AN INNOVATION IN WATERSHED STEWARDSHIP

Ontario
Ministry of Natural Resources

Wetland Drain Restoration Project

"HOW TO GUIDE"

Enhancing
Water Storage and **Water Quality**
within a Watershed through
Wetland Restoration

NORFOLK LAND STEWARDSHIP COUNCIL

Norfolk County

Ontario

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Wetland Drain Restoration Project

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The partners of the watershed-based demonstration projects have been working collaboratively since April 2002 to produce the results contained in this final report, released in May 2003.

INTRODUCTION

The Wetland Drain Restoration Project has been an ongoing effort by the Ministry of Natural Resources, Norfolk County, and other significant partners since 1999. The project was developed in 1996 after the Norfolk Land Stewardship Council, former Township of Norfolk and partners successfully restored a wetland through a pilot project.

Since then, the Wetland Drain Restoration Project has allowed for the successful restoration of numerous wetlands in Norfolk County. Active wetland restoration is required to re-establish ecological functions, and the associated economic, social and cultural benefits (OMNR, Wetland Evaluation Technical Team, 2002). Targeted restoration sites have been within agro-ecosystems and provide measurable benefits to these communities and land-based operations.

Restored wetlands will function in a naturalized state and provide numerous benefits to the local community. Benefits include water purification, groundwater recharge and discharge, the maintenance of base flows in streams, sustained soil moisture for better crop production, improved ecosystem health and the provision of fish and wildlife habitat.

It is intended that this comprehensive "How to Guide" will help guide similar initiatives and facilitate successful wetland restoration efforts throughout Southern Ontario. The guide outlines strategic tactics and recommendations that have been developed and tested through the project's duration. The appendices of the guide provide specific wetland restoration methods and tools.

The goal is to realize the benefits of water quality improvement and water quantity regulation in association with restored wetlands. The project has received enthusiastic support with landowners, drainage superintendents, municipalities and resource management agencies throughout the agricultural belt of Southern Ontario. It is evident that there has been an increase in understanding of the social and community benefits provided by wetlands and their associated functions.

PROJECT BACKGROUND/RATIONALE

Much of the original wetlands in Southwestern Ontario have been converted to other uses through drainage. In today's climate it has become apparent that wetlands have a natural capacity to store and transmit water in times of need as well as improve water quality and groundwater supplies. Consequently, wetlands act to improve the agroecosystem and human health (Spaling and Smit; 1995).

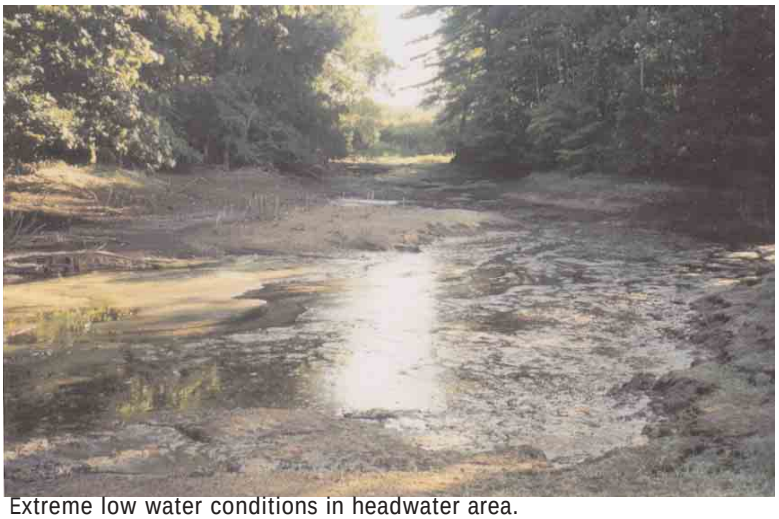
Significant water issues arose in agricultural areas across Southern Ontario in the summers of 1998, 1999, 2001 and 2002 due to lack of precipitation. These conditions negatively impacted crop yields and lowered the water table. These low water conditions were exasperated by the efficient removal of surface water by agricultural drains early in the growing season. The use of water for irrigation purposes and the lack of wetlands and their associated ability to store and release water later in the growing season are also contributing factors. Many streams and aquifers could not meet the water use demands and were depleted to critical levels.

(Photo: MNR, Aylmer District)

Valuable water draining from the landscape through a Municipal Drain in late summer months.

It became obvious that innovative solutions were required to safeguard against future low water conditions and to improve the dependability of both clean and abundant water supplies. One of the most efficient and cost effective solutions was to promote the use of the *Drainage Act* as a tool to restore surrounding wetlands, without harming agricultural business objectives. Restoration involves extending the hydro-period within previously ditched and drained wetlands by increasing water storage in them, thus returning them to a more natural state. Water storage is achieved through methods such as drain naturalization, installation of water control structures, or bioengineering within those drains that remove water from wetlands.

A common method to restore wetlands is through the use of water control structures (low head structures). These structures allow water levels to increase in historical, natural wetlands, thereby contributing to the restoration of such habitats and water storage, without inhibiting the ability of farmers to drain portions of their land.



(Photo: Norfolk Land Stewardship Council)

Extreme low water conditions in headwater area.

