and riparian habitat (Environment Canada 2015).
• Eastern prairie fringed orchid • *Platanthera leucophaea*	Endangered	• Marshes • Fens • Swamps	• Requires open conditions with full sunlight and is restricted to graminoid-dominated vegetation communities (Bowles 1993). • It requires soil that is neutral to slightly calcareous (Bowles et al. 2005, Case 1987, Bowles 1983) and can tolerate pHs of between 5.3 and 7.5 (Zambrana Engineering Inc. 1998). • The eastern fringed-orchid is adapted to fluctuations in water levels (COSEWIC 2003)	The largest threats to the orchid are the lack of suitable habitat due to its specific habitat needs as well as habitat loss and degradation (Eastern Prairie Fringed-orchid Recovery Team 2010)

3.2 Wetlands: Nature's water quality regulators

Wetlands are vital for human health and safety, through their ability to control flood waters, protect against natural disasters, and mitigate and adapt to climate change. The natural water purification system within wetlands removes silt and sediments, preventing them from entering rivers, gathering nutrients and forming fertile agricultural land. Chemical reactions detoxify and neutralize toxic substances in the water, thereby protecting us from pollution. As more of the City's land is transformed with impervious covers of asphalt, concrete, and rooftops, rainwater run-off becomes increasingly severe. As such, London's remaining wetlands become increasingly important for flood management and water purification. In a city like London, that is surrounded by agricultural land, preserving and expanding our wetlands would help remove organic material, particularly phosphorus and nitrogen (resulting from fertilizer runoffs) from entering our streams, rivers and lakes. These wetland functions are not just 'nice' – they have real economic benefits for society as a whole. .

London is surrounded by agricultural land..

Figure 2. An image from space showing a toxic algal bloom occupying over 70% of Lake Erie. These algal blooms are now an annual summer occurrence due to pollution from farm run-off and sewage overflows. London gets half of its drinking water from Lake Erie. Avoidance of run-offs, in combination with healthy and abundant wetlands, could avoid these toxic events. (get copyright permission and date) Wetlands also alleviate drought by holding water when conditions are dry. Water accumulated in wetlands seeps into the ground, helping to replenish underground aquifers. Wetlands work to mitigate climate change by absorbing greenhouse gases, acting as carbon sinks that stabilize climate conditions. In

London, the City's wetlands lessen the urban heat island effect, which will become increasingly important as temperatures rise.

4 Protecting London's Wetlands

Currently, land conversion is the biggest threat to wetlands in southern Ontario. Urban pressures are driving up the price of land, making land markets highly competitive, which ultimately leads to significant rates of wetland conversion (Lantz et al., 2013). Ecosystem services — considered free, common goods— provided by wetlands are routinely omitted in the market prices of projects. Consequently, wetland loss or disturbance is rarely given adequate consideration in land-use planning decisions.

London, as a growing and dynamic city, is faced with the persistent challenge of balancing expanding city infrastructure and conserving its ecosystems, especially wetlands. Economic interests consistently bump up against efforts to conserve natural areas, particularly wetlands. In year 2017 and 2018 , XXX number of development projects involving wetlands were undertaken in London, Ontario. Consequently, the City of London requires a clear set of guidelines governing development projects, such as housing plans and expanded transportation infrastructure, to avoid disturbance, reduce impacts and mitigate unavoidable damage. This document is meant to offer a means by which the City can ensure that development projects and other works do not negatively impact the City's wetlands or lead to their complete loss.

4.1. Wetlands as an important natural heritage feature of our city

People must have access to a good natural and cultural environment, rich in biological diversity, as a basis for health, quality of life and well-being.

4.2 Wetland Conservation: Legislative Background

Provincial and municipal action is vital to ensure that the region's wetlands can continue to provide ecosystem services. Ontario, influenced by international conventions and agreements, is moving forward with a strategy to stop wetland loss and to restore wetlands where the largest losses have occurred. The City of London likewise needs to have clear guidelines regarding wetlands, their preservation, restoration and rehabilitation.

Most nations have recognized the need to preserve wetlands. Internationally, their protection is governed by the Ramsar Convention, a treaty for the conservation and sustainable use of wetlands, signed in 1971, ratified in 1975 and adopted by Canada in 1982. A subsequent Working Group on Criteria and Wise Use clarified the terms "sustainable utilization" as found in Article 3 of the Ramsar Convention as "human use of a wetland so that it may yield the greatest continuous benefit to present generations whilst maintaining its potential to meet the needs and aspirations of future generations" (Birnie and Boyle, 2002, p. 618). **This Working Group also confirmed that activities involving wetlands should be governed by the *precautionary principle*, and argued that when complete knowledge is lacking regarding the outcomes of an activity, that activity should be prohibited (Birnie and Boyle, 2002)**. To date however, the majority of nations are not applying the *precautionary principle* regularly in regards to wetlands, as evidenced by the continued rapid loss of wetlands. The City of London has likewise faltered in regularly employing this principle in its development planning.

