Institute for Wetland Science and Public Policy of the Association of State Wetland Managers

A Guide for Local Governments

DISCLAIMER

The views expressed herein are those of the author and do not necessarily reflect those of The McKnight Foundation, the U.S. Environmental Protection Agency, the National Park Service, the USDA Natural Resources Conservation Service or other cooperating organizations.

PREFACE

This guidebook has been written to help local governments simultaneously achieve water resources management, water-related ecosystem protection and land use management goals. It has been written for engineers, biologists, planners, staff of environmental nonprofit organizations, landowners, legislators and others interested in developing integrated community resource management programs and reducing community water-related conflicts. It has been written to help local governments achieve "smart growth" and attain "sustainable" communities by

ACKNOWLEDGEMENTS

Principal funding support for this guidebook was provided by the McKnight Foundation. The U.S. Environmental Protection Agency, Wetlands Division and the National Park Service Rivers and Trails Program also provided support. All of this support is gratefully acknowledged.

The help and guidance of Dan Ray of the McKnight Foundation,

OTHER GUIDANCE MATERIALS

Other Priority Reading

We suggest another group of priority readings. See the bibliography of this report for a broader list.

- *Association of State Floodplain Managers. 1997. Using Multi-Objective Management to Reduce Flood Losses In Your Watershed.. Association of State Floodplain Managers, Madison, WI.*
- *Crane, S. (ed.) 1995. Wetland Conservation: Tools for State and Local Action. World Wildlife Fund, Washington, D.C.*
- *Carter, J.G. (l989). A Citizen's Guide to Protecting Wx*

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"To be effective, the nation's wetlands protection and management programs must anticipate rather than react. They should focus on the future, not the present or the past; on effectively protecting the remaining resources and actively restoring or creating additional wetlands. They should anticipate needs and problems on the basis of rigorous analyses of regional resources, trends, stresses, and values. They should consider the whole, not just the individual parts."

— The Conservation Foundation, Protecting America's Wetlands: An Action Agenda. The Final Report of the National Wetlands Policy Forum (1988).

"...(W)etlands management should be integrated with other resource management programs such as flood control, allocation of water supply, protection of fish and wildlife, and stormwater and nonpoint source pollution control."

— National Governors Association, Water Resources Policy Statement, February 1992.

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CHAPTER 1: WETLANDS AND WATERSHED MANAGEMENT: THE CONCEPT

THE NEED FOR INTEGRATED APPROACHES

"Historically, this nation has approached water resources as isolated and categorical, with prog

"watershed planning" and management programs. Programs for specific areas have also been described as "greenway," "environmental corridor," "wetlands and watershed management" and "floodplain management."

The goal of these efforts is much the same — to plan and guide future growth and development consistent with environmental, historic, and other functions and values. Wetlands, riparian areas, floodplains, and related aquatic ecosystems (lakes, streams, coastal waters) provide a wide range of natural functions and values.

Box 1

Wetland, Riparian Area, Floodplain Functions and Values

- **Flood storage**
- **Flood conveyance**
- **Wave retardation**
- **Erosion control**
- **Natural crops and timber**
- **Pollution control**
- **Fish and shellfish habitat**
- **Waterfowl and other bird habitat**
- **Endangered species habitat**
- **Ground water recharge**
- **Micro-climate modification**
- **Recreation and ecotourism**
- **Historical, archaelogical**
- **Aesthetic**
- **Education and research**

See Appendices F and G for mo

Similarly, efforts to protect and restore wetlands and related ecosystems have been separated into wetland, public waters, lake protection, coastal zone management, river management, floodplain management, “critical area” and other types of programs. These efforts have also focused on a specific type of area or issue (e.g., fisheries) and have been staffed by individuals with a disparate expertise and interest. These programs have tended to concentrate on a single goal, or limited goals, for a particular component of the broader ecosystem.

For each of these types of programs, separate bureaucracies have partnered with different political “clients,” such as agricultural interests, developers, fishermen and duck hunters.

Fragmentation, conflicts, and lack of coordination among programs was less a problem as long as communities had an abundance of open land and water resources, ample tax revenues and federal or state grants-in-aid for separate treatment of flood control, waster disposal, stormwater management, acquisition of recreation and open spaces and other purposes. Single purpose programs could be independently pursued, despite the lack of cost

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Box 4
Some Wetland Facts

- **Of the 215 million acres of original**

But, community integration of water resources and ecosystem programs is still quite rare. Most of the nation's waters and wetlands continue to be managed on a fragmented, program-by-program basis. There is limited coordination between water quality, flood loss reduction, source water and ecosystem protection and management programs.

In recent years wetland, riparian area, stream and floodplain restoration has emerged as a key component in local wetlands and watershed management programs. Wetland restoration, creation and enhancement provides opportunities for solving existing water quality, erosion, habitat, fisheries and other water resources proj10.98 08(e)Tj10.98 0 0 914.35684 527.46191 Tm(.98 Tm(nagement)Tj0.0007.

protect and restore lakes, rivers, streams, drainageways and their associated wetland, riparian, and floodplains while, simultaneously, achieving broader water resource management and land management goals. The protection and restoration of water and water-related land corridors simultaneously serves a broad range of water resources and ecosystem management goals.

Wetlands and watershed management requires going back to basics: What are community water and ecosystem management goals? What are the water-related problems? Where is the water in the community coming from and going? What paths does it take? What role does the wetland related ecosystem play in achieving water management goals? What is the community's vision for the future and how can it achieve this vision?

