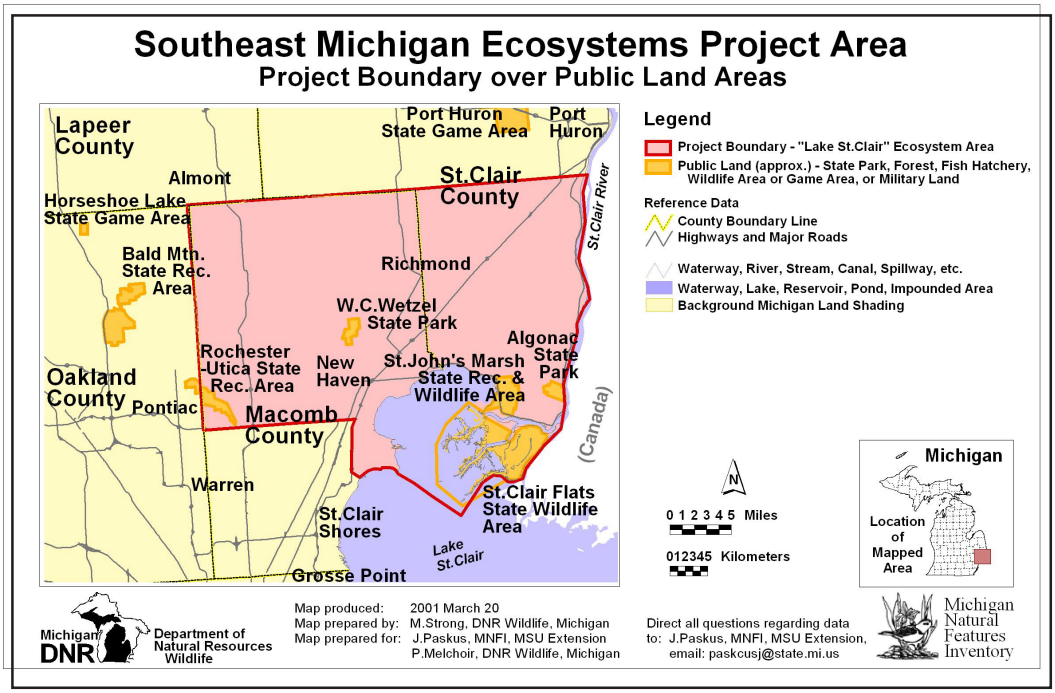
Summary of the Southeast Michigan Ecosystem Project: 1994-2001



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MICHIGAN STATE UNIVERSITY EXTENSION

Michigan Natural Features Inventory

Executive Summary

The Northern Maumee Lake Plain Ecosystem project was initiated in 1995 as a result of two conflicting management plans written for the St. Clair Flats area in St. Clair County. This large wetland complex is one of the largest freshwater deltas in the world. It is also considered one of the most significant staging areas for migratory waterfowl in Michigan. The Flats area contains some of the best remaining examples of Great Lakes marsh and lakeplain prairie, two globally imperiled communities, in Michigan as well as great opportunities for the restoration of lakeplain oak openings another globally imperiled community.

The purpose of this pilot project was to develop a planning process to serve as an adaptive model for the management of private and public lands in the southern ecoregion of the state. The team was charged with the development of 1) a management plan outline and written document, 2) an outline of the planning process, and 3) a plan to incorporate public input. Over a six-year period (1995-2001), the team wrestled with delineating the project boundaries, designing the management plan and public participation process, writing the ecosystem assessment section, and defining the scope of the socio-economic assessment.

People closely associated with the project probably consider those past six years on the team as neither a failure nor a success, but rather a work in progress that has been temporarily postponed until a decision is made by the MDNR statewide council on how to proceed. Although few products have been produced from this endeavor, the groundwork has provided a strong foundation and framework for continuation of the project. Many lessons were learned along the way about planning, group processes, ecosystem management and product development. As a result, the team produced a list of challenges faced over the course of the project, as well as a list of potential options regarding the future of the project. In the end, the team recommended what it thought was the most feasible and best alternative for delivering a high quality product. This recommendation focused on hiring outside consultants to provide three critical services; leading the group, completing the socio-economic assessment, and facilitating the public input process. The MDNR wildlife division management team, however, decided to proceed with a more short-term alternative focused on summarizing the team's activities and accomplishments (hence this document).

Despite the fact that this project was never completed, there have been several on the ground successes, particularly at Algonac State Park and St. John's Marsh Wildlife Area (SJMWA).
In addition, increased interagency interaction has lead to increased coordination, sharing of resources, and appreciation of the work accomplished by the different divisions and departments involved. Participation in the discussions, meetings, working groups, and retreats has lead to an increased knowledge and understanding of the ecosystem planning process, and the abundant wildlife and unique ecosystems found in the St. Clair Flats region.

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Background Information

The team was formed in 1995 as a result of two draft management plans for the St. Clair Flats area (located in southeast St. Clair County) that had several conflicting management goals and objectives; one plan focused on increased management for game species, while the other plan concentrated on the protection and restoration of the unique natural ecosystems and associated biota in the area. Pete Squibb, wildlife management section leader, and Dick Elden, scientific services leader, decided to bring together a diverse group of staff to abandon the conflicting management strategies identified in the plans, and instead develop a holistic ecosystem management plan for both the state lands and surrounding private lands in the St. Clair Flats region. The original team consisted entirely of staff from the Michigan Department of Natural Resources, wildlife division. Over time, staff members from other divisions and departments were added to the team, and some of the original team members were replaced by other resource professionals.

The mission of the team was to enhance, restore, and conserve the St. Clair Flat's (Northern Maumee Lake Plain sub-subsection) wildlife resources, natural communities, and ecosystems for the benefit of Michigan's citizens, visitors, and future generations. The original purpose was to develop a planning process to serve as an adaptive model for the management of public and private lands in the southern ecoregion of the state. The purpose of the team was also strongly grounded in the principles of ecosystem management that focus on the integration of ecological, social, and economic systems to maintain and restore native ecosystem integrity over the long-term. The project lasted approximately six years and ended when the last official team meeting was held in March, 2001.

Expected Products

Initially, the group was charged with developing a management plan for the Maumee Lake Plain sub-subsection (Albert, 1995). The plan was to include: 1) a set of long-range objectives for management of the southeast Michigan planning unit, 2) objectives for master plans of Wildlife Division administered public lands within this area, and 3) a set of objectives for habitat management of private lands within the area. Over time, the charge changed from development of the objectives state above to the development of: 1) a management plan outline and written document that incorporates both private and public lands, 2) an outline of the planning process, and 3) a plan to incorporate public input.

Planning Process

The overall planning process the team decided on was developed and refined over the course of the project's existence. The team tried to hold daylong monthly meetings with a few retreats scattered in when intensive work sessions were needed. Agendas were always sent out ahead of time, and meeting minutes were recorded and disseminated to team members and wildlife management staff in Lansing. To facilitate the development of the final product, a writer was contracted in 1997 to write and produce the ecosystem management plan.

Although there is a lot of talk about ecosystem management in Michigan, there are no true regional models to emulate or other agency groups to necessarily learn from. Other groups were working on ecosystem planning/management during the same time period, but they were struggling with the process just as much as we were. Communication with wildlife management continued to reinforce that this was

a pilot project, and like most pilots the process was very iterative. We developed the planning process as we moved forward towards our goal of ecosystem management, recognizing that the process we were creating was just as important as the management plan itself.

The planning process that the group ended up with essentially paralleled the outline of the management plan (figure 1). A core team was assembled that consisted entirely of wildlife division staff. Field staff included Tim Payne, Ernie Kafcas, and Jon Schafer, while Lansing staff included Kim Herman, Penney Melchoir, Earl Flegler, and Mark Sargent. Eventually, staff from other divisions were added the team including: Jeff Braunscheidel, Fisheries Division, Ray Fahlsing, Parks and Recreation Division, Tom Graf, Land and Water Management Division, Department of Environmental Quality, and Kathie Arney, Forest, Mineral, and Fire Management Division. Over time, some of the original team members were replaced by other resource professionals for various reasons. For example, Greg Soulliere replaced Earl Flegler when Earl was transferred to another part of the state, and Barry Horney replaced Tom Graf. In 1997, John Paskus, Conservation Planning Specialist from the Michigan Natural Features Inventory, was hired on as technical writer to assist the team in developing the management plan.

The direction of the group was initially determined by George Burgoyne, MDNR Deputy Director, who developed the team's mission and purpose. The group then set out to define the management plan, develop the planning process, and define the preliminary ecosystem boundary. The next step in the process focused on designing the public input process, and conducting the ecological assessment of the area. This assessment incorporates information on ecosystems, social and economic trends, and a summary of existing protection/conservation policies and programs as well as land protection status within the project area. Conducting a preliminary public scoping process is included in the social and economic trends assessment. Following this assessment is the development of management options and recommendations. This step in the process is what most people think of as the plan because it provides direction and list of activities. This step also incorporates the majority of the public input process, and is distinguished from the rest of the process by a finalized document. Despite the fact that the document is completed, however, the process is not over. Two very important steps follow the finalization of the plan: implementation and evaluation. Implementation is simply carrying out the strategies and actions identified in the plan. Last but not least, evaluation is one of the most important steps in the process. Evaluation measures the progress towards goals and objectives, and provides an opportunity to make adjustments to different parts of the plan.

One last important point related to the planning process is in regards to important issues that occasionally surface during a meeting. Because a team is inherently made up of people, often with diverse interests, discussions often diverged into related and timely topics. Occasionally, these topics could dominate a meeting and even demand additional meetings or on-site discussions. Some of the topics addressed over the course of the project included the River Rouge watershed assessment, Great Lakes water levels, large scale development proposals, the St. John's marsh mitigation project for a sewage overflow violation, trails and interpretive materials for St. John's marsh, numerous grants, exotic species control, and day to day management activities of state lands. Although these discussions were often tangential to the plan and appeared to distract the team from the project, they were important issues to address. They often provided concrete projects for the team to wrestle with while stumbling through the nebulous world of ecosystem management.

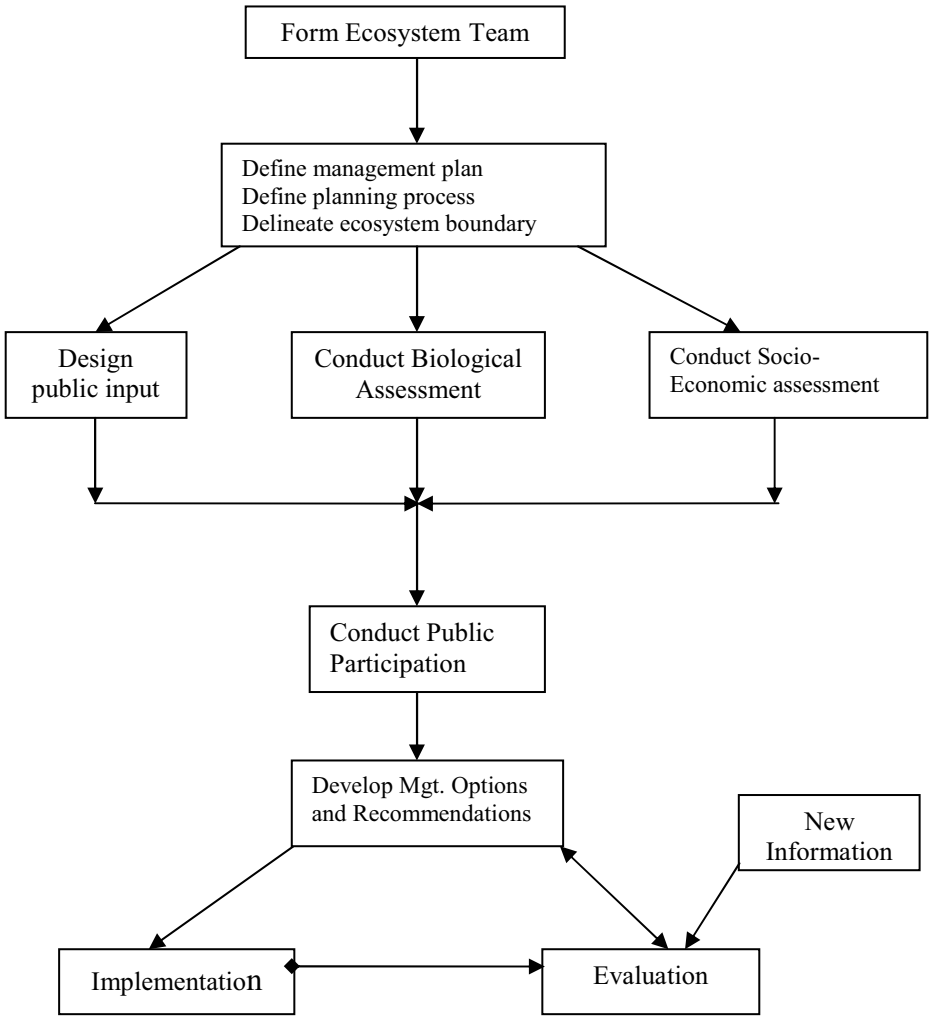

Figure 1. Planning process flow chart.

Public Participation

Throughout the United States, public participation has become one of the most important elements of an ecosystem management or conservation plan. Pubic involvement can increase public support of the management plan, broaden source of expertise, gather information vital to planning, build relationships with key constituents, and resolve conflicts early on. Given the magnitude of the role the public can have in the final outcome and implementation of the plan, the group struggled for quite a while on designing the public involvement process. In fact, public participation was part of the group's discussion as early as 1996. After many meetings and assistance from a few experts, a plan was developed for incorporating public participation into the planning process in 1999.

The public involvement strategy contained 5 major steps: 1) focus groups to obtain initial information on key issues, 2) interactive workshops to prioritize issues, 3) issue-based focus groups to develop management options/recommendations, 4) open workshop for public review of draft document, and 5) document finalization. Over seventy different entities were initially identified as potential stakeholders in the project (please see appendix A).

1. Focus groups (playing field). Develop 4-6 focus groups representing different interest groups. Use trained facilitator and have a gift for each participant. Main Priority is gathering input. Lesser priorities are public education, and stakeholder ownership.

2. Interactive workshops (play book). host several workshops around the area to present current information (biological, social, economic, and focus group). Break down into smaller groups to address certain topics (determined after focus group). Strive for consensus by using a "voting method" in which you ask for highest priorities and go around the room more than once. Main priorities are public education, gathering input, and maximizing stakeholder ownership.

3. Issue-based focus groups (game plan). Form several groups, each focused on a specific priority, to develop recommended alternatives based on results from the interactive workshops. Main priorities are gathering input and reinforcing stakeholder ownership. Lesser priority is public education.

4. Review draft plan – (half time coaches briefing). Send out draft plan before meeting. Open meeting to present draft plan followed by an interactive workshop to attain public comments. Could break down into smaller groups to address specific topics. Main priorities are public education, gathering input, and maintaining stakeholder ownership.

5. Finalize plan based on comments from step 4 and make available to the public.

Project Boundaries

The group struggled throughout the duration of the project with defining the boundaries of the focus area. Originally, the boundaries extended south to the Ohio border to include the entire Maumee Lake Plain sub-subsection (Albert, et al, 1995) (fig. 2). Over time, certain members of the group pushed for decreasing the boundaries of the focus area to a more pragmatic area. Eventually, the entire group decided to restrict the focus area to the portion of the Maumee Lake Plain sub-subsection north of the high density urban zone. Since Canada was not a partner in this project, the eastern boundary was determined strictly by the U.S./Canadian border. The north, east, and south boundaries however were much more difficult to come to a consensus on.

The major factors that went into the decision-making process were landform, watershed, political jurisdictions, and urban landcover. Eventually the group decided on using the northern border of Macomb County and shooting it eastward across St. Clair County to the St. Clair River for the northern boundary of the study area. The southern boundary was the most controversial for several reasons. As mentioned earlier, several of the local members wanted to reduce the size of the area. Other members, however, felt that although there was very little open space remaining in the Detroit urban zone, the residents living there could be a tremendous asset to the project from a political, economic, and volunteer standpoint. Eventually the group decided to use a major highway (M-59) to form a significant length of the southern

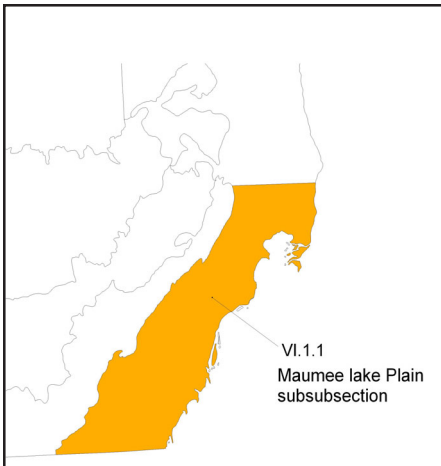

Fig. 2 Maumee Lakeplain sub-subsection

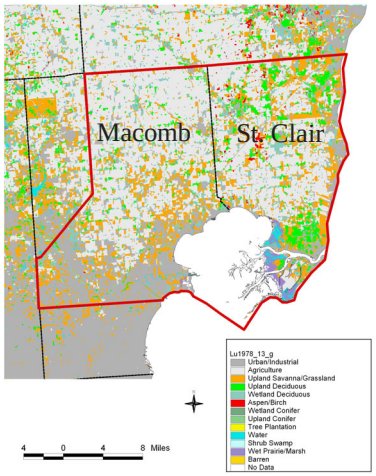

Fig. 3 Old boundary line

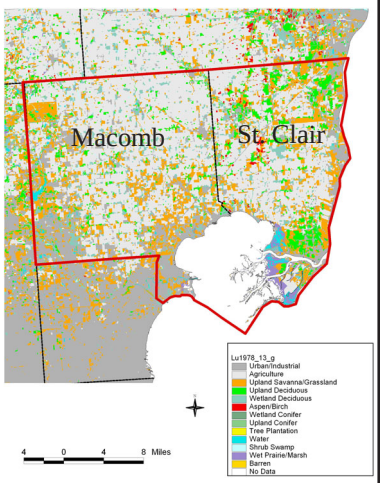

Fig. 4 Current boundary line

boundary and incorporate a small but significant portion of the Clinton River floodplain. The western boundary, although not controversial, was probably the most difficult to determine. Dennis Albert's ecoregional boundaries were delineated at the broad scale and happen to cut across several townships in Macomb County. After making adjustments based on more refined topographical information, the ecoregional boundaries still cut across several township boundaries, and the watershed of the Clinton River extended beyond Macomb County into Livingston and Oakland Counties (fig. 3). In the end, the most important factor in this process turned out to be the political jurisdictions. The team decided that all townships in Macomb County along the western border should be incorporated into the study area (fig. 4).

St. Clair

Near the end of this step, the team learned several important lessons about project boundaries: 1) boundaries are very difficult to set in stone because they have a high degree of psychological impact on team participants, residents, stakeholders, and politicians, 2) boundaries can be "fuzzy", and 3) boundaries can be hierarchical. By fuzzy, we acknowledged that a boundary is actually a very artificial human construct, and is really used to help focus a group's efforts, with an emphasis on focus. To assume a line can be drawn on the ground that perfectly reflects the true limits of an ecosystem is too simplistic of an approach. Boundaries can also be complex by incorporating multiple data layers into the process. For example, we can have a limited study area to focus limited resources and efforts, while also acknowledging factors outside the study area can have an impact on the smaller study area, such as the larger watersheds that feed into Lake St. Clair.

Management Plan

The detailed outline for the management plan is located in appendix B. The group discussed the outline from the inception of the project, and the final outline was agreed upon in 1997. The five major components of the plan outline are:

1) Introduction (includes an overview of ecosystem planning, the project area and ecosystem management)
2) Ecosystem assessment (includes a biological, socio-economic, and protection/conservation assessment)
3) Management options and recommendations
4) Implementation
5) Evaluation

In my opinion, this is one of the group's most important accomplishments because it can be used in perpetuity regardless of who is working on the project and how much progress has been made. The outline for the plan is very detailed and meticulously thought out. Every nuance that could possibly be included in a management plan was thoroughly discussed and researched before a decision was made whether or not it should be included. In the end, although the group spent a tremendous amount of time struggling with a final version of the outline, it is a very strong product that has served as a cornerstone for the group.

One last important point regarding the management plan relates to its name. The term "plan" can be perceived by many in today's society as too restrictive and even as regulatory. Regardless of the group's intent, public perception can determine the ultimate success of a large scale project such as this one. One suggestion was to incorporate less restrictive language such as a guidebook, set of guidelines, or framework into the title. Since the document is based on recommendations, rather than a legally binding agreement, non-controversial language may be more appropriate especially when private land is recognized as part of the solution.

Introduction Section

The introduction will focus on an overview of ecosystem planning as it relates to this project. It will include a statement of need or mission, overview of the project area (description, ecological significance, threats, etc), and a description of the ecosystem management process. A draft of the introduction and statement of need were written early in the project, while the remaining chapters have not been addressed yet. The group decided that it would be more efficient to write the final version of the introduction after the public participation process is completed.

Ecosystem Assessment Section

This section is probably the most robust of all the sections because if its comprehensiveness and complicated subject matter. Containing the biological assessment, socio-economic assessment, and protection/conservation assessment of the area, this is essentially the inventory stage of the project. Not surprisingly, the team spent the majority of its efforts focused on this section, particularly the biological assessment which contains information on geomorphology, climate, soils, environmental quality, and ecosystems. More specifically, the team predominantly focused on the ecosystem descriptions chapter which contains ten subchapters.

One of the main issues the team struggled with during the project was the amount of involvement by individual team members. At first, individuals and small groups were assigned chapters. Once the writer was hired, team members were only responsible for research and first drafts. Unfortunately, most members didn't have the time to commit to this, which lead to long delays in the writing process. In the end, the writer took on the responsibility of research and development of first drafts in addition to the final version.

Biological assessment

The biological world is complicated due to the fact that it is made up of many living organisms with fluctuating populations that react to changes in the environment over periods of time. There are also many ways to analyze biological diversity including genetic, species, community, and landscape diversity. Initially, the group divided the biological assessment into nine chapters that focused on components common to all native ecosystems: 1) land use, 2) geomorphology, 3) soils, 4) climate, 5) natural communities/flora, 6) fauna, 7) water resources, and 8) air quality. The ninth chapter was to be a summary of landscape change across the study area.

One of the methods employed by The Nature Conservancy (TNC) is to identify high priority conservation targets and focus all conservation efforts on those targets. The team attempted to employ this method in the study area. As a result of the exercise, a list of 75 different values was generated from the group (majority were state and federally listed species). Targets that received the highest votes in order of priority were: 1) Great Lakes marsh, 2) lakeplain prairie/oak openings, 3) riparian corridors, 4) endangered species, 5) forests, 6) ducks, geese, and native swans, 7) warm water steams/rivers, 8) yellow perch and walleye, and 9) water quality. Afterwards, one of the members asked if we could take a different approach. It was suggested that rather than just focus on high priority targets, we instead focus on improving the health of the entire landscape. After much discussion, the group decided to abandon the targets approach developed by TNC, and instead divided the Northern Maumee Lakeplain into a logical set of "systems." At first, only natural systems were included, but as the process proceeded, human dominated systems such as agricultural lands and developed lands were also included. The basic premise for including human systems was the principle that humans are as much apart of the ecosystem as any other species, and that a true ecosystem approach integrates the economic, social, and ecological components of the living world.

The team divided the study area into ten major systems: 1) mesic southern forest, 2) inland marsh, 3) lowland hardwood forest, 4) coastal wetlands complex, 5) dry mesic southern forest, 6) agricultural land, 7) developed land, 8) rivers and streams, 9) old field, wet meadow, and shrub upland, and, 10) shrub-carr. Contents of the chapters include an introduction, a description of the historic and current condition, description of stresses and threats to the system, ownership/protection status, management recommendations, information gaps that may exist, and opportunities for maintaining and enhancing the system. Although the chapters have not been formatted yet, the vision is to also include images, maps, and tables. The section on historic condition focuses on a description of the system, associated plant and animals including federally and state listed species, and key ecological processes. A glossary was also planned to accompany the chapters at the end of the ecological section. Final chapters for the biological assessment subsection are: landuse, geomorphology, soils, climate, ecosystem descriptions, significant fauna, environmental quality, and summary of landscape change.

Current status

The majority of writing for the ecological assessment section is not completed. Each of the ten subchapters in the ecosystem description chapter has had a least one draft version. Areas that still need research for each subchapter include: 1) ownership/protection status, 2) information gaps, 3) management recommendations, and 4) conservation opportunities. The tables below show the current status of each chapter. Each subchapter can be viewed in appendix C. A first draft of the geomorphology, soils, and climate chapters was also completed. In addition, several landcover and natural resource maps were also developed during the project (appendix E).

Table 1. Status of each ecoystem chapter.

Ecosystems	introduction	Historic condition	Current condition	stresses, threats	ownership/ protection status	management recommendations	information gaps	Conservation opportunities
agricultural land	X	X	X	NA				
coastal wetlands complex	X	X	X	X				
developed land	X	X	X	NA				
dry mesic southern forest	X	X	X	X				
inland marsh	X	X	X	X				
lowland hardwood forest	X	X	X	X				
mesic southern forest	X	X	X	X				
old field, wet meadow, and shrub upland	X	X	X	X				
rivers and streams	X	X	X	X				X
shrub-carr	X	X	X	X				

Table 2. Status of chapter images

Ecosystems	**circa 1800 map**	**2000 land cover map**	**Acres table (statewide and within site)**	**Acres pie chart**	**Graphic images**	**T/E specie table**
Agricultural land	NA					
Coastal wetland complex						
Developed land	NA					
Dry mesic southern forest						
Inland marsh						
Lowland hardwood forest						
Mesic southern forest						
Od field, wet meadow, and shrub upland						
Rvers and streams						
Shrub-carr						

Socio-economic Assessment

To truly conduct an ecosystem assessment, the team felt that we needed to get a handle on the social and economic trends in the area. Initially, the group wanted to collect information on: 1) urban, rural, recreation, and family trends, 2) urban sprawl and population growth, 3) key issues within the community, 4) social values, and public attitudes, 5) economic growth zones, 6) business and industrial trends, 7) and a summary of impacts on ecology of the area. After much discussion, a more detailed list of socio-economic information needs was developed. Major categories include: population characteristics, economy and employment, land use, agricultural trends, and environmental quality (appendix D). This list was based on previous studies conducted by The Nature Conservancy, Michigan Natural Features Inventory, Planning and Zoning Center Inc., as well as other ecosystem based projects from around the country. A copy of a map entitled "Urbanization, Southeast Michigan 1965, 1995, 2010" was obtained from SEMCOG (The Past and Future Growth of Southeast Michigan, 1998) and used as a visual guide for viewing past and projected development trends in the area.