Often conservation is limited to areas within parks and protected areas; more must be done to protect biodiversity and ecosystem services beyond reserves in daily operations and land use planning. The four Articles most relevant to wetland protection are found in Appendix 'X'

Provincial Legislation. Since the early 1980s wetland conservation has risen in importance in Ontario. The province continues to recognize that wetlands are one of its most vital natural capital assets. The 2014 *Provincial Policy Statement* is central to provincial wetlands conservation. **The policies contained within the *Provincial Policy Statement* are minimum standards only; planning authorities and decision-makers are free to take more stringent measures regarding conservation.**

The *Provincial Policy Statement* asserts that our natural heritage is a resource: "The Province must ensure that its resources are managed in a sustainable way to conserve biodiversity, protect essential ecological processes and public health and safety, provide for the production of food and fibre, minimize environmental and social impacts, and meet its long-term needs" (p.4). The PPS prohibits development or site alterations in all provincially significant wetlands, or in lands adjacent to provincially significant wetlands, unless it can be demonstrated that the wetland and its ecological functions will suffer no negative impacts (PPS 2.1.4(a)). The PPS further specifically prohibits any development or site alteration to fish habitat (PPS 2.1.6).

The purpose of the provisions within the PPS is to protect "natural features and areas… for the long-term" (PPS, p.22). This principle must be remembered when analyzing development proposals. When considering the merits of a project proposal, City staff, Council and developers should take a broad look at the effects of the works not just on the narrow development site, but at the broader functioning of ecosystems within the city. The PPS clearly states that "[t]he diversity and connectivity of natural features in an area, and the long-term *ecological function* and biodiversity of *natural heritage systems,* should be **maintained**, **restored** or, where possible, **improved**, recognizing linkages between and among *natural heritage features and areas, surface water features,* and *groundwater features*" (PPS 2.1.2, bold added). The City must return to this provision each time a project considers removing, altering or otherwise damaging a wetland.

Currently, Ontario's wetlands strategy is specifically guided by "A Wetland Conservation Strategy for Ontario 2017-2030". It strives for a social and political climate where "Ontario's wetlands and their functions are valued, conserved and restored to sustain biodiversity and to provide ecosystem services for present and future generations" (A Wetland Conservation Strategy for Ontario, 2017, p. iii). The strategy comprises two targets: the net loss of wetland area and function will stop by 2025 where wetland loss is the greatest, and a net gain in wetland area and function will occur by 2030 where wetland loss has been the greatest. The Strategy also puts forth the principle that wetlands should be conserved according to three hierarchical priorities —

- protect (retain area and functions of wetlands)
- mitigate (minimize further damage)
- restore (improve and re-establish wetland area and function).

Most significantly, the fourth principle in "A Wetland Conservation Strategy for Ontario" calls for a *precautionary approach* regarding wetlands and development and other projects affecting wetlands. This stipulation means incorporating wetland conservation into environmental impact statements provincially and municipally.

Given the interconnectedness of wetlands with other areas of environmental protection, such as biodiversity conservation and climate change, wetlands and their preservation appear in several other provincial documents. Among these documents are: “Biodiversity: It’s in our Nature” (2011) and “Climate Ready: Ontario’s Adaptation Strategy and Action Plan, 2011-2014”. The statements within these documents pertaining to the importance of wetlands for climate change mitigation and adaptation, as well as for their role in ensuring the survival of Ontario’s endangered and threatened species, are significant. For the purposes of this document, it is mainly necessary to note that all departments concerned with various areas of conservation recognize the importance of preserving our wetlands.

Municipal Policies: The London Plan. Land use planning has the greatest influence on the conservation of wetlands. Official plans (e.g. *The London Plan*), local decisions on land use, and community-based land use plans have far reaching impacts on the green spaces of our City, and how the City moves forward with approval for development projects that conflict with conservation values. *The London Plan* has clear provisions for the “identification, protection, conservation, enhancement, and management of our Natural Heritage System” (1293.1). These provisions are listed in Appendix XXX.

Of particular importance for London as it considers **the retention of its wetlands, no matter how small,** is *The London Plan’s* statement, following the *Provincial Policy Statement* that “[t]he diversity and connectivity of natural features and areas, and the long-term ecological function and biodiversity of Natural Heritage Systems, will be **maintained**, **restored** or, where possible, **improved**, recognizing linkages between and among natural heritage features and areas, surface water features, and groundwater features” (*The London Plan* 130, bold added).”

The London Plan specifies that no development or alteration shall occur in provincially significant wetlands (PSW) as evaluated and confirmed by the Ministry of Natural Resources and Forests (MNRF), designating them instead as Green Space (*The London Plan,* 1332, 1333, 1390). This provision is in accordance with the *Provincial Policy Statement,* but it only applies to Sifton Bog and Westminster Ponds, the two PSWs located within London.

Notes:
[1] These paragraphs do not specify that the wetland must be “provincially significant” nor do they qualify ‘wetland’ with a size.

[2] Clause 1334 does suggest an opening for relocation and/or offsetting disturbed wetlands, but without specifications on how these projects should be undertaken or monitored. These guidelines will attempt to fill this gap.