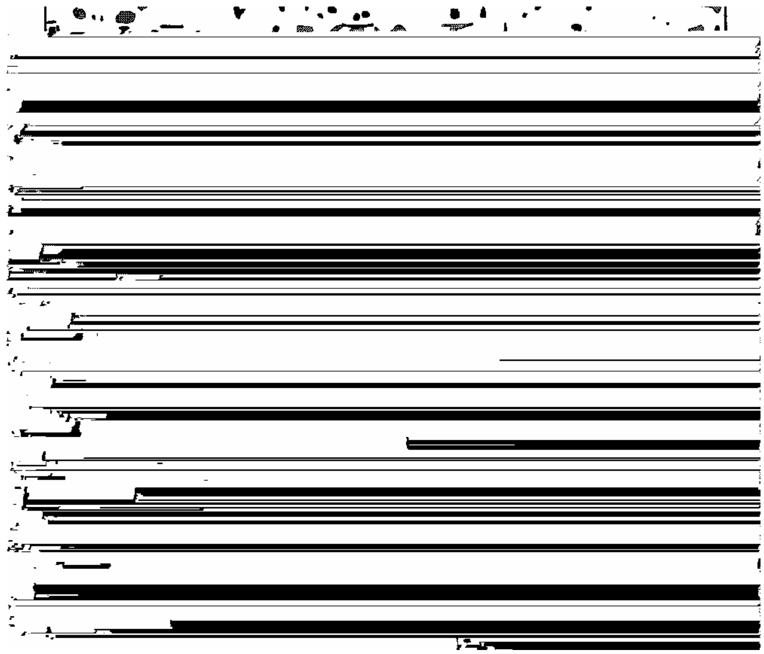
Efforts to integrate water resources management and ecosystem management are not new. Partial integration of watershed and ecosystem management has already been applied in hundreds of local watershed planning, ecosystem planning and land use planning and management efforts from cities as widespread as Boston, Milwaukee, Baltimore, Washington, D.C., Atlanta, Denver, San Francisco, Portland, and Seattle. There is considerable experience to draw upon to guide future efforts.

CHALLENGES

However, bringing together people and groups with different needs and perspectives is not easy. Gathering the information needed to meet a broad range of water and ecosystem management objectives can be complicated and costly.

At all levels of government improved databases, technological and scientific advances in water resources, and aquatic ecosystem assessment and analysis such as watershed hydrologic models and wetland assessment models can help. But, technological advances are a double-edged sword. On the one hand, advances allow more accurate information gathering and analysis for integrated management of water resources and aquatic ecosystems. Computerized mathematical models, such as geoinformation systems, can be used to determine runoff, flood levels, sediment regimes and manya

Figure 1
Wetlands Within Central Sheridan County, North Dakota



THE NEED FOR TAILORING

Successful wetlands and watershed management, therefore, requires innovation and sensitivity to local conditions. The content of a program must depend upon specific .98 0 0 0ovation

WHERE WETLANDS AND WATERSHED MANAGEMENT IS PARTICULARLY NEEDED

Integrated water resources and wetland assessment, planning and management is particularly needed where there are many wetlands in the landscape, where there are serious water resources problems or where extensive development is taking place with resulting changes in watershed hydrology.

Wetlands occupy much of the landscape in the northern band of glaciated states and in some coastal states (e.g. Louisiana, South Carolina, Florida). Here are numerous wetlands and their collective impact on land use and water use decision-making is even greater. Because they are scattered throughout the landscape and along minor rivers and streams, wetlands form key components of many parcels intended for subdivision, road building, agriculture and other purposes.

These wetlands include much of the estimated 50 million plus acres of partially drained agricultural wetlands. They include many stormwater detention facilities, which have inadvertently become wetlands, and wetlands created when roads, railroads, bridges, dikes and levees, and other fill and grading operations blocked natural drainage.

It is not only difficult to carry out development without affecting wetlands in these areas, but wetlands are also affected by activities througho0.0011 Tc 0.9 0 0 10.98 94.98744 428.6434c571 4r294to

ILLUSTRATION OF WETLANDS/WATERSHED MANAGEMENT: DU PAGE COUNTY, ILLINOIS

Du Page County, Illinois provides an example of integrated wetlands/watershed management.

In the 1980s, Du Page County, the most rapidly growing County in Illinois, was faced with competing and highly fragmented water and natural resource programs much like their counterparts throughout the nation. The county was concerned about water and related wetland resources from several major perspectives:

- Stormwater management
- Flooding and floodplain management
- Water supply (domestic wells, local government, commercial, industrial)
- Water quality including sediment, toxics, nutrients (point and nonpoint source)
- Wetland and riparian area protection
- Recreation and aesthetic uses of water (fishing, swimming, canoeing, bird watching, education, research, etc.)

To address water from these perspectives, the county concluded that it needed to address:

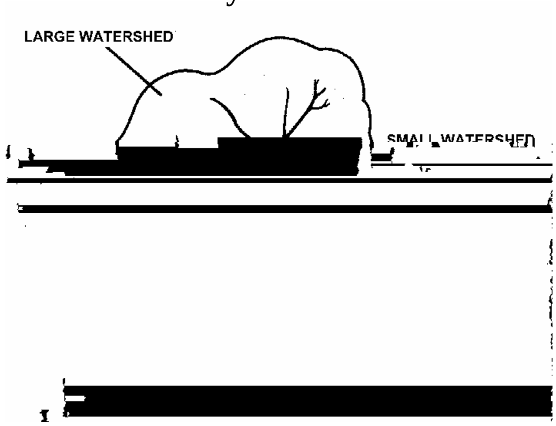
- Normal flows (water supply, water quality, recreation)
- High flows (flooding, stormwater, erosion)
- Low flows (fish, recreation, water supply, water quality)

In 1989, the Illinois legislature authorized Du Page County and several other counties in the metropolitan Chicago area to establish multi-objective, county-wide water management districts.

Du Page County established a Department of Environmental Concern to implement such a district. The Department decided to go back to basics in addressing multiple water management issues. Instead of focusing on individual water management programs in existence, the county decided to ask the questions: Where was every drop of water which fell in Du Page Country coming from over a period of years (normal flows, high flows, low flows)? Where was every drop going? What happened to the water as it flowed off the land and through the county? What did this mean to the citizens of Du Page County? What should happen to the water?

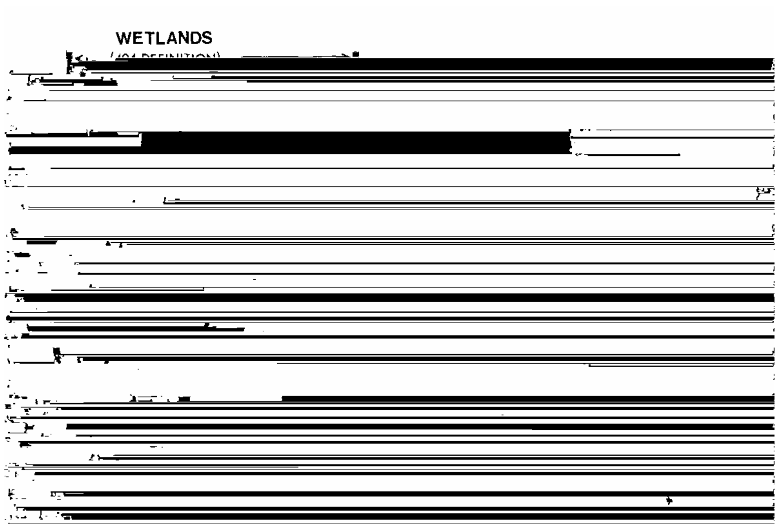
“regulatory

Figure 4
A Hierarchy of Watersheds



Community lands constitute a "hierarchy" of watersheds (i.e.. lands and waters contributing runoff to a single point or points). Usually planning and management areas (see area contained in square) constitute a small portion of the watershed of a major river of stream. But, these same areas may constitute the entire watersheds for smaller streams, lakes, or ponds. Source: E.P.A. Office of Water, Protecting Natural Wetlands: A Guide to Stormwater Best Management Practices, EPA 843-B-96-001 (October, 1996)