Once it was decided what information was needed, we struggled with how to complete the assessment. No one on the current team had the expertise to conduct such as assessment nor the inclination or time. Eventually, it was decided that it would be most effective to hire someone outside the MDNR to conduct the socio-economic assessment as well as the public input process. It was decided that a few team members get together and develop a procurement form that included a budget and job description. Estimated costs for the socio-economic assessment ranged between $10-15,000, and approximately $5,000 for facilitating the public input process. Due to funding constraints, however, the procurement form was never completed.

Protection/Conservation Assessment

This section was added to gain a better understanding of existing protection and conservation tools that are currently available to advance conservation efforts within the study area. Specifically, this section will focus on identifying and summarizing: 1) outreach and education programs (both public and private), 2) laws and policies targeted towards the protection of species and habitats, and 3) status of protected lands. No work has been done on this section.

Management Options and Recommendations Section

This section focuses on identifying the goals, objectives, strategies and actions for the plan. This is a hierarchical approach with each step fitting into the one above it. At the broad scale you have the goals, for each goal there is a set of objectives, under each objective is a set of strategies, and under strategies is a set of actions. Although each category can be easily defined, they are all interrelated. The approach starts at the top with the goals and proceeds in a downward direction ending with actions. In essence, this section is the cornerstone of the project, and it is distinguished from the rest of the process by the development of the management plan document. All of the work preceding this step was preparation for the written document, and all the work following it is supposed to be based on the strategies and actions identified in this section. This section also includes development of the draft and final written document. Since this section is dependent on the completion of the assessment section and initial public input process, no work was done on this section.

Goals are broad general statements that describe a desired state or condition. A good example of a goal is to maintain a huntable population of ruffed grouse in southeast Michigan.

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Objectives are clear specific statements of expected quantifiable results related to one or more goals to be achieved within a given timeframe. A good example of an objective is to increase a population of ruffed grouse in a specific management area by 20% in 10 years.

Strategies provide the road map on how you are going to get to your destination. There is always more than one way to go from point A to point B and strategies determine which route to take. An example of a strategy is to conduct field surveys.

Strategies can also be mapped onto a base layer using “conservation zones” as developed by The Nature Conservancy. Conservation zones visually depict a synthesis of information and analysis collected in previous steps and are intrinsically linked to ecological boundaries. Conservation zones allow the user to spatially view where on the ground each strategy will be employed. Since the situation or information can change, strategies can also change over time and should be evaluated periodically. It is important that at least one strategy for each objective should be designed to measure progress towards that objective. Types of strategies include: 1) protection, 2) management and restoration, 3) community relations, 4) information and research, 5) programmatic, and 6) monitoring progress.

Actions break strategies into specific units, and identify who is going to work on a given task, what exactly will be accomplished, and when and where it will be accomplished. An example of an action is to have field technicians conduct grouse surveys on state land each spring for the next 5 years.

Implementation Section

This is the step in the process where the rubber meets the road. You have gone through endless hours of research, countless meetings, and numerous drafts and workshops and now the group is finally ready to test the waters. Very simply, implementation is carrying out the strategies and actions identified in the preceding step. Since the state owns a significant amount of land in the St. Clair flats area and will probably play a key role in influencing planning and stewardship on private land, the team recommended that the management structure of state resource agencies should be the foundation for implementing strategies and actions. This step also includes the development of an information/service resource team, and identifying and securing funds for implementation.

Evaluation Section

Last but not least is the evaluation step. Most people do not consider this step to be as important as some of the others. People involved in an ecosystem planning project are often too busy implementing the plan to take the time to evaluate their progress. Unfortunately this oversight leads to many failed projects. Evaluation consists of measuring progress towards goals and objectives and tracking and evaluating strategies and actions. This step also includes reviewing new ecological and socio-economic information at it becomes available, identifying information gaps and research priorities, and revisiting goals, objectives, strategies, and actions based on the results.

Unfinished business

As mentioned earlier, the majority of work completed for this project was focused on the biological assessment section, and none of the chapters have a final version. All subchapters in the ecosystem description chapter have at least one draft completed, and several are almost complete. There are also drafts for several chapters in the introduction section, however, these are only in very rough form. A draft outline of information needed for the socio-economic assessment has also been completed. Since no one in the group had any expertise in this area, nor the time, it was decided that it would be most effective to contract this work out. A draft request for proposals (RFP) was developed by a subgroup, however it was never submitted. Related to the socio-economic assessment is the public input process. Although the MDNR is required by law to conduct formal public hearings for certain activities and proposals, the team realized early on that the plan needed support from the local community to succeed. After many discussions the group developed a sound strategy for public input, but again needed expertise outside of the existing group as well as an objective facilitator. A draft RFP was also developed to contract with a consultant to organize, develop, facilitate, and summarize the focus groups and workshops identified in the outline. This work includes the public workshops that identify the goals and objectives for the plan and the strategies to achieve them. Lastly, the final written document needs to be written, designed, and produced.

Challenges

For those not involved in this project or who have never been involved with other ecosystem projects it may not be apparent why the group struggled so much. First, there is the nature of the beast. Ecosystem management by its very nature is inherently complicated. Ecosystems are complex, living things that change over time and vary across the landscape. They are made up of many living organisms that can move in and out of the landscape, react to change, influence other organisms and impact the environment. First hand information about the local landscape, ecosystems, and species can be scarce or non-existent. Then there are the difficulties in integrating the disparate worlds of ecology, sociology and economics. On top of the complex information the group is attempting to understand, there are the numerous personalities involved in the project, each with different motives, biases, and levels of buy in to the project.

Given the inherent complexity of most ecosystem management projects, the main reason the team struggled cannot be pinned to one particular cause, but rather a collection of factors that, at times, considerably slowed the project down to the point of inertia. Fortunately, many of these factors can be neutralized upfront at the beginning of the project before much time has been invested. During the last period of the project, several members developed an analysis of the factors that caused the group the most

problems. This list included **a lack of**: 1) time, 2) funding, 3) commitment, 4) updated roles and responsibilities, 5) guidance, 6) decision making authority, 7) expertise in key areas, 8) support from other divisions, and 9) strong team leadership.

Time – one of the major problems was not having designated time from DNR employees that was tied to the division work plan. All members essentially added it on to their existing responsibilities (which were already overloaded) rather than integrating it into an official workplan (having it replace something else).

Funding – directly related to time is funding. Without a specific budget to cover staff salaries and travel there was no way to directly tie responsibilities related to the group to a workplan. Funding was also needed to contract with experts outside the MDNR. The only person with funds designated to work on this project was John Paskus, MNFI.

Commitment – This is directly related to time and funding. Although many members thought this was an important project, in almost all cases this project was relegated to the bottom of the priority list if other issues happened to pop up. This resulted in incomplete attendance for almost all meetings with members missing in action for several months at a time.

Updated roles and responsibilities – There is a need for a stronger commitment to ecosystem management at all levels throughout the MDNR wildlife division. Current position descriptions are outdated and reflect division values developed from a prior era that was focused on game and single species management. Position descriptions at all levels need to be updated so that ecosystem management principles are explicitly integrated into roles and responsibilities. To help make this transition successful, there will also need to be a strong focus on employee performance, particularly progress made towards developing a more holistic management paradigm in their area of influence (statewide, management unit, state forest area, state game area, etc.).

Guidance – In order to function efficiently, the team needed transparent guidelines and expectations set at the beginning of the project. However, very little direction was provided from management staff, which inevitably led to a lot of dead ends and backpedaling. To the defense of the management team, the initial concept was to treat this as a pilot project and give the team as much freedom and flexibility as possible.

Decision-making authority- In addition, there was no guidance provided on how the group should make decisions, and how much decision-making power the group really had, particularly on day-to-day operations that could have a profound impact on the project area. Because of the long duration of the project, the team needed authority to approve or disapprove projects on state lands. The team also would have benefited from the ability to propose projects and seek funding to support high priority research, inventory, restoration, and or demonstration projects.

Expertise– The team lacked expertise in assessing socio-economic data, conducting public participation process, and GIS analysis. In addition, no one had past experience with developing an ecosystem management plan at such a large scale.

Support from other divisions – Staff from other divisions and departments became involved part way through the process, however, similar to wildlife division staff, never had formal approval or a budget to charge their time to. Since only one person represented another division or department at any one time, if someone from outside the wildlife division was missing, their division or department was not represented at the meeting. This particularly caused problems when a group decision or a specific expertise was needed.

Team Leadership – Lastly, the team could have benefited from a designated team leader with strong skills in planning, coordinating, and facilitating. Penney Melchoir served diligently as the team's facilitator; however she admittedly was not able to commit the time and effort that such a position required. Ideally, the team leader would 1) have 50% or more of there time dedicated to the project, 2) have strong leadership abilities, 3) have previous involvement in an ecosystem management project, and 4) focus their efforts on the development and maintenance of a productive team.

Options and Team Recommendation

Potential options/alternatives

1) Continue working on project and complete plan by March 2003.
2) Turn over project to future eco-unit planning team.
3) Hire team leader and work with him/her to complete the project; contract with consultant to complete socio-economic assessment and facilitate public input process.
4) Complete a preliminary/interim document – complete biological assessment and develop draft set of solutions by October 2002, and turn over the public input process to eco-unit planning team for completion.

Team Recommendation

The team decided to recommend option number three; to hire a team leader (planner/coordinator/ facilitator) to work directly with the team and technical writer, and hire consultants to complete socio-economic assessment and facilitate the public input process. To achieve the desired results from this recommendation, several requirements are necessary: 1) formal commitment from Department of Natural Resources and resource divisions, 2) formal endorsement of SEMP team, 3) day-to-day access to GIS expertise, 4) time commitment for each individual team member from supervisor (for 2 year period), 5) team role clarification, 6) decision making authority, and 7) secured funding.

Specifically, the team recommended the following time commitments by position for a 2 year period:

Postion	% time
Wildlife Biologist	25%
Wildlife staff specialists	5-10%
Wildlife technician	10-20%
Wildlife Management Unit Supervisor	10-15%
Representatives from other divisions	10-20%
Team leader	50%
Writer	35%

In regards to funding, the team felt that it should be given the same recognition as a management unit. In other words, the team should be able to develop its own workplan, have its own budget, and tie the workplan directly to the work planning-budget process. In addition, other divisions and departments should cover 10% of the total team's budget, which initially would include costs to cover: travel, GIS support, consultants, writer, meeting places (if offsite), and employee salaries.

Most Recent Decision

After several presentations by Penney Melchoir to the MDNR wildlife division management team and the MDNR statewide council, it was recommended that the team proceed with a version of alternative # 4 and contract with the current writer to summarize the process, work completed to date, remaining tasks, and lessons learned by October 1, 2002.

Future Considerations

Ecosystem management projects are inherently complicated, time consuming, and controversial, and the Southeast Michigan Ecosystem Project is no different. Many ecosystem-based projects across the country were initiated over the past 10 years, and although each one is slightly different, they all share a few key elements. In a widely respected 1996 study, of the 105 ecosystem management projects across the United States, nine factors were identified as essential for a successful project (Yaffee, et al):

1) Involve all stakeholders in the process, and involve them early in the process.
2) Clarify goals, objectives and responsibilities.
3) Use collaborative processes, build consensus and trust.
4) Ensure adequate resources are available.
5) Secure agency and political support.
6) Use broad flexible management strategies.
7) Make science part of decision making.
8) Understand local community needs.
9) Educate the public about the project.

In a recent report developed by the Great lakes Commission (2002), a set of common process elements for collaborative management were identified as keys to a successful project:

1) Involve diverse stakeholders in the process

An adaptive approach to stakeholder participation is most effective when it involves different stakeholders at various stages within the process, and that considers stakeholder's different roles, responsibilities, and capabilities.

2) Clarify mission, goals, and objectives

An initiatives mission should be consistent with and supportive of other regional programs, and avoid duplicating the efforts of other organizations and institutions.

3) Use Collaborative Processes

Many different goals of collaboration including to share information, develop mangement goals and objectives, make decisions, and coordinate efforts. Functions of collaboration include:

Coordination across scientific disciplines, agency boundaries and jurisdictional boundaries.

Consideration of diverse interests and concerns
Providing a forum exchanging information and learning from others
Facilitating diverse stakeholder participation

4) Develop Decision making Process/ Rules and Procedures

Need to establish some way to manage the initiative which may include: selecting a facilitator, establishing clear rules for the group to follow, and establishing a mechanism for decision making and managing conflict.

5) Establish Clear Boundaries

Helps identify which stakeholder groups should be involved in the process. Initiative should also be sensitive to resource management needs outside those boundaries.

6) Adopt an Ecosystem Approach

Need to integrate political, ecological, and socio-economic factors into one comprehensive framework. Environmental problems are ecosystem problems and cannot be addressed in a vacuum.

Conclusion

The Northern Maumee Lake Plain Ecosystem project was initiated as a result of two conflicting management plans written for the St. Clair Flats area in St. Clair County. The project started out as a wildlife division pilot project with little direction and resources. The purpose of the project was to develop a planning process to serve as an adaptive model for the management of private and public lands in the southern ecoregion of the state. People closely associated with the project probably consider the past six years neither a failure nor a success, but rather a work in progress that has been temporarily postponed until a decision is made by the MDNR statewide council on how to proceed. Although few products have been produced from this endeavor, the groundwork has provided a strong foundation and framework for continuation of the project.

Many lessons were learned along the way about planning, group processes, ecosystem management and product development. As a result, the team produced a list of challenges faced over the course of the project, as well as a list of potential options regarding the future of the project. In the end, the team recommended what it thought was the most feasible and best alternative for delivering a high quality product. This recommendation focused on hiring outside consultants to provide three critical services; leading the group, completing the socio-economic assessment, and facilitating the public input process. The MDNR wildlife division management team, however, decided to proceed with a more short-term alternative focused on summarizing work completed to date.

Despite the fact that this project was never completed, there has been several on the ground successes, particularly at Algonac State Park and St. John's Marsh Wildlife Area (SJMWA). For example, several restoration projects are currently underway to enhance and restore lakeplain prairie, lakeplain oak openings, and Great Lakes marsh. All three of these natural communities are considered globally imperiled by The Nature Conservancy, and the public lands in the St. Clair Flats offer a great opportunity to conserve these rare and unique ecosystems. These systems also provide nesting habitat for several important waterfowl species, and the marsh provides an important staging area for migratory waterfowl and shorebirds. In addition, an interpretive trail was just recently designed and installed through a portion of the SJMWA. Already, local biologists have observed a tremendous increase in passive recreation at St. John's marsh, which provides a great opportunity to educate the public about this unique resource in

southeast Michigan. One of the added benefits of the trail is the increased focus on ecological restoration and the control of exotic plants.

Lastly, increased interagency interaction has lead to increased coordination, sharing of resources, and appreciation of the work accomplished by the different divisions and departments involved. Participation in the discussions, meetings, working groups, and retreats has lead to an increased knowledge and understanding of the ecosystem planning process and the unique ecosystems found in the St. Clair Flats region, such as Great Lakes marsh, lakeplain prairie, and lakeplain oak openings. Despite the current postponement of the project, we are hopeful that the professional relationships that have built up over the years between the different divisions and departments will continue into the future.

Appendix A. List of Stakeholders

Southeast Michigan Planning Team
Stakeholder List

Zoning Commission (If different from Planning Commission)
Chamber of Commerce
Native American representation
Michigan Historical Society
Bureau of History/SHPO
Sierra Club
Southeast Michigan Greenways (Norman Cox)
EPA/GLNPO
Department of Environmental Quality (LWMD, etc.)
Department of Natural Resources (other divisions)
U.S. Fish and Wildlife Service
Corp of Engineers
Soil Conservation District
MACD
Michigan Natural Areas Council
Outdoor Writers Association
Schools (Intermediate School Districts) (Math/Science programs)
Walpole Island (possible just mailing list??)
Ontario Canada representation
Major Landowners (FORD, DETROIT EDISON, CONSUMERS POWER, etc.)
Landowners with special/unique habitats
Lake Associations
Michigan Department of Transportation
County Commissioners
Humane Society/PETA/Friends of Ducks & Geese?????
SCD Forester in St. Clair County (NRCS)
Development Groups
Audubon Society
Michigan Wildlife Habitat Foundation
Legislative Representatives
Michigan Association of Forest Consultants
Michigan Association of Wildlife Consultants
Michigan United Conservation Clubs---District 8
Waterfowl U.S.A.
Harsens Island Waterfowlers
Michigan Duck Hunters Association
MSU Cooperative Extension
Pheasants Forever
Fisheries Organizations
Townships
Land Trusts
Drain Commissioners
The Nature Conservancy
Michigan Nature Association
Michigan Forest Association
St Clair County Health Department
St Clair County Parks and Recreation Commission
Nature Centers
Jan Eathorn (interested citizen)
Stakeholder List
(continued)

Universities (Oakland University, etc.)
Michigan Environmental Council
National Biological Service
Institute of Fisheries Research
Michigan Botanical Club---Southeast Chapter
Safari Club International
Service Clubs (Boy Scouts, Lions, etc.)
Ducks Unlimited
Global Releaf
National Wild Turkey Federation
Environmental Educators
Michigan United Conservation Clubs (general)
Wetlands Consultants
Farm Bureau
Michigan Landscape and Nursery Association
Wildflower Association
Michigan Association of Parks/Recreation (private)
Garden Clubs
Outdoors Forever
Whitetails Unlimited
MBIA (boating)
Ruffed Grouse Society

Southeast Michigan Planning Team
STAKEHOLDERS

1. St. Clair County
   Metropolitan Planning Commission
   Parks and Recreation Commission
   108 McMorran Blvd.
   Port Huron, MI. 48060-4062

2. St. Clair County Farm Bureau
   5388 Lapeer Rd.
   Kimball, MI. 48074

3. Downriver Recreation Agency - Janet Canode
   (City of Algonac, Clay Twp. and local schools)

4. South East Michigan Council of Governments
   660 Plaza Drive, Suite 1900
   Detroit, MI. 48226

5. Huron Clinton Metropolitan Authority
   13000 High Ridge Drive
   P.O. Box 2001
   Brighton, MI. 48116-8001

6. Macomb County Department of Planning and Economic Development
   Att. Bernard E. Giampetroni
   115 S. Grosbeck
   Mt. Clemens, MI. 48043

7. Clinton River Watershed Council/East Michigan Environmental Action Council
   Att. Peggy Johnson
   1970 E. Auburn Rd.
   Rochester Hills, MI. 48307

8. Macomb County Health Dept.
   Att. Gary White
   43525 Elizabeth
   Mt. Clemens, MI. 48043

9. Michigan Society of Planning Officials
   Att. David Downey
   414 Main Street, Suite 211
   Rochester, MI. 48307

10. St. Clair River Remedial Action Plan Group
    Att. Gary Johnson and Diana Klemans

11. Wildlife Habitat Council
    Att. John Young
    C/O Detroit Edison, 2000 Second Ave.
    Room 1020 - WCB
    Detroit, MI. 48226

12. Lake St. Clair Advisory Committee
    Att. Don Gunning
    49505 Callens Rd.
    New Baltimore, MI. 48047

Appendix B: Management Plan Outline

Northern Maumee Lakeplain Ecosystem Project

(Outline for Planning Process and Written Plan)

I. Introduction

1.0 Ecosystem Planning Overview
- 1.1 Introduction
- 1.2 Statement of Need (Mission)
- 1.3 Overview of Project Area (highlights)
  - 1.3.1 location/description (include reference subsection boundaries)
  - 1.3.2 ecological significance
  - 1.3.3 threats
  - 1.3.4 other values
- 1.4 Ecosystem Management Process
  - 1.1.1 Description of EM process and site selection process used by group; include brief description of other EM paradigms and landscape classification systems

II. Ecosystem Assessment

1.0 Biological Assessment
- 1.1 Land Use
  - 1.1.1 circa 1800 vegetation
  - 1.1.2 settlement patterns
  - 1.1.3 present landuse conditions
- 2.2 Geomorphology
- 2.3 Soils
- 2.4 Climate
- 2.5 Ecosystem Descriptions
  - 2.5.1 agricultural land
  - 2.5.2 coastal wetlands complex
  - 2.5.3 developed land
  - 2.5.4 dry mesic southern forest
  - 2.5.5 inland marsh
  - 2.5.6 lowland hardwood forest
  - 2.5.7 mesic southern forest
  - 2.5.8 old field, wet meadow, shrub upland
  - 2.5.9 rivers and streams
  - 2.5.10 shrub-carr
- 2.6 Significant Fauna
  - 2.6.1 federal and state listed species
  - 2.6.2 economically significant species
  - 2.6.3 declining species
- 2.7 Environmental Quality
  - 2.7.1 hazardous waste
  - 2.7.2 air quality
  - 2.7.3 water quality
- 2.8 Summary of Landscape Change

2.0 Socio-Economic Assessment
- 2.1 Social
  - 1.1.1 Population characteristics
  - 2.1.3 Preliminary public scoping process - use a focus group approach to obtain initial information on key issues; gauge public attitudes
  - 2.1.4 Public Input - use interactive workshop approach to develop and prioritize more specific issues
- 1.2 Economy and Employment

1.3 Land Use Trends
1.4 Agricultural Trends

3.0 Protection/Conservation Assessment
- 3.1 Existing Public Outreach And Education Programs
- 3.2 Existing Conservation Programs (federal, state, county, township, city land targeted for conservation. Include existing management plans- possibly in appendix).
- 3.3 Existing Habitat Protection (legal protection, laws)
  - 3.3.1 Federal
  - 3.3.2 State
  - 3.3.3 County
  - 3.3.4 Other

III. Management Options and Recommendations

1.0 Conservation Planning
- 1.1 Mission
- 1.2 Goals
- 1.3 Objectives
- 1.4 Strategies
  - 1.4.1 Use focus “issues” approach to develop management options/alternatives
- 5.5 Identify and map “Conservation zones”
- 5.6 Actions

2.0 Develop Draft Ecosystem Management Plan
- 2.1 Use information from II & III
- 2.2 Compile Team recommendations

3.0 Public Review of Draft Document
- 3.1 hold workshop and open meeting
- 3.2 List of contacts (stakeholders)
- 3.2 Literature cited

4.0 Finalize Document

IV. Implementation

1.0 Management Structure
- 1.1 Identify responsible divisions and personnel
- 1.2 Identify additional on-going projects
- 1.2 Develop recommendations

2.0 Implement Strategies (opportunity to address needs identified in III)
- 2.1.1 Public Lands owned by the state
  - St. Johns Marsh
  - S.C.F.W.A.
  - Algonac State Park
- 2.1.2 Public Lands owned by local units of government
- 2.1.3 Private Lands
- 2.2 Implementation/Service Resource Team
- 2.3 Funding Sources

V. Evaluation

1.0 Progress Towards Goals and Objectives
- 1.1 Completed or initiated actions
- 1.2 Impacts of actions

2.0 Adaptive Management and Planning
- 2.1 Develop monitoring program
- 2.1 Evaluate operational procedures on state lands

Appendix C: Draft Ecosystem Chapters

Circa 1800 Vegetation

Maumee Lake Plain

The Maumee Lake Plain is located in the southeast corner of Lower Michigan bordered by Lake Erie and Lake St. Clair to the East, and the Ann Arbor Moraine to the West. The Maumee Lake Plain is a broad, flat, clay lake plain which slopes gradually east towards Lake Erie. The lake plain is dissected by sandy drainageways and narrow beach ridges, and is a mosaic of slight rises and depressions. Elevation differences between areas supporting different vegetation types are often only 1-2 feet. Before the logging era, beech-sugar maple forests, located on the well and moderately well drained sites, dominated the landscape. Mixed hardwood swamps, which contained a large variety of trees including American elm, red ash, and silver maple, often occupied large depressions adjacent to the beech-sugar maple forests. Large pockets of lakeplain prairie were found throughout the lakeplain primarily on poorly drained sandy soils particularly along the shoreline between beach ridges. Dry oak-hickory forests, oak savannas, and dry prairies occupied the well to excessively drained beach ridges. Small pockets of black ash swamp, tamarack swamp, bogs, and emergent marsh were found scattered throughout the lakeplain in poorly drained depressions. Kentucky coffee tree, sycamore, red ash, cottonwood, Ohio buckeye, and hackberry, were found on the floodplains along the major creeks and rivers.

Adjacent to the Maumee lakeplain is a series of large end moraine ridges with moderate to steep slopes. Before the logging era, dry forests, such as oak-hickory forests and mixed oak savannas, were located on the loamy, well-drained soils on these ridges, while beech-sugar maple forests were located on the clayey, moderately well-drained soils.

The northern boundary of the subdistrict is somewhat arbitrary, indicating the gradual change from the warm climate of the Maumee lakeplain to the cooler climate of the Huron lakeplain. To the north, the lakeplain actually continues onward all the way to the north end of Saginaw Bay and beyond. The sugar maple-beech forest continued to be the dominant presettlement vegetation type until approximately the Sanilac County border. At approximately the southern edge of Sanilac County, the circa 1800 vegetation dramatically changed from hardwood communities to communities that had a strong conifer component, namely: hemlock-white pine forest, mixed conifer swamp, and beech-sugar maple-hemlock forest.

