Exploring Applications of the Net Gain Principle

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Section 1: Introduction

There is widespread recognition that, even though progress has been made in many areas, the global environment continues to deteriorate, and sustainable development is still an elusive, yet critical, goal. According to the United Nations Environment Programme:

"Loss of biodiversity continues, fish stocks continue to be depleted, desertification claims more and more fertile land, the adverse effects of climate change are already evident, natural disasters are more frequent and more devastating and developing countries more vulnerable, and air, water and marine pollution continue to rob millions of a decent life."[1]

Closer to home, the very sensitive and threatened Great Lakes Basin ecosystem continues to face pressures due to human activities, such as urbanization, water use, air pollution and waste generation. These practices, combined with the significant population growth expected in the Great Lakes region, will continue to stress the Basin's capacity to support future life. To reverse these powerful trends, Great Lakes stakeholders[2] need to develop new ways of thinking about and managing our shared resources in the Basin.

In leading the world to focus on the concept of sustainable development, the United Nations' World Commission on Environment and Development said, "Development today must meet the needs of the present without compromising the ability of future generations to meet their own needs."[3]

As we move closer (as we must) to the goal of long-term sustainability in the Great Lakes Basin and elsewhere, we will need to develop new concepts and tools, new policies, new institutions and new arrangements that will begin to address the environmental deficits that we face now. The idea of sustainable development means that a healthy and sustainable environment goes hand-in-hand with a healthy economy and a thriving society.

In economic terms, we need to re-balance budgets so that we are not dipping into our economic capital; we need to live off the interest that this capital provides. We also need to pay off the debts that we have accrued in order to get back on a healthy, economically sustainable footing. The same is true in social and environmental terms. This report explores how, for the environment, the principle of "net gain" or "net improvement" might be useful in establishing a new standard

[1] United Nations Environment Programme. Change and Challenge. A State of the Environment Briefing for the Global Environment Facility. 2002, p. 23.
[2] Includes academia, business representatives, First Nations, governmental agencies, non-governmental organizations and others whose actions affect or depend upon the environmental integrity and quality of the Great Lakes.
[3] World Commission on Environment and Development (Brundtland Commission), Our Common Future (Oxford/New York: Oxford University Press, 1987), p. 8.

for decision-making that will help bring us back into ecological balance. The report also examines whether, by striving for a net gain in ecological assets, we will be able to "pay off the ecological debt" and move our natural accounts back into a range that will head us in the long term direction of a more sustainable ecosystem, society and economy.

Pollution Probe, with a number of public and private sector collaborators, is working on putting in place practical solutions at a number of levels. At a macro level, we are working on a "Policy Framework for Environmental Sustainability" that we hope will benchmark the concepts and tools, policy instruments and processes that will move society towards a more environmentally sustainable relationship with the planet. At an issue-specific level, Pollution Probe has developed a "New Approach to Water Management" initiative, which takes a precautionary, prevention-oriented and forward-looking view of what is needed to achieve sustainability with respect to water quality and quantity. While our vision recognizes that many positive gains have been achieved over the years, it suggests that new partnerships, new institutions, and new ways of thinking about how to deal with the environment and water resources are needed.

In the context of the "policy framework" and "new approach" initiatives, this report focuses on one idea — the "net gain/net improvement" principle — with the hope that its application may help us "re-balance the accounts" and move closer to long-term sustainability. As our point of departure, we look at how the net gain (or net improvement) principle is emerging in the Great Lakes Basin. We also explore the net gain idea from the perspective of a number of related concepts and initiatives around the world.

What does "net gain" or "net improvement" mean, and how would we know when we have achieved it? Simply put, net gain means achieving a net environmental benefit. It could mean, for example, that when a change in land or water use is made, there would be widespread recognition that this change should only happen if it results in an improvement in the ecological assets of the area, in terms of the ecological services or functions and functional capacities of the affected ecosystems. How we measure net gain and know when we have achieved it will be the subject of considerable future work. This report points to some possible approaches. Throughout this report, we will use the terms "net gain" and "net improvement" interchangeably, but for the sake of brevity we will usually refer simply to "net gain."

To date, Pollution Probe has been involved in two initiatives that have explored the net gain principle. In one initiative, we worked in collaboration with others on the idea of using ecological currency concepts to develop, quantify and apply a net improvement standard to deal with new water withdrawal applications in the Great Lakes Basin. The project team, led by CH2M Hill and Enterprising Environmental Solutions Inc., was initiated to respond to the challenge of the June 2001 Annex to the Great Lakes Charter of the Great Lakes Governors and Premiers, which states that all new and/or increased water withdrawal proposals in the Great

Lakes Basin must result in an improvement to the waters and water-dependent natural resources of the basin.[4] Applying the net gain/net improvement standard using an ecological currency approach requires a new way of assessing projects that may have an impact upon the Great Lakes Basin ecosystem. The Ecological Currencies Project is examined in more detail in section 2 of this report.

In the second initiative, Pollution Probe prepared a paper for the Neptis Foundation that urged the Ontario government's Smart Growth Secretariat to adopt the net gain principle as a central concept guiding future land-use planning.[5] The basic concept is that growth can only be "smart" if development activities result in a net environmental benefit. In that report, we recommended that adopting the net gain principle would be an important contribution to ensuring that growth and development in Ontario happens in a more sustainable way.

Through work on these two initiatives, Pollution Probe believes that the net gain principle has merit, but there is a need to further develop answers to the question, "How do you measure and apply it?" Both science-based ecosystem measurements and policy development are required to move the net gain principle forward.

To advance thinking on the net gain principle, this report explores ways that this principle has been developed and used in various applications worldwide. It examines how different jurisdictions have applied, or are considering applying, the net gain principle and examines some complementary concepts, such as "no net loss."

Applications of the "no net loss" principle to protect and conserve natural resources have been examined because the net gain principle could be considered an extension of this principle. Pollution Probe believes that net gain goes beyond protecting and conserving, and looks towards enhancing ecological functions. Valuable lessons can be learned, however, by examining the no net loss principle and its implementation. "Cross-fertilizing" the principles and ideas used to develop and implement the net gain and no net loss principles can help us determine how best to chart a path forward.

The following applications of net gain and no net loss are analysed in this paper:

1. Using an "ecological currency" to identify and quantify improvements in the ecological integrity of the Great Lakes Basin for proposed new water withdrawal applications.
2. Applying net gain in urban planning initiatives.
3. Implementing the Kyoto Protocol.

[4] The Great Lakes Charter Annex — A Supplementary Agreement to the Great Lakes Charter. June, 18, 2001. See http://www.cglg.org/1pdfs/Annex2001.pdf.
[5] Pollution Probe. Air, Water and Soil Quality: An Issues Paper. 2003, p.12 http://www.neptis.org/pdfs/air_water_soil_ip2.pdf.

4. Applying net gain to protect and enhance remnant native vegetation in the State of Victoria, Australia.
5. Applying the no net loss principle to protect the productive capacity of fish habitat in Canada.
6. Applying the no net loss principle to protect and enhance wetland functions in Canada.

It is not possible in a report such as this to describe in detail each application of net gain/net improvement and the no net loss principle. Rather, key components of each application have been highlighted. Some applications demonstrate how to measure gains and losses even when the available scientific data are inadequate. Others indicate that there is a need to quantify gains before policy decisions can be made. Finally, and perhaps most importantly, these examples demonstrate the wide range of applications that can use the net gain principle to protect and enhance the quality of the environment.

1.1 What is Net Gain?

This review defines net gain as a net environmental benefit. Defining and measuring gains and losses in order to determine a net benefit or improvement can be done in ecological terms based on the values of environmental indicators. To measure gains and losses in economic terms, for example, "net income" would be defined as "revenue (benefits) minus expenses (costs)." In an ecological context, we take the word "net" to mean the value of the ecological benefits associated with a new change, activity or development, less the development's associated ecological losses. In considering the meaning of net gain, one should consider these questions:

- Is "net" assessed on a global, regional or local scale?
- What criteria should be used to measure progress towards the net gain goal?
- What are the appropriate benchmarks or reference conditions to which gains and losses should be compared?
- How much of a benefit is required to offset a loss?
- What types of losses and compensatory measures are acceptable?
- How are cumulative effects taken into account?

If a net environmental benefit is measured in ecological terms, ecological services (or functions) and their associated ecological values need to be considered. Ecological services refer to the natural properties and processes of ecosystems. Ecological values refer to the worth that humans place on ecosystems, such as the worth of clean water and recreational opportunities that ecosystems provide. Values may be measured and expressed using various value systems (or currencies). Ecological values can be measured in ecological units. Analogously, economic values are measured using monetary currencies, such as the dollar. An ecological currency approach to applying the net gain principle is described in section 2.1.

It is also important to address the fact that ecosystems are complex; often the science is not adequate to measure ecosystem services, and the data may not be readily available. If it is not possible to quantify ecological gains and losses, then qualitative measures must be a part of the net gain analysis. Individuals place different values on the quality of the environment, and their views on what constitutes a net environmental benefit may vary. As a result, it is important to include all interested and affected stakeholders in the decision-making process of determining how to measure or assess a net gain.

An interesting application of the net gain principle in the State of Victoria, Australia, resulted in the following descriptions: "A reversal, across the entire landscape, of the long-term decline in the extent and quality of native vegetation, leading to a net gain;" and "Net gain is the outcome for native vegetation and habitat where overall gains are greater than overall losses and where individual losses are avoided where possible." This application is described in more detail in section 2.4.

If the overall societal goal is to achieve sustainable development, it should be noted that this report is dealing with the net gain principle in mainly an environmental context. Before making a decision about an action, it may not be sufficient to consider only the ecosystem gains and losses associated with new development proposals. Ultimately, social and economic values will be considered. These aspects of decision-making are explored in greater detail in Section 3 of this report.