5 Ensuring the future of London’s wetlands

The purpose of wetland conservation is to both halt wetland loss as well as to restore and rehabilitate wetlands that have been lost. The following section will outline some of the steps that the City of London could undertake to preserve, restore, relocate, and create wetlands.

5.1 Preservation should be the norm: Upholding the Precautionary Principle

“Natural ecosystems provide the foundation of a functioning human society” (Pattison-Williams et al., 2017, p. 400).

According to the mitigation hierarchy, preservation or avoidance of harm should always be the first priority. Wetlands are afforded even greater protection under any offsetting policy, with greater multiplier ratios due to the recognition of the vital ecosystem services they provide, and the realization that wetland areas have already declined dramatically. **Consequently, in London, preservation of our wetlands, no matter their size, should be paramount.** The possibility of relocating a wetland for a development project should not be used as an excuse to undertake that project, when avoidance of disturbance is equally an option. Economic concerns should not be given greater weight than environmental concerns where wetlands are involved. It is the case that "project impacts cause immediate and certain losses, whereas the conservation gains of an offset are uncertain and may require many years to achieve" (McKenney and Kiesecker, 2010, p. 171).

International, national and provincial legislation and policies stress the importance of employing the *precautionary principle* in regard to environmental problems. This principle should be applied more rigorously when wetlands are concerned due to our limited knowledge of their functions and processes. Instead, too much faith is put into the ability of restoration, relocation and recreation of wetlands to recover lost biodiversity (Maron et al., 2012). This misguided faith has led to an increase in biodiversity loss, as decision-makers, believing that restoration can deliver equivalent or better results, approve development projects that promise to damage ecosystems and functions. Time lags, uncertainty and problems with the measurability of the value being offset can seriously limit the technical success of offsets (Maron et al., 2012). Where evidence is lacking that restoration science and practice can achieve no-net loss of biodiversity, the *precautionary principle* should prevail.

Studies have shown that larger wetlands recover faster than smaller ones, and that smaller restored or created wetlands often become more isolated. Moreover, their lack of connectivity to larger systems greatly hinders the ability of local biota to restore the wetland to pre-impact functioning (Moreno-Mateos et al., 2012). This finding is significant for London where development projects will likely only involve smaller wetlands within a highly fragmented landscape.

Preservation should be the top priority since restoration, relocation and recreation projects seldom meet targets. As Poulton and Bell noted, "[nowhere is there a resounding success story, where offsetting has been demonstrated to achieve its full potential" (Poulton and Bell, 2017, p. i). In a study by Suding (2011), reviewing global successes and failures of restoration projects, it was found that only one-third to one-half of projects were successful where restoration was used to fix a degraded system, and that when restoration was used to re-create a habitat, the success rate was even lower (Maron et al., 2012). Re-vegetated areas on highly degraded sites rarely resemble the target ecosystem (Maron et al., 2012). In a meta-analysis of restored wetland systems around the world by Moreno-Mateos et al. (2012), it was discovered that even after a century, the biological structure (i.e. plant assemblages) and biogeochemical functioning (storage of carbon in wetland soils) was on average 26 percent and 23 percent lower, respectively. than reference sites. Recovery is clearly very slow, or in some cases the post-disturbance systems move toward a state that is different from the reference conditions (Moreno-Mateos et al., 2012). Therefore, wetland offsetting should be used as an absolute last resort in the mitigation sequence.

5.2 Primary screening when changes to a small wetland are proposed

5.2.1 Ontario Wetland Evaluation System
Link: **https://www.ontario.ca/page/wetlands-evaluation**
Wetlands are ranked to determine whether they should receive special protection as “provincially significant”. Significance is determined by the Ontario Wetland Evaluation System (OWES) .

Provincially Significant Wetlands (PSWs) are those areas identified by the province as being the most valuable. PSWs are identified using objective criteria based on the best available science. The OWES ranking system is a standardized method of assessing wetland functions and societal values, which enables the province to rank wetlands relative to one another. A wetland that has been evaluated using the criteria outlined in the OWES is known as an "evaluated wetland" and will have a "wetland evaluation file”. As wetlands may change over time an OWES file for a given wetland is considered an “open file”.

5.2.2 Perform Comprehensive evaluation for non-evaluated small wetland

The following checklist will assist in determining whether small isolated wetlands should be preserved.

Small wetlands will be considered significant:

IF	YES	NO
The wetland has a groundwater connection to a larger complex (i.e. PSW)		
The wetland is supported by groundwater discharge (re: specific wetland plants presence)		
The wetland is part of a floodplain		
A watercourse connects the wetland to other aquatic features		
The wetland serves as storm water storage		
The wetland is habitat for breeding amphibians		
The wetland sits close to a woodland and Western Chorus frogs were heard calling		
The wetland was recently (within the last 20 years) a fish habitat		
The wetland was recently (within the last 20 years) a turtle nesting habitat		

The wetland was recently (within the last 20 years) habitat for seasonal Concentration Areas (i.e. migrating birds)		
Terrestrial crayfish chimneys were observed surrounding the wetland		
Barn Swallows were observed foraging in the area		
SAR species (threatened or endangered) were found		
The wetland serves a corridor function linking neighbouring natural heritage features together		

5.2.3 Annual Post-Construction Monitoring of a Relocated Wetland

Before the monitoring process even begins, practitioners, developers, and the City must clearly define what a "successful" relocation or restoration would entail for each *individual* project and outline a clear set of objectives. For instance, even if a site has revegetated, it could be functionally inadequate, and/or the plant composition may differ from the initial goals.