Project Area

Before the logging era, the landscape of the project area was characterized as very flat, and poorly-drained. Hardwood forests, primarily beech-maple forest and mixed hardwood swamp, dominated this extensive, flat landscape. Vast beech-sugar maple forests were located on the moderately well-drained sites, while large and small pockets of mixed hardwood swamp were scattered throughout the clay lake plain in slight depressions and sandy glacial drainageways. One mixed hardwood swamp, located in the middle of the study area, stretched over 60 square miles of land. The rest of the interior of the project area consisted of scattered pockets of other types of wooded and open wetlands such as tamarack swamp, black ash swamp, shrub swamp, and emergent marsh.

A large variety of natural communities occupied the Lake St. Clair and St. Clair River shorelines. Beech-maple forests were found on the well drained sites, mixed hardwood swamps were located on the poorly drained sites, and a unique mosaic of wet and dry communities, referred to as a Great Lakes marsh complex, was located at the mouths of two major rivers. One of the marshes was located at the mouth of the St. Clair River, and stretched inland as far as 5 miles along large bends of the river. The other marsh developed at the mouth of the St. Clair River on the largest freshwater delta in the United States. This large delta historically supported several unique natural communities, including the largest Great Lakes marsh complex in Michigan (world?). This extensive Great Lakes marsh complex included several

lakeplain prairies, a unique grassland community adapted to the fluctuating water levels and poorly drained sands, and lakeplain oak openings, another grassland community with scattered wide-spreading oaks, located on the well-drained beach ridges and dunes. In addition, a large oak-hickory forest was located on a well drained site on the mainland adjacent to this complex.

Interesting Note: (taken from Edsall, et al, 1988)
Before modern times, the St. Clair River developed a channel west of the present river channel. This channel (Leverett and Taylor, 1915) begins at the city of St. Clair and parallels the St. Clair River for 13 km. South of Marine City the channel veers eastward, crosses the modern river, and integrates itself with the interlaced channels of Walpole Island. The mouth of the old channel has been occupied by the Pine River, which had incised its own channel within the old valley. It appears from aerial photographs that this old channel is the current location of the Marine City drain which passes through the middle of Algonac State Park.

Human Settlement
(Early history - 1930's)

Early History

The archeological records reveal that the Native American population in the Lake St. Clair region was relatively high compared to other coastal areas in Michigan (Peebles and Black, 1976). Sixty three prehistoric sites occur in Macomb County, the highest number in any county in the state. St. Clair and Macomb Counties have 1.2 and 4.4 prehistoric sites per km of shoreline respectively, and most of these sites are concentrated near Port Huron (outside of the project area) and the shoreline of Anchor Bay (Edsall, et al, 1988). Between 1400 and 1600 AD, the area was dominated by the woodland Iroquois association. By 1720, Missasauga and Ojibway (Algonquin origin) tribes had villages in the vicinity of the St Clair River Delta (Tanner, 1986).

The Ojibwa of the Walpole Island area followed a traditional seasonal round of hunting and fishing. During the winter, small family groups would resort to interior hunting areas along the minor waterways that drain into the St. Clair basin often camping besides swamps. During early spring, these small bands would begin to move, first towards maple sugaring areas and then to intercept the spring spawning runs of fish such as pike and pickerel in the St. Clair River delta. Base camps were established during late spring, often along the waterways where corn, gourds, and squash were planted. Also during late spring, people netted, trapped, and speared fish in the delta. In the early summer, different fish became available as well as other aquatic food such as turtles, clams, wildfowl, and water mammals (Nin.da.waab.jig, 1987). During the height of the summer a second period of community dispersal characterized by hunting and berrying induced the people to dislocate into small groups (Adams, 1985). People would hunt deer, elk, wild turkey, and raccoon. People gathered during the fall for the corn harvest, the fall fish runs, and to harvest nuts. In the winter the cycle would start over again (Nin.da.waab.jig, 1987).

As early as 1840, Pottawatomi and Ottawa tribes arrived in the area as a result of displacement after the French and Indian Wars (Clifton, et al 1986; Tanner, 1986; Paskus, 1992). Currently, Walpole Island, Ontario, is inhabited by three tribes of the Algonquin Nation: Pottawatomi, Ojibwa, and Ottawa (Paskus, 1992).

The French were the first European settlers in the St. Clair waterway establishing Fort St. Joseph on the upper Detroit River in 1686. This settlement was abandoned in 1688, and eventually was replaced by Fort Pontchartrain in 1701. The French settlers practiced trading, trapping, and subsistence type agriculture. Today, the French longlot patterns are still visible on the landscape primarily along the coastal rivers and lakes (Edsall, et al, 1988). Jacob Harsen, a Hollander from New York, settled Harsen's Island in 1769 because he was attracted to the abundance of wild game on the island.

1800's-1950's

Three major cultural activities in the 19th and 20th century significantly altered the landscape within the study area: 1) lumbering, 2) agricultural development and 3) urban growth. The latter two particularly had an impact on the coastal wetlands along Lake St. Clair. Historical accounts suggest that the wetlands of Lake St. Clair were not excessively exploited by the fur traders as were other wetlands of the Great Lakes such as those along western Lake Erie. In addition, historical maps reveal that the wetlands were not significantly impacted in the 1850's (Meade, 1857), and Jenks (1912) noted that wild rice was abundant in the marshes as well as 116 other wetland plants.

Interestingly, the first sawmills of the Northwest Territory were located on the St. Clair River and its tributaries with at least 8 built before 1800 (Mitts, 1968). In fact, it is believed that there was a sawmill on the St. Clair River in 1690 (Jenks, 1912). In addition, the first steam sawmill in the Northwest Territory, the Black River Steam Mill, was built on the north bank of the Black River in 1832 in what is today Port Huron (Mitts, 1968). These sawmills played a very significant role in the development along the Great Lakes. For example, the pine timber used to built the Citadel in Detroit is believed to have come from Patrick Sinclair's sawmill on the Pine River. The Ignace Morass mill, located on the Black River, supplied the US Government with spars and ship timbers during the war of 1812, and lumber form the Ai Beard mill at Ruby literally built the city of Milwaukee, Wisconsin (Mitts, 1968). In 1869, more than 64 million feet of logs floated down the Black River alone (Jenks, 1912). The lumbering era reached its peak in the St. Clair River area in the late 1870's, and forests were worked until they were depleted.

From the 1840's through the civil war, a ship building industry developed in the St Clair Delta. In the mid-1860's, both the Toledo and Detroit salt companies exploited the shallow evaporite bedrock beneath the St. Clair River bank for halite. During this period, Great Lakes shipping utilized the North Channel of the river because this channel was the deepest. Anchor Bay received its name from the ships that anchored there while waiting for their cargo to be lightened for transit over the river mouth bar of the North Channel. The transferring of cargo furnished employment for a large percentage of the people living on the Lake St. Clair shoreline (Edsall, et al, 1988). The 1850 Swamp Acts stimulated tremendous alteration of wetlands in Michigan, and by 1873 most of the land between the Detroit and Clinton Rivers was converted to agriculture. The north shore of Lake St. Clair also supported agriculture and approximately 1/2 of Harsen's Island was diked (Herdendoff, et. al., 1986). In addition to the Swamp Acts, the abundance of fish and wildlife in the marshes of Lake St. Clair attracted farmers from the Detroit area, and eventually led to the establishment of fishing and hunting clubs in the late 1800's. By 1857, New Baltimore was the only community in the northern part of Lake St Clair. Mt. Clemens and Marine City emerged later to service the local farmers (Edsall, et al, 1988).

By the mid 1870's, the development and gradual improvement of transportation routes also had a significant impact on the landscape. An electric railway was constructed along the shoreline of Lake St. Clair from Detroit to Algonac and north along the river to Port Huron (Edsall, et al, 1988). The railway was built right through the St John's Marsh. In 1873, a channel 6 meters deep was dredged through the South Channel to avoid shipping delays caused by the sand bar at the mouth of the North Channel (USACE, 1981). Finally, on the Canadian side, the Lake Erie and Detroit River Line was constructed along the east bank of the St Clair River joining Sarnia and Port Lambton, Ontario to other agricultural communities in southern Ontario. In addition, the Grand Trunk Railway linked the villages of Stoney Point and Belle River to Windsor, Ontario (Edsall, et al, 1988).

As transportation improved access to the flats, more people started to farm along the northern portion of Lake St. Clair and build small cottages on the flats. To accommodate this development, the natural levees were modified by bulkheading (particularly along the South Channel) and filling on the river shoulders, crevasses, and edges of deep water bays. In addition to farms and small cottages, several fishing and hunting clubs began to establish on both the US and Canadian sides of the Lake during the 1870's. Five clubs were located on the US side: the Old Club (formerly the St. Clair Hunting and Fishing Club), Rushmore Club, Marshland Club, Peninsular Fishing and Shooting Club, and the North Channel Club House. On the Canadian side, there was the Canada Club House, and Ste. Anne Club. All but one of these establishments was located on the improved South Channel. Later, resort hotels developed, primarily on the US side. These included the Mervue, Star Island, Boydell's, Butler's, Dame's, Trautz's, Maple leaf, Sans Souci, Grande Pointe Hotel, and Muir's Landing. The combination of hunt clubs, hotels,

and cottages built on backfill and stilts with waterways as the main mode of transportation led to the nickname “Little Venice” (Dixon, 1985).

In 1886, the US Congress authorized the deepening of the Clinton River to 2.4 meters and Lake St. Clair and the St. Clair Flats Channel to 8.4 meters. By 1892 the St Clair River was also dredged (Herdenoff, et al, 1986). Thanks to the deepening of the South Channel, excursion boats between Detroit and the Flats became more feasible, and on a typical Sunday evening 500 or more may have been waiting at the dock of each club and hotel. When Detroit had a population of 300,000, about 200,000 would visit the Flats over the course of a season. By the 1890’s there was 4 main passenger ships: the Star, Cole, Red Star, and Detroit, Windsor & Belle Isle Ferry Company. In 1896, the White Star Line was formed and had 5 excursion boats (Dixon, 1985). One of these boats, the Tashmoo, was licensed to carry 3,000 passengers (O’brien, 1951). The Tashmoo annually transported about 300,000 visitors to resorts in the area. In 1897 the Tashmoo Amusement Park opened and continued to attract excursionists as recently as 1951 (Dixon, 1985).

While recreational development centered on Lake St. Clair, industry developed on the St. Clair River. In 1858, the first oil field in North America was developed at Oil Springs, Ontario northeast of Lake St. Clair. By 1897, Imperial Oil Company constructed a refinery in Sarnia, Ontario, which initiated the development of southern Ontario’s chemical valley. In Michigan, most industry (Diamond Crystal, Morton Salt, Dunn Paper, and Detroit Edison) was sited between St. Clair and Port Huron (Edsall, et al, 1988). Urbanization began in the early 1900’s. Channels and roads were constructed along Middle and South Channels to improve access to the hunt clubs, hotels, and private cottages. To construct roads in the flats, spoil was dredged from the landward side of the main channels which inadvertently led to the channelization of the shallow bays (Herdendoff, et. al., 1986). When the automobile became more popular, use of the railways and steamboats declined rapidly. The electric railway was replaced by highway M-29 which linked Algonac with communities to the west, and recreational boating facilities began to appear. Between 1900 and 1930, urbanization more than doubled, and agricultural land use declined 50% in the St. John’s Marsh area (Herdenoff, et al, 1986). By 1935, summer cottages were prevalent along the west side of the river and lake, and as access improved, linear development occurred along the Michigan shoreline (Hudgins, 1935).

Human Communities in Project Area

Human settlements in the northern Maumee Lakeplain region can be divided into 5 categories: 1) major coastal, 2) minor coastal, 3) major inland, 4) minor inland. Major coastal communities include: Algonac, New Baltimore, St. Clair, Marine City, and Mt. Clemens. All of these communities except Mt. Clemens are located in St. Clair County, and New Baltimore is actually located in both counties. Minor coastal communities include: Anchorville, Fairhaven, Robert’s Landing, and Sans Souci all of which are located in St. Clair County. Moderately sized inland communities include: Richmond, Armada, New Haven, Romeo, and Memphis all located in Macomb County. Minor inland communities include: Columbus, Rattlerun, Peters, Adair, Starrville, and Anchorville (St. Clair County), and Ray Center, Meade, Macomb, Waldenburg, Milton, Muttenville, Davis, Doyle, and Chesterfield (Macomb County).

History of Settlements
Richmond, New Haven
Marine City, New Baltimore, St. Clair, Algonac, Mt. Clemens
Major roads = I-94, M29, M19, M53
South channel was widened, deepened, and bulkheaded since 1873

Impacts of Human Settlement - Notes

Human development has a variety of impacts on natural resources and processes such as bioactivity, climate, soils, nutrient cycling, hydrology, and water and air chemistry. The degree of these impacts is dependent on the type, density, location, and design of the development. Different types of development include: Industrial, commercial, institutional, residential, recreational, and transportation/communication/ utilities.

Insert Description for Developed Lands

Present Settlement Districts (my own analysis)
Agriculture – NW corner
Urban Sprawl – SW corner
High density cottage/residential development– coast line
Mix of forest, wetlands, agriculture, old field – NE corner (focus on riparian corridors)
Rural residential/early successional – SE corner
Coastal wetlands/upland forest – St. Clair flats

Move to another chapter

By land, Algonac had always been isolated from the roads between Detroit and Port Huron. The principle obstacle was the marsh land area in the southwest known then as the 'Pointe Trembles Prairie.' Today what remains of Pointe Trembles Prairie is now known as St. John's marsh. Communication to Port Huron occurred by road, while to Mt. Clemens it occurred by boat. The primary industry of Algonac was salt production. In 1882 Albert Miller tried to build a large dyke around the marsh in order to control water levels for farming. His plan was unsuccessful, and in 1898 the interurban railway rain a line over the dyke from Perch Pointe to Pearl beach. Later in 1924 "Dyke Rd." was built.

"Agricultural interests of St. Clair County in the days of early settlements were considered but very little, as the early settlers……were interested in boats and the rivers and the Great Lakes or Lumbering." Timber was the first industry in the area

Dry-Mesic Southern Forest (oak-hickory forest)

Introduction

Dry-mesic southern forests are forests located primarily in southern Michigan on very well drained, acidic, sandy soils. These forests are dominated by several species of oak and hickory.

Historic Condition

In the mid 1800's, dry-mesic southern forests covered about 6 percent of Michigan's landscape and about 16 percent of the southern lower peninsula where they were primarily found. Interestingly, the amount of dry mesic southern forest has remained surprisingly stable. Historically, however, oak-hickory forests were never abundant in the Maumee Lakeplain ecoregion. This is primarily due to the high water table and clay soils at or near the surface both of which favor plants that like wet feet. In fact, in the mid 1800's, there were only 2,500 acres of dry mesic forest within the project area, covering less than 1% of the project area. The majority of dry mesic forest was located in and around an area where the city of Algonac stands today. This forest covered approximately 2,320 acres. A few other smaller forests occurred near the Lake St. Clair shoreline and on the Islands.

White, black, and red oak and pignut hickory are the typical dominant tree species in most dry mesic southern forests found in southern Michigan. Understory tree species include witch hazel, hazelnut, flowering dogwood, sasafrass and historically chestnut (chestnut blight has eliminated chestnut from the system). Shrubs include: New Jersey tea, arrow-leaved virburnum, downy viburnum, blueberry, and black huckleberry. Ground cover species include: may apple, pensylvania sedge, clustered-leaved tick-trefoil, naked tick-trefoil, white snakeroot, black snakeroot, whorled loosestrife, fragrant bedstraw, wild strawberry, sweet cicely, asters, and several species of goldenrod (i.e., blue grey goldenrod). Soils are sandy loam and loam, and slightly acid to neutral. Dry mesic southern forests in the project area are primarily found on beach ridges and slightly higher elevations of the lakeplain with well drained soils. These forests are actually a variation of the typical oak-hickory forest type found in southern Michigan. Trees that dominate these lakeplain dry mesic forests are white, black, burr, and scarlet oak. Co-dominant canopy trees include red maple, pignut hickory, white ash, black cherry, sassafras, and red oak.

Large, healthy dry-mesic forests support a diversity of wildlife species. Many mammals are attracted to the acorns and hickory nuts and other mast produced here. Mammals commonly found in these forests include fox squirrel, southern flying squirrel, white-tailed deer, chipmunk, deer mice, raccoons, and voles. As oaks mature, they tend to develop heart rot which provides good den sites for mammals and a few bird species such as owls. Many birds are also attracted to the hard mast produced in these forests as well as the open character of the forest structure, and standing stags. Birds attracted to oak-hickory forests include wild turkey, wood duck, red-bellied woodpecker, downy woodpecker, northern flicker, black-capped chickadee, blue jay, cardinal, rose-breasted grosbeak, scarlet tanager, red-eyed vireo, white-breasted nuthatch, titmouse, great-crested flycatcher, eastern wood peewee, ovenbird, eastern screech owl, and great horned owl. Herps attracted to oak-hickory forests include Eastern American Toad, blue spotted salamander, five lined skink, blue racer, smooth green snake, eastern milk snake, black rat snake, and eastern hognose snake. In addition, neotropical migratory songbirds are attracted to oak trees during spring migration. Oaks produce catkins, a tube shaped cluster of flowers, in early April. Catkins attract insects, which are readily eaten by travel weary songbirds looking for a quick source of energy.

Key Ecological Processes

The canopy of an oak hickory forest tends to be much more open than a beech-sugar maple forest allowing more sunlight to reach the forest floor. Plants that are shade intolerant are able to compete in this type of open environment. The soils are well drained, sandy, and slightly acidic creating a very dry

environment. Drier conditions favor fire, so most plants found in these forests tend to be adapted to fire. These forests depend on fire to maintain an open canopy, remove competition from shade tolerant species, release nutrients, remove the leaf litter, prepare a seedbed for acorns and nuts to germinate, and warm the soil in the spring to hasten germination. However, if fires are too frequent or severe the forest might convert to an oak barrens or dry sand prairie. If fire was completely removed from the landscape, such as it is now in many places, these oak-hickory forests tend to be invaded by more shade tolerant species and converted to beech-maple forests. Spreading of acorns and hickory nuts by squirrels provides opportunities for seeds to germinate beyond the canopy of the parent tree.

Oak-hickory forests may be relicts of past native American activities in the area. With little or no fire, areas in the interlobate area of Lower Michigan that were once barrens and prairies probably succeeded to oak-hickory forests. These oak-hickory forests remained until a major disturbance knocked the whole stand down, or shade tolerant species were able to gain a foothold and outcompete oak and hickory seedlings and saplings in the understory. In a highly complex landscape, oak-hickory forest was one of several fire dependent systems. Together these dry, fire dependent systems developed a dynamic mosaic that shifted over time and space and was influenced by Native American activities.

Other natural processes that tended to keep dry mesic forests open include windthrow, insect infestations, and disease. Similar to beech maple forests, oak-hickory forests were also subject to windthrow, particularly those located in higher elevations. Disturbances caused by tornadoes, sheer winds, or high winds could be local creating small gaps in the canopy, or they could cover hundreds of acres. Historically, bison and other grazing mammals such as woodland caribou may have used open oak woodlands as grazing areas.

Present Condition

Today it is estimated that approximately 5% of the state supports this type of forest. The difference is that the distribution has changed. Southern Michigan has actually lost two-thirds of its original dry forests, while dry forests in the nothern lower peninsula have dramatically increased. In addition, many of the remaining oak-hickory forests in southern Michigan are contained in small fragmented woodlots of 20 to 40 acres. Today, there may actually be more oak-hickory forest in the project area than in the mid 1800's (**can't decipher between upland decidous forest types - 1978 or 1992 landcover).** Lack of fire disturbance and hydrologic alteration are the two primary factors. Lower water tables due to ditches, drain tile, and possibly young forests pumping water out of the system, have allowed dry mesic forests to establish in areas previously unsuitable for drought intolerant seedlings to establish. These alterations caused many of the areas that were once lakeplain prairie or lakeplain oak openings to succeed to oak-hickory forest and other landcover types.

Stresses and Threats

Fire suppression

Fire suppression is the number one threat to this fire dependent system. Oak-hickory forests throughout the region are difficult to regenerate. The partially open forest canopy historically created by periodic wildfire has tended to close in, producing too much shade for oak seedlings. In many oak-hickory forests in southern Michigan, sugar maple and beech saplings dominate the forest floor shading out sun-loving forbs, grasses, and tree seedlings. White-tailed deer or cottontail rabbits browse oak seedlings that are able to regenerate usually before they reach sapling status. Competition from shade tolerant maple and beech saplings can set back a large population of oak seedlings and saplings for many years. Fire suppression in Michigan is primarily due to local fire and public safety policies that were created back in the 1930's.

Invasive plant species

Invasive plant species such as garlic mustard, honey-suckle, common buckthorn, Kentucky bluegrass, and autumn olive are also a major threat to plant regeneration. Invasive exotic plant species out compete and displace native plant species leaving behind only a handful of hardy native species. All of the above species were imported from other continents and seem to thrive in disturbed, somewhat open forests. Many of these species migrate into new areas and spread throughout forest remnants via fragmentation, trails, ORV's, horses, and native animals, such as birds, bringing in seeds from other areas. Many dry-mesic forests in southern Michigan have undergone major transformations and harbor a number of these invasive species. In some forests invasive species may actually dominate the understory.

Habitat Loss

Since oak-hickory forests in the project area continue to be limited to the Algonac area and small areas of nearby Islands, habitat loss is also limited to those areas. Residential development and related activities, and industrial and commercial development are the primary sources of habitat loss. As the city of Algonac continues to grow, more oak-hickory forests will be converted to residential lots, recreational facilities (softball fields, soccer fields, etc), roads, commercial facilities, parking lots, and industrial parks.

Ecological Restoration of Rare, Fire Dependent Systems

Lakeplain oak openings and Lakeplain prairie are two very rare fire dependent systems that were historically much more abundant than they are today. Due to fire suppression and Hydrologic alterations, these two systems have converted to other cover types such as oak-hickory forest. Some of these forests in Algonac State Park have been targeted for restoration to both Lakeplain oak openings and Lakeplain prairie. In fact, the Parks and Recreation Bureau has developed a stewardship plan for the entire Park. Future restoration efforts could occur on private lands surrounding Algonac State Park and St. John's marsh, as well as at Dickinson Island.

Other stresses

Other stresses to dry-mesic forests include: 1) loss of diversity in the understory due to intensive livestock grazing and deer browsing, 2) disease outbreaks such as oak wilt and chestnut blight, the latter of which was due to historical importation, and 3) air pollution, such as acid rain (SO2, NO2, CO2), due to industry, automobiles, and 2 cycle engines (i.e., lawn mowers), and 4) Gypsy moths. Gypsy moths favor oaks over all other tree species and are able to completely defoliate a tree in one season. The oldest trees are the most likely to suffer any damage from these imported pests (Asia?). Coupled with drought, flooding, high air pollution, and/or disease outbreaks such as oak wilt, gypsy moths can have a devastating impact on mature oaks and oak dominated forests.

Ownership/Conservation Status
Management Recommendations
Information Gaps
Opportunities

Coastal Wetlands Complex

Introduction

The coastal wetlands complex consists of several natural communities found at or near the Great Lakes shoreline and adjacent waters. This complex is relatively flat and wet, and ranges from submergent plants found in 6+ feet of water to tall wide spreading white and black oaks found on narrow sandy ridges formed thousands of years ago by lowering lake levels. The two major natural communities that form this complex are lakeplain prairie, and Great Lakes marsh.

Historic Condition

In southeast Michigan, glacial lake deposits of clay are up to 100 meters thick over Peleozoic bedrock. The lacustrine deposits are thickest at their inland extremes, and thinnest along the Lake St. Clair and Lake Erie shorelines. Within the clay plain, there are several broad channels created when sand was deposited into the shallow pro-glacial lakes by glacial meltwater streams. These sand channels can be several miles wide, but only one to three meters thick. The combination of a relatively flat landscape with subtle elevation changes sloping towards Lake St. Clair, a thin layer of sand over clay, and the fluctuating water levels of Lake St. Clair produced the right conditions for coastal wetlands complexes to develop in the St. Clair Delta region.

Lakeplain prairie and Great Lakes marsh, both very rare communities and considered to be globally imperiled, are the dominant community types in the coastal complex. Typically, Great Lakes marsh extends from 5+ feet of water to saturated sand, and lakeplain prairie borders the inland portion of the marsh. These communities can be found adjacent to each other on Dickinson Island and St. John's Marsh. Lakeplain prairie can also be found inland in slight depressions adjacent to hardwood swamps, mesic southern forest, dry mesic southern forest, and Lakeplain oak openings.

Historically, these communities were tied together by the fluctuating water levels of Lake St. Clair, which altered the size and boundaries of these systems both seasonally and annually. In 1873, scientists estimate that there were approximately 7,506 hectares of coastal wetlands on US side of Lake St. Clair, and approximately 13,860 hectares on the Ontario side for a total of 21,366 hectares or 52,795 acres (Herdendorf, et al 1986). In addition, it appears that some coastal areas north of the Clinton River were drained in the 1860's so that the 1873 data is not a true reflection of total wetland acreage (Edsall, et al, 1988).

Great Lakes Marsh

Relative to other natural communities in the midwest, Great Lakes marsh, which consists of mudflats, shrub swamps, emergents, and submergents, contains a high diversity of habitat. It is also considered to be the most productive natural system in the temperate zone, and provides important habitat for a wide diversity of animal species including waterfowl, shorebirds, songbirds, turtles, crayfish, snakes, frogs, insects, fish, and small mammals. The primary factors that determine the location of different vegetation zones within this system include: water depth, water movement, and soil substrate. For example, the shallow emergent zone is found in shallow, non-moving water with a sandy substrate, while the submergent zone is typically found in 5+ feet of fast moving water with a clay substrate (please refer to figure x). Processes important to the long-term health of Great Lakes marshes include sedimentation, wind seiches, wave action, and both seasonal and long-term water level fluctuations. Healthy Great Lakes coastal marsh systems which can include mudflats, shrub swamps, emergents, submergents, and adjacent lakeplain prairies, are maintained in a state of perpetual change by these natural processes. Jaworski and Rapheal (1979) have stated that the Lake St. Clair wetlands are in a state of dynamic equilibrium or

"pulse stability" in which the size, location, and structure of the wetland plant communities shift dramatically in response to the periodic changes in water levels (Edsall, 1988).