There are a number of challenging questions to address in exploring the net gain principle, but Pollution Probe believes the application of the net gain principle is important and may help bring about the paradigm shift we are looking for as society strives towards achieving sustainable development. The purpose of this report is to engage stakeholders in constructive dialogue around this promising and timely principle.

Section 2: Exploring Net Gain in Six Applications

2.1 The Ecological Currency Project

The ecological currency project provides background information on the net gain principle. It will assist the reader in understanding the applications that are examined in this report. The ecological currency project also demonstrates the importance of, and ways to quantify, net gains in ecological functions and services. Important policy considerations are addressed, such as the need to take cumulative effects into account and to make decisions on how much of an environmental benefit is enough to be considered a net gain.

The waters and water-dependent natural resources of the Great Lakes Basin remain at risk of damage from pollution, environmental disruptions and unsustainable water resource management practices, which may individually and cumulatively alter the hydrology of the Great Lakes ecosystem.[6] The Great Lakes Governors and Premiers have signed the Great Lakes Charter, Annex 2001, which states that all new and/or increased water withdrawal proposals in the Great Lakes Basin must result in an improvement to the waters and water-dependent resources of the basin.

Under the Annex, an improvement is defined as: "additional beneficial, restorative effects to the physical, chemical, and biological integrity of the Waters and Water-Dependent Natural Resources of the Basin resulting from associated conservation measures, enhancement or restoration measures which include, but are not limited to, such practices as mitigating adverse effects of existing water withdrawals, restoring environmentally sensitive areas or implementing conservation measures in areas or facilities that are not part of the specific proposal undertaken by or on behalf of the withdrawer."[7]

Under the provisions of the Annex, before a new water withdrawal proposal is accepted, the applicant must demonstrate that the proposed initiative will include an improvement to the ecosystem integrity of the Great Lakes Basin. Improvement is synonymous with net gain — both terms signify a net environmental benefit. In this case, a net environmental benefit can be defined as an ecological improvement to an existing impairment in the waters and water-dependent resources of the Great Lakes Basin. Some losses are expected, and therefore mitigation is an acceptable compensatory measure. To support the implementation of the improvement standard, Pollution Probe worked with CH2M Hill, Enterprising Environmental Solutions Inc. and other Great Lakes organizations (herein called project team) to develop an ecological currency approach that would identify and quantify improvements across a wide range of water withdrawals.[8]

[6]The Great Lakes Charter Annex — A Supplementary Agreement to the Great Lakes Charter. June, 18, 2001. See www.cglg.org/1pdfs/Annex2001.pdf.
[7]Ibid.
[8] A final report called "Creating Ecological Currencies for Resource Improvements" was produced. (Unless otherwise noted, it has been referenced throughout Section 2 of this report.)

An ecological currency is a unit of exchange used to compare the ecological changes of an ecosystem (i.e., ecological gains and ecological losses) that are measured in terms of the quantity and quality of ecosystem functions and services. To quantify ecological changes, the ecological currency approach applies a Habitat Equivalency Analysis (HEA)[9] model. With HEA, changes in ecological services are measured as percentage changes from a baseline or reference condition. The baseline condition is defined as fully functioning; the ecological services provided by the area in question provide an "ideal" habitat, and therefore the area provides 100 per cent of its ecological services per acre. Using HEA, the present ecological service flows per acre (as a percentage of baseline services) are compared to the predicted ecological service flows per acre (also relative to the baseline) from a new water withdrawal proposal. In order for the proposal to result in an improvement, the overall ecological service flows must increase over time with the proposed withdrawal. Describing the HEA quantification tool in detail is beyond the scope of this report. Only the components of HEA that relate to the resource improvement/net gain principle have been addressed below. For more information on HEA, the reader is invited to refer to Chapter 5 of the Ecological Currency report.[10]

The ecological currency approach includes a series of steps, tools and approaches that an applicant for a proposed new water withdrawal can use to help identify, evaluate and quantify improvements. The approach itself does not define how much of an improvement is enough to signify that a net gain in the ecological integrity of the Great Lakes Basin has actually occurred. The project team believes that, ultimately, government policy makers are responsible for making decisions on how much of a net gain is required to count as an improvement under the Annex. Resource improvements can be demonstrated in many ways, ranging from qualitative descriptions to the use of formal quantitative models. Quantification may not be necessary, but it adds value for the applicant, reviewers and other stakeholders, as it leads to greater predictability in decision-making. It enables proponents for new water withdrawals to find least-cost solutions that maximize resource improvements, while providing regulators with a consistent, systematic and defensible process.

[9] HEA has been used to in other applications to determine compensation for the public from injuries to natural resources resulting from the discharge of oil, release of hazardous substances, or physical impacts from vessels.

[10] CH2M Hill *et al*. 2003. Creating Ecological Currencies for Quantifying Resource Improvements, p.5.1–5.9.

2.1.1 Steps, Tools and Approaches Used to Quantify Net Gain

The steps that an applicant would take to achieve an improvement associated with a proposed water withdrawal project are described below.

1. *Define the water need.*
   The applicant defines the amount and timing of the proposed water withdrawal. Each water withdrawal application is evaluated on a case-by-case basis.

2. *Identify hydrologic and ecological pathways.*
   The applicant defines the pathways of the withdrawal and expected return flow. Settings, such as the water source, location of the return flow and consumptive loss estimates are determined.

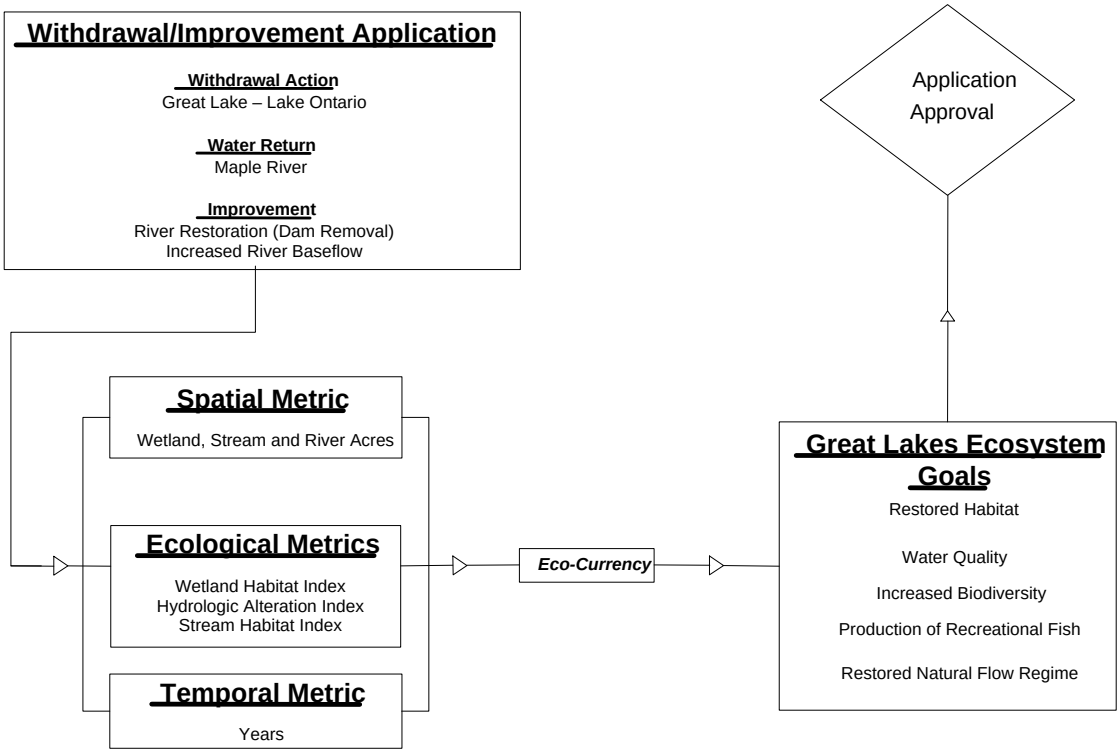
3. *Identify hydrologic and ecological impairments and improvement opportunities.*
   To identify improvement opportunities in the Great Lakes Basin, local impairments to the water and water-dependent natural resources of the water source and discharge location need to be identified. A water withdrawal application must provide assurance that, from a watershed perspective, a clear ecosystem improvement will occur and that a hydrologic-ecological linkage exists, whereby the improvement actions improve the ecological attributes directly affected by the withdrawal scenario. In some cases, in order to achieve an overall improvement, the withdrawal/return flow proposal may require actions to mitigate losses.

4. *Identify hydrologic and ecological linkages — quantifying changes in ecosystem functions and values.*
   At this stage, the applicant prioritizes which improvement opportunities identified in Step 3 should be implemented. The decision is based on which valued ecosystem functions are most affected by the proposed water withdrawal scenario and which indicators could best measure the changes in ecosystem functions. To assist applicants in decision-making, eight improvement goals related to improving existing impairments in the Great Lakes Basin were identified.[11] Appropriate indicators and indices that measure the changes in the associated ecosystem improvement goals, and that are responsive to potential new water uses and improvement actions, were also selected.[12] The list of "Great Lakes Ecosystem" goals and related indicators can be found in the Appendix.

   The applicant then uses a conceptual model to illustrate the relationship between the ecological goals, indicators and improvement actions for the water withdrawal application (see Figure 1).

[11] Based on literature reviews and stakeholder workshops.
[12] In the Ecological Currency Project, the term metric (or metrics) was used instead of indicator (or indices). A metric is used to measure the progress/regression made towards the ecosystem improvement goals.

Figure 1: Conceptual Model of a Hypothetical Water Withdrawal Scenario



For example, in Figure 1, the hypothetical water source is Lake Ontario. It has been determined that the withdrawal scenario could negatively impact wetland and stream habitat. However, the applicant has proposed the removal of an existing dam, an action that would restore the natural flow regime of Maple River, the river that is expected to receive the return flow of the withdrawal. If the gains achieved by the dam removal are greater than the wetland and habitat losses associated with the withdrawal, then it can be concluded that an overall improvement has occurred. These ecological debits and credits are quantified using the ecological currency approach and the Habitat Equivalency Analysis.

