Executive Summary

The Nature for Niagara's Future project is an assessment of the natural features within the Niagara watershed and their contributions towards a healthy and sustainable system. The Niagara watershed covers an area of 2,424 square kilometers encompassing all of the Region of Niagara, 21% of the City of Hamilton, and 25% of the County of Haldimand. The watershed study area of the project (see Figure1) currently contains about 30% natural cover, two thirds of which is mature wooded area such as forested woodlots, of which half are swamp type wetland communities.

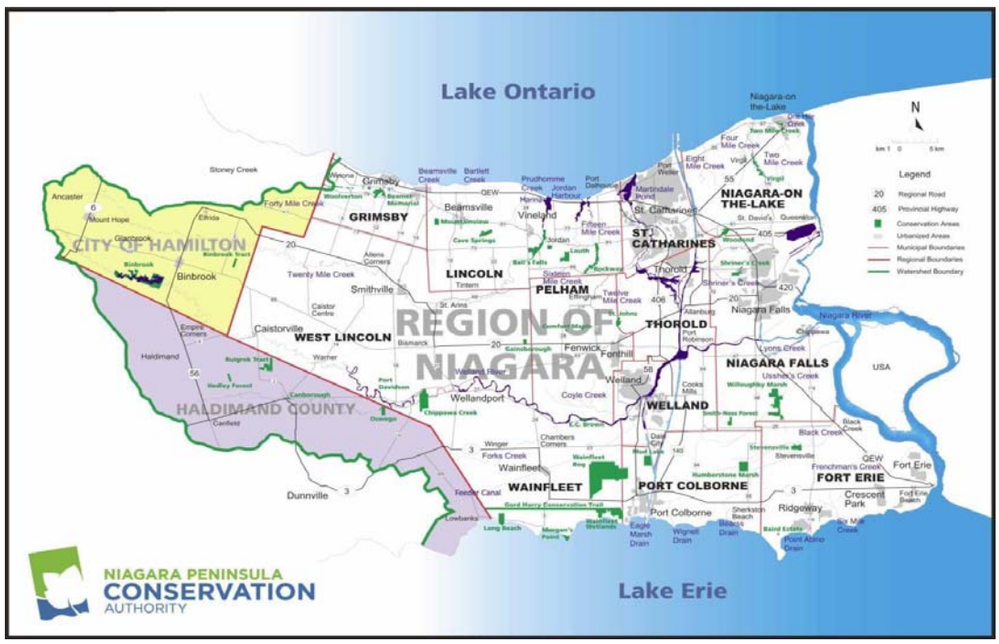


Figure 3: Study Area Map

Planning for natural heritage is necessary for the maintenance and enhancement of biodiversity, protection of species at risk, mitigation of climate change, protection and improvement of water quality, and the fulfillment of public values.

A healthy environment is also important for a thriving economy and rich cultural heritage.

This is a multi-partner project funded by the Region of Niagara through the Water Smart Program and coordinated by the Niagara Peninsula Conservation Authority (NPCA). The project involves working with community members, practitioners, and other stakeholders in the twelve Niagara municipalities, County of Haldimand, and City of Hamilton to ensure a system that balances the social, environmental, cultural, and economic attributes of the area that we all value.

The project is a consensus-based, integrated, whole-system and objective approach to conceptualizing a Natural Heritage System (NHS) for the Niagara watershed. The purpose of this project was to evaluate the natural features identified and classified through the Natural Heritage Areas Inventory (2006-2009) for their individual and collective contributions to the health and resilience of the local ecosystem. The best available scientific data, knowledge and existing inventories were combined with input from stakeholders through an engagement process which utilized an objective and quantitative decision support tool. This has led to an improved understanding of the condition of Niagara's existing natural heritage resources.

The Need for this Project

Following the completion of the multi-year Natural Areas Inventory (NAI), the Niagara Peninsula Conservation Authority and its partners collaborated on a means of assessing the available data in an attempt to quantify the contribution of the existing natural heritage features to an overall natural heritage system across the watershed.

Natural Heritage Systems (NHS) are networks of connected or to be connected natural spaces that provide ecological functions over an extended period of time, and also provide for the movement of species. However, the term 'Natural Heritage System' is often used interchangeably to infer several subtly different references to this concept. In the context of this project, the collection of natural features that currently exist on the landscape are considered to represent a Natural Heritage System.