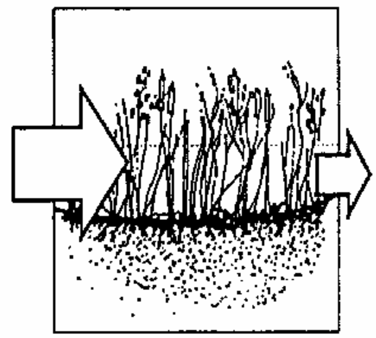
Figure 5
Wetland-Related Ecosystems



Box 7: Examples of

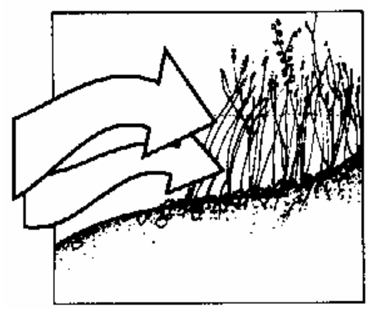
Figure 6
Some Principal Functions of
Wetlands, Riparian Areas, and Floodplains
Needed for Water Resources/Watershed Management
(See Appendix D for a More Detailed Description of Functions/Values)

Flood Protection



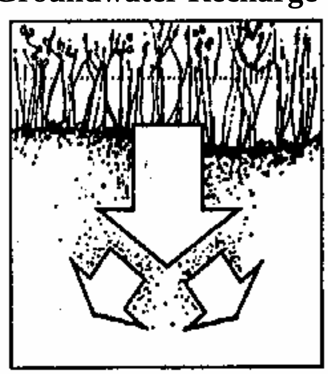
Wetlands store and convey runoff during severe storms, reducing downstream flood damages.

Shoreline Stabilization



Vegetated wetlands can help prevent shoreline erosion and reduce the impact of storm waves. Wetland vegetation absorbs energy from surface waters and binds the soils.

Groundwater Recharge



In some instances, wetlands can help recharge ground waters which provide drinking water and maintain stream flows. This is particularly true for seasonally flooded wetlands and riparian zones.

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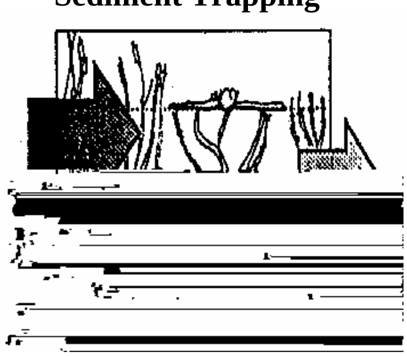
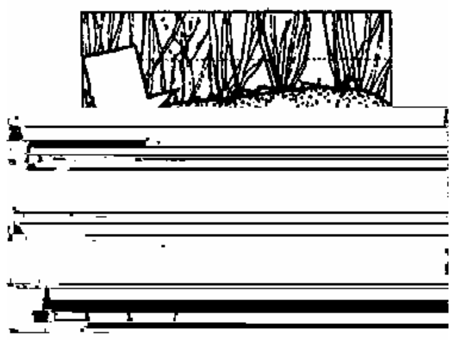
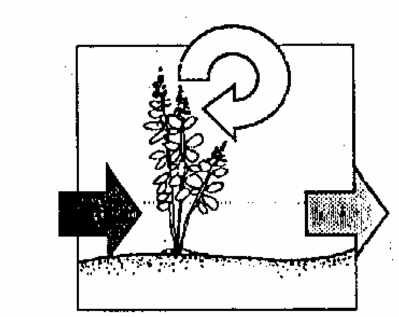
Sediment Trapping







CHAPTER 2: STEPS IN WETLANDS AND WATERSHED MANAGEMENT

Key components of a wetlands and watershed management stand-alone effort include:

- ***Identify problems and issues***
- ***Identify and bring together key actors ("stakeholders")***
- ***Formulate overall goals***
- ***Define the geographical planning/management areas (watersheds and sub-watersheds).***
- ***Map wetlands and water resources; assess existing and possible future conditions***
- ***Examine impacts of alternative land use and water use options***
- ***Carry out more detailed analyzes as needed***
- ***Involve the public***
- ***Develop specific plans for particular areas***
- ***Implement plans for particular areas***
- ***Monitor, enforce, and make adjustments***

CHAPTER 2: STEPS IN WETLANDS AND WATERSHED MANAGMENT

1. IDENTIFY PROBLEMS AND ISSUES

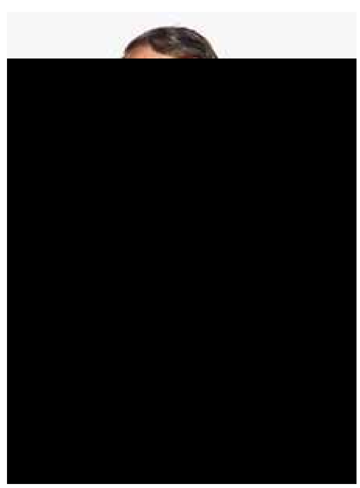
Most wetlands and watershed management efforts have begun with identification of a specific set of problems or issues (see box on p.23) such as serious floods, pollution or other problems.

Systematic identification of water-related problems can help develop support for wetlands and watershed management, and identify key actors or stakeholder groups. One motivated individual, a local or organization, or an agency can begin the process. Problem “prevention” and long term resource management must eventually become program goals as well.

2. IDENTIFY AND BRING TOGETHER KEY ACTORS (“STAKEHOLDERS”)

A second step in wetlands and watershed management is identifying and bringing together in a work group key actors, or stakeholders. Initially, this work group may include only a few individuals. It may be informal.