Ecological currency is the combination of ecological, spatial and temporal metrics used to measure the ecological debits and credits associated with the withdrawal and improvements, where debits and credits reflect movement away from, or towards, the ecosystem goals. Ideally, the metrics for a water withdrawal proposal would be recognizable and measurable with reproducible units, they would have a strong link to the ecological goals, and they would measure changes in valued ecological functions due to the withdrawal, return flow and improvement actions.

Ecological metrics include biological, chemical and physical units that measure the change in ecosystem function or services: spatial metrics are measurement units related to size or area (acre); temporal metrics are time-based

measurements that quantify the duration of the withdrawal, return flow and improvement (years). To acknowledge the fact that ecological services generated from an improvement project will not benefit society today, the flow of ecological services is discounted to the present, using the best available estimate of the public's time rate of preference.[13] Therefore, projects that take longer to implement and reach maturity must provide a greater flow of services to compete with actions that could be implemented today. Taking all of these attributes into consideration, the ecological unit becomes the "discounted-service-acre-year."

One discounted-service-acre-year (DSAY) is defined as one acre of habitat providing 100 per cent of reference condition services (i.e., full functionality) for one year. The currency is used in the Habitat Equivalency Analysis to quantify the change in the ecological value of the resource by summing the changes in DSAYs over time that would result from the new water withdrawal proposal. Using the DSAYs, the applicant can determine whether or not the new water withdrawal proposal will result in an overall improvement to the waters and water-dependent resources of the Great Lakes Basin.

5. *Select improvements that target Basin goals.*
   The applicant can repeat step 4 to find the least-cost solutions that maximize improvements.

6. *Develop the application.*
   The applicant submits an application for the proposed water withdrawal scenario to the appropriate regulatory authority. The application must include descriptions of a monitoring program and assurances that the selected improvement project will be effective in achieving the ecological goals. In addition, public outreach and information-sharing processes must also be established.

2.1.2 Policy Considerations

In the analysis described above, an important assumption has been made to account for cumulative effects of multiple withdrawal applications. It is assumed that each new withdrawal decision has taken into account the anticipated effects of previous (and current) withdrawal decisions to ensure that a net gain is achieved, locally, regionally and Basin-wide. Conducting assessments of cumulative effects at various scales should be the responsibility of a jurisdiction, such as a province or state, and not the applicant.

Policy makers must agree on what improvements count, how much of an improvement is required to be considered a gain, and what type of offsets would be acceptable under the Annex. The administrative system that governs Annex

[13] The National Oceanic Atmospheric Administration has adopted a three per cent discount rate as a matter of policy. This rate was used in the project.

2001 must have clear procedures and regulations that manage and minimize the uncertainty for the applicant, the regulator and the public. The applicant needs understandable, accessible procedures to follow that are fact-based, with established timeframes and clear appeal processes.[14] The public and the regulator will look for assurance that the proposed improvement action will occur. However, because the Great Lakes Basin is a complex and evolving ecosystem, it is possible that the proposed gain in ecological integrity associated with the withdrawal action may not occur. How uncertainty should be managed, and where the burden of unexpected outcomes should fall, are areas that need to be clarified.

Conflict over the weighting of impacts and benefits to Great Lakes resources is inevitable. As a result, stakeholders affected by the Annex 2001 improvement standard should be involved in the decision-making process. Appropriate oversight and enforcement authorities must be established. It is also imperative that any new policies establishing the net improvement standard do not conflict with existing (or appropriately modified) regulations.

2.2 Application of the Net Gain Principle in Urban Planning Initiatives

In this application, gains and losses are not based on ecological functions and services, but are proposed to be calculated using environmental indicators. This application demonstrates the need to apply net gain in urban planning initiatives. It is in the "idea" stage and therefore has not been fully developed. The application does, however, convey the variety of questions and issues that decision-makers must address when developing the net gain principle for this kind of application.

Urbanization has been a major source of stress to ecosystems such as the Great Lakes Basin. The ecological footprint of the Great Lakes Basin in terms of total waste generation of all kinds already exceeds the carrying capacity of the Basin, with resulting ecological feedback mechanisms delivering poor air, water and soil quality. According to the International Joint Commission, urbanization is threatening the water quality of the Great Lakes.[15] Urban sprawl is increasing demands on sewage treatment plants, increasing runoff as a result of increased impervious surfaces, destroying wetlands and causing air pollution deposition from increased vehicle traffic.[16] The threat continues, as the population of the Great Lakes Basin is expected to rise. The population of Ontario, for example, is expected to increase by more than 22 per cent in the next 30 years. If low-density, automobile-dependent, "business-as-usual" development continues, environmental problems will become much worse than today.

Smart growth initiatives have been proposed or are under consideration in communities across North America to design strategies that reduce urban sprawl in

[14] Henderson and McCabe. 2003. Developing a Decision-making Standard for Great Lakes Water Withdrawals.
[15] The International Joint Commission. 2001-2003 Priorities and Progress under the Great Lakes Water Quality Agreement, p.76.
[16] Ibid., p.79.

ways that are economically, socially and environmentally sustainable.[17] Well-managed growth is viewed as an opportunity to improve a community's competitiveness and enhance the quality of life and the environment. Pollution Probe believes that the net gain principle should become the overarching principle against which future urban form and growth management decisions are assessed. The net gain principle is the only way "…that we can stop depleting natural capital, such as forests, wildlife, agricultural land, and water, upon which life on this planet depends, and go beyond to undo some of the existing damage."[18]

In September 2002, Pollution Probe submitted an issue paper through the Neptis Foundation[19] urging the Central Ontario Zone Smart Growth Strategy Panel[20] to set an aggressive 25 per cent net gain target for specific environmental indicators, relative to established baselines. The basic concept of net gain in the Smart Growth context is that: "Growth cannot be 'smart' unless it results in a net environmental benefit." [21]

Proponents of new developments should be required to implement actions that would more than offset the environmental impacts of their developments and achieve a net gain in air, water and soil quality. To recognize and accommodate population growth, Pollution Probe recommended that net gain calculations should measure the total, not per capita, improvements. Ten potential environmental indicators that could be used to track the net environmental impacts of new developments were selected, and are shown in Table 1. The developer would be responsible for achieving an overall net gain among the indicators. Trade-offs among indicators were considered acceptable, depending on the circumstances of the proposed development. The indicators were chosen because they are linked to the quality of air, water and soil, are usually quantifiable, and if not, they can be used to provide a sense of direction on whether or not the project is heading towards a net gain or loss.

[17] Central Ontario Smart Growth Panel. 2003. Shape the Future, p.1.
[18] [20] Pollution Probe. 2003. Air, Water and Soil Quality: An Issues Paper (2003), p.12. www.neptis.org/pdfs/air_water_soil_ip2.pdf. (Unless otherwise noted, this paper has been referenced throughout Section 3.)
[19] The Neptis Foundation, based in Toronto, Ontario, Canada, was established to foster knowledge and ideas on how urban regions function and grow. www.neptis.org.
[20] The Central Ontario Smart Growth Strategy Panel was appointed by the Ontario Minister of Municipal Affairs and Housing in February 2001 to advise the government on a long-term growth strategy.

Table 1: Ten Potential Indicators for Net Environmental Gain

1. Emissions of nitrogen oxides and volatile organic compounds (which affect air quality and human health through ground-level ozone formation).
2. Emissions of fine particles (which create smog and harm human health).
3. Emissions of sulphur dioxide (which cause smog and acid rain, thus harming human health and natural capital).
4. Emissions of greenhouse gases (which cause global warming and widespread negative effects on human health and natural capital).
5. Total and per capita water consumption (which affects ecosystems and natural capital).
6. Regional percentage of impervious surfaces (which is linked to water quantity and quality).
7. Protection of significant woodlands and significant wildlife habitat (which contributes to increasing natural capital).
8. Brownfield clean-up and re-development (which contributes to urban intensification and to restoring natural capital).
9. Population density per hectare (which contributes to the viability and cost-effectiveness of urban transit and protects natural capital — greenfields — from unnecessary development).
10. Agricultural and natural land preservation (which enhances food security and contributes to maintaining natural capital).

According to the Pollution Probe issues paper, the selection of environmental indicators in Table 1 is a preliminary list that should be developed and expanded upon. Benchmark values of the selected environmental indicators, to which new improvement proposals can be compared, must also be established. Is it reasonable, for example, to establish benchmark values based on the state of the "natural" environment, which has not experienced growth? If stakeholders agreed on the definition of the natural environment, and it was selected as the benchmark value, it may be sometimes difficult, if not impossible, to achieve an improvement for a specific new development and, therefore, a net gain in certain environmental indicators. Perhaps the environmental impacts from new developments should be compared to those that would occur from a business-as-usual development approach. Then one must decide how much of an increase in the measurement values of the indicator(s) is required, relative to the selected benchmark value(s), to demonstrate that the proposed development project has achieved a net gain. Assuming that tradeoffs among indicators are permitted, then decisions on what constitutes reasonable tradeoffs must be made.

It is important to highlight that Smart Growth is not purely an environmental concept. The initiative is based on the principles of sustainable development, whereby social, economic and environmental factors are equally emphasized. It

has been argued that sustainable, long-term growth can only be achieved by protecting the planet's ecological resources. Therefore, by achieving a net environmental benefit, we will improve ecosystem health, and in turn protect our own health and the productive capacity of the economy, thereby moving towards sustainable development.