More often than not, the term NHS has become associated with the environmental and natural heritage policies that are generally applied to protect existing natural areas. This is in part due to land use planning processes being strongly encouraged by the Province and science in recent years to utilize a systems based approach when dealing with natural heritage matters.

The Natural Heritage Systems approach to the management of natural areas is largely predicated on the principal that the sum is greater than its parts. In recent decades, there has been growing recognition, backed by considerable scientific documentation, that individual natural features have strong ecological ties and work together in a systematic way to keep our environment healthy and resilient. Nature for Niagara's Future was envisioned as a way to measure this phenomenon while fostering a better understanding about how Niagara's natural areas currently work together.

The identification, design and management of conserved or protected areas that represent the biodiversity and other conservation values of a region is known as "systemic conservation planning". This approach is a departure from ad-hoc, site by site specific, feature based methods that have been used in the past to identify Natural Heritage Systems. This is a much more efficient way to configure a network that comprehensively represents a full complement of ecological values identified for a landscape. What sets this approach apart from the planning of the past is a clear definition of system wide goals and objectives that are determined through up front stakeholder engagement. This input, in combination with the attempt to efficiently meet the goals and objectives in the smallest geographic footprint are truly the benefits of this approach.

The Natural Heritage Areas Inventory

The Natural Heritage Areas Inventory (NAI) of Niagara and Haldimand was a project conducted between April 2006 and December 2009 for the purpose of identifying, classifying and mapping natural heritage areas in our watershed (NPCA's jurisdiction). The goal of the project was to use industry standard, scientifically-defensible protocols to inventory all of the natural areas in our community.

Goal number one of the NAI was a mapping exercise. All of the natural areas within the watershed were mapped to the Ecological Land Classification (ELC) Community Series level based on the provincial protocol developed by the Ontario Ministry of Natural Resources. Goal number two of the project was field verification of the mapping. This was completed on more than 500 sites throughout the watershed in an effort to "ground truth" the mapping.
The emphasis behind the Natural Areas Inventory (NAI) was data; mapping data, and related observation data (tabular) from field collection efforts. Aside from some very coarse preliminary investigations into determining community ratios across the study area to indicate the return on the investment and demonstrate the potential, the new inventory and mapping was largely not analyzed during the NAI project.

The NHS project is the next logical process in the traditional resource inventory, assess, and manage cycle. The assessment through this project has derived new information from use of the NAI data by endowing it with meaning and significance through objective analysis. Beyond this, the NHS process also facilitates the production of knowledge by transforming the new information through reasoning and reflection into a better understanding around the current condition of Niagara's natural heritage resources.

This is NOT Land Use Planning but rather, an Information Tool

Natural Heritage System design is a science based endeavor that falls under the specific discipline of 'conservation planning' within the field of conservation biology as part of the broader practice of natural resources management. While socio-political, economic and cultural interests and values are considered in this project's evaluation process of natural heritage resources, it is not from a formal land use planning perspective but rather as a design concept. The design approach used by this project is sophisticated and recognizes that there are constraints and other controlling factors existing on the landscape that may influence where conservation values can realistically contribute to system wide ecological objectives. It would be naïve to operate under any other assumption. As with any resource management recommendations, they will be subject to scrutiny of social license and political acceptance when used to inform the larger balancing act at the land use planning stage.

While there has been discussion that new insight and knowledge about the natural heritage system in Niagara could inform and influence future policy decisions with respect to the local natural environment, this project has only been focused on producing information that will serve as an information base for the strategic implementation of voluntary conservation activities. Many local organizations and agencies are involved in voluntary conservation, but more often than not their activities are not integrated through a common vision that has been conceptualized. In a region with limited resources to spend on environmental issues we can't afford redundancy. As a result, assessing the existing natural areas through a credible systematic evaluation has facilitated a common understanding about the current condition of this resource that is now backed up with a robust information base. This new information asset provides innovative capabilities for future decision support that all involved with local conservation activities can benefit from, and work with collaboratively.

The Process

Vision Statement

Through a consensus-based process create a natural heritage system for the Niagara watershed that embodies our shared vision for a sustainable natural environment in balance with socio-political, economic and cultural interests and values.