Key



Box 9
Recommendations from Symposia and Workshops

What are keys to success for wetlands and watershed management efforts? Selected suggestions by speakers and participants in the ASWM wetlands and watershed workshops during the 1995-2002 period include the following:

- **"Recognize from the onset that implementing multiobjective management is more than a technical issue. Bringing key actors with regard to a set of issues or problems to the table is essential."**
- **"Look multi-objectively at water resources (pollution prevention and co**

Box 10
Examples of Problems or Issues Prompting Wetlands and Watershed Management Efforts

Inadequate Water Supply

- Falling ground water levels
- Inadequate quantity of surface water for domestic, industrial and other uses
- Water disputes among landowners, governmental entities
- Fish kills, other loss of wildlife or habitat due to inadequate flows, low water levels in rivers, ponds, lakes, streams

Repeated and Serious Flood Damages

- Disaster or flood insurance payments
- Residences, commercial activities, other activities subject to frequent flooding
- Loss of life
- Loss of jobs or serious "down time" for economic activities
- Repeated damage to public works (roads, sewer and water)
- Threats to levees, dams, etc. due to increased flood heights cause by watershed activities
- Liability law suits

Erosion and Sedimentation

- Reservoirs, lakes quickly filling with sediment
- Erosion threatening bridges, infrastructure
- Streambed and bank erosion threatening residential, commercial, industrial, agricultural, other activities
- Breach of barrier islands, destruction of beaches
- Coastal land loss (e.g., Louisiana) due to sediment deprivation

Pollution

- Algae blooms in lakes, streams, and estuaries due to excessive nutrients in water
- Fish kills
- No fish or shellfish, or fish with high levels of contaminate
- High coliformtlevels, limiting swimming, water skiing, or other water sports, and domestic water supplies
- High level of toxics in waters threatening fish, wildlife, domestic water supplies, and other uses
- Loss of waterfowl, other birds, amphibians, etc.
- Abandoned lanutrients in water

(Examples of Problems or Issues, cont.)

Loss of Community Heritage, Cultural and Aesthetic Values

- Archaeological values
- Biodiversity
- Ecotourism
- Education, interpretation
- Recreational use
- Natural views, open spaces

Conflicting Agency Policies, Inadequate Mechanisms for Resolving Conflicts Regarding Floodplain Resources

- Stormwater
- Water supply
- Flood control
- Pollution control
- Land use, land use regulation

Inadequate Information for Planning/Management

- Water resources management, watershed management planning
- Wetland/aquatic ecosystem planning/ management
- Zoning and land use planning
- Regulatory permitting

Landowner, Developer Complaints

- Inadequate maps and other information concerning wetland and other aquatic ecosystem boundaries
- Inadequate information concerning wetland functions/values
- Confusion and uncertainty concerning various program requirements
- Lack of predictability and certainty
- High costs of permitting, information gathering

Box 11: Tips for Involving Key Actors

- **Identify people and groups that will benefit or suffer costs from improved resource management or loss of resources.**
- **Use simple and understandable language.**
- **Include all key actors from the beginning.**
- **Recognize that each actor has something important to contribute.**
- **Focus on specific geographical areas and problems/issues. People often tend to be area-specific in their interests. However, simultaneously keep the big picture in view.**
- **Look for common issues and win-win solutions.**
- **Challenge each participant to have a vision.**

Box 12: Key Actors

Key actors in wetlands and watershed management vary, depending on local context. Key actors may include:

1. Local, state, federal water and 0 10.98 3719f0.0004 Tc 0.00101 Tw 10.rto906 0.71997 12.60I 0.0010

3. FORMULATE OVERALL GOALS

General goals for wetlands and watershed management will differ somewhat, depending upon the context. One overall (general) goal of federal, state, and local wetland and watershed management efforts is the overall goal stated in Section 101 of the 1972 Water Pollution Control Amendments: "(R)estore and maintain the chemical, physical, and biological integrity of the Nation's waters." Other more specific land and water management goals may include:

- Promoting the most suitable use of land and waters throughout the community,
- Protecting community cultural and historic resources including property values,
- Reducing or preventing community flood and stormwater losses,
- Providing recreation opportunities,

[redacted]

Box 13
No Net Loss Goal

The National Wetland Policy Forum in 1990 recommended the following interim and long term goals (See Protecting America's Wetlands: An Action Agenda, The Conservation Foundation, Washington, D.C.):

Interim Goal: To achieve no overall net loss of the nation's remaining wetlands base.

Long Term Goal: To increase the quantity and quality of the nation's wetlands resource base.

Box 14
Ecological Planning Goals — Wetlands and Related Ecosystems

- Maintain the biodiversity of habitats and plant and animal species,

Box 15

Standards for Activities in Wetlands (Section 404 Program)

A variety of specific regulatory and guidance standards have been developed at federal, state, and local levels to achieve the overall no net loss goals. For example, at the federal level, sequencing steps and requirements for reviewing Section 404 wetlands and waters permits are set forth in EPA's 404(b)(l) Guidelines (40 CFR Part 230):

Step 1: Determine whether the proposed project is water dependent.

Step 2: Determine whether practical alternatives exist for the proposed project.

Step 3: Identify the potential impacts of the proposed project on wetland functions in terms of project specific and cumulative effects.

Step 4: Identify how potential project impacts can be avoided or minimized in terms of project specific and cumulative effects.

Step 5: Determine appropriate compensatory mitigation for unavoidable project impacts.

Step 6: Grant or deny a permit to discharge dredged or fill material based on a comparison of the values of the benefits gained from the proposed project versus the benefits lost from the proposed project.

Step 7: If a permit is granted, monitor compensatory mitigation to determine compliance.

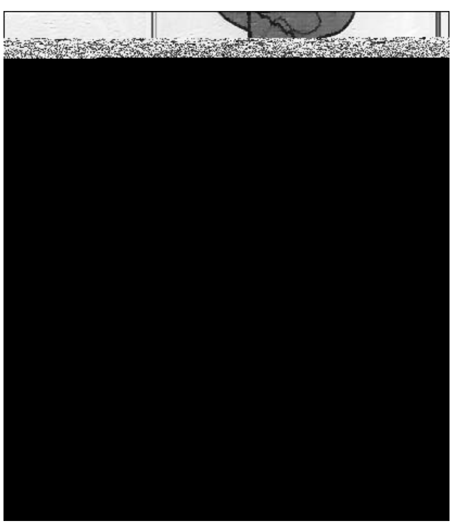
4. DEFINE THE GE

Determining the sources and paths of water in a community

planning for particular portions of river, stream and drainage corridors. These assessments may address problem areas (e.g., floodplains, degraded wetlands, sources of pollution, segments of stream with erosion problems), areas with special resource values (e.g., endangered species habitat, greenways, etc.), areas under intensive development pressures (e.g., a major subdivision), and, in some instances, proposed economic development areas (e.g., an industrial park).