2.2.1 An Example — Low Impact Development

Low Impact Development (LID) is a conceptual tool that may work well with a net gain approach to control growth-related impacts on the environment. The objective of LID is *"…to maintain and enhance the pre-development hydrologic regime of urban and developing watersheds"* — a net gain. LID incorporates strategic planning and micro-management techniques to achieve environmental protection, while allowing development or infrastructure rehabilitation to occur. Some communities, such as the Town of Huntersville, North Carolina, have turned to LID to address growth-related water quality problems. An ordinance was passed requiring developers to use LID to control runoff volume and improve water quality. Developers use a Site Evaluation Tool, which calculates the site runoff volume and pollutant quantities of present conditions, as compared to developed conditions without Best Management Practices and those with Best Management Practices. The developer modifies proposed site plans to comply with a series of performance criteria designed to meet the water quality goals. To date, the tool has been used for pilot projects, but will be applied for new development proposals.[22]

2.3 Kyoto Protocol

The Kyoto Protocol can be viewed as an example of the net gain principle in action, depending on the definition of what constitutes "a net environmental benefit" and the benchmarks selected for the analysis. This application demonstrates that people's differing values and opinions affect the definition and development of the net gain principle. Some say there is no way the Kyoto Protocol represents a net gain to the environment because we are so far beyond equilibrium in atmospheric concentrations of carbon dioxide. Others say the Protocol will result in a global net gain and that the collective approaches the world is using to deal with climate change may be instructive.

On December 17, 2002, Canada ratified the Kyoto Agreement, thereby committing to reduce greenhouse gas emissions to six per cent below 1990 levels by the period between 2008 and 2012. Reducing greenhouse gases will contribute to the global climate change effort, help clean the air and create opportunities for investment in new, advanced technologies. Depending on how one views what constitutes a net gain, the six per cent reduction target (for Canada) may or may not be considered an application of the net gain principle (depending on the selection of the benchmark value and the definition of net environmental benefit). The following

[22] United States Environmental Protection Agency. Nonpoint Source News Notes, #72. September 2003, p.9.

two examples demonstrate the importance of selecting an appropriate and relevant standard from which to compare a net gain.

According to one point of view, the benchmark is the level of greenhouse gases emitted in 1990. The net environmental benefit would be the reduction of greenhouse gas emissions, and the net gain would be the per cent reduction in greenhouse gas emissions.

However, some stakeholders argue that reducing greenhouse gas emissions by, say, six per cent is not enough to signify a net gain because a six per cent reduction barely has an impact on climate change. Climate change will continue to occur at a significant, albeit perhaps somewhat slower, rate. In their opinion, achieving a net gain means substantially reducing the rate of human-induced climate change, such that the concentrations of greenhouse gases in the atmosphere can at least begin to stabilize. According to the Intergovernmental Panel on Climate Change, an 80 per cent reduction in North American greenhouse gas emissions below 1990 levels is required to stabilize greenhouse gas concentrations. This does not imply that there will be no further climate change, but that the anthropogenic climate change effects will end. In this viewpoint, the benchmark can still be the level of greenhouse gases emitted in 1990. However, the net environmental benefit is "stopping the rate of climate change induced by human activities," and the net gain goal is the 80 per cent reduction target in greenhouse gas emissions.

2.4 Application of the Net Gain Principle to Protect Native Vegetation (Victoria, Australia)

This application demonstrates the value in looking internationally for applications of the net gain principle. It presents another method that can be used to quantify and account for gains and losses, even when absolute measurements do not exist. The selection of a baseline, as well as decisions on how much of a benefit is enough to constitute a net gain, have been described. This section also describes how the Victoria government aims to achieve net gains through non-regulatory methods.

In Victoria, Australia, due to population growth and economic development, an estimated 66 per cent of the State's native vegetation has been cleared since European settlement (post-1750). Clearing controls introduced in 1989 reduced land clearing from an average of 13,000 hectares per year to approximately 2,500 hectares per year; however, the annual land clearing rate remains unsustainable, and the quality of the remaining native vegetation continues to decline. In addition, ecosystems continue to be adversely affected by developments that degrade soil, increase salinity, undermine biodiversity, and reduce water quality and quantity.[23] To improve the quality of remnant vegetation, accelerate revegetation activities and achieve ecological sustainable development on private land, the Government of the State of Victoria (in consultation with a broad range

[23] Government of Victoria (Australia). 2002. Native Vegetation Management Plan — A Framework for Action. (Unless otherwise noted, this paper has been referenced throughout Section 5.)

of stakeholders) developed, and in 2002 endorsed, Victoria's Native Vegetation Management — A Framework for Action. The framework establishes a consistent approach to account for, protect and enhance native vegetation. The primary goal for native vegetation management is to achieve:

"A reversal, across the entire landscape, of the long-term decline in the extent and quality of native vegetation, leading to a Net Gain," and "Net gain is the outcome for native vegetation and habitat where overall gains are greater than overall losses and where individual losses are avoided where possible."

When reviewing new or expanding development proposals, the effects of the proposal on both the quantity and quality of native vegetation and habitat are taken into account. The net gain principle can be applied through taking the following three steps:

1. Avoid adverse impacts, particularly through vegetation clearance.
2. If impacts cannot be avoided, minimize impacts through appropriate mitigation options, and obtain the advice of experts in the project design and management stages.
3. Achieve gains in the extent and quality of native vegetation by selecting the appropriate offset actions.

The Government established a methodology to quantify the net outcome for native vegetation due to new development proposals, using the net gain principle, a "habitat hectare" approach and conservation significance levels. The Framework was designed to deal with unknowns in classifying a wide variety of vegetation communities, to quantify the quality of native vegetation and habitat when absolute measurements do not exist, to select appropriate benchmark values, and to determine how much action is enough to ensure that there is a net gain in native vegetation. It has also been designed so that assessments can be made quickly by non-specialist ecologists. By learning about Victoria's Native Vegetation Management Framework, North Americans can gain valuable knowledge about different ways to assess and achieve the net gain principle, potentially for any application. A simplified version of the methodology used in the Framework is described below.

2.4.1 A Simplified Approach to Quantifying Net Gain

The framework for native vegetation management uses a combined quality-quantity measure, called the "habitat hectare" approach, to evaluate losses and gains of native vegetation and habitat over a specified area and period of time. The "habitat hectare" approach is calculated using the following formula:

1 Habitat Hectare = Habitat Score (quality measure) X Habitat Area

The habitat area represents the area of native vegetation affected by the development, and is measured in hectares. However, because an absolute measure

of vegetation or habitat quality does not exist, determining the quality measure is much more challenging. In this case, the "habitat hectare" approach uses a practical, relative measure by combining a number of well-accepted indicators. The habitat quality measure, also called the habitat score, is described in greater detail below. The "habitat hectare" approach is analogous to the Habitat Equivalency Analysis (HEA) approach taken by the Ecological Currency Project described in section 2.1 of this report.

The quality of an assessed vegetation site is compared to an established benchmark, which represents the average characteristics of a "natural," mature and long-undisturbed vegetation community of the same type. Typically, benchmark values are established based on the state of existing natural vegetation that has not been through any major ecosystem changes, or based on historical information on native vegetation before European settlement. Parkes *et al*. point out that it would be impossible to return all vegetation to its former state, but the choice of the benchmark was "…simply to provide a consistent and logical reference point for naturalness against which loss of quality and direction for improvement can be considered."[24]

As with ecosystems, vegetation communities are defined by a number of attributes. A broad range of ecologists and botanists selected nine site-condition components (also called indicators) and three landscape context components, which typically shape the characteristics of vegetation communities (Table 2).[25] Each component is assigned a weighted score, depending on how important the component acts as an indicator of the vegetation community. For example, "understorey components" are weighted higher (with a maximum value of 25 per cent) than logs because the understorey is typically much richer in plant life and can be a better indicator of site disturbance. Since there are many different types of vegetation communities, some will not contain all of the components outlined in the table. In such cases, the irrelevant components are deleted and the remaining ones are standardized.

[24] Parkes, D., *et al*. 2003. Assessing the quality of native vegetation: The 'Habitat Hectares' Approach.
[25] For more information on these components, the reader is asked to refer to Parkes *et al*.

Table 2: Components and Weightings of the Habitat Score

	Component	Max. Value (%)
Site condition	Large trees	10
	Tree (canopy) cover	5
	Understorey (non-tree) strata	25
	Lack of weeds	15
	Recruitment	10
	Organic litter	5
	Logs	5
Landscape context	Patch size	10
	Neighbourhood	10
	Distance to core area	5
		100

A field officer visits the affected vegetation community and uses established guidelines and criteria to determine the habitat score value for each component of the assessed community. The guidelines and criteria have been designed so that assessments can be made quickly by non-specialist ecologists. Each score is recorded, and the total is calculated to obtain the final habitat score. The habitat score represents the proportion of the complete habitat present, and the highest possible score is 100 per cent. Subsequently, using other established guidelines and criteria, the conservation status of the vegetation community is determined according to its rarity, degree of threat and importance for supporting other significant features (endangered, rare, etc.).

Using the habitat score and conservation status, the conservation significance of the vegetation community can be determined (see the Appendix). The conservation significance dictates whether or not the development proposal can be accepted, and if so, what type of actions must be taken to ensure that the outcome is a net gain in native vegetation. The priority is to avoid clearing. If clearing is permitted, offset criteria have been established to provide a clear link between gains and losses and to ensure that the appropriate amount of mitigation effort has been met. The following is a sample of the chart used to determine the actions and offset criteria, graded according to the conservation significance of the vegetation community.