PROJECT GOALS AND OBJECTIVES

The Wetland Drain Restoration Project represents an ongoing effort by resource management agencies and landowners to balance the advantages provided by municipal drainage projects with the water purification, storage, recharge and discharge functions provided by wetlands. This will mutually benefit farming practices, local landowners, the environment and the local community. Restored wetlands can benefit landowners within the landscape without negatively affecting agriculture. Improved ecosystem health in the affected landscape will also benefit society as a whole.

The project also aims to create sustainable partnerships with community groups, landowners and natural resource agencies. This provides opportunities for education and advancement in natural resource, watershed and particularly wetland management.

Audience

Target audiences for implementing the Wetland Drain Restoration Project in the landscape include:

- Provincial and Federal government agencies
- Municipalities (i.e. Drainage Superintendents)
- Stewardship Ontario
- Conservation Ontario
- Special Interest Groups
- Private Landowners

WETLAND FUNCTIONS AND BENEFITS TO SOCIETY

Wetlands are a critical component of watersheds and landscapes in Ontario. Wetlands provide immeasurable benefits to society, within urban landscapes and rural agro-ecosystems. The following is a brief outline of wetland functions and wetland values:

Water Quality Improvement

Wetlands purify water through physical, biochemical and hydrogeological processes involving vegetation, microorganisms and percolation (Spaling and Smit; 1995). Suspended sediments, nutrients and other pollutants (including heavy metals) are assimilated or filtered by these wet areas. Furthermore, nutrients that are stored in wetlands in the spring will offset downstream eutrophication and reduce algal blooms in lakes. The availability of nutrients is then increased in the autumn, after the spring green-up by the release of stored water (A. Hill; 1976).

(Photo: MNR, Aylmer District)

Restored treed swamp functioning to benefit water quality and quantity.

Groundwater Recharge/Discharge

Wetlands are often found in areas where the water table is close to the surface. In dry seasons water held within hydric soils is released as base flows within streams. It will also percolate into the underlying water table recharging groundwater supplies (Spaling and Smit; 1995)

Flood Attenuation

Wetlands form part of the catchment basin within a watershed. Their organic soils and generally flat topography can provide storage for large volumes of water. In additions, these spongy organic soils act to temporarily hold water that would otherwise breech stream banks and flood farm fields. Wetlands therefore reduce the incidence and intensity of flood peaks downstream (A. Hill; 1976).

Fish and Wildlife Habitat

Wetlands are essential habitat for many different species of plants, mammals, birds, reptiles, amphibians, fish, and invertebrates. Wetlands provide critical habitat for all or part of their life cycle. Wetlands provide habitat for game species such as ruffed grouse, wild turkey, white-tailed deer, and waterfowl. Fish such as trout, salmon, bass, northern pike, walleye and yellow perch utilize wetlands for forage, reproduction, nursery and rearing purposes.

Support of Cold Water Fisheries

Wetlands found in headwater areas provide the necessary aquatic environments and support for cold-water fisheries. Wetlands will regulate water levels and buffer against low water conditions, and will also regulate water temperatures and quality necessary for sustaining healthy downstream fisheries.

Social/Economical Benefit

The economical benefits of water quality, quantity, and retention are invaluable. Surface and ground water storage functions associated with wetlands improves agricultural crop production. Wetlands also provide recreation such as hunting, fishing, birding, and hiking. Marketable products produced by wetlands include trees, sport fish, furbearers, and food (Spaling and Smit; 1995). Swamps are especially noted for the production of large hardwood species.