Throughout the duration of the project it became clear that the ability to actually create a natural heritage

system in the sense of a truly connected set of core natural areas and future corridors that would provide for healthy resources and sustainable environmental functions would not be possible due to significant concerns expressed by stakeholders. These issues are documented throughout the report but are largely related to the misconception that this project was a land use planning activity intending to result in new policy development, not a resource management exercise, an assessment, intended to produce information that would be helpful to integrate efforts around the broader conservation of Niagara's natural heritage resources. Consequently, the project vision conceded to simply identify from existing natural areas, the most important areas to function as the 'back bone' for a conceptual system moving forward.

Goals

In order to reach the Vision the following goals were set:

1 **Education**: People have an awareness and understanding of the natural heritage system.
2 **Information Tool**: We will create an information tool that the stakeholders agree with and that can be used to better understand natural heritage.
3 **Collaboration**: To collaborate on this process and better understand and respect all perspectives.

Guiding Principles

-Identify a system of priority natural heritage features based on the best available science and information, local knowledge, and stakeholder interest; -Engage and involve local stakeholders throughout the process; -Be open and transparent with all reporting on process and results; -Consider ecological, economic, social, and cultural values; -Be consistent with all applicable legislation; -Respect existing and approved land uses including: agriculture, urban development, tourism and recreation, resource extraction and mining, transportation and infrastructure and energy production; -Consider ecological goods and services; -Consider cultural heritage values.

Organizational Structure

Three committees (Steering, Outreach and Education, and Scenario Development) formed the governance of this project. (See Appendix A for list of Committee membership) All committees met as often as deemed necessary to complete the tasks as laid out in the project workplan. NPCA staff provided logistical and technical support for all meetings. Time and location of meetings was determined at each prior meeting.

Relevant data for discussion was distributed by NPCA staff one week before each meeting allowing for sufficient time for review. It was therefore expected that committee members would arrive at the meetings prepared to represent the interests of their organization in the decision making process. At any time the represented organizations could make written comments directly to the Project Coordinator.

Recognizing that participants represented varied interests, it was imperative that as a group, the committees continued to move forward in the process. There was periodic review of the goals and objectives in an effort to remind participants of their shared vision.

It was decided that committee decisions and recommendations would be arrived at by consensus. If this was not achievable, the various points of view were recorded. Where decisions were required in order to move the project forward, majority decision of those present provided direction.

All participants were expected to communicate in a respectful manner.

Steering Committee

The Steering Committee was made up of volunteer representatives of stakeholder groups within the NPCA watershed. (See Appendix A for list of Committee members)

Members were responsible for expressing the views of their respective organizations and for ensuring that all relevant information was disseminated to the appropriate individuals within those organizations. They were also expected to actively participate in meetings and to assign an alternate in their stead should they be unable to attend a meeting.

Steering Committee members contributed by:

- providing representation from their respective organizations in the NHS planning process; communicating frequently with those they represent to report on progress and solicit input for key decisions;
- helping to identify and select new committee members when needed; reviewing and advising on matters related to the development of the NHS (i.e. issues and concerns, goals and objectives, information needs, etc.);
- developing and implementing the communications and consultation plan by seeking the participation of all interested parties.

Facilitation

The Steering Committee meetings were facilitated by a representative of the Region of Niagara or the Niagara Peninsula Conservation Authority as decided by the Committee.

Meetings

The Steering Committee met 4 times from June 2010 to June 2011.

Meetings were held at the Niagara Peninsula Conservation Authority boardroom.

Minutes were kept at each meeting and were approved by the Steering Committee at each subsequent meeting.

Scenario Development Team

Members of this Committee actively participated in the value-based decision-making process that produced the recommendations for input of relevant data into the MARXAN modeling exercise. They represented their respective organizations during the process and communicated the issues and concerns from those organizations throughout. (See Appendix A for list of Committee members).

Scenario Development Team members contributed by:

- adding to an inventory of existing data sets appropriate for use in the modeling exercise;
- working closely with NPCA technical staff and other experts to decide if/how data is used;
- making informed decisions on the targets and constraints associated with each identified value;
- providing direction for the development of scenarios through the use of the MARXAN model; communicating the results of the modeling to their respective organizations for comments and recommendations

Facilitation

The Scenario Development Team meetings were facilitated by a neutral third party that assisted the Committee in meeting its objectives. The Facilitator was hired by the NPCA.