The three, five, ten-year annual monitoring report includes qualitative and quantitative observations of water level, riparian and aquatic vegetation, overflow, breeding birds, amphibians, terrestrial crayfish chimneys and incidental wildlife associated with the constructed feature. However, given that significant time lags occur before a mitigation project can be determined a success, the time scale may require adjustment. Evidence has demonstrated that even 100 years after disturbance and restoration, the functions of a wetland may not have fully recovered. Indeed, to date restoration ecologists have been unable to re-create full functional replacement; it may not even be possible to fully re-create all the functions of a wetland. Careful and regular monitoring over a long period of time is vital to catch any problems that may arise (wetland shrinkage, incursion by invasive species) and to ensure greater probability of success of any wetlands project. In the absence of sufficient monitoring and adaptive management, designing wetlands to be self-sustaining and self-managing will better guarantee their success.

Quantitative observations include an amphibian call survey (three spring visits), crayfish burrow count using the quadrat method, baited minnow trapping, riparian and aquatic vegetation inventory, and the measuring of spring, summer and fall water levels.

Qualitative observations include turtles, any incidental wildlife, backyard encroachment and the health of neighbouring woodlots and other vegetation (invasive species) near and beyond the wetland.

If monitoring indicates that certain populations are in decline, additional individuals can be transferred into the compensation wetland (e.g. import tadpoles, broadcast more native seeds). Wetlands are particularly vulnerable to invasive species, due to their interconnection with waterways, their proximity to roads (paths along which invasive species may travel), and climate change, which puts stress on wetlands as a result of changing weather patterns (increased rainfall and/or drought). Re-created, restored or relocated wetlands will be particularly vulnerable to invasive species as they have suffered a disturbance and opportunistic plants can establish themselves quickly in areas where native species are stressed. If an invasive species (e.g. phragmites, purple loosestrife) is observed, the growing population can be carefully removed.

5.3 Wetland Offsetting

One option to prevent the net loss of wetlands in Ontario is the development of a wetland offsetting policy. Recently offsetting has become a popular approach to balance development projects with the need to protect biodiversity. It is meant to ensure no net loss of biodiversity, and, ideally, a net gain of biodiversity. However, it must be made clear that offsetting will not replace other legislation that provides protection for certain wetlands (i.e. provincially significant wetlands) where disturbance is prohibited.

Wetland offsetting involves mitigating negative impacts upon one wetland by intentionally restoring or creating a new wetland at a different location. This type of policy is typically set within a mitigation hierarchy and involves the hierarchical progression of alternatives, including avoidance of impacts, minimization or mitigation of avoidable impacts and offsetting of impacts that cannot be avoided. The Ontario government remains committed to offsetting only being used as a last resort (OMNF, 2017). However, there is always the risk that the offset never achieves an equivalent conservation value; ecologists have expressed concern that biodiversity offsetting exchanges “certain losses for uncertain gains” (Maron et al., 2012).

Accepted methods of compensation include wetland restoration, creation, enhancement and preservation. *The London Plan* touches on offsetting or “compensatory mitigation” in **1402,** stating that it may be provided through “[additional rehabilitation and/or remediation beyond the area directly affected by the proposed works” and/or “[off-site works to restore, replace or enhance the ecological functions affected by the proposed works” (*The London Plan,* 1402). Some policy statements require offsets to be in place before a project takes place. Though this provision may be advisable with the pace of development in London, it may not be practicable.

Offsets are never one-size-fits all; local contexts can provide a variety of challenges and . relocation or re-creation are unable to produce an exactly equivalent wetland. The City and developers must then determine how to best create “equivalency” to address the losses of biodiversity and functionality. In particular, prior to any relocation or offset project the City must ascertain where the offset should be located, when and for how long it should be operational, how risk of failure will be managed, and what will be the next course of action should an offset fail to reach its goals (McKenney and Kiesecker, 2010).

Multiplier ratios. To address the problem that restoration or re-creation projects rarely, if ever, produce an equally biodiverse and functional wetland, multipliers are employed to determine the scope of an offset project. Since wetlands are particularly valuable, the offset multiplier for wetlands is usually higher compared to other areas. *The London Plan* specifies that “mitigation shall mean the replacement of the natural heritage feature removed or disturbed on a one-for-one land area basis” (*The London Plan,* 1401), which is not sufficient given the uncertainties of success and the goal of the provincial wetland strategy of creating a net gain in wetland area. However, *The London Plan* goes on to say “compensatory mitigation shall mean additional measures required to address impacts on the functions of the Natural Heritage System affected by the proposed works. The extent of the compensation required shall be identified in the environmental impact study, and shall be relative to both the degree of the proposed disturbance, and the component(s) of the Natural Heritage System removed and/or disturbed" (*The London Plan,* 1401). 1402 (3) likewise states that "[replacement ratios greater than the one-for-one land area [are] required to mitigate the impacts of the proposed works" (*The London Plan*, 1402).