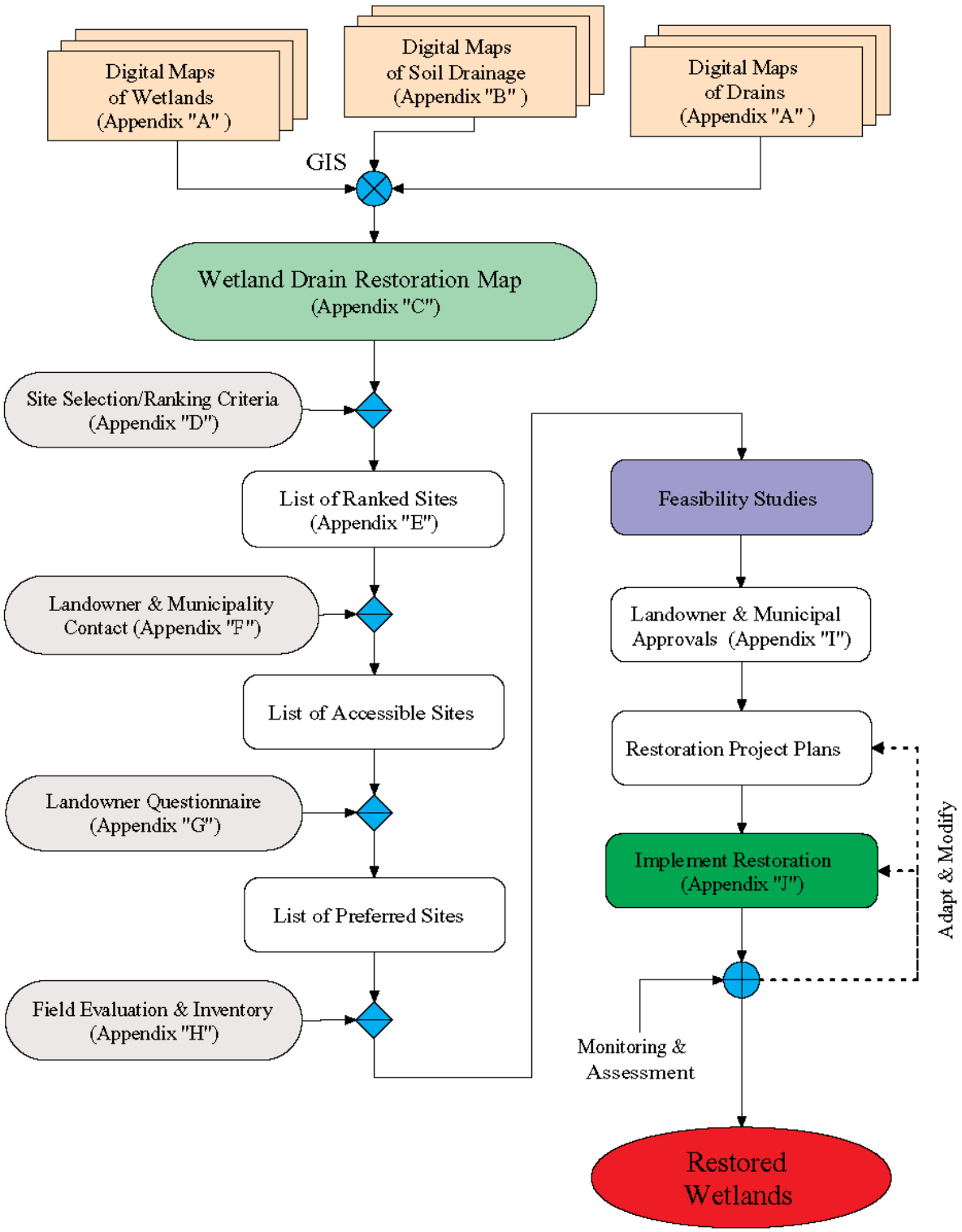
(Photo: Norfolk Land Stewardship Council)

Searching for a sustainable water supply to support agricultural business objectives during low water conditions.

Special Features

Provincially, regionally or locally significant plant and animal species are often found in wetland habitats. Rare species of flora and fauna as well as the rarity of the wetland itself may be valuable to society. It is unfortunate that wetlands remain undervalued in some sectors of society given their strong ecosystem functions and ecosystem services. Wetland losses in southern Ontario continue today and a key factor in the continuing losses of wetlands, and conversions to other uses, is the lack of awareness and understanding of how wetland functions benefit societal needs. The conservation of existing wetlands and restoration of wetland habitats provide a cost-effective and sustainable means of maintaining a healthy environment and thus an overall benefit to human health. The Wetland Drain Restoration Project focuses on identifying suitable sites for restoration to maximize wetland functions and benefits to the local communities. The step by step process of the Wetland Drain Restoration Project is illustrated in Figure 1.

Figure 1. Wetland Drain Restoration Project Flow Chart



DESKTOP METHODOLOGY (GIS/ArcView)

To begin assessing landscapes and reveal potential restoration sites a desktop mapping method has been developed. The method also allows for efficient use of time and the reduction of project costs. The key is to identify potential wetland restoration sites that are presently being affected by municipal drains. A landscape map of these sites and a system to rank priority sites for further field investigation is the first critical step in a successful wetland drain restoration project.

Potential restoration sites and target areas are identified using digital mapping techniques. Basic mapping information that is compiled includes NRVIS (Natural Resource Values Inventory System) data. The NRVIS map data includes municipal drain locations, hydric soils, wetland locations, forest cover and streams. Additional information such as Permit to Take Water locations (MOE), potential wetland sites, and aquifer sites enhance the landscape map. Prioritizing sites will determine the order in which field investigations should be conducted.

(Photo: MNR, Aylmer District)

Dry Creek Drain Restoration Site, identified using desktop methodology (note: hydric soils).

The following Appendices provide a step by step process to create Wetland Drain Restoration Maps and prioritize sites on which to conduct feasibility studies:

Appendix A: Digitizing Municipal Drains, contains images from ArcView 3.2 software, showing View screens and attribute tables, to illustrate the digitization process of Municipal Drainage layers and the creation of associated attribute tables.

Appendix B: Querying Poorly Drained Soils, contains methods to sort hydric soils information.

Appendix C: GIS Mapping Techniques, contains methods for compiling data and revealing/displaying necessary landscape values.

Appendix D: Desktop Methodology for Prioritizing Sites, contains a list of materials needed to prioritize target sites for field investigations; and contains a step by step process list to follow, a procedure that helps to substantiate the legitimacy of targeted sites.

Appendix E: Ranking Spreadsheet, contains an example of prioritized sites, which also reveals the order in which field investigations will be conducted.