In deltaic systems, such as the marsh system located in the St. Clair flats area, outflow of both water and soils, and fluctuating Great Lakes water levels are the two most important processes. Soil particles, including sand, silt, and clay are carried from uplands via major rivers systems like the St. Clair River and its tributaries. As the flow of water decelerates near the delta river mouth, soil sediments fall out creating shallow zones, particularly within bays, as well as build up in existing shallow zones creating wet meadow habitat. This sedimentation process allows the delta marsh to expand lakeward when the Great Lakes experience extended "low water periods."

Historically, this system was highly influenced by the fluctuating water levels of Lake St. Clair. In high water years, stands of emergent plants die off or become uprooted by wave and ice action. Strong on shore winds from a storm event could produce waves strong enough to uproot thousands of plants and cause severe erosion. However, because of the flat landscape, the marsh usually was able to migrate inland in shallow water areas that were once wet meadow. As the cycle continues, water levels eventually fall, allowing the rhizomes of emergent plants destroyed above ground to produce stems and recolonize shallower open water over time. This natural dynamic system of "lateral displacement" (where vegetative zones expand and contract) sets back succession, accelerates nutrient cycling, increases habitat diversity, and enhances coastal wetland values for wildlife. Between 1918 and 1952 water levels of Lake St. Clair fluctuated between 173.7 and 175.7 meters - a difference of approximately 6 feet. Since 1964, however, average yearly water levels have steadily increased, and the variance between the high and low peaks has decreased. Lake St. Clair had a record high of 175.78 meters in October, 1986, and a record low of 173.71 meters in January of 1936.

In addition, wetland scientists have determined that water level fluctuations are critical to water, nutrient, and energy exchange in coastal marsh wetlands. For example, during the breakdown of detritus (dead plant material), nutrients are released which are used for new plant growth. This process however requires oxygen. Periodic de-watering of the marsh during low water periods allows wetland bottom soils to aerate which increases detritus breakdown and nutrient exchange. After the area is reflooded during high water years, new emergent plant growth is stimulated.

Typical plant species associated with Great Lakes marsh include: button bush (*Cephalantus occidentalis*), silky dogwood (*cornus amomum*), red-osier dogwood (*cornus racemosa*) and willow (*Salix eriocephala*) in the shrub swamps, hardstem bulrush (*Scirpus acutus*), three-square (*Scirpus americanus*), softstem bulrush (*Scirpus validus*), common reed (*Phragmites communis*), giant bur reed (Sparganium eurycarpum), common arrowhead (*Sagittaria latifolia*), water plantain (*Alisma plantago-aqautica*), pickeral weed (*Pondetaria cordata*), and cattail (*Typha spp*.) in the shallow emergent zone, and Eurasian water milfoil (*Myriophyllum spicatum*), pondweed (*Potomogeton pectinatus*), wild celery (*Vallisneria americana*), naiad (*Najas flexilis*), and common waterweed (*Elodea canadensis*) in the submergent zone. Chara, a species of algae, is also commonly found growing on the bottom of the submergent zone.

Coastal wetlands provide habitat for a wide diversity of animal species. Thirty-nine species of amphibians and reptiles and 15 species of mammals occur in the St. Clair system (Herdendorf, 1981). Waterfowl species observed in the Lake St. Clair coastal wetlands include: 2 species of swan, 3 species of geese, and 21 species of ducks. Birds other than waterfowl that may be found in the St. Clair system include: 2 species of grebes, 5 species of rails, 7 species of herons, 3 species of plovers, 12 species of sandpipers, 7 species of gulls, 4 species of terns, 8 species of hawks, bald eagle, osprey, American kestral, short-eared owl, belted kingfisher, and an extended list of perching birds (Edsall, 1988). **In addition, 47 species of**

snails, 36 species of mussels, and 29 species of clams were found in the coastal marshes and nearshore waters of Lake St. Clair (Herdendorf, 1981). This data has changed due to zebra mussels). Forty-eight species of fish are known or presumed to utilize the coastal wetlands of the St. Clair River and Lake St. Clair (Herdendorf, 1981).

Wildlife associated with the emergent zone include: invertebrates, waterfowl (nesting, breeding, and brood cover), American bittern, least bittern, black tern, turtles, frogs, snails, and forage fish. Wildlife associated with the submergent zone include: fish (spawning, nursery, and feeding), invertebrates, diver ducks, mudpuppies, terns and gulls. In addition to the shrub swamps, submergent zone, and emergent zone, mud flats are constantly forming and reforming throughout the system depending on currents, water levels, and sedimentation rates. Wildlife associated with mudflats are primarily shorebirds such as plovers and sandpipers.

Current Condition

By 1968, however, only 4,131 hectares of coastal wetlands remained on the US side of Lake St. Clair, and approximately 9,096 hectares remained on the Ontario side. In total, 8,139 hectares of coastal wetlands were lost; approximately a 38% reduction (Herdendorf, 1986). The majority of wetland losses occurred in the St. Clair Delta area where approximately 4,744 hectares were lost (Herdendorf, et al, 1986). The percentage of wetlands lost in Michigan is greater than that of Ontario (45% vs. 34%) however the actual area lost in Ontario far exceeds that lost in Michigan (Herdendorf, 1986). Despite these alterations, the St. Clair River Delta is considered the largest and one of the highest natural quality Great Lakes marshes in Lower Michigan (Albert,). This area also contains the largest and only intact Coastal Delta marsh on the continent, and likely in the world (TNC).

Approximately 50% of the remaining coastal wetlands in the St. Clair River Delta (which includes St. John's marsh) are now diked (Herdendorf, 1986). Remaining coastal marshes on the US side of Lake St. Clair include: the mouth of the Clinton River (400 ac); St. John's marsh (2,300 ac); Dickinson Island (2,100 ac); and Harsen's Island (**10?ac**). Of these 4 sites, only Dickinson Island (A rank) and St. John's Marsh (A rank) are considered to be of high quality by The Nature Conservancy (MNFI, 1999).

Rare Species

No rare plant species associated with Great Lakes marsh are currently found in the Lake St. Clair area. Rare animal species associated with Lake St. Clair Great Lakes marshes include: King rail (*Rallus elegans*) state threatened, Forster's tern (*Sterna forsteri*) state special concern,common tern (*Sterna hirunda*) state threatened, and black tern (Sterna) state threatened. In addition, Great Lakes marsh provides potential habitat for least bittern *(Ixobrychus exilis)* state threatened, and American bittern *(Botaurus lentiginosus)* state special concern.

Stresses/Threats

Habitat Alterations

Stresses to Great lakes marshes are numerous due to its location between open water and land that is dry during parts of the year. Historically, dike and channel construction have caused the greatest amount of marsh alteration in the southern half of the Lower peninsula (Albert, et al, 1988). Barriers, such as dikes, that prevent de-watering or the movement of oxygenated lake water into coastal wetlands must be critically evaluated. Diking fragments coastal wetlands, reduces vegetative diversity (Keddy and Reznichek, 1984), reduces water quality and fish use, and simplifies invertebrate communities (Edsall, 1988). In addition, a study conducted by Dennis and North (1981) showed that the use of diked wetlands by dabbling ducks decreased by 73% during the spring period from 1968-69 to 1976-77. Commercial

dredging to create, deepen or widen channels will directly take vegetation, remove soils necessary for plant establishment, and increase rate of water flow making it more difficult for plants to re-establish. From the inland side, shoreline development usually requires dredging from the channels to fill in the emergent zone and armoring of some sort to minimize erosion. Hardened shorelines such as rip-rap and seawalls interrupt energy dissipation from wave action and prevent lateral displacement of vegetative zones.

From the open water, shipping, pleasure boating and personal water craft (PWC's) use cause increased wave action and can directly destroy both emergent and submergent plants turning these vegetative zones into open water areas. Ice scour due to winter shipping will also negatively impact submergents and emergents. Areas where there are multiple boat slips such as marinas also tend to lead to destruction of the emergent beds. In addition, spawning carp can have a negative impact on regenerating cattails and other emergents by increasing turbidity, and muskrats can turn an emergent marsh into a simplified, open marsh system by feeding on emergents.

Contamination

Major pollutants in St. Clair River include: mercury, lead, phenols, oil and grease, and a variety of chlorinated organics including PCB's, hexachlorobenzene, octachlorostyrene, hexachlorobutadiene, and volatile organics. In Ontario waters, 12 industrial waste dischargers and 6 municipal sewage treatment plants are concentrated along the shoreline of the upper St. Clair River, where about 1.7 million cubic meters of effluent are discharged daily from the large petrochemical complex near Sarnia. In June 1985, there were 19 permitted industrial dischargers and 7 discharges of treated sewage to Michigan waters. Ninety-five percent of chemical loading from St. Clair River is deposited on Lake St. Clair basin and does not pass through to the Detroit River (TNC). The impact of these effluents on biological resources is incompletely known. However, a study conducted in 1986 regarding a spill of perchloroethylene in Ontario waters indicated that water, sediment, and biota were adversely affected by pollutants from chemical industries, and sediment near the spill site were acutely toxic to some species of benthic invertebrates. In addition, nonmigratory waterfowl in the marshes near Walpole Island have elevated levels of QCB, PCBs, HCB, and OCS, indicating that these organic compounds from the St. Clair River are being trapped in the delta wetlands (TNC). Records also show that there were 11 major oil spills totaling 1,182 tons, and 21 major spills of other hazardous substances totaling 10,336 tons into the Ontario waters and its tributaries between 1974 and 1985. Oil spills pose serious hazards to fish and wildlife, and have caused large losses of waterfowl throughout the Great Lakes (Edsall, 1988; Hunt, 1965).

Nutrient runoff from upland activities such as agriculture or lawn maintenance can also negatively impact coastal wetlands. High levels of nitrate and phosphorus favor exotic and/or invasive plant species such as purple loosestrife (*Lythrum salicaria*), and common reed (*Phragmites australis*) over native species, and at high levels can actually prevent the establishment and growth of plants. Few comprehensive water quality investigations have been conducted on Lake St. Clair and measurements in the coastal wetlands are rare. In 1973, the Michigan Water Resources Commission conducted a thorough survey of the open lake and bays along the American Shore. The results of the survey found relative high nitrate, phosphorus, and silica levels in the nearshore waters of the wetland bays, reflecting high watershed inputs (Herdendorf, 1986). Leach (1972) also found high nutrient loading from the Thames River (Herdendorf, 1986).

Exotic and Invasive Plant Species
Exotic plant species are plants that evolved in one part of the world and are suddenly transported to another part typically by humans. Invasive species are native or exotic plants that display aggressive behavior given the right conditions and have the ability to displace a large number of plants that have evolved in a given place. Purple loosestrife (*Lythrum salicaria)* is an example of both an exotic and invasive plant species. Purple loosestrife thrives in saturated soils, high in nitrates, typically where there has been some sort of soil or hydrologic disturbance. (Studies of purple loosestrife and Great Lakes marshes?). **Extent of purple loosestrife in St. Clair Delta? Trends? Life History?**

Common reed (*Phragmites australis)* is an example of a native, invasive plant species. Common reed is an aggressive grass that also thrives in saturated, disturbed soils. Unlike purple loosestrife, however, It does not do well in soils or waters that are high in nitrates **(what about phosphorus?)**. Common reed spreads through horizontal and vertical rhizomes. It can grow up to 13 feet tall and can spread up to x feet per year. Common reed is found on every continent except Antarctica. Although considered a native plant by most botantists, a few experts believe that the recent aggressive behavior of common reed may be due to an introduced geneotype. Common reed is ubiquitous throughout southern Michigan particularly in ditches, along roadsides, marshes exposed to soil disturbance, and along dikes, berms, and spoils. In some areas in southern Michigan common reed is the dominant plant species in the wetlands. Common reed is quite dominant all along the Lake St. Clair shoreline and marshes. Common reed is particularly abundant on Harsen's Island, in St. John's marsh, and in wet swales throughout Algonac State Park. In fact, it appears to be spreading out into Lake St. Clair on substrates recently exposed due to lower Great Lakes levels. Evidence shows that common reed is very difficult to control once it becomes established. Native marsh plants and most animals are already negatively impacted by the abundance of common reed throughout the coastal marshes.

High Water Levels
Another potential threat to the Great Lakes coastal marsh system is the upward trend in average water levels of Lake St. Clair and a decrease in fluctuations between the low and high peaks. The reasons behind these changes are not well understood and could be due to a combination of factors such as higher precipitation and lower evaporation cycles, increased urbanization (higher degree of impervious surface), the seasonal control of runoff through impoundments (for shipping industry?), and control of Lake Superior water levels. According to Herdendorf (1988), the most significant long-term factor affecting the level of Lake St. Clair and other Great Lakes is probably precipitation. According to records, precipitation in the Great Lakes between 1950-86 was above average in most cases, and the record high precipitation in 1985 coupled with a surplus over the previous decade, led to near-record high lake levels in 1986.

According to an article in Science News (Feb. 1987), the historical record shows that the period between 1930 and 1960, which shows Great Lakes water levels frequently dropping below the average water level, was a drier-than-usual period and perhaps the warmest 30-year period in the last 2,000 years. In fact, since 1997 Lake St. Clair water levels have dropped x feet due to three consecutive years of low precipitation and above average temperatures. In November, 1999 Lake St. Clair water levels were at x feet, a drop of x inches compared to November, 1998. In addition, according to several global warming models, Great Lakes water levels are predicted to continue declining for the next 30 years (source?).

Lakeplain Prairie
The lakeplain prairie system typically occupies the position between the shallow emergent marsh zone of the Great Lakes marsh community and the adjacent uplands. It also can occur inland on the glacial lakeplain landform in shallow depressions. Like the Great Lakes marsh, lakeplain prairie and lakeplain

oak openings are considered globally imperiled by The Nature Conservancy. Ecologists prefer to track this native grassland system by splitting it into three different sub-types based on subtle differences in elevation and hydrology: lakeplain wet prairie, lakeplain wet-mesic prairie, and lakeplain mesic prairie. All three of these sub-types are found within the Lake St. Clair flats area. In addition, lakeplain oak opening, another unique type of grassland, is found scattered throughout these prairies on old beach ridges. (For organization purposes lakeplain oak opening is discussed in the upland forest chapter).

The soils of this grassland system are characterized by 2-4 meters of highly permeable sand over clay. This type of soil profile sets up a characteristic hydrological regime with spring flooding followed by droughty conditions during the growing season. Seasonal fluctuations in water tables of lakeplain prairies can range from one to three meters. In addition, seasonal water level fluctuations combined with a gently rolling topography results in a patchwork where portions of the prairie flood nearly every spring while other portions remain dry at the surface (Comer, et al, 1995).

The combination of the buildup of organic material and droughty conditions during the growing season would also leave lakeplain prairies prone to wildfires. However, it remains unclear whether lightning strikes and/or Native American activities would have played a role in the maintenance of lakeplain prairie (Hayes 1964, Rogers, 1966; Faberlagendoen & Maycock 1987. It is clear that Native Americans utilized dune ridges on the lakeplain for settlement and trails (Jones & Kapp, 1972; Comer et al 1993), and that fires probably resulted from this use, spreading to adjacent savanna and grassland (Comer et al, 1995). One indication of the significance of fire on the lakeplain is the fact that many of the historical oak savannas located along the beach ridges have succeeded to closed-canopy oak forest since the 1800's (Comer et al, 1995). Fire was probably more prevalent in the drier lakeplain mesic prairies where today, burning is required to remove competition from woody vegetation (Comer, et at., 1995).

The majority of wet prairie along or near the shoreline was drained in the mid-late 1800's and converted to agriculture. At present, the amount of remaining lake plain prairie is approximately 1,000 acres or .7% of the original prairie present at the time of European settlement (Comer, et al, 1995). Presently, there are 18 known lakeplain prairie sites located within the study area ranging from 1-60 acres in size and totaling approximately 269 acres. The St. Clair area contains 25% of lakeplain prairie in Michigan. St. John's marsh prairie, which has a BC rank and is approximately 60 acres in size, is the only high quality lakeplain prairie in the project area. Statewide, 53 plant species, six insect species, two bird species, and one species of snake associated with lakeplain prairies are state listed as endangered, threatened, or special concern.

Lakeplain wet prairie is typically found closest to the water adjacent to the emergent zone of the Great Lakes marsh. Currently, there are 3 known occurrences of lakeplain wet prairie in the St. Clair Delta area totaling approximately 95 acres. Soils of this lakeplain prairie sub-type range from medium sands to silty clay loam soils that are on poorly drained and moderately alkaline (pH 7-8). Lakeplain wet prairie is dominated by bluejoint grass (*Calamagrostis canadensis*), prairie cordgrass (*Spartina pectinata*), rush (*Juncus balticus*), meadow sedge (*carex stricta*), sedges (*Carex aquatilis*), and (*Carex pellita*), shrubby cinquefoil (*Potentilla fruticosa*), swamp milkweed (*Asclepias incarnata*), and twig-rush (*Cladium mariscoides*) (Comer, et. al. 1995). Other common plant species include: bushy aster (*Aster dumosus*), golden-seeded spikerush (*Eleocharis elliptica*), whorled loosestrife (*Lysimachia quadriflora*), and softstem bulrush (*Scirpus validus*). Wildlife associated with lakeplain wet prairie include: mallards and blue-winged teal (nesting, brood rearing, and feeding), frogs, turtles, black water snake, crayfish, and furbearers (muskrat, raccoon, mink, and weasel).

The eastern prairie-fringed orchid (*Platanthera leucophea*), federally threatened and state endangered, is the only rare plant species associated with the lakeplain wet prairies in the St. Clair Delta area (Comer, et al, 1995). Rare animals include spotted turtle (*Clemmys guttata*), state special concern, and eastern fox snake (*Elaphe vulpina gloydi*), state threatened.

Lakeplain wet-mesic prairie is found further inland on slightly better drained, medium to fine textured sands that are slightly acid to moderately alkaline (pH 6-8). They experience seasonal flooding and typically include small pockets that remain wet throughout the year. The lakeplain wet-mesic prairie sub-type is the most common sub-type in the St. Clair Delta region (Comer, et al, 1995). Currently there are 14 known occurrences in the St. Clair Delta area totaling approximately 170 acres. Lakeplain wet-mesic prairies are among the most floristically diverse plant communities in Michigan with as many as 200 plant species found within a single remnant. Characteristic plant species include big bluestem (*Andropogon gerardii*), Indian grass (*Sorgastrum nutans*), little *bluestem (Andropogon scoparius*), switchgrass (*Panicum virgatum*), common mountain *mint (Pycnanthemum virginianum*), heath aster (*Virgulus ericoides*), colic root (*Aletris farinosa*), New England aster (*Virgulus novae-angliae*), shrubby St. John's wort (*Hypericum kalmii*), marsh blazing star (*Liatris spicata*), Ohio goldenrod (*Solidago ohioensis*), Canada goldenrod (*Solidago canadensis*), and tall coreopsis (*Coreopsis tripteris*).

Rare plant species associated with lakeplain wet-mesic prairie in the St. Clair River Delta include: three-awned grass (*Aristida longespica*) state threatened, Gattinger's gerardia (*Agalinis gattingeri*) state threatened, short fruited rush (*Juncus brachycarpus*) state threatened, seed box (*Ludwigia alternifolia*) state threatened, Skinner's gerardia (*Agalinis skinneriana*) state threatened, Sullivant's milkweed (*Asclepias sullivantii*) state threatened, small white lady slipper orchid *(Cypripedium candidum*) state threatened, Leiberg's panic grass (*Panicum leibergii*) state threatened, gentian leaved St. John's wort (*Hypericum gentianoides*) state special concern,, cross-leaved milkwort (*Polygala cruciata*) state special concern, dwarf bulrush (*Hemicarpha micrantha*) state special concern, and tall nut rush (Scleria triglomerata) state special concern. Rare insects associated with lakeplain wet-mesic prairie in the St. Clair River Delta include: red-legged spittlebug (*Prosapia ignipectus*) state special concern, blazing star borer (*Papiapema beeriana*) state special concern, and culver's root borer *(Papiapema sciata*) also state special concern. The only rare animal found in this habitat is the eastern fox snake (*Elaphe vulpina gloydi*) state threatened.

Lakeplain mesic prairie is not commonly found close to the Great Lakes shoreline, and there is only one known occurrence (4 acres) in the St. Clair Delta area. Soils range in texture from loam to medium sand and encompass a wide range in pH. These sites may never flood, but probably remain moist throughout spring. Characteristic plant species include: little bluestem (*Andropogon scoparius*), Indian grass (*Sorgastrum nutans*), colic root (*Aletris farinosa*), prairie dock (*Silphium terebinthinaceum*), round-headed bush clover (*Lespedeza capitata*), tall coreopsis (*Coreopsis tripteris*) and wild indigo (*Baptisia tinctoria*) (Comer et. al., 1995).

Stresses/threats

Historically, nearly all of Michigan's prairies were converted to agriculture due to the relative ease of establishing homesteads in open grasslands. Rich upland prairies were the first to be converted to agricultural land in the early 1800s. The conversion of wet prairies to farmland required extensive drainage systems and did not take place until the mid-1800s (Comer et al, 1995). Large county drains, often in combination with pumping have lowered the water table resulting in conversion of most of the remaining prairies to either shrub swamp, forested swamp, or upland forest (Comer, et al, 1995). Today, this woody vegetation is encroaching upon the few remaining remnants of lakeplain prairie, by dewatering the soil through rapid transpiration. Woody plants invading lakeplain prairies include: red maple (*Acer*

rubrum), trembling aspen (*Populus tremuloides*), *sassafras (Sassafras albidum*), red-osier dogwood (*Cornus stolonifera*), silky dogwood (*Cornus amomum*), and Morrow's honey suckle (*Lonicera morrowi*). Invasive herbaceous plants invading lakeplain prairies include: common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), and cattails (*Typha spp*.). If the hydrological regime is disrupted, fire suppression becomes an additional threat to this system. Commercial, residential, and industrial development will continue to threaten the remaining isolated fragments of lakeplain prairie through direct habitat destruction, increased drainage (lowering of water table), increased fire suppression, and increased nutrient runoff into these systems which encourages invasive species such as purple loosestrife, cattails, and common reed and displaces native prairie species. Another threat is the armoring of the shoreline. Armoring, which includes rip rap, seawalls, and gabions, cuts off the inland habitat from Lake St. Clair disrupting the natural hydrological regime and destroying potential habitat. Similar to lakeplain prairies, hydrologic alteration and fire suppression are the major threats to lakeplain oak openings, however, fire is believed to be the most significant factor in maintaining lakeplain oak openings.

Management Recommendations

Existing management of lakeplain prairie and Great Lakes marsh on state lands

Ownership/Protection Status

Information Gaps

Date of last systematic surveys; potential areas to survey

- LPP- mid 1990's
- GLM- early 1980's
- Invert's- late 1990's
- Birds – late 1980's

Research – opportunities, recommendations, historic

- Great Lakes marsh study in Les Chenaeux's
- Compare diversity in diked marshes vs. natural marshes

Opportunities

Inland Marshes
(Emergent and Submergent)

Introduction

Inland marshes are a common wetland type, found throughout Michigan in depressions with poorly drained, muck soils. Inland marshes are aquatic communities characterized by emergent and/or submergent aquatic plants and permanent to semi-permanent water. Inland marsh is generally dominated by emergent plants along the edges, with submerged and surface (floating-leaved) plants occurring in the deeper portions of the water body.

Historic Condition

Inland marsh was never a major part of the Maumee lakeplain nor the project area. In the mid 1800's inland marsh occupied about x acres or x % of the project area. Historically, these marshes were found along the edges of mixed hardwood swamps, blach ash swamps, lakeplain prairie, and scattered in small depressions throughout the southern mesic forest matrix.
On average, marshes produce at least 3 times more biomass then lakes, grasslands, and farmland. This high rate of productivity allows marshes to support complex food chains and a broad diversity of wildlife. Common marsh plants found in the shallow water or emergent zone include cat-tail, sedges, arrowhead, pickerel-weed, bulrush, spike rush, bur-reed, wild rice, water lily, pond lily, and smartweed. Submerged plants normally increase in dominance with water depth where emergent plants are less suited for growth. Typical plants found in the submergent/floating zone include: wild celery, duck weed, water-meal, water weed, pond weed, coontail, and water-milfoil.

Marshes provide food, water, cover, and living space for many species of wildlife. Mammals such as muskrats, raccoons, mink, cottontail rabbits, and deer find food in marshes. Herons, shorebirds, waterfowl, red-winged blackbirds, sedge wrens, common yellowthroats and other songbirds seek nest sites and food, such as insects. Marshes with dense cattail stands provide quality winter habitat for ring-necked pheasants. They also supply food and cover for leopard frogs, chorus frogs, snapping turtles, red-eared slider turtle, northern water snakes and ribbon snakes. Common shorebirds found using marsh mudflats include greater and lesser yellowlegs, killdeer, common snipe, and solitary sandpiper. Marshes connected to rivers, streams, and lakes often have significant fisheries values. Fish species that depend on marshes connected to rivers, streams, and lakes, for spawning and/or nurseries include northern pike, yellow perch, bluegill, large-mouthed bass, and a variety of minnow species such as dace and shiners. Rare bird species found in inland marshes include: black tern, American bittern, least bittern, and king rail. Rare reptiles and amphibians found in inland marshes include: Blanchard's cricket frog, spotted turtle, and Blanding's turtle.

Ecological Processes

Emergent and submergent marshes are the ecotones typically found between uplands and open water. Inland marshes may be isolated within a basin surrounded by uplands, they may be connected by a stream or river system, or they may occur adjacent to a lake or pond. Inland marshes receive hydrologic inputs from above ground and from ground water although ground-water movement is limited in much of the lake plain. They are strongly influenced by their drainage basins, the chemical composition of waters flowing into the basins, and the amount and rate of surface water input. Soils are typically muck, anaerobic, and can range in pH from x to x. Aerobic conditions may be present only in a shallow layer of soil lining the basin.