Table 3: Summary of Responses and Offset Criteria graded according to Conservation Significance[26]

Conservation Significance	Very High	High	Medium	Low
Response to proposal to clear and offset	Clearing not permitted unless exceptional circumstances apply (i.e., impacts are an unavoidable part of a development project with approval of the Minister for Conservation and Environment (or delegate) based on considerations of environmental, social and economic values from a state-wide perspective).	Clearing generally not permitted.		Clearing may be permitted but only as part of an appropriate sustainable use response as determined by the responsible planning authority.
If some clearing is to be permitted, the following offset requirements must be met.				
Net outcome	Substantial net gain (i.e., at least 2 X the calculated loss in habitat hectares[1]).	Net gain (i.e., at least 1.5 X the calculated loss in habitat hectares[1]).	Equivalent gain (i.e., at least 1 X the calculated loss in habitat hectares[1, 2]).	Equivalent gain (i.e., at least 1 X the calculated loss in habitat hectares[1, 2]).
Formal agreement to achieve and secure offset	Requirements to achieve offsets must be identified in the associated management agreements and/or the permit conditions. Gains must be of an ongoing and secure nature. Once achieved, the offset must be maintained and the relevant planning authorities must maintain adequate and readily accessible records of agreed offset arrangements (ultimately on the Native Vegetation Permit Tracking system).			

[26] Adapted from: The Government of Victoria, Australia. 2002. Victoria's Native Vegetation Management — A Framework for Action, p. 54.

Conservation Significance	**Very High**	**High**	**Medium**	**Low**
Like-for-Like				
vegetation or habitat type of offset	The same vegetation/ habitat type.	The same vegetation/ habitat type OR a Very High significance vegetation/ habitat in the same Bioregion.	Any Ecological Vegetation Class in the Bioregion OR a Very High or High significance vegetation/ habitat in an adjacent Bioregion.	
landscape role	Similar, or more effective, ecological function AND land protection function as impacted by the loss.	Similar, or more effective, ecological function OR land protection function as impacted by the loss.	Similar, or more effective, land protection function as impacted by the loss.	
quality objectives for offset	The existing vegetation proposed as the basis of an offset must be at least:			
	90 % of the quality in the area being lost.	**75%** of the quality in the area being lost.	**50%** of the quality in the area being lost.	
	The proportion of revegetation included in the offset (in habitat hectares) is limited to:			
	10%	25%	50%	100%
Large old tree objectives for offset	**For remnant patches of native vegetation that contain large old trees** for each large old tree removed as part of permitted clearing:			
	Eight other large old trees to be protected AND 40 new trees to be recruited.	Four other large old trees to be protected AND 20 new trees to be recruited.	Two other large old trees to be protected AND 10 new trees to be recruited.	no specific 'other large old tree protection' offset required.

[1] Gains can include active improvements of quality and/or avoiding potential losses of quality by agreement to forego permitted uses. Note that applying all of the following offset criteria (where relevant) may require more than the minimum habitat hectares specified by these multipliers.
[2] Where gains are achieved in vegetation/habitat of a higher significance than the vegetation lost, the amount of the offset will be proportionally reduced (e.g., offsetting losses in medium conservation significance with very high conservation significance gains will reduce the amount of the offsets required by half; for example, the medium multiplier divided by the very high multiplier).

If a vegetation community has been graded "high" then clearing is generally not permitted. If clearing is permitted, then the proponent for development must demonstrate that a minimum net gain of 1.5 times the calculated loss (in habitat hectares) will be achieved before the proposal can be accepted. Calculation of the amount of gain associated with the offset actions is based on an estimate of the improvements that would be realized within ten years of the actions being initiated.

To achieve a net gain, the chart outlines the required like-for-like compensatory measures. For example, for a vegetation community ranked with high conservation significance, a vegetation community ranked as very high or high must be established in the same bioregion; the same or more effective ecological functions or land protection functions must be established; four large old trees must be protected and twenty new trees recruited. In addition, the vicinity and timing requirements for the implementation of the compensation action(s) have also been defined. The proponent for development can analyze the different options to determine which offset action(s) would be most feasible and cost-effective. A commitment for the implementation of the offsets is formalized and an enforceable management plan is established.

2.4.2 Policy Considerations

Approximately seventy local governments in the State of Victoria (200,000 km^2) are the responsible authorities that make decisions on planning applications. If a proponent for development objects to the decisions made by the authority, an appeal can be made to the Victorian Civil Appeals Tribunal, which typically hears appeals on a range of administrative and planning decisions.

The Government of Victoria believes that regulations to control clearing of native vegetation are essential, but they are only part of a range of tools necessary to achieve a net gain in remnant native vegetation. Providing encouraging incentives to landholders is another means. For example, a Natural Heritage Trust Partnership Agreement between the Government of Australia and the state governments has been established to achieve a net gain in Australia's native vegetation. One component of the Trust has resulted in more than $36 million invested in on-the-ground projects to reverse the decline in extent and quality of native vegetation over the four years of the program. Another example is an incentive program called BushTender. BushTender is a competitive auction process in which landholders establish a price for the management services they are prepared to offer to improve native vegetation on their land. The Government compares the tenders, and the landholders offering the best value for the money receive periodic payments for their services under a three-year management agreement.

Some non-governmental organizations based in Victoria agree with the Government's goal to protect and increase remnant vegetation in the State. However, they are concerned with the proposed net gain trade-off approach, as

they believe it allows clearing of native vegetation in one area in exchange for revegetation in another.[27]

2.5 Application of Net Gain and No Net Loss — Fisheries and Oceans Canada

This application demonstrates the development and implementation of the no net loss principle. It is examined in this report because net gain can be seen as an extension of no net loss; no net loss focuses on protection and conservation, while net gain includes both of these components and goes one step further to include "enhancement." As a result, in the process of examining the ways in which the Canadian Government has developed and implemented the no net loss principle, valuable lessons may be drawn on how to implement the net gain principle.

The Canadian *Fisheries Act* states that no person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat[28] unless authorized by the Minister or regional Habitat Management staff of the Department of Fisheries and Oceans Canada (DFO). To guide staff in interpreting and implementing these authorization powers, DFO developed a Policy Framework for Fish Habitat Management. The Framework's long-term policy objective is to: "achieve an overall net gain in the productive capacity of fish habitats."[29]

Productive capacity means the natural capability of habitats to produce healthy fish that are safe for human consumption, or to support and produce aquatic organisms upon which fish depend. In an effort to achieve a net gain, the following three goals have been established:

Goal 1: Fish Habitat Conservation
Goal 2: Fish Habitat Restoration
Goal 3: Fish Habitat Development

Goals two and three focus on achieving a net gain of fish habitat. DFO believes that Fisheries Management Plans and Watershed Management Plans are essential components of any net gain assessment. Watershed-based management planning enables the community and decision-makers to understand the needs of the watershed community, which includes the natural environment. Using this information, informed decisions can be made on selecting and setting priorities for the types of actions that are required to reverse ecological damage and achieve a net gain in the productive capacity of fish habitat. With Watershed Management Plans, decision-makers can also see the big picture and understand the

[27] Environment Victoria. 2001. www.nccnsw.org.au/member/cbn/projects/LifeLines7.1/NatVeg_VIC.html.
[28] Fish habitat comprises physical, chemical and biological attributes of the environment that are required by fish to carry out their life processes.
[29] Fisheries and Oceans Canada. 1986. Policy for the Management of Fish Habitat. (Unless otherwise noted, this document is referenced throughout Section 6).

implications of development proposals on a larger scale. To date, DFO is expanding research on technology and procedures that will contribute to the effective application of the net gain policy objective. The application of the net gain principle for the rehabilitation of the productive capacity of fish habitat has been investigated for a new development project in the Grand River watershed in Waterloo, Ontario, Canada, but limited information is available.

To achieve fish habitat conservation and protection and to maintain the productive capacity of fish habitats (Goal 1, above), no net loss (NNL) is used as the guiding principle. "The Department will strive to balance unavoidable habitat losses with habitat replacement on a project-by-project basis so that further reduction to Canada's fisheries resources due to habitat loss or damage may be prevented."[30]

Based on the no net loss principle, DFO has developed Habitat Conservation and Protection Guidelines that are used by staff to conserve and protect habitat and ensure that new development projects are assessed and treated equitably across Canada.[31] In the process of examining the guidelines, as well as DFO's implementation strategies and procedural classifications, we should be able to discover ways to develop and implement the net gain principle, as it is a direct extension of no net loss. A Habitat Alteration Assessment Tool helps to quantify gains and losses in a scientifically defensible way. Highlights of some of the approaches that DFO uses to apply the no net loss principle are described below.

2.5.1 Applying the No Net Loss Principle (Goal 1)

The no net loss principle is applied on a project-by-project basis. Fish Management Plans are typically required, as the no net loss principle is applied on either a fish stock-specific or a geographic basis, depending on how fisheries are managed and harvested. When a new development site is proposed where fish habitat is present, an assessment officer from Fisheries and Oceans will evaluate whether or not the project could alter, disrupt or destroy the productive capacity of the habitat(s). In cases when there is doubt about the impact of a project on fish habitat, and when sufficient information is not available, the Policy recommends that assessment officers adopt a precautionary approach. When the risk can be demonstrated, the officer works with the developers and relevant provincial agencies to find ways to avoid any loss. In larger habitat loss projects, several sections within the department are involved in the decision-making process.

The application of the no net loss principle is dependent upon the "relative importance" of the fish habitat being assessed. For example, a habitat may be designated as critical if it contributes to sustaining the nation's fisheries resources for commercial, recreational or Native fishing activities.[32] Development projects affecting critical habitats may not be approved. DFO is less stringent on approving

[30] Ibid. Section 2.2.1.
[31] Fisheries and Oceans Canada. 1998. Habitat Conservation and Protection Guidelines.
[32] Fisheries and Oceans Canada. 1998. Habitat Conservation and Protection Guidelines. Section 4.

losses for marginal habitats. However, a higher-value type of habitat is typically required as a compensatory measure and, as a result, may result in a net gain of habitat. For example, DFO may require that a square meter of open shore zone with low productivity be offset by a square meter of wetland type shore habitat. Potential impacts of a development project are also assessed according to the type, size and functionality of the affected habitat.