The desktop exercise has hopefully identified "best bet" sites for wetland restoration on the Wetland Drain Restoration Maps. Wetlands that show up on the map with extensive drainage should be considered as prime sites to implement Feasibility Studies. The next step is to determine if it is feasible to restore the wetlands identified in your desktop exercise. Feasibility field studies are one of the best tools to determine if wetland restoration is an option.

FIELD METHODOLOGY (Feasibility Studies)

Conducting in-field feasibility studies distinguishes sites that may be restored from otherwise unsuitable sites. Suitable sites are wetlands in which municipal drainage networks exist and where water may be stored, while maintaining and enhancing agriculturally based operations. Furthermore, candidate sites are those in which restoration will result in the re-establishment of wetland functions, specifically, water purification, storage, ground water recharge and discharge, as well as to provide for fish and wildlife habitat. In order for a site to be considered for restoration works, local landowner understanding, cooperation and consent is a must.

(Photo: MNR Aylmer District)

Perched root systems and the settling of soil are strong indicators of efficient drainage; a great candidate site for the Wetland Drain Restoration Project.

The following represents the base line data to be collected and addressed within feasibility studies:

- Landowner Support;
- Topography (Digital Elevation Models/Contours);
- Land Use (immediate and surrounding);
- Soil Types (looking for hydric soils from OMAF data);
- Hydrology (streams, aquifers, Permit to Take Water sites etc.);
- Municipal and Other Drainage Systems (closed & open);

- Drainage History (last clean out);
- Drainage Superintendent Support;
- Municipal Support;
- Fish Habitat (Species present, water temperature, migration);
- Landowner interests and perceptions (questionnaire, interviews, on site meetings);
- Wildlife and Vegetation Communities on and adjacent to the site;
- Degree of Effectiveness (Linkages to wildlife corridors, forest cover, headwater areas, think big picture within the landscape).

(Photo: MNR, Aylmer District)

Our first field visit to the Garnham site indicated that our desktop methods were accurate (note: wetland vegetation in a municipal drain).

Be aware that Drainage Superintendent and landowner consent must be sought and provided prior to accessing any private lands.

The following Appendices provide a step by step process to conduct social and biological inventories at selected sites that have been chosen for feasibility studies:

Appendix F: Landowner and Municipality Contact, contains lists of necessary materials for contacting landowners and for pre-field study preparations.

Appendix G: Landowner Questionnaire, contains a sample of questions used to address social concerns and assess landowner views.

Appendix H: Field Inventory Sheet, contains a comprehensive spreadsheet outlining biological and ecological parameters, which must be inventoried and studied in the field and office.

DRAINAGE ACT OVERVIEW (APPLICABILITY AND PROCESS FOR WETLAND RESTORATION)

Applicability

The Ontario Ministry of Agriculture and Food manages several drainage-related statutes, one of which is the *Drainage Act* R.S.O. 1990, cD. 17. The *Drainage Act* involves democratic processes and therefore public and landowner involvement is the catalyst behind any changes to a drainage system. Responsibilities for implementing changes to a drainage system rest with the municipal council, usually through the advice of their appointed Drainage Superintendent(s), since the municipality remains liable for any changes imposed. Damming or diversion of surface water over 50 cubic metres a day requires a permit to take water issued by MOE office.

Subsection 78(1) of the *Drainage Act* is the main section that allows for the Wetland Drain Restoration Project to be implemented. **Ss78(1)** permits changes to be made to a drainage system to include such water management structures as dams, dykes and weirs etc. Furthermore, **ss78(1)** is activated by a Municipal Council decision to implement drain improvements that are usually based on recommendations from the local Drainage Superintendent(s) to the Council.

The *Drainage Act* legislation affords other advantages for the implementation and persistence of Wetland Drain Restoration Projects:

(Photo: MNR, Aylmer District)

Water Control Structure functioning to restore natural water regime (note: spring run off being passed successfully).

Project Permanency

Each restoration project is secured via by-law through Municipal Council's adoption of a Professional Engineer's report. The by-law gives each project legal status increasing the security of the restoration site since the project can only be abandoned through the repeal of the by-law following a defined process in the *Drainage Act*. The responsibility of maintenance and repair is assigned by the Act to the appointed Drainage Superintendent ensuring that the project will be properly managed.

The site restoration can only be altered through hiring an engineer under **ss78(1)** of the *Drainage Act*. Drainage Superintendent approval and recommendation is mandatory prior to a submittal to Municipal Council to hire an engineer to promote any change. Also, changes are only supported by virtue of the drainage system malfunctioning in the role or purpose developed.

(Photo: MNR, Aylmer District)

Water Control Structure operating to hold back a more natural water regime (note: change in water level elevation).

Project Costs

When work is undertaken under a new engineer's report under the *Drainage Act*, the Ministry of Agriculture and Food (OMAF) may provide a one-third grant towards assessments imposed on agricultural land for this work. No grants are paid towards the assessments imposed on non-agricultural land.

The cost of the Professional Engineer's Report and physical alterations (Water control structure manufacturing and installation, maintenance etc.) to a drainage system are eligible for this grant. Once the project is completed, the grant can be claimed. The municipality must submit to OMAF a grant application form signed by the treasurer and the engineer along with all the necessary supporting documents.