Periods of low hydrologic inputs are characterized by lowering of the ground water table, draining of sediments, and an increase in the depth of the aerobic zone. These wetting and drying cycles play an

important role in the nutrient dynamics of inland wetlands. Whereas marshes are generally covered by standing or slow-moving water, some marshes dry out late in the growing season or during dry years. Fluctuating water levels are part of a natural process that increases marsh community diversity and helps to sustain community health over time. Mudflats are a type of habitat that may appear within a marsh complex annually or intermittently. Mudflats are simply bare soils exposed in shallow areas during low-water periods which usually occur during the summer months. These mudflats are critical to several species of shorebirds, such as sandpipers, who probe or glean invertebrates from the moist soil. In addition, it provides exposed substrate for emergent plant species to colonize. This is particularly important for annual plants that are out competed by aggressive perennial species such as cattails.

Marshes are typically very productive relative to other temperate zone systems. As stated earlier, marshes produce 3 times as much biomass as lakes, grasslands, and farmland. One of the reasons for this high biomass is plant productivity. Most species associated with marshes are herbaceous perennials that whose above ground parts die off every year. In addition, many species such as cattails spread by rhizomes forming thick mats of vegetation. As this vegetation dies off in the fall, it falls into the water. Since standing water is not highly oxygenated, the breakdown of plant material will remove oxygen from the water body creating a more anaerobic condition. Over many years, this vegetated layer will build up on the bottom creating a thick layer of partially decayed, organic material. In addition, as this material breaks down, nutrients are released creating an environment suitable to nutrient loving plant species such as cattail, and purple loosestrife. Without a natural drawdown period, the partially decayed material will continue to build up and eventually fill in the water body.

Current Condition

Overall, there was a loss of x acres of wetlands since the mid 1800's. Today, emergent marshes cover about x % of Michigan, the majority of these remaining marshes occur in ?. Very little inland marsh remains in the project area. In 1978, the average size of inland marshes was approximately **x acres.** No rare species are known to occur in inland marshes within the study area.

Stresses and Threats

Many human activities threaten the health of inland marshes. The two main categories of stress on marshes are altered hydrology and altered chemistry. Construction and dredging projects, some farming practices, and logging may destroy marshland directly or increase silt loads into marshes. Draining marshes to create farmland and filling marshes to make building sites are activities that most commonly have destroyed these wetlands. Invasive plants such as common reed, reed canary grass, and purple loosestrife often invade disturbed shorelines, reducing marsh health. Surface water runoff and streams that feed marshes may also alter hydrology and deliver pollutants and unnaturally high nutrient levels (fertilizer runoff), resulting in undesirable changes to the marsh. Some marshes are destroyed by landowners that excavate shallow portions and deposit the spoil in the surrounding marsh area to create open water habitat.

Ownership/Protection Status

Management Recommendations

Information Gaps

Opportunities

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Appendix

Emergent Flora
Carex
Eleocharis
Lemna
Nuphar
Nymphaea
Polygonum
Pontederia cordata
Sagittaria
Scirpus
Sparganium
Typha
Zizania aquatica

Submergent/surface flora
Ceratophyllum
Elodea
Myriophyllum
Najas
Potamogeton
Vallisneria americana
Chara

Lowland Hardwood Forest

Introduction

Lowland hardwoods are found in areas that hold water at least some part of the year. In southern Michigan there are two different types of lowland hardwood forests: southern swamp and southern floodplain forest. Southern swamps are forest wetlands that grow in isolated, seasonally flooded, depressions containing standing water at least part of the year. Southern floodplain forests are forested wetlands found next to rivers and streams along flat seasonally flooded areas, which are commonly referred to as floodplains.

Historic Condition

Lowland hardwood forests occur throughout Michigan, however the majority of these wet forests are found in southern lower Michigan. In fact, in the mid 1800's, approximately 2/3 of Michigan's hardwood swamps were located in the southern lower peninsula. Historically, lowland forests were found throughout the Maumee lakeplain, and were quite common in the northern Maumee project area. Ecologists estimate that lowland forests covered 81,300 acres or 26.4% of the project area in the early 1800's. Historically, lowland hardwood forests were scattered across the lakeplain in large blocks ranging from approximately 100 acres to over 30,000 acres

Description

The abundance of lowland hardwood forest during the pre-logging era (circa 1800) in the project area is due to several factors: 1) the flat character of the lakeplain glacial deposit, 2) a thick clay layer covered by a thin layer of loam or sand, 3) high water table, and 4) numerous large scattered depressions. This forest type is characterized by poorly drained slightly acidic loam and silt loam soils that are often inundated with water in the spring and fall. Silver maple, cottonwood, red maple, black ash, and red ash typically dominate the canopy layer of southern swamps. Other trees found in the canopy include yellow birch, swamp white oak, bur oak, pin oak, black willow, basswood, and occasionally American elm. American elm used to be more dominant than it is today, however dutch elm's disease shortened its life cycle and reduced its dominance. Shrub and understory tree species include: boxelder, trembling aspen, American elm, rock elm, slippery elm, nannyberry, gray dogwood, red-osier dogwood, willows, and buttonbush. Ground cover is often quite sparse due to the high water table, seasonal flooding, and dense shade cast from the closed upper canopy.

The southern floodplain forest is one of Michigan's most diverse natural communities as well as one of its most threatened. Damming, dredging, and channelization are all human induced threats to these forests. Seasonally flooded in spring and fall by the wide rivers and streams they flank, these forests grow in loam or silt-loam soils that are rich in minerals. Silver maple, red ash, red maple and cottonwood dominate these forests. Red oak, swamp white oak, black willow, and black walnut also occur as smaller components. Trees that reach their northern limit in these forests are Ohio buckeye, paw-paw, red bud, blue ash, Kentucky coffee tree, honey locust, sycamore, hackberry, and red mulberry. Alternate leaved dogwood, prickly-ash, spicebush, American bladdernut, blue-beech, steeplebush, ninebark are typical shrubs found in southern floodplain forest. Ground cover include various ferns such as sensitive fern, cinnamon fern, royal fern, and marsh fern; forbs such as marsh marigold, skunk cabbage, jewelweed, and stinging nettle; vines such as poison ivy, wild cucumber, and river bank grape; and a variety of sedges, grasses, and rushes. Rare plants found in lowland forests in the project area include: wing-stemmed monkey flower (*Mimulus alatus*) state threatened, and twinleaf (*Jeffersonia diphylla*), state special concern.

Small mammals such as the meadow vole and shrews (who feed primarily on insects and other invertebrates) are common in forested wetlands, providing important prey for carnivorous mammals, hawks and owls. The white-tailed deer spends a great deal of time in forested wetlands taking advantage of the protective herbaceous cover and food in the form of grasses, Forbes and woody vegetation. Other larger mammals include coyote, fox, raccoon, opossum, muskrat, beaver, weasels, mink, skunk, cottontail rabbit, squirrels, and bats. Rare mammals found in lowland hardwoods include Indiana bat (*Myotis sodalis*), state and federally endangered. No occurrences of Indiana bat however are known within the project area.

Researchers have documented high densities of breeding birds in forested wetlands. The total number of birds as well as number of bird species nesting in a given area of forest tends to be higher in wetlands versus upland sites. This has been attributed to the increased availability of water, leading to more abundant and diverse foliage for nesting and cover from predators, and to increased food supplies in the form of high invertebrate populations. Neotropical migratory songbirds represent the greatest number of bird species utilizing this habitat type. The following is a list of family groups that utilize lowland forests: woodpeckers, tyrant flycatchers, swallows, chickadees and titmice, nuthatches, creepers, thrashers, thrushes, gnatcatchers and kinglets, waxwings, vireos, wood warblers, blackbirds and orioles, tanagers, grosbeaks, and sparrows.

Forested wetlands are also important nesting and brood rearing habitat for duck species such as, mallard, black duck and wood duck. Wood ducks like to nest in the cavities of dead trees, but require nearby water rich in invertebrate foods in order to raise their broods. Black ducks and mallards like the combination of water, cover, and seclusion that forested wetlands provide.

The great blue heron and other raptors such as the great horned owl and barred owl rely on the abundance of woody and herbaceous cover to provide safe nesting sites. The great blue heron nest in colonies near the tops of trees (rookeries) and are close to the invertebrate, reptile and amphibian food sources needed to raise there young. Raptors successfully feed upon the plentiful rodents living on the rich forest floor. The woodcock and wild turkey also use this wetland habitat during different times of the year for nesting brood-rearing and feeding.

Rare birds that nest in lowland hardwood forests include: red-shouldered hawk, state threatened, prothonotary warbler, state special concern, yellow-throated warbler, state threatened, and cerulean warbler, state special concern.

Because forested wetlands are subject to periodic flooding and rising water tables, vernal ponds are typically associated with this habitat type. These ponds, which may last from only a few days to several weeks, are critical to the reproductive cycle of many amphibians. A rich food supply of microscopic algae and tiny invertebrates plus a lack of predators contribute significantly to the survival of the egg and tadpole stages of their life cycle. Spotted salamanders, blue spotted salamander, eastern tiger salamander, red-backed salamander, four-toed salamander, eastern American toad, western chorus frog, northern spring peeper, gray treefrog, and wood frog are among the amphibians that utilize vernal pools. Rare amphibians found in lowland forests include Blanchard's cricket frog. Among the reptiles found in forested wetlands are the eastern garter snake, northern ringneck snake and five-lined skink. Rare reptiles found in lowland forests include the spotted turtle and massasauga rattlesnake.

Key Ecological Processes

Hydrology, soil type and soil chemistry help produce conditions that are ideal for development of a healthy lowland forest. The hydrologic regime of lowland forests is similar for both southern swamp and

southern floodplain forest. Both systems are regulated by a fluctuating water table during the spring after snowmelt and in the fall due to cooler temperatures and high precipitation. Standing water in the spring and fall prevents shade tolerant woody plants, such as sugar maple, from establishing in the understory. Long periods of drought, however, can allow these trees to establish and become a part of the midstory or even canopy. Successional years of high precipitation, however may kill these tree species and convert them into snags providing valuable nest and den sites for wildlife as well as habitat for invertebrates (termites, beetles, ants, etc). Trees and plants must be adapted to wet, low oxygen conditions for survival. Some, such as willow and ash, are stimulated when flooded to produce new, air-filled roots to replace those that the flood has destroyed. The process of nutrient release through decomposition (nutrient cycling) is largely responsible for recharging the system with nutrients, which in turn support an abundance of life.

In addition, southern floodplain forests may experience flood events along riparian systems. Flood levels can vary dramatically from one event to another, and can cause a dramatic increase in flow rates. Woody debris can be carried for miles and deposited in slow moving water or on high ground. Several tree species, such as cottonwood, (*red ash*), and black willow are adapted to flood events. These species drop their stems in the spring and fall, which are carried downstream and deposited in saturated soils. If conditions are right, these stems will produce root systems and develop into mature trees. Floods also transport nutrient rich silt and clay soil particles from one area to another, and strong floods can actually change the meander of the river or stream creating oxbows in some places and eroding others. In fact, southern floodplain forest is one of Michigan's most dynamic natural communities.

Windthrow is another natural disturbance in lowland forests. High water tables and deep clay soils prevent trees from establishing deep root systems. Windthrow coupled with chance lightning strikes creates a complex forest of various age classes and tree species. Windthrow disturbances can be extremely large extending for miles or quite small affecting a few local trees.
Critical minimal area? No more than 20% of forest historically disturbed at one time? Average disturbance size? Use TNC criteria for developing functional landscape criteria – 10,000 acres?

Current Conditions
Today, they are one of the state's largest remaining natural habitats, covering approximately 5% of Michigan's landscape. In 1978, lowland forests were still scattered but in much smaller fragments. Due to a 75% loss, lowland hardwood forests only covered 18,300 acres or 6% of the landscape in 1978. Today, lowland hardwood forests are primarily located along and in close proximity to the Belle and Pine Rivers, and north branch of the Clinton River. The largest patches of lowland hardwood forest in project area are located in St. Clair County. The largest single block of lowland forest, about 640 acres, is located just south of Adair, and there is also a large cluster of lowland forests along the Belle River.
No rare species associated with lowland hardwood forest species are known to occur in the project area.

Stresses and Threats
Forested wetlands are highly dependent on water regimes and hydrology. Activities associated with development and agriculture have caused major hydrologic changes to the landscape that threaten the integrity of the remaining forested wetlands (ditches, drain tile, clearing and dredging for pond, trails, and roads). Human alterations such as channelization, dumping dredge spoils along banks, dams, and diversions disrupts the natural flow regime of the river and essentially disconnects the floodplain from the river channel. Flood events become more frequent and severe yet decrease in duration. Fish species that use backwaters in the floodplain for spawning are unable to access these areas, and habitat for herps such as frogs and amphibians is lost. In addition, although instream sedimentation has increased in recent

decades, floodplain sedimentation has decreased. Nutrient rich fine silts and clays are no longer available for seedlings to establish. Channelization and dredging also minimize or eliminate natural changes in stream meanders. Changes in stream meanders expose new sediments to plant colonization, destroy previously vegetated sites, and create backwater wetlands.

Fragmentation of the landscape is another threat that continues to escalate due to urban sprawl, development of roads/trail/utilities and recreational pressure. As existing floodplain forests become more fragmented, edge species become more prevalent, invasive species are provided pathways to invade the interior portions of forests, and nesting forest bird species suffer increased predation. In addition, the time it takes a forest to recover from natural or artificial disturbances increases as they become smaller and more isolated.

Invasive plants displace the native flora and reduce native species diversity. Invasive plant species found in lowland forests include garlic mustard, reed canary grass, glossy buckthorn, and purple loosestrife.

Pollutants/contaminants from industrial and commercial development, urban development and agriculture may cause increased nutrient enrichment impacting the flora and fauna of the forested wetland community.

Overgrazing by livestock
Air pollution
Over browsing by deer

Ownership/Protection Status
Management Recommendations
Information Gaps
Opportunities

Mesic Southern Forest

Introduction

Mesic southern forests, commonly referred to as beech-maple forests, are found throughout the state in areas where there is moist, rich, somewhat well-drained soils. They are also the most common forest type in Michigan.

Historic Condition

Prior to the logger era, beech-maple forests (both northern and southern) covered nearly half the state. *Today, these forests cover about 19 percent of the landscape with more than half of the total occurring in the Upper Peninsula.* Historically, mesic southern forest also dominated the Maumee lakeplain and the project area, occupying 185,350 acres or approximately 60% of the project area.

Description

Due to the dense shade produced by tall long lived trees in the canopy, typical beech-maple forests are characterized by high humidity, cooler temperatures, rich organic layers, and shade tolerant, slow growing plants, that produce a high amount of leaf litter. Historically beech-maple forests had a diverse structure which included the super canopy, canopy, sub-canopy, shrub layer, and ground cover. Mesic southern forests in the Maumee lakeplain are dominated by American beech, red oak, swamp white oak, and burr oak. These forests also contain sugar maple, basswood, yellow birch, white ash, black cherry, shagbark hickory, black walnut, American elm, red maple, and tulip poplar. The mesic forests in the lakeplain are actually slightly different than mesic forests found on better drained soils. They occur on somewhat poorly drained medium to fine textured soils in the lakeplain which favors beech over sugar maple. Sugar maple is less tolerant of poorly drained areas.

Understory trees and shrubs include: sassafras, hazelnut, spicebush, blue beech, ironwood, serviceberry, flowering dogwood, highbush cranberry, maple-leaved viburnum, and alternate leaved dogwood. Many of the forbs found in these densely shaded forests are considered spring ephemerals because they bloom before the trees have leafed out. Spring ephemerals include: spring beauty, trout lily, toothwort, dutchman's breeches, squirrel corn, large flowered trillium, wild ginger, hepatica, bloodroot, wild geranium, and jack-in-the-pulpit. In wet depressions, gentians, skullcap, square stemmed monkey flower, and showy orchis can be found. What about ferns, grasses, sedges, and fungi? Rare plants associated with mesic southern forest include ginseng, painted trillium, and cranefly orchid.

Diverse mesic hardwood stands offer varied habitats that are used by a wide variety of songbirds, invertebrates, amphibians, and mammals. Deep leaf litter in these stands affords different levels of decomposition. Combined with fallen branches and logs in varying stages of decay and seasonal pools of water, the forest floor is critical habitat for insects, white footed mice, shrews, moles, voles, and chipmunks. Other animals found in these forests include white tailed-deer, raccoon, fox squirrel, and coyote. The seasonal or vernal pools scattered throughout these forests also provide critical breeding habitat for several frogs such as chorus, wood, spring peeper, and gray tree frogs, and many of the mole salamanders such as the blue spotted salamander.

Seasonal pools also attract many migrating and nesting birds due to the large amount of insects produced. Birds found in mesic southern forests include: barred owl, broad-winged hawk, ruffed grouse
(refer to BBA data for more comprehensive list)
Downy woodpecker, Northern flicker, eastern wood peewee, least flycatcher, Acadian flycatcher, red eyed vireo, northern cardinal, wood thrush, tufted titmouse, and American robin.

Key Ecological Processes

Mature, healthy mesic southern forests are both structurally and compositionally quite diverse. This diversity is due to the variety of natural disturbances that occur in these forests, and the long lived tree species that dominate the forest. Disturbances include small and large scale wind throw, periodic ground fires in droughty years due to lightning strikes, pest outbreaks and disease, and infrequent ice storms that could wipe out large areas of forest. These disturbances provide both small and large openings or gaps within the forest, as well as standing snags. As the large trees decay on the forest floor, young saplings that were struggling for light are released and compete with each other for nutrients, water, and light. In addition, fast growing, pioneer species such as trembling aspen and black cherry quickly fill in these gaps. Birds that use these openings bring in seeds from other systems. Eventually these fast growing short-lived species are overtaken by shade tolerant species such as sugar maple and American beech, which eventually mature and become part of the canopy layer. Older trees that survive multiple disturbances form the super canopy layer. Nutrients are recycled from the leaves, branches, and logs that drop to the forest floor. This debris is converted to humus and eventually to soil and nutrients, which are taken up by the roots of other plants. The roots in mesic forests on well-drained soils are typically deep, however, on the lakeplain roots are not able to penetrate deep in to the clay layer. Although this shallow rooting holds the topsoil in place, these roots are not strong enough to withstand high winds. Trees in the lakeplain are therefore very susceptible to windthrow.

Current Condition

Today, very little mesic southern forest exists, and all remaining forests are small-scattered woodlots ranging from 2 acres to 40 acres. All upland forests (oak-hickory and beech maple) combined within the project area occupy about 6.33 % of the landscape. This represents a greater than 90% loss of mesic southern forest. This major transformation from a forested landscape to an open landscape was primarily due to farming. By the late 1800's, the majority of the project area was converted to agriculture. Farmers targeted beech-maple forests because they were dependable indicators of rich soils. An area that was once 95% forested was cleared and converted to open fields of corn, soybeans, and wheat, as well as pasture and hayfields. Farmers used remaining woodlots on their property for subsistence goods such as maple syrup, building materials, equipment, firewood, etc. Some good examples of remaining mature mesic southern forests in the project area are 1) MNA preserves?, 2) Walcott Mills State Park?, 3) along Rivers?. Walpole Island, which is located in Canada just east of Harsen's Island, also has several good examples of mesic southern forest ranging from x acres to x acres.

Stresses and Threats

As stated in the introduction, the largest transformation to mesic southern forest occurred during the mid to late 1800's during the logging era and farmstead period. Since that time beech maple forests in the Maumee lakeplain have not had to opportunity to rebound and reestablish. Only a few small remnant mesic southern forest still exist in the project area. Threats to these remaining islands of forest include: invasive plant species (such as garlic mustard, honey-suckle, and buckthorn) competing with native plants; over-browsing of native species by white-tailed deer; air pollution from factories, automobiles, and 2-cycle engines (i.e., lawn mowers, snow blowers); insect pests such as gypsy moth; overgrazing of native species by livestock; and piecemeal removal of the forest by individual landowners. Although none of these appear to be major threats, they are all exacerbated by the small size and isolated nature of these forests. The large amount of edge relative to the small size of the forest patches has allowed many of these threats to reach the interior of the remaining forests.

Ownership/Protection Status

Management Recommendations

Information Gaps

O**pportunities**
Restore or allow adjacent open space to succeed to mature southern mesic forest. Increase area and edge/ area ratio of existing forests. For forest interior species particularly breeding birds such as;
minimum threshold size for A rank (TNC)?
x acres 70% forested seems to be critical area for most breeding songbirds (use Canada info)

Rivers and Streams

Introduction

Rivers and streams and the wetlands that border them are classified as Riverine Systems. In the project area, the riverine systems include natural streams and creeks, sections that have been channelized and dredged, man-made ditches and drains and headwater wetlands. The riverine systems serve as vital corridors for wildlife and as major moderators of pollutants, besides providing economic and aesthetic benefits to the community. Michigan has an abundance of moving water—more than 36, 000 running miles of navigable rivers and streams and countless more miles of brooks and other tiny seasonal tributaries. There are three major hydrological units located within the Southeast Michigan Ecosystem Project area: St. Clair River basin, Clinton River basin, and Lake St. Clair. Since there are no major streams in the Lake St. Clair interstitial basin, that hydrological unit is not covered in this chapter.

Geology/Climate

The rivers and streams in the project area flow across three major sub-subsections as identified by Denny Albert (1995). Several rivers originate in the Jackson Interlobate sub-subsection. The underlying bedrock is Mississippian and Pennsylvanian sandstone. Glacial deposits are 250-300 feet thick. Soils in the northeast portion of the sub-subsection are primarily well-drained sands and gravels. Immediately east is the Ann Arbor Moraines sub-subsection which is a long, narrow band of fine and medium textured end and ground moraines. The bedrock is Devonian sandstone and Mississipian shale which are overlayed by thick glacial deposits up to 250 feet deep. The soils are primarily loam and sandy loam textured soils, with silt loams and clay loams more common on the eastern edge. All of the river systems in the project area flow through the Maumee Lakeplain sub-subsection, which encompasses the majority of the project area. Lacustrine deposits are more than 100 feet thick along the inland edge of the lakeplain and gradually decrease eastward to less than 5 feet thick at the Lake St. Clair shoreline. These deposits are underlain by Mississipian, Devonian, and Silurian marine and nearshore bedrock including sandstone, shale, coal, limestone, dolomite, gypsum, and other evaporites. Most stream water in the project area is moderately hard to very hard as a result of contact with carbonate bedrock and surficial materials of similar origin.

Regional average annual rainfall in the Maumee Lakeplain sub-subsection is 31 inches, 59% of which occurs during the six-month period from April through September. Annual Mean temperature is 48.3 ^{0}F and the average annual snow fall is relatively light ranging from 30 to 50 inches. Heavy spring and fall rains in the flat Maumee lakeplain where there is very little gradient can cause high streamflow and occasionally lead to severe flooding.

St Clair River Basin

There are 2004 miles of rivers and streams in the St. Clair River Basin, however, only 634 miles are perennial. Major Rivers and streams in the St. Clair River basin are the St. Clair River, Pine River, and Belle River, which are all located in St. Clair County. Both the Belle and Pine Rivers flow into the St. Clair River. The total number of Lakes in the St. Clair River watershed is 121.

Size of total watershed for each river? What % is in project area? ***The portions of the project area contained within the Belle and Pine River watersheds are 59, 810 acres and 126, 110 acres respectively. The average annual stream flows of the Pine and Belle Rivers are 95 and 104 cfs (cubic foot per second) respectively, while that of St. Clair River is 177, 000 cfs.***

St. Clair River

The St. Clair River, which is basically a Great Lakes connecting channel, originates at the southern tip of Lake Huron and empties into Lake St. Clair approximately 40 miles to the south. The width of Lake St. Clair ranges from about 800 to 2500 feet and the maximum depth ranges between 35 and 50 feet.

Sixty-eight species of fish from 19 families have been recorded in the St. Clair River. In a recent study of the river, emerald shiners comprised 33.4 per cent of the total catch. There was also considerable variation in the temporal distribution of different species. Walleyes were present only in summer and fall; an influx of gizzard shad and brook silversides occurred in the fall; and juvenile alewife, smelt and northern hog-sucker were present in large numbers in late summer and fall.

St. Clair River also hosts a diverse phytoplankton community of over 180 species. Cold water diatoms dominate the community. The type of algae found are characteristic of oligotrophic lakes, and several species of blue green algae are common. Primary productivity, as represented by the phytoplankton community, is low to medium (500 areal standard units per milliliter). In addition, approximately 62 taxa of macro zooplankton were identified at this site in a survey conducted in 1974. Of these, 46 % were cladocerans, 37 % were copepods and 17 % were crustacean invertebrates. Zooplankton densities peaked in August and November. Densities ranged from 14 organisms/m^3 in May to over 19,000/m^3 in August. A monthly successional pattern of dominant species was reported. Mid river bottom densities were generally higher than the surface densities, and the benthic or bottom macro invertebrate community, dominated by snails and caddis flies, was relatively homogeneous.

Common plant species found in the St. Clair River include water milfoil (*Myriophyllum* sp.), water weed *(Elodea* sp.*)*, pickerel weed (*Pontederia sp.)*, and pond weed *(Potomogeton sp.)*.

Pine River

The main channel of the Pine River is 27 miles long, of which 12 miles are located within the Project Area. Smith's Creek is a major tributary of Pine River that flows through the project area. In addition, there are a series of major drains, such as Holland Drain, London Drain, Moak Drain, and Rattle Run that join the Pine River at various places in the project area. **Number of dams?**

The overall biological integrity of the Pine River was rated fair based on the macroinvertebrate ratings (DEQ, 1992). A biological assessment of the Pine River conducted in 1997 by the Great Lakes and Environmental Assessment Section (GLEAS) also gave a rating of fair at Wadham's Rd. for macroinvertebrates (DEQ, 1997). However, the presence of mottled sculpins and rock bass indicate that the water quality at and upstream of Wadham's Rd. is good.