Roles of the Facilitator

- overall conduct of meetings;
- basic administration & adherence to this Terms of Reference;
- assisted in building consensus;
- reviewed and advised on matters relating to the development of the Natural Heritage System (i.e. issues and concerns, goals and objectives, information needs, etc.).

Meetings

The Scenario Planning Team met for 14 full day workshops from August 2010 to November 2011.

Meetings were held at the NPCA boardroom, Ball's Fall Centre for Conservation and the Regional Public Health Building in Welland.

Minutes were kept at each meeting and were approved by the Scenario Development Team at each subsequent meeting.

Outreach and Education Committee

The Outreach and Education Committee was led by the Director of Communications for the NPCA. A consultant was hired to help deliver options for the communications plan and newsletter.

This Committee worked in partnership with both the Steering Committee and Scenario Development Team and will be responsible for the dissemination of information about the Nature for Niagara's Future Project to interested organizations not participating in the process, and the public.

Outreach and Education Committee members contributed by:

- developing information tools for the Nature for Niagara's Future Project;
- developing the communication and consultation plan;
- providing consistent and positive messaging for stakeholder engagement, education activities, and for interested members of the public;
- providing updates to the Scenario Development Team and Steering Committee.

Facilitation

The Outreach and Education Committee was led by the Director of Communications for the NPCA.

Meetings

The Outreach and Education Committee meetings were informal and included the consultant and, the project management team.

Methodologies

A Consensus-based Approach

What is consensus?

Consensus is a process for group decision-making by which a group can come to an agreement on specific resolutions. The input and ideas of all participants are gathered and synthesized into a proposal to arrive at a final decision acceptable to all. Through consensus, a group works to achieve solutions that are reflective of the group's input and to promote the growth of community and to build trust. It is a process of synthesizing many diverse elements together and creating a solution(s) that all participants can support.

With consensus people can and should work through differences and reach a mutually satisfactory solution. No ideas are lost and each member's input is valued as part of the solution. Following discussion, a proposal for resolution is put forward. It is amended and modified through more discussion, or withdrawn if there are still major objections. During this discussion period it is important to articulate differences clearly. It is the responsibility of those who are having trouble with a proposal to put forth

alternative suggestions.

Consensus is based on the knowledge that collective intelligence comes up with better solutions than individuals. Consensus takes more time and requires more skill from all participants before a decision is made. In doing so, it creates commitment to the decision and often facilitates creative decisions.

What does consensus mean?

Consensus does not mean that everyone thinks that the decision made is necessarily the best one possible, or even that they are sure it will work. It means that in coming to that decision, people feel that their perspective on the matter was understood, given a proper hearing and they can live with the decision.

There are ways to check the extent of the support for a proposal by providing mechanisms for participants to express their objections (e.g. nonsupport - "I don't see the need for this, but I'll go along."), reservations- “I think this may be a mistake but I can live with it.", standing aside - "I personally can't do this, but I won't stop others from doing it. ", blocking - "I cannot support this or allow the group to support this. It is immoral.", or withdrawing - walking away from the group). Some groups use the terms “Abstain” and “Object”. If too many people object even in a mild way, there may be a need to revise/rethink the proposal and work through the differences again. If more than one person blocks or stands aside, the proposal should be revisited. Often, the discussion following these objections results in better and more creative solutions that can be supported by the group.

The fundamental right of consensus is for all people to be able to express themselves in their own words and of their own will. The fundamental responsibility of consensus is to assure others of their right to speak and be heard. Coercion and trade-offs are replaced with creative alternatives, and compromise is replaced with synthesis. Whereas compromise is giving up a portion of each person’s position to reach agreement, consensus is a process for building collaborative solutions through mutual understanding of interests and synthesis of all ideas and suggestions.

Collaborative Natural Heritage Systems Design

Even in a landscape with a high level of fragmentation among its remaining natural features, such as Niagara, there are many different options for Natural Heritage System design. A decision-support tool is very useful to quickly and objectively produce a number of different options for comparison. This project used a conservation planning and decision support software system called MARXAN to produce several different NHS learning scenarios.