Landowner assessments may be further subsidized through other funding sources.

Project Maintenance

After the project is constructed, Section 74 of the *Drainage Act* compels the local municipality to take responsibility and liability for maintaining the site and allows the municipality to assess the cost of the maintenance to the landowners in the watershed. Grants are available for maintenance work performed under the supervision of an approved drainage superintendent.

DRAINAGE ACT PROCESS

It is fundamental to remember that municipal drains are communal projects that are implemented by the local municipality, but paid for by the community of landowners. If the feasibility study identifies a candidate site for restoration, and all partners are in support of the recommendations, the following is a brief overview of the *Drainage Act* process that is to occur:

Step One: Identify Need

The municipal representative (usually the Drainage Superintendent) becomes aware of a need for improvement to the design of the drain, the result of either the landowner(s) request or the completion of a feasibility study.

Step Two: Landowner Consent

Landowner consent is received through signatures within a County/Township memorandum. Although this step is not required under the *Drainage Act*, it is important to gain the support of the landowners for this type of project as early as possible. Given that the wetland restoration has water quality and quantity benefits most landowners have proven to be very supportive.

Appendix I: Municipality Memorandum, contains a sample of a memorandum.

Step Three: Municipal Council to Appoint Engineer

The municipal representative (Drainage Superintendent), with the signed memorandum and feasibility study, prepares a report and recommendation to submit to Municipal Council. If the Council decides to accept the recommendations, the local Conservation Authority and Ministry of Natural Resources are notified and in accordance with ss78(1) of the *Drainage Act*, Council appoints a Professional Engineer to prepare a report outlining alterations to the drainage system.

Step Four: On Site Meeting

An on-site meeting is arranged by the Municipality to be held with the interested parties including the Professional Engineer, Drainage Superintendent(s), landowner(s), and project partner(s), to review alterations to the drainage system.

Step Five: Preparation of the Engineer's Report

The Professional Engineer prepares a report outlining plans, profiles, and details for the recommended alterations. The report includes cost estimates and a schedule that shows how the cost of the project will be assessed to the individual landowners. The engineer is also responsible to ensure that all necessary approvals are obtained from the Federal Department of Fisheries and Oceans, the local Conservation Authority, and any other authorities that may have applicable legislation.

Step Six: Engineer's Report Submitted to Municipal Council

The Engineer's Report is presented at a Municipal Council meeting whereby all parties may voice concerns/support for the proposed alteration(s). The Municipal Council will either provisionally adopt the report by giving two readings to a by-law, or the report may be sent back for revision.

Step Seven: Appeals

If the report is provisionally adopted, the landowners involved in the drainage project have the right to appeal the report to the Court of Revision, The Drainage Tribunal or the Drainage Referee. It is anticipated that this situation should not occur since both the landowner and the Drainage Superintendent have indicated support for the project in the early stages of the process.

Step Eight: Construction/Implementation

After the appeal period, the municipal council may give third reading to the by-law, which then authorizes the construction of the project.

Detailed information on the drainage process can be obtained from your local Municipal Drainage Superintendent and are outlined in the *Drainage Act*.

(Photo: Norfolk Country Public Works)

Water Control Structure installation by Norfolk County staff.

PROJECT TACTICS/RECOMMENDATIONS

In-field feasibility studies will result in three basic recommendations:

1. No wetland restoration possible given that the municipal drain is functioning to provide agricultural benefits as per its original design or where landowner support cannot be obtained;
2. Some wetland restoration possible given that the municipal drain can act to store water without negatively impacting agricultural practices (through modification of the drain maintenance schedule);
3. Definite wetland restoration possible given that the municipal drain does not function to provide agricultural benefits in the given area (landowner and Drainage Superintendent input and approval required).

Should the second or third option be feasible, restoration may be achieved through various methods such as drain naturalization, installation of water control structures, and/ or bioengineering methods. These tactics will extend the hydro-period within the affected wetland(s) and allow for the wetland(s) to be naturalized. Furthermore, installation of water control structures allows for flexibility and precision in restoration designs by allowing for the manipulation of water levels within the drain. Please note that maintaining a drainage outlet is necessary and legally binding to the municipality, unless the drain can be abandoned.

The design and placement of water control structures is dependant on the desired restoration outcomes which may include: hydration of wetland specific pockets, restoration of various wetland types, improved water recharge, discharge and improved water quality, modification or restoration of the drain hydro-period and/or regulation of the watershed hydrograph.

Appendix J: Restoration Design and Structures, samples of typical water control structure designs.

Detailed restoration designs and parameters are outlined in the Temperate Wetland Restoration Course Manual. The Temperate Wetland Restoration Training Course (TWRTC) is a six day course introducing resource professionals to basic principles, concepts and ideas on wetland restoration. Two days are spent in the classroom reviewing lessons learned from a synthesis of the science and practical experience from three decades of wetland restoration in North America. Four extensive field days are spent in the field looking at wetlands, wetland complexes, drained and degraded wetlands in the context of their watersheds. Focus is placed on important principles and concepts distilled from science synthesis and actual practice of doing wetland restoration projects.