More detailed inventories and planning are needed because a generalized wetlands and watershed assessment plans invariably lack the requisite scale for site-specific management.

Communities have found it impractical or impossible to gather detailed information and carry out detailed and accurate analyses sufficient for an entire community or region as a whole. Successful wetlands and watershed management efforts must bridge the gap between regional, broad brush hydrologic and ecosystem analysis, goal setting, and planning



techniques may also be needed. (See discussion in the chapters that follow).

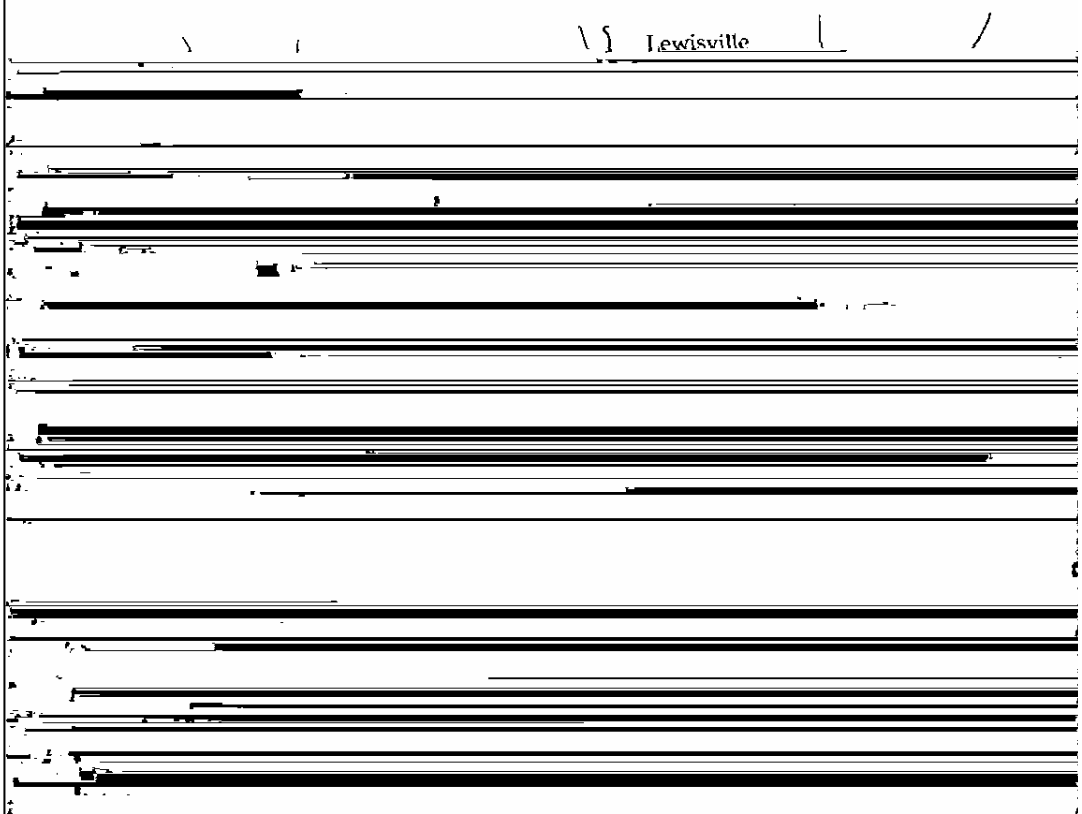
11. MONITOR, ENFORCE, MAKE ADJUSTMENTS

Assessment and management efforts require monitoring, enforcement and adjustments over time as new and more detailed information is gathered, implementation plans are developed, and site-specific plans are implemented for specific areas.

A flexible, dynamic approach to wetlands and watershed management is needed because all of the required information cannot be gathered at once and water is a highly dynamic resource, causing changes to occur over time. The quantity, quality and timing of flows vary naturally over time due to climatic cycles. Flows also change with human activities. Plans and policies which indicated future watershed and hydrologic changes such as anticipated“ build out” can reduce the number and magnitude of future adjustments.

Box 18

Figure 11
Trinity River
Dallas-Fort Worth, Texas



Example of river corridor planning and protection. From: Floods, Floodplains and Folks, National Park Service Rivers, Trails and Conservation Assistance Program (1996).

CHAPTER 3: INVOLVING KEY ACTORS

Key actors often include:

•

CHAPTER 3: INVOLVING KEY ACTORS

Without the involvement and support of key actors (stakeholders), wetlands and watershed management efforts will fail, no matter how accurate the scientific information and how creative the project designs. Involving key people and groups, such as engineers and biologists, into wetlands and watershed management processes is the subject of this chapter.

Some overall recommendations for involving key actors or stakeholders are first provided. Then, recommendations are included for involving specific key groups.

PEOPLE ARE KEY

To make wetlands and watershed management work, people must want integration and coordination. This is not so easy when groups view their programs as their "territory". Multi-objective management begins when an individual or group reaches out to others. This individual or group must understand that achievement of a vision will require the help of many.

The individuals and groups crucial to the success of watershed management efforts include: the engineers and planners from water resources management programs; the biologists, botanists and planners from ecosystem management programs; land use planners; staff of not-for-profit organizations (e.g., local land trusts); transportation agency staff; landowners, developers and others.

A VISION

A work group can be drawn together and motivated by a vision or combination of visions for the future. This vision may involve cleaning up a stream, creating greenways, restoring wetlands, creating parks, or reducing flood hazards ls0m0.98 0 0 10.98 0 0 10.98 256.0s(pa38Tc 0.0022 Tw r71651 Tw 1

Joint resource assessments at a landscape level (e.g., mapping of wetlands and waters) can lead to more detailed assessments for particular areas, such as eroding sections of streams. A major problem with both water resources/watershed management and wetland/aquatic ecosystem management efforts has been the inability of these efforts to move from a broad scale down to the ground level.