MARXAN

MARXAN is globally the most widely used conservation planning decision support tool. It can address a range of conservation planning and spatial prioritization problems but is most commonly used to assist with the design of new reserve networks, and facilitate gap analysis to determine the efficiency of existing systems. MARXAN uses a mathematical (not ecological) optimization algorithm to objectively search through millions of design options. The software effectively identifies near-optimal spatial arrangements of areas that best meet the objectives and targets, subject to constraints and costs, established for the system by the project’s Scenario Development Team.

MARXAN was designed at the Ecology Centre at the University of Queensland, Australia and is internationally recognized having been scientifically validated and widely published. As a result, it is well understood by the broader conservation community. The MARXAN methodology for NHS design in Ontario was pilot-tested by MNR in 2006 and was found to be an effective means of identifying priority

natural areas (Communities of South Frontenac: 2009).

The systematic conservation planning approach is significantly enhanced through the use of MARXAN because it can rapidly provide solutions to very complex problems consisting of multiple objectives at a variety of geographic scales. It selects areas from millions of different possible combinations of sites that together would meet the identified objectives in the most efficient manner (minimal 'cost' based on area as the fundamental principle) and provides these solutions as output for consideration within a larger decision making process. As humans, selecting an efficient system is computationally beyond the Scenario Development Team's intuition; however understanding and gaining insight from model results makes this feasible when implementing a decision support tool. The quantitative evaluation of how well each option achieves conservation and socio-economic objectives facilitates the critical exploration of trade-offs. MARXAN can also be used to highlight those places that occur in a large number of solutions, which can help set priorities for conservation action. (Ardon: 2010, p.5)

How is this different from other approaches?

MARXAN overcomes several limitations associated with traditional quantitative multi-criteria scoring approaches which can lead to unclear, unsystematic, and inefficient systems. These scoring approaches suffer from the misleading cumulative effects of subjective ranking (do 5 features with a score of 1 equal 1 feature with a score of 5?) and thus there is no valid indication of what a high score really means. Also, getting a comprehensive set of sites that efficiently cover all system objectives becomes trial and error because one would likely have to include the lower rankings as well before all needs are represented. Sites with high scores normally don't cover everything complementary to the system.

The benefits to using MARXAN in a Natural Heritage System design and assessment process such as Nature for Niagara's future are many. MARXAN requires users to clearly define their objectives with mappable criteria and explicit measures, thereby resulting in a very objective and credible process. Demanding that users identify values and issues with measurable criteria, targets, and indicators makes MARXAN analyses highly quantitative which empowers the evaluation of tradeoffs and sensitivities when comparing how inputs and other assumptions influence outcomes. By rapidly exploring a large number of possible design combinations subject to a significant number of target variables, underlying costs and selection constraints, it provides for a comprehensive assessment. MARXAN also supports adaptive management principles since it is relatively easy to update and can rapidly provide new solutions.

This is not to say that MARXAN is perfect, it has its limitations like any other modeling product. In the context of Natural Heritage System design the structural and functional connectivity of a system is difficult to model. Structurally, the use of hexagons as opposed to a grid as the planning unit aids the process by increasing the efficiency for connections but they are still a generalization of the underlying natural features. Functionally, connectivity is linked to the biology and life history of species for which there may be data gaps affecting the ability of this to be represented in the outputs of the software.

How does it work?

MARXAN works by simplifying the discrete geographic complexities of a landscape into containers called planning units which improve the performance of the model in terms of generating solutions. These units are a continuous mesh of 5 hectare hexagons (hexagons tend to generalize the topology of natural features better than squares, rectangles or triangles). There are approximately 60,000 across the study area. Using a higher resolution of planning units (such as 1ha hexagons) could have facilitated more detailed mapping results but that would have been at the price of significantly longer modeling input preparation, and processing times. The 5 hectare size, while generalizing features spatially, readily supports the analysis of trends and assessment of features at the landscape level. As a result, the direct spatial outputs from MARXAN are hexagon based and therefore not implementation ready maps. These outputs can and would need to be mapped back to the explicit boundaries of the underlying features identified in the analysis to support and inform operational needs.

These planning units are assigned with the inputs that guide analysis such as the underlying cost and

status, and are further populated with all the potential contributions to any of the identified conservation features that it may contain based on overlap with conservation feature inventories. Targets are set for the amount of each conservation feature needed in the overall system design and MARXAN then uses all this information to meet these objectives while trying to minimize the cost. Each deviation from the Baseline Comparator inputs in a particular analysis are generally referred to as learning scenarios.