LEGISLATION (APPROVALS FOR WORK ACTIVITIES)

Certain wetland restoration work activities (e.g. water control structure installation) will require the appropriate authorization under the acts listed below. Early communication and involvement of the appropriate agencies will ensure a timely review of proposed work activities.

Department of Fisheries and Oceans Canada
***Fisheries Act* (R.S. 1985, c. F-14)**
Federal legislation containing habitat protection laws covering works which may result in harmful alteration or destruction of fisheries habitat.

Ontario Ministry of Natural Resources
Lakes and *Rivers Improvement Act* (R.S.O. 1990, cL. 3)
Provincial legislation requiring the approval of works on rivers or streams, including the construction and alterations to dams or other works.

Ontario Ministry of the Environment
***Ontario Water Resources Act* (R.S.O. 1990, cO. 40)**
Provincial legislation covering the taking of water and the protection of water quality.

Conservation Ontario
***Conservation Authorities Act* (R.S.O. 1990, cC. 27)**
Provincial legislation administered by Conservation Authorities requires a permit prior to alteration or construction within waterways.

PROJECT OUTCOMES AND DELIVERABLES

Restoring wetlands by extending the hydro-period in target sites will result in restoration of some wetland functions. Therefore, associated outcomes from the Wetland Drain Restoration Project include:

(Photo: MNR, Aylmer District)

Impaired Fen due to drainage, now under successful restoration.

Wetland Drain Restoration Project

Outcomes

- Increased wetland habitat within Southern Ontario ecosystems;
- Slowing the rate of loss of the past trend of continuing wetland loss in Ontario;
- Improved water quality within affected landscapes;
- Enhanced carbon sequestration in wetlands;
- Improved surface and ground water storage, discharge and recharge functions during dry periods;
- Enhanced ability of the landscape to buffer against drought conditions;
- Improved stream base flows (and stream temperature regulation);
- Soil conservation;
- The provision and support of fish and wildlife habitats (and associated recreational opportunities);
- Improved agro-ecosystem health with the coexistence of wetlands and municipal drains and established buffer zones between natural areas and agriculture;
- A unique way to utilize the *Drainage Act* for the betterment of the environment, while co-existing with sustainable agriculture:
  - Up to 1/3 grant from OMAF after project completion;
  - Democratic process that involves landowners and increases their awareness of municipal drainage capabilities;
  - Increased landowner awareness of wetlands for their water supply benefits and associated functions;
  - Incorporation of Wetland Drain Restoration Projects within Professional Engineers report adopted by municipal by-law assures longevity of the project despite future landowner changes;
- Municipal responsibilities for the repair and maintenance of all drainage projects including any wetland restoration projects undertaken under the *Drainage Act*;
- Potential reduction of drain maintenance costs through modification of drain management schedule and use of environmentally friendly management techniques;
- Increased public awareness of the importance of wetlands;

(Photo: MNR, Aylmer District)

Excellent riparian buffer potential downstream from wetland restoration site.

- Improved landowner awareness of land stewardship and improved understanding of the influence that their land practices have on surrounding areas and water supplies (quality & quantity);
- The fostering of a spirit of cooperation between farmers and other community groups;
- Improved understanding among project partners will lead to other joint projects benefiting the environment;
- Overall economic benefits for society as a whole.

(Photo: Temperate Wetland Restoration Course)

Dave Reid, Norfolk Land Stewardship Council, explaining key role of land stewardship in the success of the project.

Deliverables

- The completion of Landscape Feature mapping and choosing "Best Bets" for new restoration work;
- Development of educational materials to maintain project momentum and communicate results to other interested agencies, landowners, municipalities and Drainage Superintendents;
- Pre- and post-construction monitoring to demonstrate wetland restoration benefits;
- Increase information base on wetlands, streams, aquifers, municipal drains, permit to take water locations and low water data to be shared between resource management agencies and community groups.

PARTNERSHIPS AND SOCIAL ASPECTS

The Wetland Drain Restoration Project involves a wide diversity of partners, increasing the understanding of wetlands and their benefits to communities, as well as, improved understanding of each other.

Partnerships both strengthen and enhance the transferability of a project, as they allow for shared expertise, respect, communication, flexibility, education, monitoring, and in-kind and financial support. Successful partnerships minimize conflicts among resource uses and users. Also, there is an immeasurable synergistic value of partners working together to achieve more benefits than individual parties working alone.

All partners must be committed to open communications, fairness, and transparency. The benefits to each partner, roles and responsibilities and jurisdictions must be clearly outlined and understood.

Furthermore, establishing partnerships with landowners requires ongoing and long-term dedication. Partnerships should be nurtured and continue throughout the project implementation and into the future, alongside monitoring tactics.

Partnership models and ideals are described within the Ontario Ministry of Natural Resources, Beyond 2000 document and the Ontario Stewardship Model. Both exemplify integrated resource management objectives, which address the full range of environmental, social and economical factors in any endeavor.

PUBLIC EDUCATION AND AWARENESS

The Wetland Drain Restoration Project uses the Principles of Ontario Stewardship, which include respect for private land ownership, working together in the community to pool available resources and helping people to help themselves. Therefore, the Wetland Drain Restoration Project encompasses a broad strategic approach to managing the environment where implementation is shared across jurisdictions and agencies.