In the mid 1980's, three sites along the Pine River, within a 1.5 mile stretch of the river just north of Frith Rd. and east of Wadham's Rd., were identified that contained high quality mussel beds. Together, all three sites constitute the Pine River macrosite, which MNFI considers one of the richest mussel communities in Michigan (MNFI, 1985). Of the 15 species recorded, four are listed as state endangered: snuffbox (*Epioblasma triquetra*), round hickorynut (*Obovaria subrotunda*), salamander mussel (*Simpsoniconcha ambigua*), and bean villosa (*Villosa fabalis*) (MNFI, 2000). In addition, the eastern sand darter (*Ammocrypta pellucida*), state threatened, was also found at this location in 1985, representing an extension of its known range in Michigan. The sand darter is known for its interesting habit of burying itself in the substrate with only its eyes and mouth exposed waiting to ambush passing prey. This macrosite received additional significance after the loss of another important mussel site in the Black River due to dredging in 1988-91. Both mussels and the eastern sand darter require well-oxygenated

water, free from siltation and pollution, in an area where there is minimal physical disturbance to the substrate. Unfortunately, it was recently documented that portions of the Pine River near Wadhams Rd. were dredged. The DEQ report also noted the presence of steep banks (approximately 30 feet height), several areas exposed to bare soil, and indications of large fluctuations in water flow at the Wadhams Rd. site.

Water chemistry data did not indicate any detectable levels of chlorinated hydrocarbons, pesticides, or PCBs in the Pine River. The iron content (700-2400 ug/L) was observed to be high compared to that of the St. Clair River (320 ug/L) and the Belle River (1260 ug/L). Experts believe that this is attributed to the high concentrations of iron in the ground water (?).

DEQ also sampled one site on Smith's Creek, a major tributary of the Pine River. The study gave the macroinvertebrate community at this site a rating of poor. According to the study, this stream is dominated by surface dependent air breathing organisms and chironomids. Dredged physical habitat, as opposed to water quality has been cited as the reason for the poor presence of a macroinvertebrate community. The physical characters of the stream have been altered at several places leading to a poor bottom substrate with less than 10 percent stable habitat. Slow and stagnant waters with black sediments indicating periods of anoxia, and unstable and bare stream banks are frequent along the stream (MDEQ, 1997).

Belle River

Running for about 48 miles through the counties of Lapeer, Macomb and St Clair, The Belle River is one of the major rivers in Southeast Michigan. About 20 mile of the river pass through the Project area, primarily St. Clair County. Wilson (1974) described the lower reaches of the Belle River as a slow sluggish stream flowing through an area of old lakeplain of little gradient. Much of the adjacent soil types are organic peat and muck deposits. The sluggish flow allows organic material inputs to settle and form organic peat and muck deposits.

In general, a recent ecological assessment of the river in the project area indicated poor scores for macroinvertebrate and fish communities in the upstream portion, good scores in the midstream portion, and poor ratings in the down stream area. For example, the midstream portion of the Pine River (which is located in the northern part of the project area) contains good riverine habitat harboring a variety of species including native mussel populations. Specifically, habitat at several sites along the stretch of river located between Bordman Rd. and Ellsworth Rd. received a rating of good to excellent, and the macroinverebrate community was given a rating of fair to good. One site in particular, the Kroner Rd. site, received the second highest score in the study for its macroinvertebrate community, and the highest score for habitat (DEQ, 1997).

In addition, the Belle River at Indian Trail Road, located on the lower reaches of the River, harbors one of the more diverse mussel communities in the state with at least 16 species represented. Of the 16 species, a total of five are currently listed in Michigan: bean villosa *(Villosa fabalis)*, state endangered, round hickory nut mussel *(Obovaria subrotunda)*, state endangered, snuffbox *(Epioblasma triquetra)*, state endangered, wavy-rayed lamp-mussel (*lampsilis fasciola*), state threatened, and elktoe (*Alasmidonta marginata*), state special concern (MNFI, 2000). The diversity of the mussel fauna here is indicative of the high quality benthic habitat at this location. Though none were confirmed to be reproducing at this location, strong hopes to find gravid females during future surveys were indicated (MNFI, 1985). In 1994, the Indian Trail Road Bridge was proposed for renovation. In 1995 the MDNR approved the project, and individual mussels located near the Indian Trail Road Bridge were permanently relocated to

the Puttygut Road Bridge situated about 1.5 miles upstream of the Indian Trail Bridge. **(what is status of relocation?)**

Stresses and Threats:
Since the Pine River is not a designated county drain in sections included in this site, it is not subject to alteration by county drain commissioners. However, many of its tributaries are drains, and any disturbance in these could release large sediment loads into the Pine River. For example, a dam and impoundment at a clay pit site on Wolvin Drain, upstream of the Firth Road site, poses a serious threat of heavy sediment load. Any devegetation of banks upstream, alteration of fish communities due to stocking or chemical treatments could be detrimental to the riverine system. The sites of ecological importance are especially vulnerable to destruction by bridgework because of location of these sites downstream of bridges. Dumping of garbage from bridge locations was identified as the main problem.

Clinton River Watershed
The Clinton River watershed located just north of Detroit, flows 80 miles from its headwaters in Independence Township, Oakland County to Lake St. Clair near the city of Mt. Clemens. The river drains 760 square miles of southeastern Michigan, including large portions of Oakland and Macomb Counties and smaller areas of St. Clair and Lapeer Counties (DEQ, SWQ, 1995). The watershed contains over 800 river and stream miles however only about half are considered perennial. There are also over 300 lakes scattered across the watershed. Major streams in the watershed include Paint Creek, Stoney Creek, North Branch Clinton River, Coon Creek, and Middle Branch Clinton River.

As mentioned earlier, the Clinton River watershed flows across three major ecoregions; Jackson Interlobate, Ann Arbor moraine, and Maumee Lakeplain. The topography is hilly in the upper portion of the watershed, and flat in the lower portions of the river. Elevations range from 1200 feet in the northwest to 670 on the Macomb Oakland County line, where the bottom slope of the stream is 7.3 feet per mile. Flood plains average 180 to 200 feet in width. The main branch of the Clinton River is a warmwater river approximately 80 miles in length. The highest gradient occurs between the cities of Pontiac and Rochester. Approximately 8 miles below the city of Rochester, the Clinton River flows over a flat glacial lakeplain of clay and sand. Nowlin (1971) listed 15 dams on the mainstem of the Clinton River. In 1978, 31 species of mussels were found in the Clinton River and its tributaries (Strayer, 1980). According to Strayer, this is a large number of species, and appears to be greater than any other stream in the Great Lakes basin with the exception of the Maumee River.

Historically, the Clinton River and its tributaries had stable streamflows and clear water as a result of highly permeable soils and abundant wetlands throughout the upper portion of the watershed, while the lower portions, draining soils of low permeability, were probably more subject to turbidity at high streamflows. The upper and middle mainstem, being warmed by lakes and cooled by groundwater, contained a coolwater fish fauna which required clear waters and coarse substrates, such as smallmouth bass, darters, suckers, and minnows. Numerous high gradient reaches in this area also provided excellent spawning areas for potamodromous stocks of species such as sturgeon and walleye. The fish fauna of Paint and Stoney Creek consisted of fishes such as sculpins, dace, and chubs which require similar habitat conditions but colder water (Zorn, et al, 1992). By the 1880's these two creeks also supported brook trout populations which originated from hatchery plants (Westerman, 1974).

The lower mainstem (especially below Utica) the North Branch, and Red Run provided different conditions for fish. With their flows being dominated by runoff, these streams were warmer, had lower base flow in the summer, and were more prone to flooding than other reaches. Fine substrates (silt and

sand) were more common due to the extremely low gradient of these streams and riparian wetlands were very abundant. These reaches supported pike, smallmouth bass, largemouth bass, other sunfishes, suckers and minnows (Zorn, et al, 1992). Historically (pre 1933), the lower mainstem of the Clinton River (stretch south of M-59) also contained a large number of mussel species. Strayer also reported, however, that four species (*Cyconaias tuberculata, Obovaria subrotunda, Ligumia recta, and Ligumia nasuta*) which resided in the lower mainstem prior to 1935, are now apparently extinct from the entire Clinton River system. In fact, he noted that the entire mussel fauna of the mainstem from Pontiac downstream was destroyed sometime between 1933 and 1977 (Strayer, 1980). Poor water quality was also documented by DEQ in the Clinton River downstream of Pontiac (1998).

Land drainage for agriculture (which began as early as the 1840's) probably increased the flashiness and sediment load of several downstream reaches. Rapid industrial growth during the post-World War II era also had a major impact on the watershed. Development of headwater areas decreased soil permeability causing increased flooding of areas downstream (Leopold, 1968). In fact, flooding became such as problem in Mt. Clemens that a 4 km spillway (The "Cut Off Canal") was constructed between the city and Lake St. Clair in order to carry away the floodwaters (Zorn, et al, 1992).

Threats

Non-point sources are the largest contributors of pollutants to the Clinton River. Non-point sources include illegal connections to storm drains, failing septic systems, and urban storm water contaminated with animal wastes, pesticides, herbicides, metals, and petroleum compounds. About half of the river's flow is treated wastewater from six municipal wastewater treatment plants, and several communities utilize combined sewer system overflows which can pollute the river with pathogens and human waste. (DEQ, SWQ, 1998)

Major streams of the Clinton River located in our Project Area are: North Branch Clinton River, Stoney Creek, Middle Branch Clinton River, and Coon Creek. North Branch has the largest drainage area (199 sq. miles), followed by Stony Creek (68), Middle Branch (23) and Coon Creek (13).

North Branch

*The North Branch of the Clinton River originates in Bruce Township, Macomb County, and joins the Clinton in Clinton Township, Macomb County. At 43.2 miles in length, it is the largest tributary of the Clinton River (Synnestvedt, 1998). Nowlin (1971) listed two dams on this river, Walcott Mills and Cascade Lake. Of the 15 sites evaluated in 1998 for habitat quality, two sites were given an overall rating of excellent, seven sites received a rating of good, and six sites were given a rating of fair (Synnestvedt, 1998). In a mussel survey of the Clinton River, Strayer (1980) found 26 species of mussels, which he noted was an exceptionally large number for so small a stream. Of the 26 species found during the 1980 survey, 4 are currently listed as either state threatened or state special concern: wavy rayed lamp mussel (*Lampsilis fasciola) *state threatened, round pigtoe (*Pleurobema coccineum*),state special concern, rainbow* (Vilosa iris) *state special concern, and elktoe* (Alasmidonta marginata*), state special concern*.

The overall biological integrity of the North Branch Clinton River was rated fair based on the macroinvertebrate community rating at several stations, and the fish community categories ranged from good to excellent. However, the overall physical habitat was categorized as poor. The middle stretch of river between 24 mile Rd and 33 mile Rd received a rating of excellent from DEQ in 1995, and 3 sites within this area received an excellent rating for habitat from the Clinton River Watershed Council in 1998 (Synnestvedt, 1998). This area received an excellent rating for the fish community, good rating for macroinvertebrates and good rating for biological integrity. Water quality appears ***good despite***

nonpoint source agricultural impacts (DEQ, 1995). In 1980 however, Strayer noted that two sites he surveyed in this stretch contained very few living mussels, none of which were older than 4 years old in 1978. He noted that large numbers of weathered shells pointed to a diverse fauna in earlier years, and speculated that some pollutant (probably from Romeo) destroyed the mussels.

The upper reaches of the North Branch of the Clinton River, north of the Coon Creek confluence, harbors a good macroinvertebrate community and an excellent fish community (MDNR 1995). Though some areas have been impacted by non point source pollution, the favorable gradient and the well vegetated riparian zone still provide a diversity of good habitat types. In fact, the headwaters of the North Branch Clinton River located in the northwestern corner of the project area are designated coldwater streams that harbor naturally producing brook trout populations (DEQ, 1997). The North Branch of the Clinton River at 27-mile Road is reported to be an excellent site in terms of diversity with 16 species of freshwater mussels recorded in 1978, including live specimens of wavy-rayed lamp mussel (Lampsilis fasciola), state threatened. Wavy-rayed lamp mussel is also presumed to be extant in riffles north of 24-mile Road.

East Pond Creek, a tributary of the North Branch, is a 16.7 mile long coldwater stream flowing from Almont Township in Lapeer County and joining the North Branch in Armada Township, Macomb County. The entire stream is designated a trout stream. Three dams are located on this creek (Nowlin, 1971). As a result of a habitat survey conducted in 1997, one site was given an excellent rating, and four sites received a rating of good.

The lower reaches of North Branch of Clinton River, after the confluence of Coon Creek, however, take on the characteristics of Coon Creek. The low gradient here produces slow current velocities and the turbid water reflects upstream clay soils with low infiltration. The habitat in this area was rated poor due to a large sediment load, unstable banks, and a narrow wooded riparian zone (DEQ, 1995).

Threats
Almont WWTP – increased nutrients – excessive aquatic plant and algal growth
Romeo WWTP – lower dissolved oxygen, increased water temperatures
Cattle feeding on streamside vegetation
Cattle trampling banks
Lack of instream habitat
Poor road crossings

Middle Branch
This is a warmwater stream, 20.8 miles in length, that originates in Washinton Township, Macomb County, and joins the North Branch Clinton River in Clinton Township, Macomb County. Most of the Middle Branch is designated as a county drain. The Middle Branch of the Clinton River has been dredged and straightened at several locations causing heavy sediment loads and extreme impairment to the habitat (MDNR, 1995). The flashy flow regime also produces bank erosion problems. The habitat and macroinvertebrate community in the upper reaches of the Middle Branch were rated fair while the fish community was rated good. Further downstream, the habitat quality worsened receiving a poor rating (MDEQ,).

Stoney Creek
Stoney Creek is a warmwater stream, 21.2 miles in length, that originates in Oakland County and joins the Clinton River in Avon Township, Oakland County. Despite the fact that it starts and ends in Oakland County, about 70% of the stream is located in Macomb County. Nowlin recorded five dams on this creek (1971), and the majority of the stream is designated as a county drain. The largest impoundments are

Upper and Lower Stoney Lakes, Lakeville Lake and Winkler Mill Pond. This stream possesses excellent stream quality from both an aesthetic and biological point of view. In fact, it was noted in 1995 that Stoney Creek was the highest quality stream evaluated in a survey of the Clinton River and its tributarties (DEQ, 1995). In addition, it was also noted in a 1997 survey of the Clinton River Watershed, that Stoney Creek contained the highest quality bottom substrates (dominated by cobble and gravel) in the entire watershed. Of the nine sites evaluated for habitat, three sites were rated excellent and six sites were rated good (Synnestvedt, 1997). Both the fish and macroinvertebrate communities were rated good, while habitat was rated excellent. The gradient of the stream averages about 12 feet per mile, and the substrate is predominantly rock and cobble.

Coon Creek

Dave Strayer noted Coon Creek is an extreme example of a stream draining clay soils of low infiltration capacities. During a survey of mussels within the Clinton River watershed in 1977-78, Strayer observed that although Coon Creek had very high flows (50-75 m3/sec) in the spring, it was reduced in late summer to a series of stagnant pools. In a later survey, DEQ biologists rated the overall biological integrity of Coon Creek as fair based on the macroinvertebrate community rating. The fish community was categorized as good, and the general stream habitat ranged from fair to excellent (DEQ, 1992). Of special note, the study categorized the stream habitat located between Hicks Rd. and 29 Mile Rd. (approximately a 4-mile stretch) as excellent. So far undredged, this reach of Coon Creek is still considered a natural stream, a rarity in southern Michigan. It exhibits all the characteristics of a natural river such as meandering waters, riffles, sandy and gravely substrates and relatively little siltation.

wastes, pesticides, herbicides, metals, and petroleum compounds. Though there are no major industrial discharges of process water and municipal sewage treatment systems have largely eliminated sources of raw sewage, combined sewer systems still exist in certain geographic areas from which combined sewer overflows occur from time to time.

Common Stresses and threats

Information Gaps

Pollutants/ Contaminants

Opportunities

Although agriculture is still common along these rivers and streams, farmland is diminishing as a result of urban sprawl. While the agricultural drainage continues to be a major source of non-point pollution severely impacting the habitat of these riverine systems, the rapid urbanization has further altered the natural drainage and increased the amount of water that reaches the riverine system via storm water discharges.

Solutions to many of the most serious problems (i.e. stormwater management plans, habitat protection) require implementation at the local level through mechanisms like landscape level land use planning, and adopting best management practices. Since these practices extend to the entire watershed encompassing the interests of several stakeholders, a comprehensive and coordinated effort is required.

The Blue Ribbon Commission Report helped create a SWIM (Surface Water Improvement and Monitoring) Team, to monitor, educate, and enforce activities toward achieving the goal of all Macomb County surface waters. Similar systematic surveillance and investigation teams to locate sources of pollution with emphasis on neighborhood-wide and community-wide issues need to be encouraged throughout the project area.

Soil Erosion and Sedimentation

The occurrence of soil erosion, caused by both wind and water, is very evident through out the basin. Several improper land and water management practices contribute to this problem. Erosion sources include cropland, stream and ditch banks, construction sites, and roads.

The land and water management division of the MDEQ processes several applications for land and water alteration along these water bodies. There is an urgent need to study the cumulative impact of these activities in order to gain a more holistic perspective of the health of each of these watersheds.

Since the surrounding area being largely agriculture and exposed to extensive plowing, siltation of the river systems is a major threat identified especially in the northern regions. The problem gets compounded in the light of regular maintenance of drains and channelization for agriculture as well as due to construction and other developmental activities owing to urbanization. Streambank erosion is also impacted by storm water run off, snow melt, and fluctuating water levels, which in turn get influenced by surrounding land use.

The habitat, benthic, and fish communities were evaluated earlier in biosurveys conducted by the Michigan Department of Natural Resources (MDNR). Water and sediment qualities were also evaluated at selected sites. In general, upstream communities were healthier than downstream. But even in areas with little toxic contamination, habitat and the benthic biota were impaired by in-stream sediment accumulation. Although the streams at certain locations have been studied, intensive surveys throughout the project area, covering indicator species such as fresh water mussels are urgently needed.

Eroded topsoil reaches surface waters in the form of sediment. This sediment then clogs waterways and ditches as deposition occurs. Water turbidity and suspended sediments are especially critical to the survival of sensitive fauna such as fresh water mussels.

Changes in the hydrological regime

Very rapid urban expansion and the subsequent loss of habitat is the second significant category of environmental problems related to water quality, apart from non-point pollution in the Clinton River watershed. Oakland County leads the state in new construction, and Macomb County is experiencing rapid urbanization as well [6]. Wetlands and other wildlife habitat have been all but eliminated from the downstream portion of the basin, and natural drainage has been drastically altered throughout the watershed. The volume of urban storm water run-off has been substantially increased due in part to the creation of large areas of paved surfaces.

Influence of non-native species

Forty-six species of unionids are found in Michigan. Of these, 18 are state endangered, threatened, or special concern, and three are also federally endangered. The greatest diversity and concentration of threatened and endangered species is in southeastern Lower Michigan ([7]). However, prevention of zebra mussel introductions is needed. Zebra mussels now occur in inland areas of seven river basins. This distribution includes the upper Clinton River in Oakland County, which contains an abundant population of the snuffbox mussel, *Epioblasma triquetra*, as well as three other state-listed species. Healthy unionid populations unlikely to be affected by high zebra mussel densities remain in areas such as the lower Belle River in St. Clair County. However, lands surrounding these waters are privately owned, making enforcement of quality watershed practices more difficult.

Ownership/Protection Status

Management Recommendations

Flora and Fauna:

Threatened and Endangered Animal Species known to exist in the Belle and St Clair River vicinity.

	Scientific Name	Common Name	Status	Remarks
Mollusks	*Cyclonaias tuberculata*		Purple wart back	Threatened:
Fish	*Hybapsis amblops*	Bigeye chub	Threatened	
	Thoxinus erythrogaster		Southern redbelly dace	
	Acipenser fluvescens	Lake sturgeon		(One specimen collected in 1974)
	Erimyzon oblongus	Creek chubsucker		(One specimen collected in 1974).
Amphibians	*Ambystoma texanum*	Small-mouthed salamander		Threatened: In moist woods- recorded in Oakland County.
Reptiles	*Clonophis kirtlandi*	Kirtland's water snake		Endangered:
	Elaphe vulpina gloydi		Eastern fox snake	Threatened***:***
	Terrapene carolina carolina			Eastern box turtle

Threatened Plant Species known to exist in the Belle and St Clair River vicinity.

	Potamogeton vaseyi		In small water bodies (< 15' deep)
	Zizania aquatica var. aquatica	Wild rice	
	Zizania aquatica var. interior		
	Triplasis purpurea	Sand grass	(On sandy shores and low dunes)

One subfossil valve of ***Dysnomia triquetra*** was discovered just north of Algonac in St Clair River in 1965. Other threatened species such as ***Hiodon tergisus*** (Mooneye) and ***Stizostedion canadense*** (Sauger) were also noted just north of Fawn Island and East of Marine City on this river.

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Inland Fish Species List
(Common names only)

Banded killifish
Black bullhead
Black crappie
Blacknose dace
Blackside darter
Bluegill
Bluntnose minnow
Bowfin
Brindled madtom
Brook silversides
Brook stickleback
Brown bullhead
Brown trout
Central mudminnow
Channel catfish
Chinook salmon
Common Carp
Common shiner
Creek chub
Eastern sand darter
Emerald shiner
Fathead minnow
Golden redhorse
Golden shiner
Goldfish
Grass pickerel
Great lakes muskellunge
Green sunfish
Greenside darter
Hornyhead chub
Iowa darter
Johnny darter
Largemouth bass
Logperch
Longnose dace
Longnose gar
Longnose sucker
Mimic shiner
Mottled sculpin
Northern hog sucker
Northern pike
Northern redhorse
Pumpkinseed sunfish
Rainbow darter
Rainbow trout
River redhorse
Rock bass
Round goby
Sand shiner
Shorthead redhorse
Silver lamprey
Silver redhorse
Smallmouth bass
Spotfin shiner
Spottail shiner
Spotted sucker
Stonecat
Tadpole madtom
Three-spine stickleback
Walleye
White bass
White crappie
White perch
White sucker
Yellow bullhead

Fish Species List for St. Clair River and Lake St. Clair
(common names only)

Alewife
American eel.
Banded killifish
Bigmouth buffalo
Black bullhead
Black crappie
Blackchin shiner
Blackside darter
Bluegill
Bluntnose minnow
Bowfin
Brindled madtom
Brook silversides
Brook stickleback
Brown bullhead
Brown trout
Burbot
Central mudminnow
Channel catfish
Channel darter
Chinook salmon
Coho salmon
Common Carp
Cominon shiner
Creek chub
Eastern sand darter
Emerald shiner
Fatheadminnow
Freshwater drum
Gizzard shad
Golden redhorse
Golden shiner
Goldfish
Grass pickerel
Great lak-es muskellunge
Green sunfish
Greenside darter
Hornyhead chub
Iowa darter
Johnny darter
Lake herring
Lake sturgeon
Lake trout
Lake whitefish
Largemouth bass
Logperch
Longnose gar
Loncnose Sucker
Mirnic shiner
Mooneve
Mottled sculpin
Northern ho- sucker
Northern pike
Northern redhorse
Pink salmon
Pumpkinseed sunfish
Quillback cai-psucker
Rainbow smelt
Rainbow trout
River redhorse
Rock bass
Rockbass
Round goby
Sand shiner
S au (yer
Sea lamprey
Shorthead redhorse
Silver chub
Silver lamprey
Silver redhorse
Slimy sculpin
Si-nallmouth bass
Sniallmouth buffalo
Spotfin shiner
Spottail shiner
Spotted sucker
Stonecat
Tadpole madtorn
Three-spine stickleback
Trout-perch
Tubenose goby
Walleye
White bass
White crappie
White perch
White sucker
Yellow bullhead

Southern Shrub-Carr

Introduction
Southern shrub-carr is a type of wetland community composed of tall, deciduous shrubs growing on saturated to seasonally flooded soils. These wetlands are typically referred to as shrub swamp.

Historic Condition
In 1800, southern shrub-carr only covered about 1 percent or approximately 43,000 acres of Michigan, the majority of which was found in Upper peninsula. *How much in the project area??*

Description
Shrub-dominated and characterized by fluctuating water levels and poor drainage conditions, shrub-swamps usually contain forbs, grasses, and sedges more characteristic of wet meadows. They are successionally moderate to long persistent, and intermediate between wet meadow and swamp forest. This cover type typically occurs next to streams, rivers, lakes, and ponds and in low depressions in the lakeplain. Soils are normally shallowly inundated to saturated muck.
Combinations of shrubs such as willow, dogwood, Michigan holly, and elderberry dominate shrub-carr. This low, thick, woody cover provides food and shelter for furbearers (mink, muskrats, beaver, raccoons) and other mammals such as deer and cottontail rabbits; reptiles and amphibians (snakes, turtles, frogs, toads); and insects (butterflies and dragonflies). Deer frequently are found bedding on high ground in these shrub wetlands. Shrub-carr also provides excellent food and cover for song sparrow, swamp sparrow, marsh wren, yellow warbler, etc. Many snakes are found in these wetlands such as the nothern copperbelly watersnake, federally endangered and state threatened.

Ecological Processes
Southern shrub-carr on the lakeplain receive hydrologic inputs largely from above ground surface runoff. They are strongly influenced by their drainage basins, the chemical composition of waters flowing into the basins, and the amount of surface water input. The ground water beneath shrub-swamp wetlands is usually anaerobic. Aerobic conditions may be present only in the surface layer of soil. Periods of low hydrologic inputs are characterized by lowering of the ground water table, draining of sediments, and an increase in the depth of the aerobic zone. These wetting and drying cycles play an important role in the nutrient dynamics of inland wetlands.

Shrub-swamps are ever changing systems. They may be wetter than lowland forest, but generally do not contain large amounts of cattail, bulrush and other deeper-water marsh plants, although these plants may appear around edges or openings. Shrub-swamps may start as lake, pond, river or stream floodplain, or other body of shallow standing water. Water-loving shrubs take root in shallows of relatively stable wetlands. As plants decay, detritus accumulates until water depth decreases and supports more dense brushy vegetation. Continued succession eventually results in shallower waters and a buildup of organic soils, which support more woody cover. Occasional flooding or several years of wet weather can slow this wetland-upland transition process, and several dry years can hasten it.