Joint natural resource assessments can produce common maps for a wide range of purposes and facilitate the development of joint analytical models, including hydraulic, hydrologic and ecological models. These models can both describe existing conditions and project future runoff and hydrologic and hydraulic characteristics under various development scenarios. The models ca

Box 19

What Does Wetlands and Watershed Management Have to Offer Water Resources/Watershed Managers?

- **Less costly and more effective achievement of traditional water resources management goals through the combination of natural system approaches and more traditional approaches for pollution control, flood loss reduction, stormwater management, erosion control and recreation.**
- **Improved landscape level mapping and assessment of wetland/aquatic ecosystem functions/values to aid planning efforts, environmental impact analysis, impact reduction, and impact compensation efforts.**
- **Improved sources of information and the ability to draw on expertise in many agencies not available in fragmented wetland/watershed programs (e.g., wetland maps, biological expertise**

INVOLVING STATE AND FEDERAL AGENCY STAFF

Local governments also need federal and state technical and financial assistance. (See Appendix A.) Virtually all local efforts have been undertaken with such assistance.

Views that could be expressed to state and federal agencies to gain their support may include:

- **Multi-objective management will more effectively meet state and federal water resources and ecosystem program goals.** Many state and federal water and land use programs have multi-objective goals—watershed management, water resources management, public land management, and coastal zone management.

- **Multi-objective management will facilitate compliance by agencies with environmental impact review and regulatory requirements.** Multiobjective management information gathering and assessment efforts can result in improved environmental impact review and impact reduction.

INVOLVING LANDOWNERS AND DEVELOPERS

Landowners and developers may be convinced to participate in wetlands and watershed management efforts with the following statements:

- **Wetlands and watershed management efforts can provide more certainty to agenetlands an**

Box 21
Private, Parcel-Level Plans

Private landowners and developers are increasingly undertaking multi-objective, parcel-level wetland, floodplain and water resources planning efforts for their lands to help comply with floodplain and stormwater regulations, erosion and pollution controls, broader zoning, subdivsion controls and building code regulations. Such efforts are particularly common for mid-sized to large projects and often involve the following steps:

1. **Site survey.** The natural resource and cultural characteristics of a parcel (soils, vegetation, topography, ownership boundaries) are surveyed to determine site potential for various economic uses and to identify potential problems (flooding, subsidence) including regulatory issues.

2. **Preparation of a concept plan for the entire property.** Such a strategy typically involves plans for various economic activities and measures to address flood, stormwater, water supply, wetland and other ecosystems considerations. It will often contain impact reduction and compensation measures (e.g., wetland restoration, revegetation of upland buffers, etc.) if the plan calls for substantial modification of wetlands and related ecosystems.

3. **Review of the plan, supplementation for particular areas.** The plan is submitted to regulatory agencies if implementation will require regulatory approval.

4. **Preparation of a final plan.** The final plan often has engineering approval and complies with other regulatory specifications.

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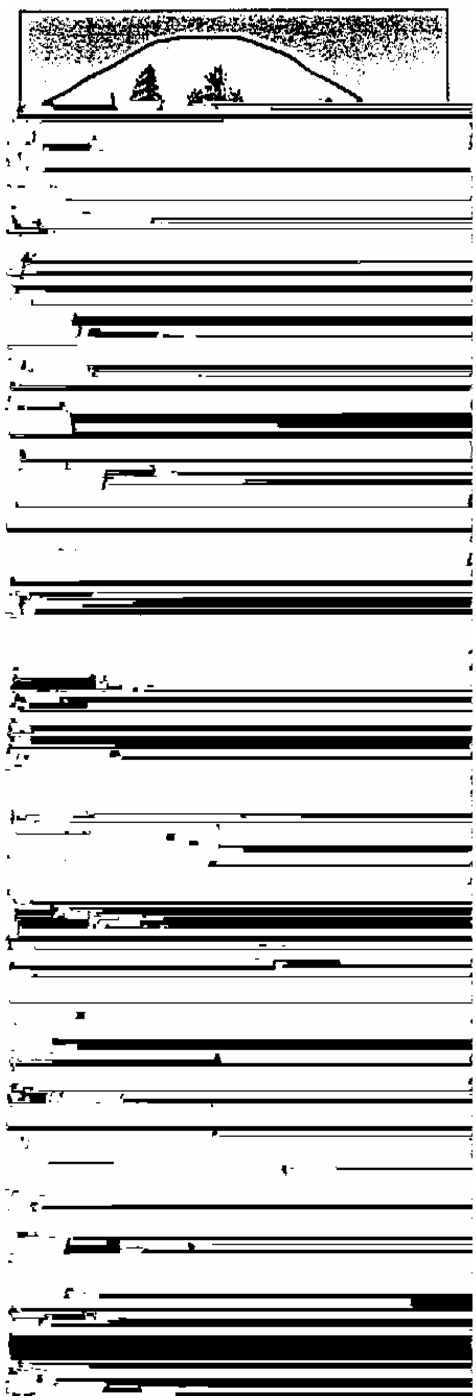
Figure 12
Wetland Values and Natural Hazards



Values

Isolated wetlands

1. Habitat for both upland and wetland species of wildlife
2. Flood water retention
3. Sediment and nutrient retention
4. Scenic beauty

Lake margin wetlands

1. See values for isolated wetlands, above
2. Removal of sediment and nutrients from inflowing waters
3. Fish spawning area

Riverine wetlands

1. See values for isolated wetlands above
2. Sediment control, stabilization of river banks
3. Flood conveyance

Estuarine and coastal wetlands

1. See values for isolated wetlands, above
2. Fish and shellfish habitat and spawning areas
3. Nutrient source for marine fisheries
4. Protection from erosion and storm surges

Barrier island

1. Habitat for dune-associated plant and animal species
2. Scenic beauty

INVOLVING LAND USE PLANNERS

Wetlands and watershed management efforts can help community planners allocate lands throughout the community to their m isolated wetlands throughout the landscape including many wetlands and floodplains along small creeks,

CHAPTER 4: MAPPING AND ASSESSMENT

"Geographic-based planning offers the potential to develop a cohesive framework that addresses both clean water and aquatic habitat, reflecting the independent relationships between water chemistry and ecological processes in the natural environment. To realize this potential, planning processes should include an inventory of wetlands and other aquatic sites that remove pollutants, reduce flood damages and/or supply food and shelter for fish and wildlife. Environmental, economic, and quality-of-life values of these areas should be assessed, their location and area extent determined, historic losses estimated, adverse consequences of past losses evaluated, and priorities for conservation and restoration ranked."