For some developments the loss of the productive capacity of fish habitats in the immediate area may be inevitable. As a result, a hierarchy of options has been established for offsetting habitat losses, which provides guidance (but also flexibility) to both fisheries managers and proponents of developments. The hierarchy aims to maximize the potential for achieving no net loss by replacing the impacted habitat with similar habitat, as close as possible to the impacted area, without actually requiring the comparison of productive capacity before and after project development.[33] In order of preference the hierarchy of options to protect habitat from adverse effects in accordance with the no net loss guiding principle are:

1. Relocation: Encourage the developers to select an alternate site, or move part of a project to eliminate adverse impacts.
2. Redesign: Redesign the project so that it does not have any negative impacts on fish habitat.
3. Mitigation: Reduce adverse impacts by, for example, selecting less harmful equipment and minimizing interference with fish migration and spawning.
4. Compensation: Compensatory measures are only accepted if the first three options are insufficient to achieve a NNL. Decisions are made on a case-by-case basis. Some of the compensation options most commonly used, in order of preference from an ecological perspective, include:
    a. Like-for-like compensation — Create similar habitat or increase the productive capacity of existing habitat at or near the development site within the same ecological unit (e.g., a square meter of loss can be offset by a square meter of replaced habitat, if it is approximately the same type in the same area).
    b. Off-site compensation — Create similar habitat or increase the productive capacity of existing habitat in a different ecological unit that supports the same stock or species.
    c. Increase the productive capacity of existing habitat for a different stock or a different species of fish, either on- or off-site.
    d. Artificial propagation — Replace the natural productive capacity of fish habitat with artificial production (rare cases).

[33] Fisheries and Oceans Canada. 1998. Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat, p. IV.

The proponents are responsible for determining and implementing the mitigation and compensation measures, and for providing evidence that the proposed measures will be effective, that their effectiveness will be monitored, and that any deficiencies will be corrected.

2.5.2 Quantifying No Net Loss

Unlike the Ecological Currency Project or Victoria's Native Vegetation Management Framework, the Policy for Fish Habitat Management has not established a standardized, consistent method to quantify the net outcome of a proposed development project. Neither has it established standardized references or benchmarks. The method to assess whether the project will result in no net loss is quite subjective, and quantitative assessments of productive capacity are rarely, if ever, completed. It is difficult to link biophysical attributes of fish habitat and productive capacity, and as a result, assessment officers frequently estimate the effects of the development on the fish habitat. Often basic ecological principles, physical parameters, such as area of habitat, and biological descriptors, such as spawning grounds, are used as surrogate measures to assist in defining productive capacity because that is all that is available.

DFO believes that, given the uncertainty and difficulty in quantifying productive capacity, there is a greater likelihood of achieving no net loss by maintaining the existing integrity and functionality of fish habitat. For this reason, relocation and redesign are the preferred options to achieve no net loss. Decisions on how much mitigation or compensation is enough to ensure that there is no net loss in the productive capacity of fish habitats are often based on the decision-maker's experience and knowledge of the species in the area. They also depend on the "relative importance" of the habitat — which is often determined on the basis of subjective criteria.

2.5.3 Policy Considerations — The Decision-making Process

Following the project assessment, if the proposed development project is large, and if the habitat officer concludes that a net loss cannot be avoided, the public is consulted. Typically a provincial or federal environmental assessment process takes place. Then DFO takes public concerns, as well as economic and environmental benefits and costs, into consideration before making a final decision on whether or not to authorize the development project. All decisions made throughout the evaluation process, from the project assessment to the final decision, are well documented with supporting rationale. If a project is not authorized to proceed, the Habitat Policy entitles the developers to appeal the decision to senior managers within the Department of Fisheries and Oceans Canada, including the Regional Directors-General, the Deputy Minister or the Minister of Fisheries and Oceans. Fisheries and Oceans Canada is obligated to ensure that compliance monitoring and evaluation programs are carried out.

Although the *Fisheries Act* does not control activities such as land-use developments and air pollution on an ecosystem-wide basis, DFO continues to cooperate with other agencies and other levels of government to implement integrated resource management procedures, and to achieve a net gain in the productive capacity of fish habitats on an ecosystem basis.

2.6 Application of the No Net Loss Principle to Protect Wetland Functions

This application also uses the no net loss principle. It is similar to Section 2.5, and the reader is encouraged to review Section 2.5 first. This application provides additional value by demonstrating that it is possible to apply the no net loss approach and, by extension, the net gain principle, despite scientific and data limitations. It also demonstrates that the application of the no net loss principle can increase awareness of the importance of wetlands among policy makers and the public, an outcome that should also be achieved with applications of the net gain principle.

The Canadian Federal Policy on Wetland Conservation uses no net loss as a guiding principle. The Policy commits federal departments to avoid wetland function losses on all federal lands and waters, and also where federal activities affect wetlands designated as ecologically or socio-economically important to a region. Federal departments are also encouraged to apply the net gain principle to: "enhance and rehabilitate wetlands in areas where the continuing loss or degradation of wetlands or their functions have reached critical levels."[34]

Proponents for development projects that may affect wetlands must obtain information on wetland functions and the values that the wetlands provide to humans. These include the hydrological, biogeochemical, habitat and ecological functions of the wetlands, as well as social, cultural, commercial and recreational values that the wetlands provide. The Canadian Federal Policy on Wetland Conservation recognizes that not all wetland losses can be avoided. As a result, wetland mitigation is used as the primary approach to meet the no net loss target on a project-by-project basis. The proponent and the authority working to protect wetlands (either a provincial authority or the Canadian Wildlife Service Branch of Environment Canada) work together to agree on a mitigation plan. The plan outlines the actions that the developer will take to protect the quantity and functional capacities of wetlands. To guide this process, a strict sequence of mitigation alternatives, with clear criteria and defined outcomes, has been developed under the Policy. The mitigation alternatives are as follows:

1. Avoidance — is recommended for all developments that may adversely affect wetland functions, but specifically for wetlands designated as ecologically or socio-economically important to a region, in areas where wetland losses have been severe, or for projects with feasible alternatives.

[34] Government of Canada. 1991. The Federal Policy on Wetland Conservation. (Unless otherwise noted, this document is referenced throughout Section 7.)

2. Minimization — modify project proposal to reduce or control adverse effects to wetland functions.
3. Compensation — replace unavoidably lost wetland functions through enhancement or rehabilitation of existing wetlands, or create new wetlands. Compensation can only be used to offset the impacts of a development once all opportunities to minimize them have been taken.

When compensation is required to replace lost wetland functions due to development proposals, Environment Canada and the North American Wetlands Conservation Council (Canada) have developed a generally accepted order of priority for compensation options.[35] Table 4 shows this order of priority:

Table 4: Compensation Options

Compensation Option	← Most favoured		Least favoured →
Mitigation Type Fully restored wetlands are preferred over newly created ecosystems	Restoration	Enhancement	Creation
Timing of Mitigation Compensation should begin before the project is initiated	Before	Concurrent	After
Location of Mitigation (relative to project site)	On-site	Off-site, in same ecosystem	Off-site, in other ecosystem
Wetland Type	In-kind		Out-of-kind

Table 4 demonstrates that the preferred compensation action is one that fully restores wetlands in the same ecosystem affected by the development, and that begins before the development project is initiated. In addition, if a compensation project is accepted as a mitigation alternative, the compensated area is generally required to be about one-and-a-half to three times larger than the original wetland area. The ratio used depends on various factors, such as the likelihood that the lost wetland functions will be replaced, the length of time required to bring a compensation site to functioning condition, and threats to the site. Strong monitoring requirements and inventory protocols are also recommended.

[35] Environment Canada and the North American Wetlands Conservation Council (Canada). 2000. Working with Wetlands — A Training Course on Considering Wetlands in Environmental Assessment under CEAA, p.27.

To date, the application of the mitigation process for wetland conservation has generally been on an ad hoc basis, primarily because no standardized, accepted procedure exists. There is a need for a standard procedure in Canada to identify and measure wetland functions and values for purposes such as mitigation design.[36]

2.6.1 Quantifying No Net Loss in Wetland Functions

For each wetland affected by a proposed development project, the scale of mitigation efforts required to compensate for losses depends on the functions that the affected wetland performs, the value or importance of the wetland, and the degree to which the wetland is performing functions relative to other wetlands or to an optimum standard. However, quantifying the functions and functional capacities of wetlands is difficult. In this case, wetland assessments are typically based on best professional judgments from knowledgeable ecologists, or on functional assessment methods, which use key physical, chemical and/or biological attributes of the wetland, such as vegetation type and density, to determine its function. Similar to the Policy Framework for Fish Habitat Management, the analysis can be quite subjective. In addition, valuing wetlands and deciding which wetland functions should be retained or replaced often depends on when, where and to whom they are important. For example, wetlands important to flood control may be replaced in the same hydrological area, and wildlife habitat may be replaced within a Native hunting area.[37] Due to limitations in understanding wetland functions, as well as limited capacity to restore or create wetlands, avoidance is the key step in the mitigation process and is considered the best way to ensure no net loss of wetland functions.[38]

To date, the Canadian Federal Policy on Wetland Conservation has been successful in raising the profile of wetlands in federal decision-making processes. The no net loss goal has represented an improvement over previous approaches. It has been claimed that fewer losses of wetlands have resulted from the application of the no net loss principle. The Policy has also established the basis for the Canadian government to promote wetland protection, sending a clear message about the importance of wetland protection to the general public.[39]

[36] Lynch-Stewart, Pauline. 2003. Recommendations made to the North American Wetlands Conservation Council (Canada) at the Canadian Wetlands Stewardship Conference.
[37] Environment Canada and the North American Wetlands Conservation Council (Canada). 2000. Working with Wetlands — A Training Course on Considering Wetlands in Environmental Assessment under CEAA, p.27.
[38] Environment Canada. Wetlands Environmental Assessment Guidelines. www.cws-scf.ec.gc.ca/publications/eval/wetl/bground_e.cfm.
[39] Lynch-Stewart, Pauline. 1992. No Net Loss — Implementing “No Net Loss” Goals to Conserve Wetlands in Canada, p. 3.