Current Condition
Today, about 730,000 acres are thought to exist statewide. The dramatic increase is due to extensive logging of conifer swamps and lowland hardwoods, and to the large network of roads that have altered hydrology. Often times, the logging of lowland forests results in a higher water table and conversion to a different wetland community such as southern shrub-carr. In 1978, however, shrub-carr was reduced from x in the mid 1800's to only 800 acres in the project area.

No rare species associated with this community are known to occur in the project area.

Stresses and Threats
Construction and dredging projects can destroy shrub swamp directly, whereas some farming practices and logging of adjacent uplands may increase silt loading into swamp. Draining for building sites or to expand farmland are activities that most commonly have destroyed shrub swamps. Surface water runoff and streams that feed shrub-swamp may also deliver pollutants and unnaturally high nutrient levels (fertilizer runoff), resulting in changes in wetland character.

Ownership/Protection Status

Management Recommendations

Information Gaps

Opportunities

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Appendix

Flora
Cornus racemosa
Cornus stolonifera
Cornus amomum
Salis bebbii
Salix discolor
Salix exigua
Salix petiolaris
Salix rigida
Salix lucida
Sambucus canadensis
Ilex verticillata

Agricultural land

Introduction

The Project Area is in a prominent part of the agricultural heartland of Southeast Michigan. Agriculture is a leading industry in the area with almost half of the land in agricultural production. Because of its size and scope, farming impacts wildlife perhaps more than any other landuse in the area, and the trend to fewer, larger, more intensively managed farms over the past several decades has been detrimental to many wildlife species.

Historic Condition

Agricultural Periods

Early years 1830-1900

1900-1950

Questions

What was the historical status of dairy and beef cattle in the area?

Seems like it was very important part of local economy.

Present Condition

In general, the central and northwest portions of the project area are the only areas with extensive agricultural lands. According to 1992 land use information (USGS), row crops, pasture, and hay account for 46% (193,680 acres) of the project area. In 1992, approximately 148,000 acres were in row crops, and 45,680 acres were in pasture and hay. The core agricultural area is centered in the northern portion of Macomb County, around the small agricultural towns of Armada, Memphis, and Richmond. On the margins of the core agricultural area is more diverse land cover with a mix of agriculture, forests, old fields, wetlands, and development. **Which watersheds is agriculture concentrated in? important segments of rivers? It appears that the N. Branch of the Clinton River (including Coon Creek) is heavily agricultural. What is % for each watershed?**

Overall, grasslands appear to be scattered throughout the project area. The only area where there is relatively few grasslands is northern Macomb County (Armada, Richmond Townships). Concentrations of grasslands occur in 1) Chesterfield and Lenox Townships (area between M-19 and shoreline) in Macomb County, 2) North Branch of Clinton River in Macomb, Ray, and Lenox Townships of Macomb County, 3) northern portion of Harsen's Island, 4) and both Clay and St. Clair Townships in St. Clair County.

Similar to most of Southern Michigan, crops grown in greatest abundance in the area are corn and soybeans. In both Macomb and St. Clair Counties, soybeans are the most commonly planted row crop. Macomb County planted 23,900 acres of soybeans compared to 11,000 acres of corn, and St. Clair County planted 66,900 acres of soybeans and 26,000 acres of corn. Dry beans and wheat follow these crops in terms of acreage. In 1998, St. Clair County ranked 9th in sugarbeet production out of 13 counties that produce sugarbeets. Hay occupies about fifty percent of the agricultural lands in the fallow season. Livestock in the project area include beef, dairy, hog, and poultry. All types of livestock production have experienced a severe decline over the past 20 years, and several such as poultry have been nearly eliminated from the project area.

Trends

Both counties have experienced declines in agriculture, although Macomb county has experienced a much steeper decline in farm area, number of farms, and cropland acres than St. Clair County. This rapid

decline is primarily due to urban sprawl moving northward from the Detroit area. **Between 1950 and 1997, farmland decreased by %, cropland area decreased by %, and number of farms decreased by %. How does this compare to the rest of Michigan? .** Between 1978 and 1992, farmland acreage decreased by 21% within the project area. Between 1992 and 1997 farmland in St. Clair County alone decreased by 10.3% (MASS). Macomb County is currently experiencing a dramatic decline in farmland due to urban development moving northward from the Mt. Clemens area.

Between 1985 and 1995, milk cows and beef cattle declined by 50% in St. Clair County and 55% in Macomb County. During this same time period, milk production decreased by 37% in St. Clair County and by 51% in Macomb County. As a result, milk production is being concentrated on fewer but larger farms, and beef cattle production demonstrates similar trends. Despite these trends, St. Clair County ranked 10th in the state in the number of beef cows in 1999. Between 1982 and 1992 pasture lands dropped by about 31%. Between 1985 and 1995, the number of hogs and sheep decreased by 33% in St. Clair County, and **%** in Macomb County. Macomb County had 5,000 hogs and pigs in 1998 compared to only 2,000 in St. Clair County. St. Clair County had 2,700 hens and pullets in 1998, while Macomb County only recorded 1,000.

Between 1982 and 1992 the percentage of cropland receiving fertilizer has increased from 74.6% to 76% although due to the decline in cropland there has actually been a 4.1% decrease in land area receiving fertilizer over that same time period. Overall, the quantity, toxicity and persistence of current-use pesticides is decreasing, potentially reducing the impacts to the environment. Between 1982 and 1992, the proportion of cropland receiving herbicide has increased from 57% to 59%, although the total area receiving herbicides has declined by 3.4% due to a 6% decline in total cropland.

Types of Agricultural Land

Row Crops

Rowcrops are crops planted every year typically in rows. Rowcrops grown in the project area include corn, soybeans, wheat, etc. Rowcrops are typically mechanically planted in the spring and harvested in the fall. The prepare the soil for spring planting, farmers usually till 100% of the soil after harvest or in early spring. Other practices include conservation tillage, and no till. Crop rotation is used to reduce plant diseases and increase soil nutrients and yields. Often alfalfa, clover, and other legumes are worked into the rotation to increase soil nitrogen.

Rowcrops typically support 2-3 nesting bird species and a total of only up to 88 birds per 100 acres. Migrating waterfowl, shorebirds, and songbirds (such as snow buntings, Lapland longspurs, and common redpolls) along with pheasants, quail and other winter residents rely on waste corn, soybeans, other grains, and weed seeds for food. Vesper sparrows show a clear preference in spring and summer for foraging in fields with the most crop residue because of the abundance of spiders attracted to those areas. Large open fields with no natural cover, like row crop fields only attract a few bird species such as brown-headed cowbird, horned lark, vesper sparrow, and killdeer. Pheasant, grasshopper sparrow, and meadowlark will occasionally nest in row crops. Mammals attracted to open fields include deer, white footed mice, voles, and ground squirrels.

Field Borders

Field borders, shelterbelts, and fencerows between fields and around the perimeter of fields can help wildlife if the borders contain grasses, legumes, and fruit bearing shrubs. (edge cover, travel lanes, food). Bird species attracted to these areas include: cardinal, wild turkey, chickadees, pheasant, kestrel, grackle, mourning dove, robins, gray catbird, chipping sparrow, blue jay, black-billed cuckoo, indigo bunting,

brown thrasher, goldfinch, common yellowthroat, and red-winged blackbird. Road to road farming operations that remove old fields, woody cover, and edge habitats can lead to a huge decline in the number and kinds of wildlife.

Abandoned Structures
Abandoned structures such as barns, silos, sheds, and farmsteads provide cover for a variety of animals. Rabbits, deer, raccoons, squirrels, and woodchucks make use of the overhead cover. These old structures attract prey such as small mammals, which in turn attract predators such as red-tailed hawks, screech owls, and milk snakes. These structures also provide roosting, perching, and sometimes nesting sites for many bird species such as crows, blue jays, woodpeckers, cedar waxwings, brown thrashers, barn swallows, song sparrows, robins, catbirds, and goldfinches.

Pasture, hayfields, and fallow fields
Pastures, hayfields, and fallow fields are sometimes referred to as cultural grasslands. They differ from native grasslands because these sites are in production and a forage crop is removed annually. However, since their structure and food sources are similar to native grasslands, such as tallgrass prairie, they often attract the same wildlife species. Both hayfields and pasture receive a minimal amount of herbicides and fertilizers.

Hayfields are fields planted and managed specifically for hay production. They are typically harvested 1-3 times per year. Hayfields are usually planted to cool season grasses (orchard grass, red top, timothy, bromegrass, bluegrass) and/or legumes (alfalfa, red clover, sweet clover, bird's foot trefoil). Some hayfields are being planted to warm season grasses such as switch grass, big bluestem, Indian grass, and little bluestem. Hayfields may be a part of crop rotation where the site is in crop production for several years followed by 5-7 years of forage production and then returned to crop production. Hayfields typically support 7-11 different nesting bird species and a total of up to 386 birds per 100 acres, or about 4 times the number found in row crops. Hayfields provide nesting habitat for American kestrel, killdeer, E. kingbird, E. bluebird, vesper sparrow, savanna sparrow, Henslow's sparrow, chipping sparrow, field sparrow, grasshopper sparrow, bobolink, red-winged blackbird, E. meadowlark, horned lark, ring necked pheasant, northern bobwhite, blue winged teal, mallard, and song sparrow. *Bird species found in hayfields but not found in pastures are horned lark, chipping sparrow, field sparrow, and grasshopper sparrow*. **Why?**

Hayfields also provide food, cover, and/or nesting sites for a number of small mammals: eastern mole, meadow vole, starnose mole, least weasel, long tailed weasel, coyote, white footed mouse, masked shrew, least shrew, badger, woodchuck, skunk, ground squirrel, chipmunk. White-tailed deer use hayfields for browse, and resting and bedding sites. Does frequently place their fawns along the wooded edges of hayfields where the fawns remain hidden while their mothers feed. Red fox will use hayfields for hunting small mammals. *Insects – crickets, spiders, grasshoppers, leaf hoppers, ants, beetles, butterflies, moths, flies, wasps?*

Hayfields cropped 2-3 times per year and with the first cutting taking place early in June usually have a significant negative impact on grassland ground nesting birds. Since most grassland nesting birds initiate nesting in May, early June harvest often destroys nests as well as breeding females. Nests not directly destroyed during harvest are very vulnerable to predation since the majority of cover has been removed. The best management practice for wildlife is to limit harvests to once or twice per year after early June.

Pasture is similar to hayfields since they are also often planted to grasses and/or legumes. The difference is the method of crop removal. Pasture is removed by allowing livestock to browse the vegetation out in

the field. These fields can be lightly, moderately, or heavily pastured. This is typically dependent on the duration livestock remain in the field. These sites can have 30-50 percent vegetation removal over a period of several months or can have 80-100 percent removal with livestock never removed from the site. Moderately grazed sites that are part of a rotation typically provide better habitat than continuous pasturing of livestock. Pastures provide habitat for many of the same species as hayfields. Similar to hayfields, pastures typically support 7-11 different nesting bird species and a total of up to 386 birds per 100 acres, or about 4 times the number found in row crops. Species found in pastures but not in hayfields are tree swallow and barn swallow.

Fallow fields are fields that have been removed from agricultural production, but have been plowed with in the last 3 years. These fields have many areas of bare soil and are typically composed of non-native grasses and forbs. The amount of bare soil is highest the 2 years after the fallow fields are removed from crop production. Perennial grasses are forbs are more common in 3 year old fields. These early successional cover types are quite common in the study area. The first 2 years the field is composed of ragweed, mares tail, quack grass, lambs quarter, and foxtail. By the third year the site is often composed of brome grass, goldenrod, spotted knapweed, and daisy fleabane. Fallow fields provide good nesting habitat for mallard, ring necked pheasant, northern bobwhite quail, killdeer, mourning dove, dickcissel, common yellowthroat, song sparrow, bobolink, and cotton-tail rabbit. Red tailed hawk, kestrel, barn swallow, kingbird, common grackle, cotton-tailed rabbit, and white-tailed deer are commonly found foraging in these fields.

Stresses/Threats
Conversion to urban or rural residential development
Increased global agricultural supply – decreased profits
Decreased demand for products
Fewer local processing plants and storage facilities (agricultural infrastructure)
Pest and disease outbreaks
Increased costs of equipment, labor, irrigation, chemicals and other supplies (increased interest rates)
Decreased government subsidies for agricultural commodities
Poor crop production – poor weather conditions

Specific threats to hayfields, pasture, fallow fields
Conversion to cropland
Succession to brushland or forest

Sources of Stress
Desire to live away from urban areas (countryside)
Price fluctuation of subsidies and/or agricultural commodities
Desire to see forestland rather than grassland or old field

Management Recommendations
Strategies to increase nesting grassland birds
Eliminate or reduce the use of insecticides – valuable insect food for birds
Delay mowing of hayfields until late July or early August to avoid high fledgling and nest mortality
Use rotational grazing practices
Increase amount and duration of fallow fields
Increase crop residue – conservation tillage, no-till plowing, or no fall plowing

Prime agricultural lands
NRCS maps, MSU-E

Soils maps of study area - Macomb and St. Clair Co.

Ownership/Protection Status

Information Gaps

Opportunities

Developed Land

Introduction

Developed lands are defined as non-agricultural lands where the landscape has been altered for human use. Because developed lands are quite diverse and very dynamic in nature, there are many different ways to categorize developed lands depending on your perspective and purpose. A Common method to describe developed lands is by unit density, either high, moderate, or low density, or urban, suburban, exurban, and rural. Some researchers have even chosen to define developed lands by focusing on a variety of different characteristics of the landscape such as: density, distribution, etc. One of the most popular ways is to categorize developed lands by their dominant use such as industrial (landfill), commercial, residential, institutional, recreational (managed wetlands?), transportation, communication, and utilities, and barren and extractive categories. The focus of this chapter is to describe the different types of developed lands and their impacts on wildlife, wildlife habitat, natural communities, water quality, water quantity, and instream and lake habitat. This chapter is fundamentally different from other chapters because it focuses on threats *caused by* developed land rather than threats *to* developed lands.

Historic Condition

Because water was the only way to access this area, the Islands in lake St. Clair were the first places settled by the Europeans. Jacob Harsen, a Hollander from New York, settled Harsen's Island in 1769 because he was attracted to the abundance of wild game on the island. A few years later, Captain John Laughton settled Dickinson Island, and in 1784 the Island was divided into 4 farms. The St. Clair Flats area was later discovered by Detroiters as a haven for waterfowl hunting, and once the South channel was dredged and widened in 1857 the St. Clair flats soon became known as 'Little Venice' because of the numerous canals, channels, and stilt structures. A total of 5 hunt clubs and 10 resort hotels were located on Harsen's Island during the late 1800's and early 1900's.

In 1833 the Fort Gratiot turnpike was completed connecting Detroit to Ft. Gratiot, which is located in present day Port Huron. The turnpike was located inland and is presently called highway 25. The city of Algonac, settled in 1836, was the first town established in the region, and St. Clair, located at the mouth of the Pine River, was later established in 1858. Marine City, located at the mouth of the Belle River, was established as a village in 1865, and New Baltimore was incorporated in 1867. Marine City, Algonac, and St. Clair all prospered as a result of salt and lumber production. In 1859, the North America railroad from Detroit to Port Huron, which nearly paralleled the Gratiot turnpike, was completed, and in 1900, an electric railway was built connecting Detroit, New Baltimore, Algonac, Marine City, St. Clair, and Port Huron. Docks along the road at Pointe Tremble, Pearl Beach, and Algonac took passengers to the various Islands. Soon afterwards in the early 1900's, M-29 was built which essentially paralleled the railroad. As a result of these transportation improvements, urbanization more than doubled between 1900 and 1930, and the entire lake and river shore from New Baltimore to Marine City was populated by summer residents.

It wasn't until the 1880's, after the timber disappeared, that attention was given over to more agricultural pursuits. As it turned out, St. Clair County had very diverse, productive soils suitable to many types of agricultural crops. The sandy soils were used to grow potatoes and fruits, while the heavy soils were used to grow wheat, grains, hay, and oats. Later farmers grew dry beans, sugar beets, and alfalfa. Very little livestock farming occurred until the early 1900's. As agriculture became more prominent, small agricultural towns, such as Richmond and New Haven, developed along the major transportation routes in the interior. Today, an old grist mill still exists at Wetzel State Park along Coon Creek as a reminder of agriculture's past in Macomb County.

Present Condition
There are a total of 14 townships and 11 cities within the project area. Based on 1995 data from SEMCOG, 21.3% of the total land in the study area is developed. 17.6% of the Macomb County portion is developed, and the vast majority (75.4%) of developed land is single family residential. 13% of the St. Clair County portion is developed, and the vast majority (76.3%) of this is single family residential. **What is the size class of these cities? It appears that the majority of these cities are small is size (<1,000 pop?).**

Descriptions (create a table – percentage/desc./size/structure/biotic/other?)

Single family residential (75.4% of developed land in Macomb; 76.3% of developed land in St. Clair; 75.6% of developed land in project area)
Parcel of land with detached dwelling units that people domicile. Highly variable. Parcels range from 1/16 acre to 40 acres in size. Common built structures associated with single family residential include driveway, sidewalk, garage, shed, and pole barn. Biotic components typically include a lawn, garden, and horticultural shrubs, trees, and forbs. On rural residential parcels, old fields, upland shrub, woodlots, artificial ponds, and small wetland depressions may be found on the property.

Multiple family residential (2.9%; 0.4%; 2.3 %)
Parcel of land with attached dwelling units that people domicile. Includes attached condominiums, townhouses, and apartment buildings. Parcels are very large and are often highly altered. Large area designated for parking. Often includes lawns, parklands, playgrounds, and sidewalks.

Commercial and office space (3.4%; 2.2%; 3.1%)
Areas that are designated as being facilities developed with the intent of providing goods and services at the retail level, and to provide office working environments for people. Includes shopping centers, gas stations, strip malls, single story businesses, and multi-story offices. Very large areas are designated for parking (average size?). Typically have a very small percentage of land set aside for open space.

Recreational (?)
Land desiginated for passive and active recreational activities. Includes playing fields for softball, soccer, football, baseball; courts for tennis and basketball; large areas of open space intensively managed for human use such as golf courses and public parks; and areas consisting primarily of natural features with trials for hiking, walking, bike riding, or rollerblading.

Institutional (4.0%; 2.0%; 3.5%)
Sites set aside for educational, civil, and medical purposes. Includes schools, universities, community college, post office, library, courthouses, police station, fire station, state offices, state capitol, legislative offices, etc. highly variable.

Industrial (6.5%; 8.2%; 6.9%)
Sites that generate the production and manufacture of goods, such as automobiles, automobile parts, electrical energy, appliances, etc. These sites can vary widely in size from a small stamping plant to a large automotive plant. This would also include warehouse areas, ie new car storage sites, lumberyards, fuel tank storage areas, and energy plants (coal, nuclear, incinerator, etc). These sites consist of primarily impervious surfaces, buildings, large parking lots and roads, with little consideration given to soft landscaping.

Transportation, communication, and utilities (7.9%; 8.1%; 7.9%)

Areas that include road surfaces, right-of-ways, utility corridors (power and telephone lines), i.e., gas/ water/sewage lines, and communications facilities which would include communication towers and poles. Although still a small percentage of developed land, represents second largest type of developed land in project area.

Barren and extractive (0.03%; 2.7%; .7%)
Areas that are usually open-minded for sand, gravel, minerals, or abandoned mining sites. Sites contain roads, driveways, parking lots, loading zones, spoils, exposed subsurface sediments, mined areas that have become vegetated by pioneer plant species, and unmined vegetated areas. Mined areas may also contain open water if below the water table. Barren and extractive lands are a very minor component of the study area.

Impacts on Natural Features

Hydrology
Water pollution degrades ecosystems, poses health hazards, and impairs our use of water resources. Non-point source water pollution is now the nation's leading threat to water quality, affecting nearly 40% of our nation's rivers, lakes, and estuaries (288). Non point source pollution is contaminated water that runs off from wide spread surfaces into surface waters or into groundwater. Typical sources include agriculture, urban runoff, logging operations, large hydro-engineering projects, and construction sites. More than 60 toxic pollutants originate from urban areas (296). Research has shown that as impervious surfaces, such as rooftops, paved surfaces, and compacted soils, increase in the watershed, water quality decreases. As impervious surface increases in the watershed, velocity and volume of surface water increases, flooding, erosion and pollutant loads increase, stream beds and flows are altered, aquatic habitat is impaired, and ground water recharge and the water table is decreased. In addition, paved surfaces can cause thermal pollution during hot weather. Paved surfaces can reach temperatures greater than 120 degrees Fahrenheit, which increases the temperature of water flowing over them, and eventually the stream temperature.

According to the research, stream degradation starts to occur when impervious cover exceeds 10% of the watershed, or when the density is greater then 1 unit/acre (298). Brown trout may disappear altogether at 10-12% impervious cover, and at greater than 30% impervious cover, the watershed is considered generally degraded. Residential lots have 10-20% impervious cover; smaller lot subdivisions and multifamily housing have 40-60% impervious cover, and industrial, commercial, and shopping center development have 75-95% impervious cover. Concentrations of pollutants (chloride, petroleum products, nitrates, phosphorus, sediments, pesticides) are highest in transportation runoff, and pollutant loads increase with traffic volume. Roads, parking lots, driveways, and side walks typically constitute 60-70% of total impervious cover in the watershed (310).

In comparison, runoff from residential areas have been estimated at up to 10 times that of pre-development condition, and runoff from commercial development at 18 times that of pre-development condition. Commercial parking lots are undoubtedly one of the biggest contributors to impervious surface in urban/suburban areas (313). One inch of rainfall on a 1 acre meadow produces 218 cubic feet of runoff, while 1 inch of rainfall on a 1 acre parking lot produces 3, 450 cubic feet of runoff.

Water supply is also impacted by development. Watering private lawns and gardens consumes the largest portion of water in an urban area. As a result, low density suburbs, which typically have large lawns and gardens, use up to 4-5 times more water compared to medium density suburbs.

Biological Impacts

The Nature Conservancy reports that the leading cause of plant and animal imperilment in the United States is habitat degradation and destruction. In addition to outright habitat destruction, habitat fragmentation disrupts migration and breeding patterns and displaces area sensitive species. Scattered developed land leaves only smaller more isolated patches suited to more generalist species. A matrix of pavement interwoven with small patches of intensively managed lawns and gardens attract generalist, and edge species such as birds = cardinal, mallard, Canadian goose, house sparrow, crow, grackle, starling, bluejay, robin, mourning dove, and pigeon, mammals = red squirrel, fox squirrel, gray squirrel, raccoon, opossum, white-tailed deer, house mouse, and cotton-tailed rabbit. Each year, thousands of birds are killed during spring and fall migration as a result of flying into tall buildings, cell towers, and guy wires **(any documentation? Ask Jenn Olson)** particularly those located along major migration flyways.

As the environment becomes more and more altered due to intensive human activities, there is a decrease in the abundance and diversity of native plants and animals and an increase in non-native invasive plants. The decreased diversity of native plants and animals is primarily due to habitat destruction and alteration, invasive species, and use of insecticides and herbicides to maintain monocultures of kentucky bluegrass or fescue lawns, and weed free flower and vegetable gardens. Native plants and invertebrates are literally pushed out to the margins, which themselves are becoming increasingly shorter, narrower, and more isolated.

In addition, invasive plant species such as purple loosestrife and spotted knapweed quickly establish themselves in disturbed and altered environments such as construction sites, abandoned and dilapidated lots, areas with altered hydrology, water quality, and soils, and along pathways such as roads, and trails. Because of the high disturbance level associated with developed lands most if not all developed lands contain some amount of invasive and/or exotic plant species. Some of the more common invasive species found in SE MI include: tartarian honey suckle, black locust, glossy buckthorn, Norway maple, oriental bittersweet, spotted knapweed, yellow sweet clover, white clover, garlic mustard, dames rocket, English plantain, Kentucky bluegrass, bull thistle, Russian olive, burdock, common St. John's wort, timothy, quackgrass, and bromegrass (*refer to Ann Arbor plant list for SE MI*).

Invasive species are problematic because they displace native species and can create imbalance in the ecosystem. Often times they are very aggressive or invasive, and once established can be very difficult to eliminate from the site. Although there is merit for plants of any type to colonize highly disturbed urban areas for wildlife habitat, once they become established invasive plants can negatively impact nearby natural areas.

Climate/atmospheric

Developed lands may have a major impact on the micro-climate at the city block or even metropolitan scale. Large buildings can deflect wind upwards or funnel it through a street or alleyway. Surrounding pavement can absorb heat and reflect it upwards creating a heat island. Temperatures can increase x degrees compared to the surrounding open lands outside of the urban area. Cities also create a lot of noise pollution and can be up to x decibels louder compared to the surrounding open space. One of the most obvious impacts of developed lands is on air quality. Industrial lands in particular contribute heavily to air pollution – nitrous oxide, carbon dioxide, carbon monoxide, mercury, ozone, etc. High and congested automobile traffic also increases air pollution (carbon monoxide, ozone). Large amounts of certain air pollutants such as nitrous oxide and sulfur dioxide can cause smog and/or acid rain.

Management Recommendations
Minimize lawn areas, increase use of native vegetation, restoration

Information Gaps
current level of air quality in project area
current level of water quality
build out analysis by township
impervious surface (current and projected)

Opportunities
Site design (guidelines), ordinances, master landuse plan, education, greenway planning, etc.

Old field, wet meadow, and shrub upland

Intro

In many ways this chapter is a follow up to the chapter on agriculture. Old fields, wet meadows, and shrub uplands are all early successional systems dominated by sun loving plants. In the project area, each of these communities is essentially a transition between agricultural lands and forest lands. All three of these communities are the result of human alterations to the landscape. Old fields succeed from fallow farm fields, upland shrubs succeed from old fields, and wet meadows, which were not documented in the project area in the early 1800's, seem to emerge when a drainage system fails and the field is abandoned.

Historic Condition

Historically, the only native grassland that occurred in the project area was lakeplain prairie which is actually more of a wetland community and is discussed on another chapter. In 1978, grasslands, which included both native and non-native grasslands (based on the MIRIS classification) totaled 31,800 acres (10 %), and shrub uplands totalled 18,900 acres (6 %) in the project area.