(Photo: Temperate Wetland Restoration Course)

Peter Bryan-Pulham, Senior Drainage Superintendent, Norfolk County, educating the Temperate Wetland Restoration Course student participants.

A diverse partnership of agencies, landowners, farm organizations and municipalities is created that works together towards a common cause, ensuring a sustainable environment through wetland restoration. Furthermore, the project's approach is based on shared responsibility with the government and non-government organizations, local municipalities, local landowners, the public and the scientific/technical community, and relies on transparent sharing of information. A Wetland Drain Project Advisory Committee has been established to guide the project as it expands in the Southern Ontario landscape.

The Wetland Drain Restoration project involves a place-based approach with environmentally derived boundaries such as watersheds. Municipal drains are organized on a sub-watershed basis and thus lend themselves to a watershed management approach. This project marries organizations and individuals that work in terms of municipal boundaries with organizations that work on a watershed basis and who both wish to influence management of private lands at a landscape or ecosystem scale.

Use of digitized mapping products including streams, municipal drains, wetlands, water taking permit locations, hydric soils, forest cover and aquifers will facilitate improved understanding of watersheds and improved communication between agencies with different interests but affecting the same water supplies. Furthermore, the sharing of project data among resources agencies and community groups will increase the ability of all parties to better manage water quality and quantity issues within the watershed.

Linkages to existing related initiatives will ensure sharing of information between respective communities. Additionally, products from the project will assist organizations and landowners with similar concerns and interests in neighbouring watersheds or municipalities, to implement similar projects.

Finally, the diversity of partners involved in the Wetland Drain Restoration Project and the democratic process required under the *Drainage Act* assures that a strategic shift towards shared responsibility and awareness and the need for sustainable agricultural and natural environments, amongst all stakeholders, will be accomplished.
Each restored site should necessitate a monitoring and evaluation plan. Monitoring may also extend throughout or encompass the watersheds in which the restored wetlands are situated.

PROJECT MONITORING

Each restored site should necessitate a monitoring and evaluation plan. Monitoring may also extend throughout or encompass the watersheds in which the restored wetlands are situated.

Monitoring techniques may vary depending on project objectives. Since the knowledge of a site's hydrology is known to be fundamental to the structure and functioning of wetland systems, either direct or indirect hydrologic monitoring should be included in all plans. Some examples of useful and comprehensive studies involve vegetation plots and/or transects to monitor habitat changes, which can demonstrate the changing hydrology indirectly. Photo stations are a tool to monitor changes in vegetative communities due to wetland restoration actions. It is the assumption that wetland dependant species will succeed back into the site, as the site is restored toward a natural functioning wetland. Surface water levels, soil moisture, local and regional groundwater levels and climatic influences are direct measures of hydrology and are important in monitoring programs.

Basic water quality data may also be collected and assimilated, if improvement of water quality is one of the project objectives. Direct measurements of water chemistry or quality (e.g.: denitrification is likely and should be assessed), or indicator organisms such as benthic invertebrates can be used to evaluate water quality.

Lastly, habitat monitoring for the presence of bio-indicator species will reveal certain aspects of ecosystem health. Local field naturalists can be involved in monitoring wildlife populations, particularly amphibians or birds.

Monitoring must take place across space and time in a comprehensive manner so that it may reveal:

- The results of each restoration program objective;
- The effectiveness of the restoration design and implementation;
- Annual and long term success of the project;
- The short and long term impacts on:
  - benefits to the environment;
  - benefits to wildlife (habitat);
  - benefits to the local community;
  - benefits to landowners;
- The necessity for alterations to the restoration plans;
- Assessment of future needs.

Pre-restoration information (baseline data) should be gathered for each monitoring project. Even basic hydrologic data is useful in planning a more successful restoration. Furthermore, attempts to collect historical data should be undertaken where possible. Lastly, monitoring should continue during and after the restoration, and should be conducted over a minimum of a 2-year (8 season) period, although years of monitoring are needed to fully evaluate a restoration, due to the slow development of ecosystems and chance hydrologic events.

(Photo: University of Western Ontario)

Sarah Boyd, University of Western Ontario graduate student, collecting data on wetland function.

CONCLUSION

There is now a strong movement to protect and restore wetlands after decades of thinking of wetlands as a wasteland or impediments to agricultural business objectives. This change in attitude is due to societies new found understanding of the enormous ecological and societal value wetlands provide. A wetland's ability to improve water quality and quantity in the landscape is, and will continue to be, extremely important to addressing human health issues.

It is intended that this comprehensive Wetland Drain Restoration "How to Guide" will help guide similar initiatives and facilitate successful wetland conservation and restoration efforts throughout Southern Ontario. The Wetland Drain Restoration process requires that you do your homework through the Feasibility Studies, take action on the recommendations in the Feasibility Studies, monitor the results of the restoration actions implemented and adjust the restoration activity as necessary.

It is strongly suggested that Wetland Drain Restoration project members be contacted to assist with the initiation of wetland restoration efforts associated with municipal drain water regime manipulation given their strong skills developed from "learning from doing". Each restoration project is an experiment and the sum of the results provides a context for future restoration actions.