Duration. Ontario is still in the process of determining an acceptable duration for wetland offsets and whether they should remain for the duration of the negative impacts, or should exist in perpetuity. Given the ongoing losses of wetlands across southern Ontario, it is strongly advisable that wetland restoration, relocation and creation projects for the purposes of offsetting should continue in perpetuity. This recommendation is critical given the lack of evidence proving that such altered and/or created wetlands recover full functionality, and given the long lags associated with wetlands' maturation. Moreover, it is imperative that once a wetland has been moved for one project, that "relocated" or offset wetland should not then itself become subject of another development project and be relocated again.

Several factors will have to be determined should London choose to prioritise offsetting over protection: the appropriate policy mechanisms for implementation, the roles and responsibilities for implementation, reviewing long-term results of wetland offsetting and restoration, and establishing monitoring requirements to make sure that the wetlands' functions have been properly restored (A Wetland Conservation Strategy for Ontario 2017-2030).
As Ontario develops its own unique wetland offset policy, lessons learned from other jurisdictions have helped to establish four key considerations (Poulton, 2017):

1. Need for reliable tracking, reporting and record keeping: Baseline data on wetland functions lost to development must be recorded. Establish long-term monitoring requirement to ensure that wetland functions are restored;
2. Need for a watershed-based approach: Rather than a piecemeal approach, decisions are based on an assessment of the wetland needs in the watershed and the potential for the compensatory wetland to persist over time. The individual offset site should be designed to maximize the likelihood that they will make an ongoing ecological contribution to the watershed;
3. Need to adhere to the mitigation sequence: Avoidance and minimization of adverse impacts must be vigorously applied first. Skipping directly to the compensation step leads to opportunities lost to preserve natural heritage;
4. Need to ensure compliance: Compliance monitoring before and after project construction should endure inspection and enforcement by the municipality.

5.3.1 Relocation

Wetland relocation (a compensation plan) is considered when the wetland feature is not categorized as provincially, or municipally significant or significant wildlife habitat is not confirmed, yet the wetland feature provides productive amphibian breeding habitat and habitat for terrestrial crayfish. Under *The London Plan*, all wetlands, regardless of size, are to be protected under the natural heritage system policies. In each case where a wetland is slated to be relocated or altered, the City must consider the merits of destroying the functionality of that wetland and replacing it with a wetland which may only operate at 75 percent functionality (in the best-case scenario), or which may shift to an alternate wetland type. In such cases, the City must ascertain whether the existing or replacement function is more important, whether the proposed wetland will increase wetland diversity, and whether the potential for increased biodiversity is worth any loss to habitat of endangered species resulting from the project

(Kentula). The more complex the hydrology or the ecological system, the more difficult it is to restore a wetland completely; in many cases it may be impossible.

5.3.2 Restoration and Rehabilitation

There are two kinds of restoration: “re-establishment” -- returning the natural or historic function of a former wetland with the goal of increasing wetland area --and “rehabilitation” -- repairing the natural or historic functions of a wetland, such that there is an increase in functions but not in the area of wetlands (McKenney and Kiesecker, 2010).
Restoration ecology is a relatively young discipline. Insufficient evidence is available to demonstrate that it is successful. Several authors warn that “it cannot be assumed that restoration efforts will successfully return a degraded area to a state which is comparable or equivalent to the reference condition” (Matthews and Spyreas, 2010, 143). Analysis of the hydrologic structure of restored or created wetlands usually only proceeds for one to fifteen years after the project is undertaken so the long-term effects are unknown (Moreno-Mateos et al., 2012). The abundance, species richness and diversity of native animals and plants in affected wetlands decreases dramatically following disturbance. Many macro-invertebrates cannot recolonize created or restored wetlands by themselves; they must be brought in by flowing waters or be brought in by other organisms (Moreno-Mateos et al., 2012). In addition, climate variability and changing weather patterns make predicting restoration outcomes difficult.

Restoration ecologists are increasingly recognizing that, given ecosystems’ complexity, restoring or (re)creating one to some specified state, especially within a short time frame, is not feasible (Hobbs et al., 2011 in Maron et al., 2012). Restoring just the functions of ecosystems can take several decades, and evidence has shown that even after a century, wetlands on average only operate at 75 percent functionality compared to reference sites (Moreno-Mateos et al., 2012). Plant biomass or species richness may return to pre-disturbance levels in a shorter period of time, while the actual composition of the plants may differ, and the soil composition, chemical properties and ecosystem functions (i.e. nutrient cycling) may take significantly longer to recover (Maron et al., 2012).

Restoration and creation of plant assemblages, particularly woody vegetation, requires the longest period of time. An average of thirty years is necessary for restored or created wetland sites to converge with the reference states of wetlands. At the same time, opportunistic invasive or non-native species may quickly colonize a disturbed area, outcompeting native species, thereby altering the plant assemblage in comparison to reference sites.