Section 3: Exploring Relationships

3.1 The Relationship Between Net Gain and Sustainability

Throughout most of this report, net gain has been defined in an environmental context as a net environmental benefit, although it is clear that decision-making is often based on the consideration of broader and sometimes more subjective societal and economic considerations. In the Introduction to this report, it was noted that if society's goal is to achieve development that is sustainable, decisions about development activities will need to consider social and economic values in addition to environmental ones. This section of the report explores the implications of more systematically considering social and economic values as the net gain principle is incorporated in policy and decision-making.

Research completed by Gibson[40] and supported by the Canadian Environmental Assessment Agency[41] (CEAA) has indicated that sustainability-based criteria should be incorporated into environmental assessments because it is no longer sufficient for projects to minimize or mitigate negative environmental effects alone. Development projects subject to environmental assessment should provide positive contributions in the broader context of long-term ecological, social and economic sustainability. Gibson identified seven principles that set out general requirements for sustainability. They include integrity, sufficiency and opportunity, equity, efficiency, democracy and civility, precaution, and immediate and long-term integration. Positive gains in all of these areas should be sought.

According to Gibson, tradeoffs in sustainability-based criteria are unavoidable. He suggested that tradeoffs between and among environmental, social and economic criteria are acceptable: "Each development should make a positive contribution to sustainability, either by actually improving the sustainability of the overall economy by reducing its demands on ecosystems and by helping society to live within ecological limits, or by resulting in some low level environmental tradeoffs in exchange for social and economic benefits that will clearly be used to bridge society towards a more sustainable future."[42] Some general tradeoff and compromise rules were developed, such as: compromises and tradeoffs in sustainability-related matters are undesirable, unless proven otherwise; neutral or positive overall effects are required in each principal category; and mitigation is preferred over compensation.

To measure sustainability, work on indicators by the International Institute for Sustainable Development[43] was noted; however, the need for better integrated sustainability indicators was also acknowledged.

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[40] Gibson, Robert. 2001. Specification of Sustainability-based Environmental Assessment Decision Criteria and Implications for Determining "Significance" in Environmental Assessment, p.1.

[41] An agency that promotes environmental assessment as a planning tool to protect and sustain a healthy environment. www.ceaa-acee.gc.ca/index_e.htm.

[42] Ibid., p.10.

[43] www.iisd.org.

3.2 Application Linkages

Each application presented in this report has examined ways in which aspects of the net gain principle have been directly or indirectly developed and applied. Each illustrates aspects of net gain as it has been, or is currently being, used as a key principle to reverse ecological damage and bring human activities closer to sustainability. Potential applications of the net gain principle appear to be very broad. This report examined the application of this principle to influence decisions on new water withdrawal applications and urban planning initiatives, and to protect and enhance vegetation, habitats and wetlands. Each application brought a unique piece to the net gain "puzzle."

The ecological currency approach indicated that quantification is important, and it demonstrated ways to quantify ecosystem functions using a common habitat-based comparable measurement unit. The Smart Growth application focused on using environmental indicators to measure gains and losses. The Kyoto Protocol demonstrated the need to clearly define net gain and to select appropriate benchmarks. Victoria's Native Vegetation Management Framework demonstrated that the net gain habitat-based assessment process can be simplified with some research, ingenuity and expert advice. The applications of no net loss principles demonstrated the usefulness of this approach, despite scientific and data limitations, through a mitigation-oriented compensation system. Common across the applications is the need for criteria and measures to help determine net gain and to guide decision-making processes. The final discussion explored the use of a broader set of indicators of sustainability, not just ecological indicators, for determining net gain.

Many of these applications use similar approaches that can be compared to develop and apply the net gain principle. Table 5 sets out key elements of the applications, and it summarizes the linkages, the similarities and differences among them. This tool can be used by both new and existing initiatives exploring the net gain principle. For example, as part of their research on finding effective techniques to apply net gain, Fisheries and Oceans Canada may inform its efforts towards quantification by reviewing the ecological currency and habitat-hectares analyses.[44] Others may follow the example of Fisheries and Oceans Canada by establishing guidelines to implement the net gain principle, with the goal of ensuring that new development projects are assessed and treated consistently and equally. In addition, the Government of Victoria's implementation of the net gain principle demonstrates the value in looking internationally for examples illustrating the challenges and successes associated with developing and implementing the net gain principle.

[44] Pollution Probe has already presented a copy of the ecological currency approach paper to a representative of Fisheries and Oceans Canada.

Table 5A: Examining Linkages

Application	Why the Net Gain Principle is used…	Applied when…	On what scale?	Indicators used to measure gains and losses	Have standardized benchmark values been established?
Ecological Currency Project	To restore the ecological integrity of the Great Lakes Basin (under Annex 2001). (In this application, net gain has been referred to as an improvement in ecosystem integrity.)	An applicant requests a new or increased water withdrawal proposal in the Great Lakes Basin.	Project-by-project basis.	Changes in ecological services are quantified using ecological, temporal and spatial indicators and indices. The Ecologically-based ecological currency unit is the "discounted-service-acre-year" (DSAYs).	Baseline condition is defined as a fully functioning ecosystem that provides 100 per cent of its ecological services per acre over time.
Smart Growth and Urban Planning Initiatives	To improve air, water and soil quality with new land-use developments.	Any activities related to urbanization and land-use planning.	Must measure total environmental improvements, not per capita.	Air, water and soil quality environmental indicators.	No, but one option is to use "business-as-usual" as the benchmark.
Kyoto Protocol* *Contentious application	Reduce human-induced climate change impacts. *Views conflict on whether or not Kyoto demonstrates an application of the net gain principle (see section 4).	Human-induced activities generating greenhouse gases.	Measures total environmental improvements, not per capita.	Level of greenhouse gas emissions OR greenhouse gas concentrations.	Level of greenhouse gas emissions in 1990.

Application	Why the Net Gain Principle is used…	Applied when…	On what scale?	Indicators used to measure gains and losses	Have standardized benchmark values been established?
Victoria's Native Vegetation Management Framework (Australia)	Reverse the decline in the extent and quality of native vegetation.	Any proposed development project on public land affecting remnant native vegetation.	Project-by-project basis.	Ecologists and botanists selected site-condition and landscape-context indicators. Field officers use established guidelines to determine the habitat score for each indicator (nonspecialist ecologists required).	Yes. Based on historical or existing natural vegetation data.
Policy Framework for Fish Habitat Management (DFO, Canada)	Increase the productive capacity of fish habitats. DFO is committed to conducting more research on net gain. (The focus of the Policy is No Net Loss.)	Net gain is under development. No net loss is applied when a proposed development project may affect the productive capacity of fish habitat.	Project-by-project basis. With Fish Habitat Management Plans and Watershed Management Plans.	Estimates based on professional judgements and basic ecological principles, physical parameters and biological descriptors; affected area is measured.	No. Dependent on the baseline data available for each project. Projects are evaluated on a project-by-project basis and designed to minimize losses.
Canadian Federal Policy on Wetland Conservation	Enhance and rehabilitate functions and functional capacities of wetlands.	No Net loss is applied when a proposed development project may	Project-by-project basis.	Best professional judgements, and functional assessment methods using key physical, chemical and/or biological attributes	No. Projects are evaluated on a project-by-project basis and designed to

Application	Why the Net Gain Principle is used…	Applied when…	On what scale?	Indicators used to measure gains and losses	Have standardized benchmark values been established?
	(The focus of the Policy is No Net Loss.)	affect wetland functions on federal lands/where functions have reached critical levels.		of wetlands; affected area is measured.	minimize losses.
Net Gain and Sustain ability	To ensure sustainable development and positive contributions to environmental, social and economical factors.	For any new proposed development.	None specified.	None specified, but social, economic and environmental indicators exist.	No.

Table 5B: Examining Linkages Continued

Application	Can net gains and losses be quantified?	Are mitigation and compensation actions acceptable?	Policy considerations — How much of a benefit is required to offset the losses?
Ecological Currency Project	Yes in terms of ecological functions and values, by using the Habitat Equivalency Analysis approach. Assumed that cumulative effects have been taken into account.	Yes. Overall gains must be greater than overall losses.	Unspecified, though policy makers must make decisions on what improvements count under the Annex; how much of an improvement action is enough to be considered a net gain; what types of tradeoffs are acceptable; how uncertainty in achieving a net gain can be managed.
Smart Growth and Urban Planning	Yes, but work is in preliminary stages.	Yes, but no net loss on any indicator is acceptable.	Undetermined.
The Kyoto Protocol	Yes.	Emissions trading.	Six per cent below 1990 levels in Canada. The target level for greenhouse gas emissions reductions varies for each country (e.g., in the United States, a seven percent reduction would apply).
Victoria's Native Vegetation Management Framework	Yes. Both quantitative and qualitative analyses are used. Use the habitat hectare approach and conservation significance levels.	Yes. Based on conservation significance levels and comprehensive pre-set charts.	Based on the conservation significance of the affected vegetation community. Also use non-regulatory measures to implement net gain principle.
Policy Framework for Fish Habitat Management (DFO,	No. More of a qualitative analysis is completed.	Yes. A hierarchy of options has been established	Net gain is still under development. For no net loss, decisions are made on a project-by-project basis.