Networks such as natural heritage systems do not begin with a “blank slate”. There are existing protected areas and hotspots of biodiversity that are already being managed for their natural heritage values. Biodiversity is defined as the degree of variation of life forms within a given species, ecosystem, biome, or the planet as a whole. Biodiversity is a measure of the health of ecosystems. It makes sense to consistently include areas of high biodiversity in the modeling scenarios. They become nodes to anchor the system on. Conversely, developed areas or areas approved for development may be areas to avoid since the natural features cannot be relied upon to contribute to targets. Assigning constraints and costs by planning unit permits stakeholders to understand how existing land use patterns affect the natural heritage system design. It makes it possible to evaluate how well these areas contribute to the achievement of targets. It helps to answer questions such as to what extent are the targets being met with what is already set aside for conservation. (Ardon: 2010, p. 3)

Beyond spatial selection results, MARXAN provides significant statistical output that can be used to enumerate many aspects of a final system. Each conservation value is quantified in terms of achievement relative to the targets set within a particular scenario. Individual planning units are also populated with selection frequency information detailing how many times a particular site was depended on to contribute to the targets which provided additional information about the relative importance of an area. Consequently, the use of a decision support tool such as MARXAN promotes the development of a robust information system that can be used to help answer many resource management questions at a variety of scales.

Project Funding

This project was funded by the Regional Municipality of Niagara through their Water Smart Program. Project coordination and technical support were provided in-kind by the Niagara Peninsula Conservation Authority.

Project Results and Recommendations

- The engagement approach was highly valued by the project stakeholders. The group chose to use consensus in their decision making and appreciated the opportunity to express their points of view and gain knowledge through exposure to natural resource science and listening to the perspectives of others.
- This process provided a quantitative and objective assessment of the information contained within the Natural Heritage Areas Inventory (2006-2009).
- The Scenario Development Team established a set of ecological objectives under the Baseline Comparator and agreed through consensus to use this scenario outcome to measure the performance and implications of alternative options across the landscape. This “measuring stick” became the Baseline Comparator Scenario.
- The process ensured that stakeholders could voice their issues and concerns openly and honestly and have them reflected in the scenario outcomes. Valuable input from the agricultural, aggregate and urban development representatives came together in the Most Constrained Scenario.
- Nineteen Learning Scenarios were developed throughout the evaluation ensuring a robust analysis which allowed the stakeholders to fully understand the implications of various options and to make well informed trade-off decisions.
- The Scenario Development Team concluded that no single scenario was preferred; however, they did agree on including one option which attempts to present as many of the competing interests as possible resulting from the combination of several of the Learning Scenarios. This became the Compromise Scenario.
- The information tool produced through the project provides and benefits a wide range of decision

support capabilities. Stakeholders expressed many potential uses for the data derived through the project by their respective organizations.

- The Scenario Development Team felt strongly that the information must be regularly updated and maintained on an ongoing basis to ensure it remains useful and relevant.
- Several critical information gaps were identified through the process and these should be addressed through investment in research and inventory projects in order that they may be included into future analyses and plans.
- A constant concern expressed by the Scenario Development Team centered on the idea of this process creating land use policy, based on outcomes from the analysis. This highlights the importance of ensuring the participants understand very early on in the process, the distinction between an objective evaluation of a landscape's natural resources towards achieving ecological objectives and the separate planning process under which land use planning decisions are made.

Final scenario performance results are detailed in the charts below. The first chart primarily compares the performance of the Baseline Comparator scenario to the science based thresholds to form an understanding of the current condition of the landscape as this achievement rate is based on almost all of the current natural areas contributing towards the system. This second chart compares the relative performance of the other two final scenarios as deviations to that initial baseline understanding. The first of these, the Most Constrained scenario excludes from system consideration certain existing natural areas that could provide for other human uses such as agriculture, urban development, or aggregate extraction. The second, the Compromise scenario is a middle ground approach between the two extremes of the Baseline Comparator and Most Constrained scenarios.