Restoration can prove even more difficult due to challenging situations occurring outside of the site, such as continued urbanization or new development projects that exert negative influences on the restoration site (Maron et al., 2012). Stranko et al. (2012) looked at the effectiveness of stream restoration in urban areas and found that these restoration activities failed to improve any of eight biodiversity indices. The authors determined that the impacts of urbanization on stream ecology are irreversible and consequently it is unlikely that any biodiversity gains can come from stream restoration projects in urban areas (Maron et al., 2012). The same is likely true of wetlands, and particularly small wetlands, in urban settings.

Recommendations for using restoration to deliver biodiversity offsets or to compensate for wetland loss with development projects.

1. The impacted biodiversity and ecosystem values should be clearly defined and measured.

2. Time lags and uncertainties should be explicitly accounted for in any loss/gain calculation.
3. Time lags should not pose an interim threat to biodiversity values.

Current restoration practice does not recover original levels of wetland ecosystem functions, even after many decades (Moreno-Mateos, 2012)

5.3.3 Artificial Wetlands

Wetland creation — construction of a wetland where one did not previously exist — is much more complicated than restoration and less likely to be successful. If the wetland functions can be replicated, a similar habitat is created elsewhere on the subject lands and target wildlife are gathered and trapped from the wetland habitat lost due to the development project and transported to the compensation wetland. Before constructing artificial wetlands, the impacted wetland should be looked at within a larger landscape context and social context to determine what roles it plays within the ecosystem/social structure. For instance, is the current wetland a stop on a migratory route? Does it contribute to the watershed levels? It is necessary to look beyond municipal boundaries, which are artificial limits when applied to ecosystems.

The elements that must be considered when planning to design and create a wetland are:

- Site-selection
- Hydrologic analysis
- Water source and quality
- Substrate augmentation and handling
- Planter material selection and handling
- Buffer zone placement
- Long-term management

Site selection usually is determined based on the availability of land or on policies that require the restored or created wetland to be in close proximity of a wetland loss (usually due to migration considerations). Location is extremely important in terms of influencing the structure and function of the wetland and guaranteeing its longevity. Planners must consider both present and future land uses.

The hydrologic conditions are probably the most important factor for determining what type of wetland can be established and what kind of wetland processes can be maintained (Kentula). These include inflows and outflows of groundwater and surface water, the resulting water levels and the timing and duration of soil saturation and flooding (Kentula). The water quality of the wetland is highly important, yet often overlooked. If there are chemical inputs from the surrounding area, these can overwhelm a wetland. This is particularly important if the wetland is close to a road spread with de-icing salts. Chemicals can alter the productivity and composition of the plant community of the wetland, possibly favouring nuisance species, and they may harm animal species that cannot survive and breed in chemically altered waters.

The soils of a wetland are equally important. Although a created wetland may be structurally similar to a natural wetland, its hydrology may differ greatly if the permeability of the substrates is different (Kentula).

Often the soils in created wetland contain less organic matter, which may affect plant growth. Using soils from a “donor” wetland or the impacted wetland to help create the new wetland may be able to increase the soil organic matter and provide the nutrients necessary for plant species, microbes and invertebrates (Kentula). Created wetlands will do better if the plants chosen closely to resemble those of similar, local wetlands.

Microbes in the wetland play a crucial role in biogeochemical reactions which causes nutrient cycle and sustain other higher plants and animals. Comprehensive understanding of microbial composition and population will facilitate better understanding about a wetland condition (Bodelier and Dedysh 2013).

Ducks Unlimited Publication - Wetlands on My Lands?
Steps to Creating a Wetland
1.Site Selection - Select the site during spring runoff to get an idea of where water flows and lies in your property. The catchment area (area that provides surface runoff into your wetland) should also be estimated at this time. A topographic survey can also provide more accurate data about surface flow. If the survey determines that there is less than a 0.6 m drop across the site, then excavating a basin is required.
2. Test the Soil - Impermeable soils are an important characteristic of wetlands. Soils that are fine-textured and not sandy and gravelly are suitable. It is also possible to bring in suitable clay soils to line the basin so the wetland will hold water.
3. Size and Shape - Wetlands come in all sizes. Make the wetland irregular in shape with many bends in the shoreline to mimic a natural wetland.
4. Wetland Depth - Excavate the wetland with an undulating bottom to encourage various types of vegetation. Emergent vegetation will grow in water depths of 1 m or less. It is advisable that approximately 25% of the area is 1 m or more in depth to ensure an ideal mixture of vegetation and open water. Excavating some deeper pockets will ensure some area will remain free of vegetation and allow the addition of native fish.
5. Wetland and Upland Enhancements - Establish a buffer around the wetland of undisturbed grasses, trees and shrubs. Install nest boxes to increase cavity nesting birds. Drag a few branches or logs into the wetland to provide basking areas for frogs, turtles and ducklings.