— Clean Water Action Plan: Restoring and Protecting America's Waters (1994)

CHAPTER 4: MAPPING AND ASSESSMENT

Box 24

MAPPING

Multi-objective mapping of wetlands, floodplains, riparian areas and waters has proven to be an essential step in developing protection and restoration policies for wetland and watershed management. For example, the Parkers Creek Watershed Task Force drafted a Parkers Creek Watershed Management Plan for a portion of Calvert County, Maryland. To begin this effort, digital maps were compiled from county, state and federal sources to inventory wetlands, waterways, hydric soils, floodplains, forest cover, habitats of special concern and water supply. Maps were compiled to not only assess existing resources, but also to estimate the impact of cumulative growth on these resources.

Communities have found the U.S. Fish and Wildlife Service National Wetland Inventory maps to be useful in mapping wetlands. National Wetland Inventory maps (see http://www.nwi.fws.gov/) and orthophotos are now available online free of charge for more than a million square miles. Even broader expansion of this service may be expected. See Appendix A.

The Federal Emergency Management Agency has also made flood maps available online for many communities. See www.esri.com/hazards/makemap.html for scalable flood maps throughout the nation.

Some communities, like King County Washington, Boulder, Colorado, have undertaken independent wetland and floodplain mapping at larger scales and with more detail. Much of this assessment is based upon air photo analysis.

Communities have discovered it is necessary to combine generalized water inventories for the community as a whole (e.g., wetland maps) or a selected planning and management area, with more detailed studies for specific areas (e.g., a portion of a stream corridor). (See Appendix G.) Determining topical and geographical information-gathering priorities is also essential.

Detailed inventory of streams, lakes, ponds, springs, estuaries, wetlands, floodplains, riparian areas and other waters in terms of water depth, velocity, quality, change in flow regimes, hydroperiod and other features is expensive and cannot practically be carried out in detail for an entire community much less a whole region. Even if such an inventory is carried out, it will often have a relatively short shelf life because certain types of information, such as maximum expected flows in small streams, change as watershed development occurs.

FUNCTIONAL ASSESSMENT OF WETLANDS AND OTHER WATERS

A number of communities, such as Juneau, Alaska, and Dade County, Florida have not only mapped wetlands but also evaluated wetlands to determine the functions and values served by individual wetlands. (See Appendix F.)

Comprehensive efforts to evaluate functions and values of all wetlands in a community have met with mixed success, although Juneau and Dade Countyhave met other waters and the scarcity of wetlands in the area.

Multiobjective broader scale evaluation of wetlands, riparian areas, floodplains and other waters taking into account overall wetland type, natural hazards, soils, existing uses and other factors without attempting to compare, in depth, individual functions and values has proven more practical for water and land management purposes Such a multiobjective evaluation may be undertaken through the simultaneous use of lake and stream maps, wetland maps, floodplain maps, soil surveys, water resource maps, existing land use maps, maps of rare and endangered species habitat, public landowner ownership maps and other types of information. These sources of information can be used collectively to suggest development and protection potential without evaluating the functions and values of individual wetlands

Some communities like Juneau have opted to use "rapid" wetland assessment techniques to compare the functions and values of wetlands. Scientists have developed more than 40 proposed rapid wetland assessment techniques since 1990 alone to help regulators, land use planners and public land managers assess wetland functions and values. See Appendix G.

But, rapid assessment techniques have all proven to be subject to limitations and problems in assessing functions and values. See Assessment of Wetland Functions and Values. There are conceptual problems with many of the techniques. The large number of methods reflects the difficulty scientists experience in agreeing on what is and is not important in assessment.

Box 25

Limitations on Data Gathering and Analysis

Common restraints on data gathering and analysis include:

- Limited funds.
- Limited numbers of staff and staff expertise.
- Limited time.
- Inadequate scales and accuracy of existing data for management purposes.
- Dynamic nature of wetland and water systems, which complicates data gathering and renders information quickly out of date.
- Location of information and expertise in a broad range of agencies, making it difficult to tap and assemble information in one place.
- Lack of adequately specific and accurate georeferencing in maps, hindering compilation and the effective use of GIS systems.

COPING WITH LIMITED BUDGETS

How can communities cope with limited expertise and funds in information gathering and analysis for wetland, floodplain, and riparian and other water areas?

- **Form assumptions based on overall wetland, riparian, floodplain, water type.**

Communities can gain considerable insight into functions and values and other characteristics of particular wetlands, riparian areas, and floodplains and other waters by simply knowing the hydrogeomorphic class for a wetland

Box 26
Examples of Existing Sources of Information

Some useful sources of information include:

- **National Wetland Inventory Maps**
- **Federal Emergency Management Agency Flood Maps**
- **USDA Natural Resource Conservation Service Soil Maps**
- **U.S. Geological Survey Geologic Maps**
- **U.S. Geological Survey and Other Orthophotos**
- **Federal, State, and Local Air Photos (Multiple Sources)**
- **State "Heritage" Program Natural Area Inventories**
- **State and Federal Lists of Rare and Endangered Species**
- **State Lake and Stream Inventories**
- **Federal, State and Local Land Use Inventories, Maps**
- **Local Plat Maps**
- **Various Types of Federal, State and Local Water Resources/Watershed Studies**

♦ **Use techniques to tap existing scientific expertise and information.**

Communities have found they often can use a variety of techniques to access staff resources, data and expertise, including regulatory and resource agencies, not-for-profits and academic institutions, among other sources.

Box 27
Techniques to Tap Sources of Information and Expertise

Techniques to tap the scientific and other knowledge include:

- **Involve in inventory efforts, early on, a broad range of agencies and groups with data.**
- **Solicit information from managers, such as flood information from public works managers, or fish information from local not-for-profits like Trout Unlimited.**
- **Develop preliminary plans and inventories and solicit comments from a broad range of groups.**
- **Hold public workshops and hearings to gather information from the public.**
- **Form commissions and work groups.**
- **Conduct joint permit processing.**

♦ **Require landowners/developers to develop more specific information on a project-by-project basis.**

When wetland regulations were first adopted in the early 1970s, regulators hoped that boundary maps and other types of assessments could be developed with sufficient accuracy to replace onsite delineation of wetland boundaries or assessment of functions and values at the time permit applications were submitted. A

- There are physical limitations in representing wetland, floodplain, and water boundaries with enough precision on maps (e.g. the width of a pencil line may be 10-25 feet) to determine precise wetland boundaries or other characteristics on the ground.