Current Condition

Acreage (can't differentiate between hayfields, old fields, and wet meadows). ***Look at both 1978 and ifmap 2000 data.***

Overall, grasslands appear to be scattered throughout the project area. The only area where there is relatively few grasslands is northern Macomb County (Armada, Richmond Townships). Concentrations of grasslands occur in 1) Chesterfield and Lenox Townships (area between M-19 and shoreline) in Macomb County, 2) North Branch of Clinton River in Macomb, Ray, and Lenox Townships of Macomb County, 3) northern portion of Harsen's Island, 4) and both Clay and St. Clair Townships in St. Clair County.

Old field

Old field, sometimes referred to as an idle field, is a transitional stage between a fallow field and a shrub upland. It is always the direct result of human alteration to the landscape. Old fields are defined as former cropland or hayfields that have been out of agricultural production more than 3 years. Biennial and Perennial grasses and forbs dominate the flora. Perennials include goldenrods, asters, milkweeds, wild carrot, chickory, spotted knapweed, daisy fleabane, and common white clover. Biennials include sweet clover, common mullien, curly dock, wild mustard, sheperd's purse, black mustard, foxglove, and various thistles. Non-native grasses, which are often times the dominant plants in old fields, include bromegrass, quackgrass, timothy, and orchard grass. Because old fields consist of annuals, perennial forbs and grasses, and scattered shrubs and small trees they can be quite diverse. An old field may contain up to 150 different species of plants.

Old fields provide nesting cover for mallards, blue winged teal, northern harrier, northern bobwhite, ringnecked pheasant, eastern bluebird, vesper sparrow, and song sparrow. Mammals found in old fields include: white footed mouse, cotton-tail rabbit, skunk, white-tailed deer, and red fox. Red tailed hawks, barn swallows and short-eared owls forage in old fields. The most common bird species are red-winged blackbird, field sparrow, and song sparrow. Other birds include meadowlark, brown thrasher, bobolink, American goldfinch, vesper sparrow, and savannah sparrow. As shrubs and young trees invade the perennials, old fields provide habitat for deer, opossum, raccoon, and songbirds such as cardinal, gray catbird, and junco. Old fields also provide valuable habitat for ring necked pheasant and bob white quail. *Abundance of butterflies and grasshoppers?*

Without mowing or chemical manipulations these sites will often succeed to shrub uplands or early successional forest in 5-10 years.

Shrub Upland
Shrub upland is a highly transitional seral stage between old field and young forest. As old fields mature, shrubs and young trees become the most dominant plant type in the community. Shrubs can invade an old field relatively easily compared to a wet meadow, because of the abundance of bare soil. Once shrubs are established, they can quickly spread through stolons and tipping (layering), as well as by birds and mammals. Common shrub and tree species include sumac, common buckthorn, high bush cranberry, autumn olive, Russian olive, hawthorn, crabapple, gray dogwood, quacking aspen, blackberry, red raspberry, northern dewberry, oaks, and red maple. The shrub uplands are dominated by forest edge bird species. The most common bird species are rufous-sided towhee, blue winged warbler, yellow warbler, and gray catbird. Other species found here include black-billed cuckoo, northern cardinal, field sparrow, and song sparrow.

Wet Meadow
Wet meadows are seasonally flooded or saturated areas that typically hold water only from late fall to late spring. They receive hydrologic inputs from above ground and from ground water. Unlike the native wet meadows found along streams and lakes, however, wet meadows in the project area are the result of land conversion. Historically, wet meadows in the project area were probably lowland forests and emergent marshes adjacent to productive agricultural lands that were converted to hayfields and pasture by farmers. These wetlands were usually drained through draintile and/or ditches. Most of these areas, however were unproductive and have been abandoned. In many cases old drainage systems are failing and wet meadow is returning to the landscape. A similar community type found in the project area is lakeplain prairie. Lakeplain prairies, however are dominated by native prairie species and are covered in the Great Lakes coastal complex chapter.

Wet meadow is typically dominated by reed canary grass (*Phalaris arundinacea*), which was planted liberally in the 1940's and 50's by farmers for pastures and hayfields. Other plants found in wet meadows include sedges, rushes, joe pye weed, boneset, bluejoint grass, red-top grass, Ohio goldenrod, and marsh aster. Hydrology and fire help maintain wet meadows not in active agricultural use. Both of these disturbances favor herbaceous plants over woody plants. Another factor is the vegetation density. Established wet meadows develop a very thick layer of sod that can be impenetrable to invading plants such as trees and shrubs. Without some kind of disturbance however, native wet meadows will typically succeed to shrub-carr and eventually wet deciduous forest.

Stresses and threats
Conversion to development (urban, rural residential)
Fragmentation from development
Conversion to agriculture
Ecological succession to forestland

Sources
Economics
Desire to see forestland rather than grassland
Desire to live away from urban areas
Increased or decreased price and/or subsidies or agricultural commodities

Ownership/Protection Status
Farmbill acreage

Management Recommendations
To maintain these systems……..
The most effective management of these systems is to allow them to naturally succeed to a more forested condition. Drain tile could be broken in wet meadows to allow them to revert to a more natural condition (emergent marsh and lowland forest).

Information gaps

Opportunities

Appendix D: Socio-economic Assessment

Northern Maumee Lakeplain Ecosystem Project

Socio-economic Data for Counties and townships

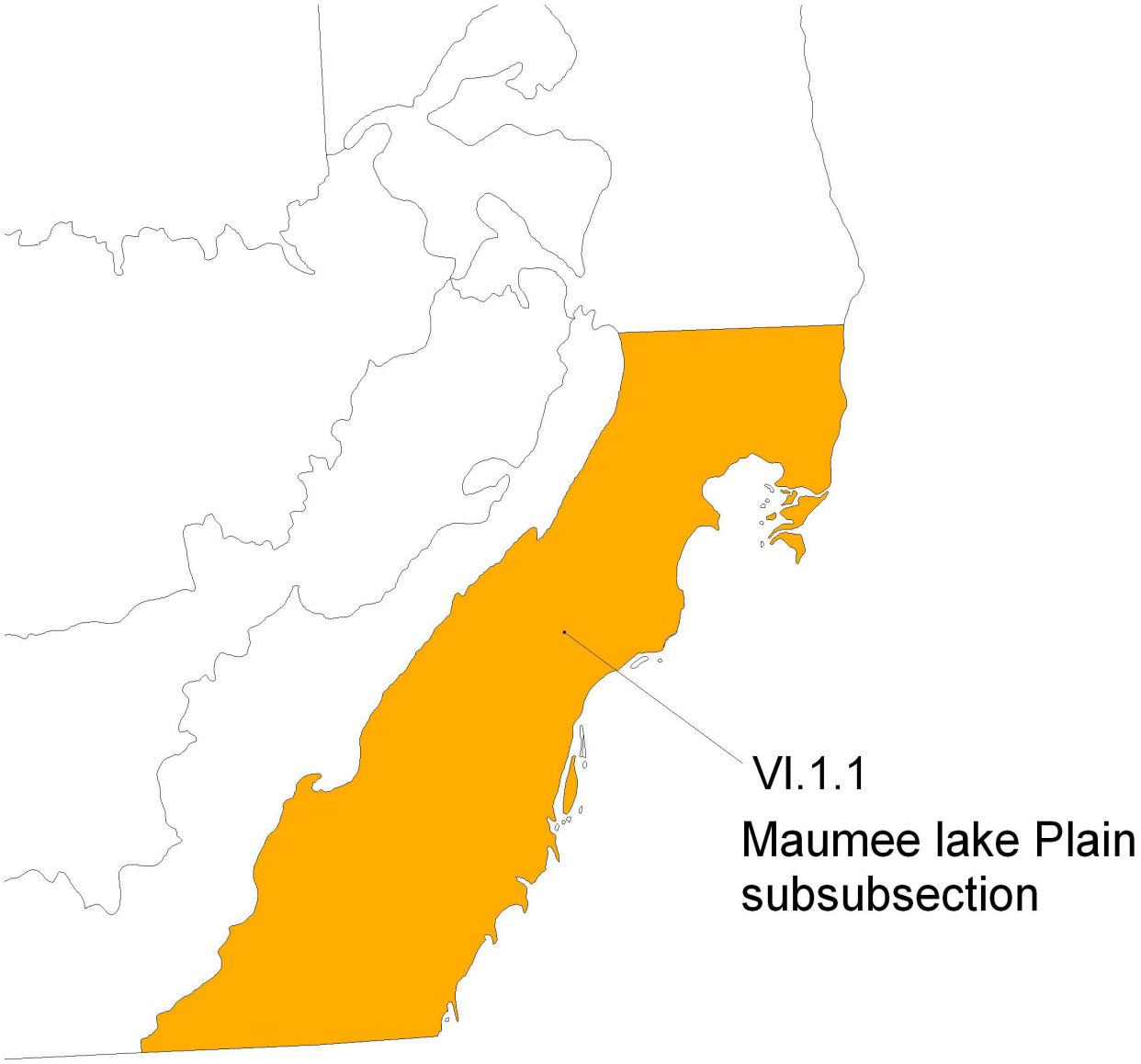
Population Characteristics
Population numbers; % change 1960 - 2000
Population; urban, rural, farm
Number of households; %change 1960 - 2000
Age structure; below 18, median age, above 65, 1960-2000
Ethnicity: % change 1960-2000

Economy and Employment
Employment and earnings by industry (most recent)
Employment by industry; 1960-2000
1990 income; per capita, median household, median family
1989 poverty status; all ages, families with related children, persons $\geq$ 65
Unemployment rate; 1960 – 2000
% of labor force working outside of county
What % of income comes from outside the community (social security, pension)?
Which sectors have had the highest gains/losses in employment over the last 20 years?
What employment trends are projected for the next 20 years?
What is the fiscal condition of local governments?
Where are the fiscal resources of local governments?

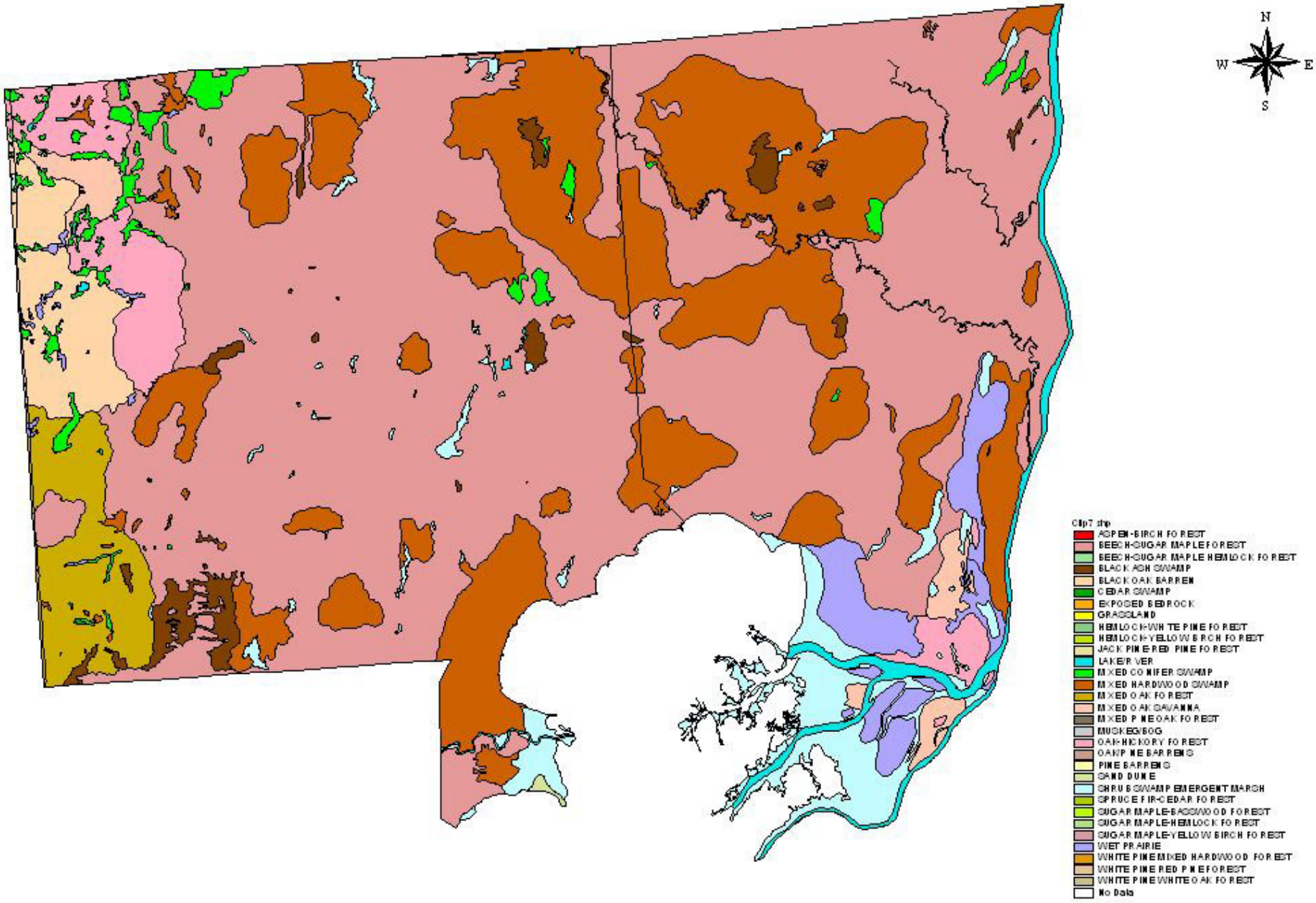
Land Use
Total # of farms (county): 1945-1997
Total acres of land in farms (county): 1945-1997
Summary of PA 116 lands
Total number of housing units; % change 1960-2000
Seasonal housing units 1960-2000; % change
Median value of owner occupied housing units
Single family residence and total building permits (1990-present)
Average parcel size: 1960- 2000
Utilities
Current land cover (% of major land cover types)
Travel time to work
Summary of factors responsible for development trends (highways, road improvements, sewer/water lines, power lines)
What are the current land use/zoning strategies of each township (growth vs. no growth)

Agricultural trends
Average age of farmers
Risk of farmland conversion
Agricultural sales
Crops grown in area
Rank of counties; crop, livestock
Market prices for crops (1984-present)
Cost of production

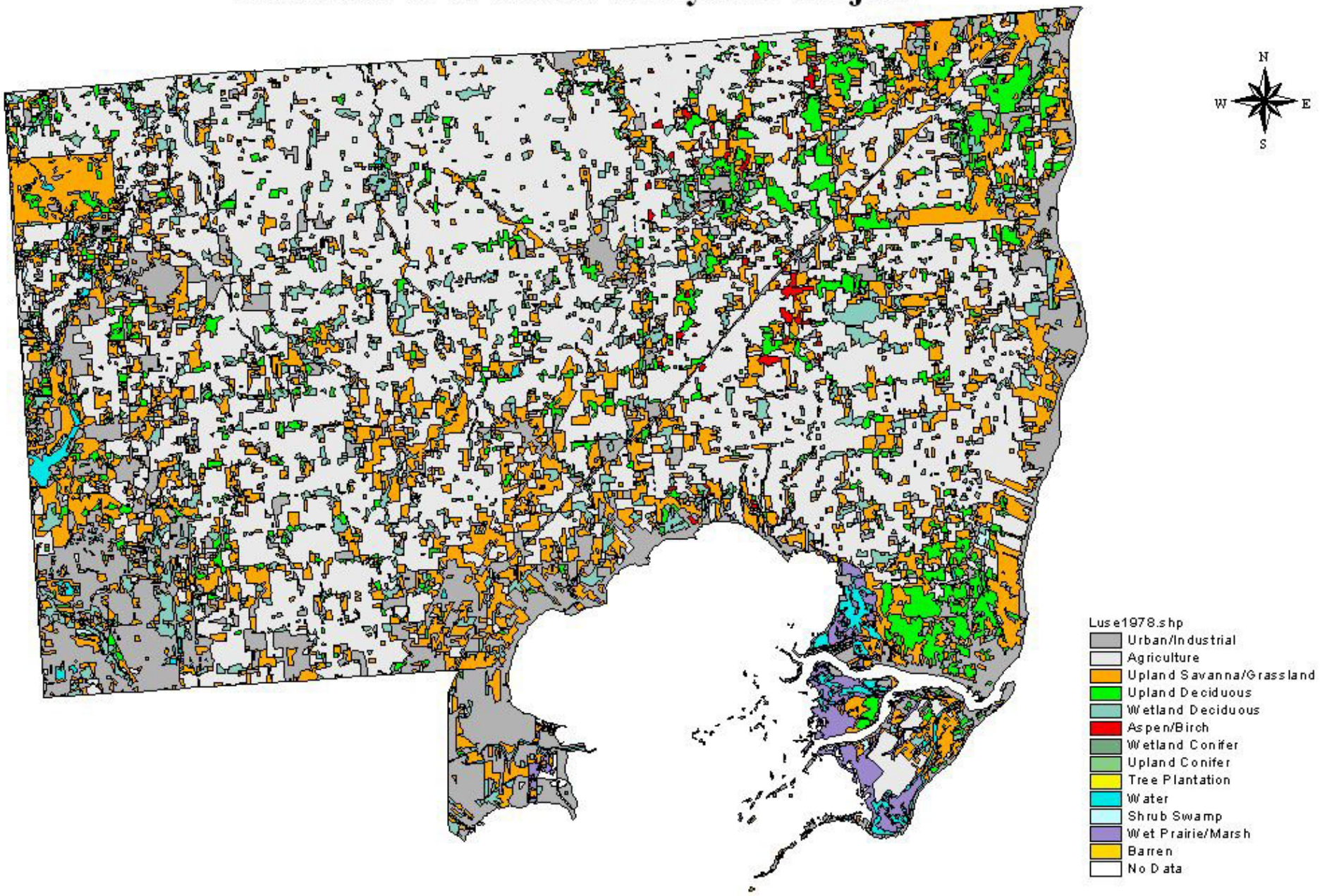
Appendix E: Maps

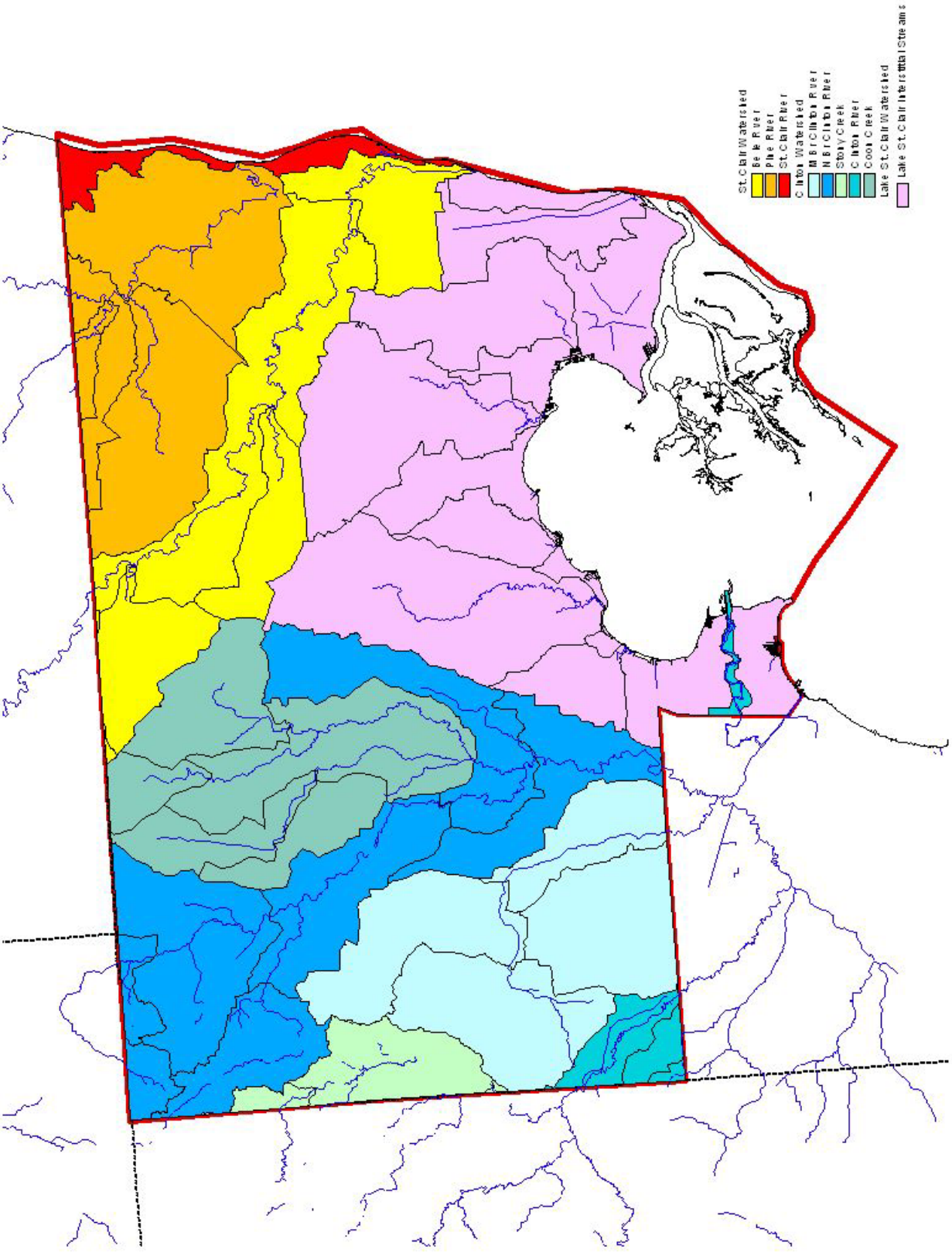

VI.1.1
Maumee lake Plain
subsubsection

Circa 1800- SEMI-Ecosystem Project

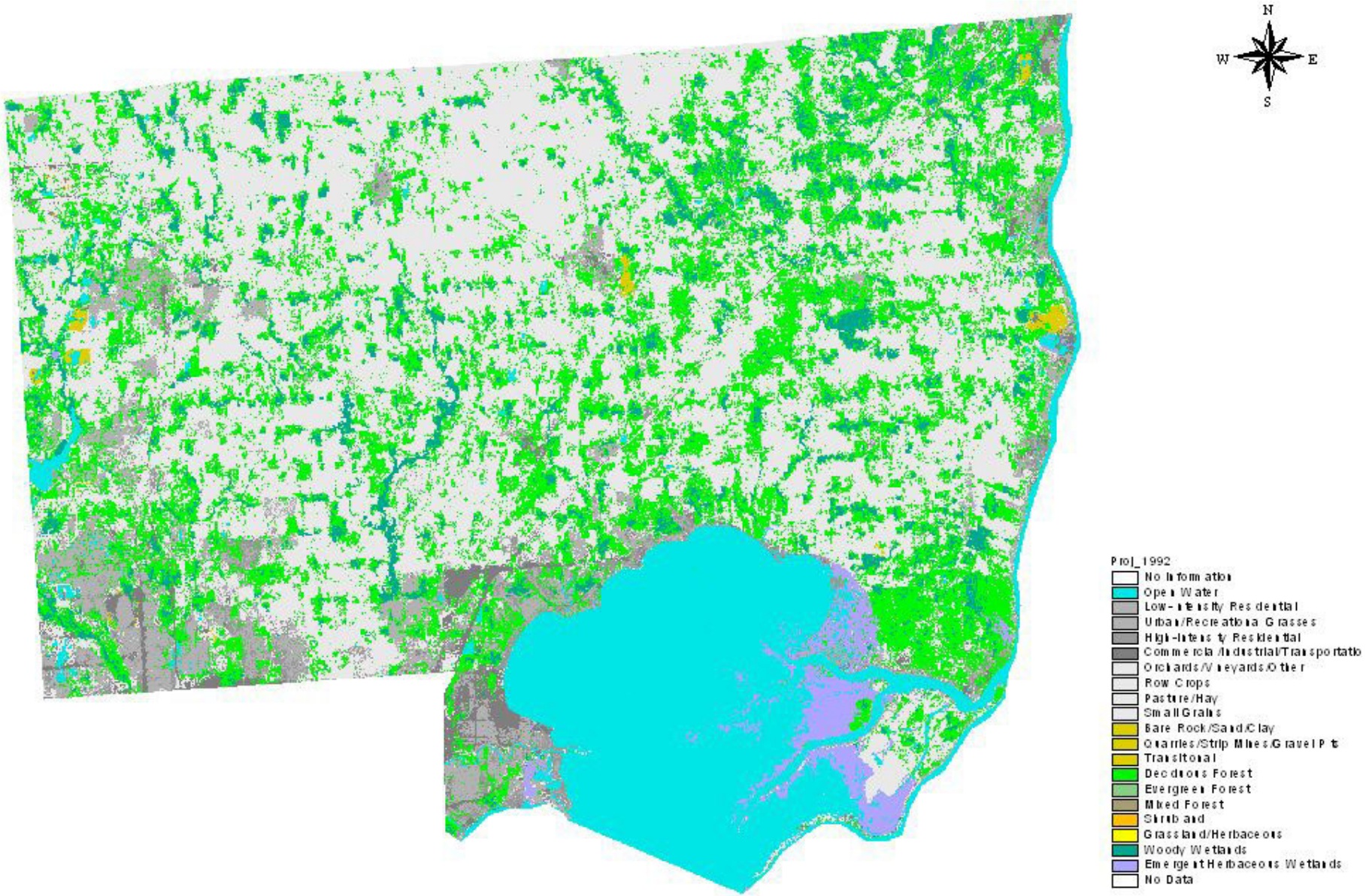


Land Use 1978 SEMI-Ecosystem Project




St.Clair Watershed
Bear River
Pine River
St.Clair River
Chilton Watershed
MBr Chilton River
NBr Chilton River
Story Creek
Chilton River
Cook Creek
Lake St.Clair Watershed

1992 landcover-- SEMI-Ecosystem Project



Wetlands SEMI-Ecosystem Project