6 Conclusion

Conservation must be incorporated into all areas of policy and development to ensure that wetlands are afforded the appropriate level of protection. We need better scientific understanding of biotic and abiotic factors that hamper the success of restoration and relocation projects before we embrace these policies as a means to compensate for losses stemming from development and urban expansion.
Invasive species regularly take hold after wetland disturbance, either due to species’ stress or due to contaminated construction equipment (like we have seen with the spread of Phragmites in our region).

7 Policy Recommendations

a. When wetlands are involved in an infrastructure project, the priority should always be to avoid impacts to the maximum extent possible.

b. Any wetland conservation strategy should integrate climate change adaptation and mitigation into its policies and outlook.

c. Compensatory mitigation should not be used to make a potentially avoidable project seem more acceptable.

d. Economic priorities should not outweigh ecological considerations in regards to new development projects.)

e. Restoration and recreation wetlands should be designed to both technically and legally last in perpetuity.

f. A wetland which has been restored or relocated in compensation for another project should not subject to removal or further threats because of its “unnatural” status. It cannot be used as an excuse for future disturbance. See recommendation d.

g. All restored and relocated and disturbed wetlands must be monitored for a period of no less than 10 years.

h. Adaptive management must be incorporated into any and all wetland restoration and relocation projects, including removal of invasive species and other necessary actions to achieve desired outcome.

i. The precautionary principle should influence all projects involving wetlands.

j. Buffer zones are very important especially in urban areas. There should be undeveloped, vegetated land around wetlands and/or a fence or barrier. The composition and width of the buffer depends on the land use that is occurring adjacent to the created wetland, and also the requirements of the animals that will use the wetland and the buffer area.

k. The guidelines should apply to ephemeral water bodies (i.e. those present in spring and early summer). Such bodies are present in many areas of London and play a significant role in the maintenance of life systems in green areas.

Case Study

905 Sarnia Road: London's First Monitored Wetland Relocation

The relocation project is located at 905 Sarnia Road in the Hyde Park Community. A subdivision now sits on an 8.2 hectare parcel. The subject land is bordered by the CP railway to the south, a significant woodlot to the northwest and a newly developed suburb to the north and northeast.

Two small wetland features (measuring 0.15ha and 0.13ha) were located within the northeast corner of the property. Neither of the wetland features was considered a Significant Wildlife Habitat. However, due to evidence of amphibian breeding and the presence of terrestrial crayfish, the City requested that the developer compensate for the loss of the south pond.

<u>The wetland compensation plan included:</u>

- the creation of similar habitat elsewhere on the subject lands;
- the creation of a pond and riparian area within and adjacent to the woodland buffer located at the western property limit;
- the transfer of target wildlife (breeding amphibians and terrestrial crayfish) to the new pond;
- the implementation of a two-year annual post-construction monitoring and adaptive management plan.

<u>Wildlife Transfer Steps</u>

<u>November 2015</u>

1. Construction of the compensation pond.

<u>May 18, 2016</u>

2. Grading of the new habitat features and the addition of root wads to the new feature banks.
3. Native seeds were broadcast in the deep pool, shallow pool, riparian areas and dry upland areas surrounding the feature.

<u>July 7-13, 2016</u>

4. Dewatering and water transfer of the old pond.
5. Wildlife transfer begins with seven days of baited minnow trapping.

<u>July 13, 2016</u>

6. Wildlife capture techniques included dip netting, seine netting and hand picking. Captured wildlife were placed in tall buckets and transported to the compensation pond.
7. Selective transfer of riparian vegetation from the existing to the compensation pond. Riparian topsoil is not transferred because of the possible presence of invasive seed banks.
8. Benthic populations were transferred to the compensation wetland.
9. Downed woody debris was collected from around the existing wetland and placed strategically around the compensation area to provide basking opportunities for wildlife transfers.
10. Additional muck is transferred to the compensation pond.

Case Study

905 Sarnia Road: London’s First Monitored Wetland Relocation

Figure 3. Historical and present aerial photographs of 905 Sarnia Road. Aerial photographs of 905 Sarnia

Road London, Ontario taken in A) 1950 (source:

https://www.lib.uwo.ca/madgic/google_index_1950.html) and in B) 2018 (source:

https://www.google.com/maps/@42.99043,-81.31777,1304m/data=!3m1!1e3).

‘Target’ Wildlife in a Wetland

1. Calico Crayfish (*Orconetes immunis*)

Calico crayfish are found in stagnant ponds and ditches and slow-moving streams, where the bottom is mud with a heavy growth of rooted aquatic vascular plants. Because this species can burrow one metre deep in the ground when necessary, it utilizes temporary pond habitat and spends the winter in the burrows. This species is largely herbivorous, feeding on the abundant vegetation of a pond, or, at night, on terrestrial plants close to shore. They are active both by day and night, but the adults are more strictly nocturnal. The species can travel across dry land at night, especially if there is rain or a heavy dew, and in this way can move from pond to pond. Copulation takes place from mid-July to early October, mostly yearling individuals participating. Eggs are laid in late October, and are carried on the underside of their abdomen through the winter. Juveniles spend the summer growing, may become sexually active in September, but most wait until late the following summer. The normal lifespan is two years. (Crocker, 1968)