Canada)			Guidelines have been established to assess and treat new development projects equally.
Canadian Federal Policy on Wetland Conservation	No. More of a qualitative analysis is completed.	Yes. A strict sequence of mitigation alternatives has been developed.	Decisions are made on a project-by-project basis; however, guidelines have been established.
Net Gain and Sustainability	Possible. The application of the net gain principle is still in preliminary stages.	Overall, tradeoffs are inevitable, but it's difficult to trade between and amongst environmental, social and economic criteria.	N/A

3.3 Potential Applications of the Net Gain Principle

3.3.1 The Great Lakes

This report examined the "net improvement standard" called for in Annex 2001 of the Great Lakes Charter, and the potential for an ecological currency approach to help decision-makers make progress in restoring and improving the health of the Great Lakes Basin ecosystem. Beyond the scope of the Annex 2001 application, Pollution Probe sees the potential to apply the net gain principle in other Great Lakes instruments. For example, net gain could be an important guiding principle in discussions on the need for a new Great Lakes vision. As parties to the Great Lakes Water Quality Agreement currently consider plans for a review of the current Agreement, it will be important to find ways to make net gain a reality in the development and implementation of the new Agreement Pollution Probe believes that new institutions may be needed to help guide the process in which the vision is developed and to explore ways in which to apply the net gain principle.

A "Great Lakes Round Table" is one initiative that could help push the idea of the net gain principle forward. The idea behind a Great Lakes Round Table is to bring together key Great Lakes stakeholders, who can provide a high level of vision, energy, coordination and direction in the Great Lakes Basin, in a round table framework to build consensus about the changes needed to attain environmental sustainability in the Great Lakes. With the support of the Joyce Foundation, Pollution Probe is in the process of bringing together stakeholders to discuss the need for a new vision for the Great Lakes Basin and for a round table approach to achieve it. As a stakeholder in such a round table process, Pollution Probe would encourage Great Lakes stakeholders and institutions to adopt the net gain principle and work on ways to apply it across the spectrum of Great Lakes institutions and mechanisms.

3.3.2 Local Watershed Management

As has been observed in the initiatives examined in this report, application of the net gain principle could be very helpful in sub-Great Lakes or local, watershed-based management planning and growth management initiatives. Pollution Probe believes the net gain principle would be particularly useful when making specific assessments and decisions about watershed protection initiatives. These may include decisions about areas where development should go ahead or be prohibited, and assessments of the mitigation and protection measures that are needed. The net gain principle may also be helpful in developing indicators for reporting to the general public, as well as decision-makers, about whether or not, on balance, their local watersheds are becoming more sustainable.

3.3.3 A Policy Framework for Environmental Sustainability

Pollution Probe is working with a range of government and business partners on a project to develop a Policy Framework for Environmental Sustainability. The goal

of the project is to develop a conceptual framework to guide environmental policy development during the next decade and beyond. Pollution Probe anticipates that the Framework will be used as a foundation for working with interested business, government and non-governmental decision-makers to implement innovative approaches that achieve positive environmental outcomes.

Elements of the Framework include principles, policy instruments, a range of concepts and tools, and stakeholder engagement and decision-making processes. Currently, seventeen concepts and tools (including environmental management systems, lifecycle management and the pollution prevention and precautionary principles) have been identified as important for industry and governments working towards environmental sustainability. Many of these concepts inherently apply the net gain principle. For example, the pollution prevention concept seeks to eliminate the root causes of pollution by minimizing or avoiding the creation of pollution and waste at the life cycle stages that cause the greatest environmental impact. Minimizing pollution clearly results in a net improvement to the quality of the environment, and hence, a net gain.

Section 4: Conclusions and Recommendations

4.1 Net Gain is Important to Achieving Sustainable Development

This report has identified a number of initiatives that have applied, or are working towards applying, the net gain principle to achieve a net improvement to the quality of the environment. The report examined the application of the net gain principle to new water withdrawal applications, to planning for future development, to watershed-based management planning, and to protecting and enhancing vegetation, habitat and wetlands. In the context of environmental sustainability, net gain says that we need to stop depleting the natural capital on which life depends, to undo some of the existing damage to the environment, and then to go beyond that to achieve a net gain or improvement. In the broader context of sustainable development, consideration must also be given to how improvements in social and economic factors (in addition to environmental ones) can be achieved in order to result in a net societal gain.

More research should be done, from both the science and the policy points of view, to develop a more rigorous and complete understanding of how net gain should be defined, measured, reported and implemented.

4.2 Net gain has a Particular Application in the Great Lakes Basin

The net gain principle as it has been introduced in Annex 2001 of the Great Lakes Charter has considerable merit.

All Great Lakes jurisdictions and institutions should examine the net gain principle closely for potential applications to Great Lakes decision-making, including the possibility of its incorporation in a new Great Lakes vision. Pollution Probe will continue to pursue the idea of net gain in discussion with stakeholders who have expressed interest in a Great Lakes Futures Round Table initiative.

4.3 Net gain has a Particular Application to Watershed Management and Source Protection

The application of net gain should be helpful in assessing the ecological value of ecosystem impairments and improvements in watersheds and should help watershed managers to make informed decisions about the relative merits of one improvement action as compared to another. This information can be used to ensure that watershed management plans lead to a net improvement in the overall integrity of watersheds.

Net gain should be considered by agencies and individuals as an important principle when developing integrated watershed management plans and local water source protection plans.

4.4 Continue to "Advance Thinking on Net Gain"

In the process of researching this report, Pollution Probe shared the ideas behind the net gain principle with a number of key stakeholders, from Fisheries and Oceans Canada and Environment Canada, and with people registered to the Internet listservs of Canadian and American Smart Growth organizations. We found their interest level to be high, and we believe there is a good opportunity to continue to engage with them to advance thinking on net gain.

Pollution Probe believes that it would be valuable to bring together stakeholders with an interest in developing and finding ways to implement the net gain principle. In addition to stakeholders whom we have already contacted, a broad range of stakeholders should be involved, including, but not limited to, representatives of academia, governmental agencies, business and non-governmental organizations. Participants would bring new ideas, advice and recommendations that would encompass a broad range of experience and perspectives. This would result in actions that are more likely to be implemented. The discussions should include the science-based ecosystem measurement steps and the policy development steps required to move the net gain principle forward.

A net gain workshop or conference should be held to bring together experts in relevant fields of science, policy and management to build further understanding of the principle, to discuss its implications and to seek consensus on what is needed to advance its application. The applications reviewed and analysed in this report should provide a basis for this event and for future discussions and applications of the net gain principle.

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Appendix — Related Tables and Charts

The Ecological Currency Project — Ecological Goals and Metrics

As described in Section 2, "the ecological currency approach," the following is a list of the "Great Lakes Ecosystem" goals and indicators used to measure the progress made towards the goals that applicants for new water withdrawal proposals can use to help identify hydrologic and ecological linkages, and quantify changes in ecosystem functions and values:

Working Set of Ecological Goals
1. Protect and enhance biodiversity 2. Maintain sustainable fisheries production 3. Protect and enhance habitat quality 4. Control and reduce invasive species range and density 5. Restore and maintain natural flow regime 6. Control pathogens in surface waters 7. Reduce toxic accumulation in aquatic systems 8. Restore and maintain water quality to sustain aquatic ecosystems

Core Temporal, Spatial, and Hydrologic-Ecological Indicators (or metrics)		
Core Temporal Metrics	**Core Spatial Metrics**	**Core Hydrologic-Ecological Metrics**
Years	Acres	1. Hydrologic Alteration Index 2. Stream Habitat Index 3. Lake Index 4. Pounds of phosphorus 5. Wetland Index 6. Habitat Suitability Index 7. Entrainment or impingement (number of fish) 8. Reduction of abundance of invasive species 9. Percent of native species 10. Biological range of invasive species

Source: CH2M HILL, Council of Great Lakes Industries, Enterprising Environmental Solutions, Inc, Lake Michigan Federation, Policy Solutions, Ltd., Pollution Probe. 2003. *Creating Ecological Currencies for Quantifying Resource Improvement.* pages 3–9 and 4–24.

Victoria's Native Vegetation Management — Determining Conservation Significance

The following chart is used to determine the conservation significance of a vegetation community using the habitat score and conservation status.

Conservation Significance	BIODIVERSITY ATTRIBUTES			
	VEGETATION TYPES		*OR* SPECIES	*OR* OTHER ATTRIBUTES
	Conservation Status	Habitat Score$_2$		
VERY HIGH	Endangered Vulnerable Rare	0.4 - 1 0.5 - 1 0.6 - 1	• best 50% of habitat for each threatened species in a Victorian bioregion	• sites with unique National Estate values • sites identified as being of national significance as a relict, endemic, edge of range or other non-species values • Other wetlands of international significance for migratory waterbirds • areas identified as providing refuges (e.g. during drought) for threatened species
HIGH	Endangered Vulnerable Rare Depleted	< 0.4 0.3 - 0.5 0.3 - 0.6 0.6 - 1	• the remaining 50% of habitat for threatened species in a Victorian bioregion • best 50% of habitat for rare species in a Victorian bioregion	• sites with rare National Estate values • sites identified as being of state significance for relictual, endemic, edge of range or other non-species values • Wetlands listed in 'A Directory of Important Wetlands in Australia' • Wetlands of national significance for migratory waterbirds • areas identified as providing refuges (e.g. during drought) for rare species • priority areas for the re-establishment of habitat for a threatened species (e.g. as determined in a Biodiversity Action Plan)
MEDIUM	Vulnerable Rare Depleted Least Concern	< 0.3 < 0.3 0.3 - 0.6 0.6 - 1	• the remaining 50% of habitat for rare species in a Victorian bioregion • best 50% of habitat for regionally significant species	• sites with uncommon National Estate values • sites identified as being of regional significance for edge of range or other non-species values • Wetlands of bioregional significance (based on application of National Land and Water Resources Audit criteria).
LOW	Depleted Least Concern	< 0.3 < 0.6		

Source: Government of Victoria. 2002. Victoria's Native Vegetation Management — A Framework for Action. 2002. p. 53.