Figure 4 : Final Scenario Performance Relative to Science Thresholds

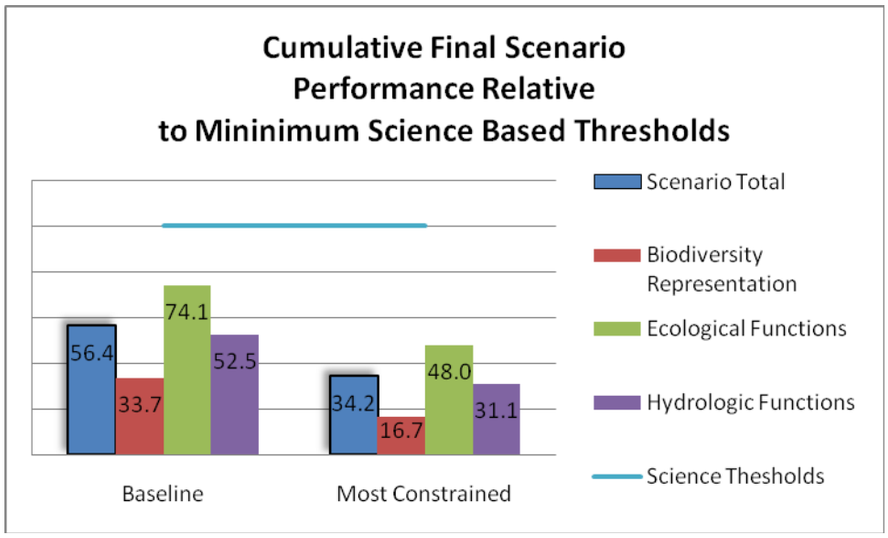
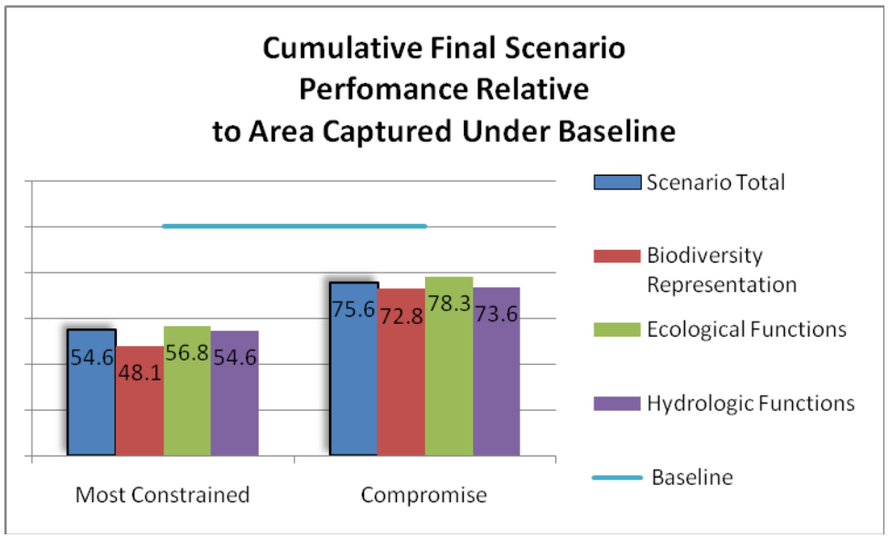


Figure 5: Final Scenario Performance Relative to Baseline Comparator



Conclusion

This process has enabled stakeholders to undertake a robust assessment and evaluation of the existing natural heritage resources on the landscape in Niagara. Stakeholders can now objectively understand how the existing natural features contribute to a common set of objectives utilizing the best currently available science, information, and local knowledge. In addition, the process allowed stakeholders to express and understand each other's goals and interests in a respectful environment that has led to positive relationships and a greater sense of trust amongst participants. The end product of this process is the information that will help better inform the development of a viable natural heritage system for Niagara over the long term.

Report Format

This final report is split into four main sections. The first section deals with the Constraint setting portion of the process. The second section lays out the targets for the modeling exercise including a fact sheet for each target that includes an explanation of how the decisions related to that target were arrived at.

The third section deals with the Learning Scenarios for the project that helped move the Scenario Development Team towards the Final Scenarios. The Final Scenarios are found in the fourth section of the report Results and Recommendations with full explanations for each. Under this section there is also a list of specific data gaps and key messages going forward from this process.

The Appendices for this report include:

-the Metadata documents for each data set

-a copy of the decision charts for constraints and targets

-a glossary of terms

-the meeting minutes from the Steering Committee and Scenario Development Team sessions

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