2. Western Chorus Frog (*Pseudacris triseriata*)

These small frogs weigh as much as a paperclip and measure no longer than approximately three centimetres. Adaptations prevent their cells from freezing. They require 25 days to travel 200 metres. Most individuals live no longer than one year, some for two to three years. They feed on small insects and other invertebrates. During breeding, western chorus frogs use shallow, fishless ponds and large puddles that dry up in the summer. Reproduction happens just after ice-out in early spring. Eggs hatch and tadpoles grow into adults in as little as two months depending on the water temperature. After breeding, the adults move overland to protected areas (woodlands) where they remain active the rest of the summer and spend the winter in undisturbed soft soil. Meadows and forests located right next to breeding ponds provide great habitat where frogs can spend the summer and overwinter undisturbed.(Bird Studies Canada pamphlet)

Results of the Wildlife Transfer-July 14, 2016

- trapping, netting and hand-picking resulted in the capture of approximately 63,874 wildlife individuals
- 80% of the total wildlife population was successfully relocated
- Species captured included: Calico crayfish (18166), Green Frog(4869), Northern Leopard Frog (1450), Other Invertebrates (28803), Brook Stickleback (11522), Eastern Newt (21), Midland Painted Turtle (10), Snapping Turtle (3)

Post-Transfer Survey – October 7, 2016

Water was restricted to the deeper (western) portion of the pond during the July survey. During the October survey, water levels had increased noticeably and the shallow (eastern) portion of the wetland was also inundated. No outflow to the surrounding woodland was observed.
By October, the banks of the compensation wetland had re-vegetated naturally to or just above the high water mark. Vegetation included grasses, forbs and shrubs. Vegetation coverage was estimated at 70%, and appears sufficient to mitigate shoreline erosion.

Comparison of Data Collected at 905 Sarnia Road

Wetland Components Surveyed	EIS 2014	Monitoring Report 2017	Monitoring Report 2018
Amphibian survey	North pond 1-1 Chorus Frogs 3 Spring Peepers South pond 1-2 Green Frogs 1-5 Gray Treefrogs 3 Spring Peepers Leopard frog observed	April 1-3 Spring Peepers May 1-2 Spring Peepers June 1-1 Green Frogs 1-3 Gray Treefrogs (calling in pond) 3 Gray Treefrogs (calling in adjacent woods) Green Frog Tadpoles observed	
Terrestrial Crayfish Chimneys	Stantec observed around north pond. Not counted City Staff observed around south pond. Not counted	Multiple chimneys observed	
Vascular Plants	67 species observed in wetland and surrounding cultural thicket 81% native plants	45 species observed 60% native plants	
Turtles	None observed	2 midland turtles observed	

Fish	North pond – not suitable for fish South pond – marginal fish habitat	Brook stickleback observed	
Birds	12 species including Barn Swallows observed	32 species including Barn Swallow and Eastern Wood-Pewee observed	
Snakes	None observed	None observed	
Incidental Wildlife	Northern Raccoon, Groundhog and Eastern Cottontail observed	Raccoon tracks, White-tailed deer tracks, Great Blue Heron, Canada Goose, Eastern Cottontail scat, Garter snake, Cooper's Hawk, Northern Flicker, White-breasted Nuthatch, Blue Jay, Turkey Vulture, Wild Turkey	
Odonata	Not reported	7 species	
Butterflies	Not reported	7 species	
Water Level	Not applicable	April – very high (to the point of overflowing) October – levels decreased, but remained high in the deeper portion	

EEPAC Review of 905 Sarnia Road Wetland Relocation Project

Each relocation project must contain concrete objectives. The simple act of recreating a wetland is not sufficient; with compensatory mitigation, tangible improvements to ecological features and functions must be realized and documented. A 'net loss' of the targeted habitat is to be avoided.
Recommendation #1: The Wetland Compensation Plan should state an achievable set of goals that serve as an indicator of a successful relocation.

A sampling of species must be conducted before any relocation is permitted. The totals collected (by species) must be recorded. A report should be prepared which includes minimum requirements for the repopulation of the various species with emphasis on 'target' or indicator species as agreed to by a City Ecologist. The requirements should include species at risk, terrestrial crayfish, birds (if relocation is adjacent to a Significant Woodland), amphibians and herps.
Recommendation #2: Measurable performance standards (baseline data) should be established, along with a detailed method for tracking, reporting and recordkeeping.

City staff must determine the suitable time frame between the construction of the compensation pond and the transfer of wildlife. This aspect of wetland relocation is significant since sufficient organic matter must accumulate in the pond bottom and emergent and submergent plants must have adequate time to become established to ensure a viable habitat for introduced fauna.

Recommendation #3: Wildlife salvage and transfer to the compensation pond should only occur once the pond becomes a functioning supportive habitat. A twelve month delay between pond construction and wildlife transfer would enhance wildlife survival.

Careful and regular monitoring over an extended period of time is vital to uncover problems that may arise, and to ensure greater probability for success.

Recommendation #4: The proponent will conduct an assessment, followed by monitoring enforcement, remedial measures and reporting for a minimum of five years.