(Photo: MNR, Aylmer District)

Water quality, quantity and wetland function restored; a successful outcome to a Wetland Drain Restoration Project.

Wetland Drain Restoration Project

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(Photo: Norfolk County Public Works)

Project leads, Dave Richards and Peter Bryan - Pulham, observing Water Control structure installation.

Demonstration Sites:

Garnham Drain Wetland Restoration

Big Marsh Drain Wetland Restoration

Walther's Overflow Wetland Restoration

Fick Drain Wetland Restoration

Dry Creek Drain Wetland Restoration

Acorus Wetland Restoration Site

VanSeveren Wetland Restoration Site

GLOSSARY OF TERMS

Agro-ecosystem: Any agricultural system, which incorporates a natural community of plants and animals within a particular physical environment, on land where domestic animals are raised or crops grown.

Aquatic: Growing or living in water.

Benthic: Occurring at the base of bodies of water: lakes, oceans, and seas.

Bioengineering: The application of biological science to engineering principles. The use of living or organic plant material to achieve engineering solutions.

Carbon Sequestration: Process by which Carbon is removed from the environment and held within, for example, a wetland.

Conservation: The protection of natural or man-made resources and landscapes for later use.

Drainage System (Under the *Drainage Act*): A drain constructed by any means, including works necessary to regulate the water table or water level. This broad definition allows for features to be included in drainage systems to restore wetlands while still protecting the agricultural interests of the private landowners.

Drained: A condition in which the level or volume of ground water or surface water has been reduced or eliminated from an area by artificial means.

Ecosystem: A natural community of plants and animals within a particular physical environment, which is linked by a flow of materials throughout the non-living (abiotic) as well as the living (biotic) section of the system.

Enhancement: To add to, or to make greater; for example, to add additional water to a wetland, in order to make greater its' environmental functionality.

Function: An ecological role for human benefit.

Groundwater: All water found under the surface of the ground that is not chemically combined with any minerals present, but does not include underground streams.

Groundwater Discharge: The function of a wetland to accept subsurface water and hold it for release over long periods of time.

Groundwater Recharge: The function of a wetland to retain large quantities of water for slow percolation to replenish groundwater supplies.

Hydric Soil: Soil characterized by an abundance of moisture and much reduced oxygen levels, to the extent that the soil supports water-tolerant vegetation.

Hydrology: The study of the earth's water, particularly of water on and under the ground before it reaches the ocean or before it evaporates into the air.

Hydro-period: The seasonal pattern of the water level of a wetland that is a hydrologic signature of each wetland type. It defines the rise and fall of a wetland's surface and subsurface water.

Hydrophytic Plants: Vegetation adapted to growing in water or in hydric soils.

Intermittent: Stopping and beginning again, pausing at intervals, for example, water flow.

Monitoring: Periodic evaluation of a site to determine success in achieving goals.

Naturalize: To make a part of the physical environment natural, free from conventional characteristics.

Poorly Drained: Soils that are saturated at or near the surface during a sufficient part of the year such that field crops cannot be grown without drainage.

Restoration: Changing existing function and structure of wetland habitat so that it is similar to historical conditions.

Values: Wetland processes or attributes which are beneficial to society.

Water Control Structure: An engineered structure designed to hold back water and mimic a natural water regimes that promotes wetland restoration, without affecting adjacent agricultural practices.

Watershed: The boundary between two river systems. The watershed marks the divide between drainage basins, and usually runs along the highest points of elevation.

Water Table: The surface below which the soil is saturated with water.

Wetland: Lands that are seasonally or permanently covered by shallow water, including lands where the water table is at or very close to the surface. In either case, the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic or water-tolerant plants.

Wetland Values: Wetland processes or attributes which are beneficial to society.

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- Dave Richards, Project Lead and Management Biologist, Long Point Area, Ontario Ministry of Natural Resources, (519) 773-4731;
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- Shawn Vanacker, Drainage Superintendent, Norfolk County, (519) 582-2100 Ext. #602;
- Jennifer Jacobson, Wetland Drain Restoration Project Coordinator, Ontario Ministry of Natural Resources, 1999-2001, 2003;
- Leora Berman, Wetland Drain Restoration Project Coordinator, Ontario Ministry of Natural Resources, 2001-2002;
- Kate MacIntyre, Wetland Technician, Ontario Ministry of Natural Resources, 2003;
- Dave Reid, Coordinator, Norfolk Land Stewardship Council;
- Robert Messier, Ontario Wetland Habitat Fund Advisor;
- Sid VanderVeen, Drainage Coordinator, Ontario Ministry of Agriculture and Food;
- Russ Piper, Past President, Ontario Federation of Anglers and Hunters and member of the Ontario Drainage Tribunal;
- Larry VanSeveren, Landowner/Realtor and member of Norfolk Land Stewardship Council;
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Wetland Drain Restoration Project

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(Photo: MNR, Aylmer District)

Improving Water Quantity

(Photo: Bran Glasman, Upper Thames River, Conservation Authority)

Improving Water Quality