- There are practical limits to accurate mapping and other information gathering, even if considerable amounts of money are spent, due to limitations on mapping technologies (e.g., aerial photo interpretation), changes in watershed hydrology and the overall lack of time series hydrologic information.

For these reasons, communities often require private and public developers proposing to alter a stream, wetland, floodplain, riparian area or other aquatic system to carry out a more detailed evaluation of the resources and project impact than would be possible for a larger area. This generates more detailed information on a site-specific basis and shifts a portion of the cost to developers.

- **Apply multiobjective management strategies.**

It is often easier and cheaper to develop several types of information for multiobjective management on a general scale than one type of information in great detail for special purpose management. For example, a combination of generalized flooding, pollution control, habitat protection and recreational use information may be used to identify potential stream corridors where lands should be acquired as a multiobjective greenway. However, much more extensive and e

Box 28
Uses for Red and Yellow Flagging Procedures

Red* and yellow flagging** can be used to:

- **Identify, early-on, wetland, riparian area, floodplain and other aquatic ecosystem areas that should be protected outright.** Red flag procedures are used to determine whether an area should be protected outright or a permit should be denied immediately due to a single important problem or failure to comply with specific criteria.
- **Identify areas with potential problems and issues (e.g., increase in flood heights or erosion on other lands) that will need to be addressed by the regulatory agency**, **other agencies, or permit applicants through more detailed studies or analysis.**
- **Help determine, on a preliminary basis, the wetland/aquatic ecosystems functions that will need to be examined in greater depth (in more specific studies or at potential permit application sites essential from cost and time frame perspectives).**
- **Determine groups and individuals (e.g., adjacent landowners, downstream landowners, environmental not for profits, academics, others) who may have an interest in proposed areas or projects, who may be able to supply data, or who may wish to appear at a public hearing. These groups may then be involved in assessment.**

* Red flags indicate the need for outright protection of a wetland or another area.
** Yellow flags suggest a cautious approach is needed.

Box 29
Important Red and Yellow Flags — Wetlands and Related Ecosystems

The following wetland features may suggest significant functions and values that need outright protection or a cautious approach to alteration or destruction.

- **Wetland, riparian area, floodplain and related ecosystem types particularly rare within a community, region (e.g., bogs).** Rare types are often characterized by rare and endangered plant and animal species. How “rare” a wetland type or related ecosystem type is within a geographical area may

(Some Important Red and Yellow Flag Features, cont.)

- **Other wetlands, riparian areas, and floodplains lying on the paths of flow from upland areas to waters (lakes, streams, oceans, estuaries).** Such wetlands may play particularly important pollution control, flood storage, flood conveyance, and habitat functions/values. Significant habitat functions and values are particularly likely where the wetlands and floodplains form water-related corridors for wildlife. Such wetlands can often be identified from topographic maps and air photos.

- **Large wetlands, riparian areas, and floodplains in a natural or semi-natural condition.** Such areas are often important areas for biodiversity and as habitat for rare and endangered species. These can be identified from air photos, topographic maps, satellite imagery, soil maps, National Wetland Inventory maps or other sources.

- **Wetlands, riparian areas, and floodplains in source water supply watersheds.** Wetlands and floodplains in such areas may play particularly important pollution (viruses, bacteria, heavy metals, etc.) and sediment prevention roles. Often source water supply maps are available in a state. These can be used in combination with National Wetland Inventory Maps, air photos or other sources to identify these wetlands.

- **Wetlands, riparian areas, and floodplains in or immediately adjacent to federal, state, local parks, refuges, sanctuaries.** These are

COMPUTER-ASSISTED ASSESSMENT AND GIS

Over the last decade, communities have increasingly used computers to assist watershed and ecosystem management efforts. See, for example, King County Washington's interact mapper at www.metrokc.gov/gis/mapportal/iMAP_main.htm which provides a broad range of GIS maps. Such systems show considerable promise for future use. Communities have used such systems to both analyze wetlands and water resources on a community-wide basis and to more specifically evaluate the impacts of development proposals, such as determination of the impacts of fills on flood conveyance through the use of backwater computations.

GIS systems allow storage and analysis of various types of information, such as topographic, vegetative, soils and other types of data and the analysis of the relationships between these data. Computerized water resource models (e.g., flood storage, flood conveyance, water quality) also utilize georeferenced information, but analyze it through the application of various mathematically-based water resources flow models.

The most common output from a GIS system is a map. But, it is also possible to develop lists, mathematical numbers (e.g., flood heights, backwater effects), three dimensional landscape models, and other outputs, depending upon the system.

Use of GIS and other computerized systems is not confined to wetlands, floodplains and water resources. Public land management agencies, local governments, states, consulting firms and academic institutions are interested in GIS systems to store and process many types of natural resource, tax, economic and census information.

Interest in GIS systems has grown exponentially as inexpensive personal computers have become available with large and rapid computing capacity (e.g., 486 Pentium processors) and large data storage capacity (e.g., ROM drivers). Relatively inexpensive software (e.g., ArcInfo, Mapinfo) with GIS capability and the availability of a great deal of natural resource information in a digital form, such as National Wetland Inventory maps, have also helped. New technologies, such as Global Positioning systems and low level digital imagery, hold promise for addressing some of the difficult georeferencing problems with GIS systems and for providing some of the detailed data which have been lacking.

Some of the strengths of GIS systems and computerized water resources flow models for wetland and water resources assessment include:

- GIS systems can store very large amounts of data,
- GIS systems can quickly process large amounts of data,
- GIS systems can combine, for analytical purposes, natural resource data with census, tax, economic, and other data,
- GIS systems can quickly analyze multiple scenarios (e.g., evaluate the impacts of various project designs), and
- GIS systems can print out analyses in a variety of formats (maps, charts, tables, 3-dimensional models, etc.)

With these strengths, one might expect widespread use of GIS and computerized information systems in wetlands and watershed assessment. Use is increasing for developing general plans, tracking development permits, analyzing functions and values, and identifying priority restoration areas. Computerized flow models have been broadly used for flood routing and backwater computations. But, there are limitations on the use of GIS and other computerized systems as well.

- "Garbage in, garbage out." The outputs of GIS and other computer modeling systems are no better (types of data, accuracy, scale) than the data imputed to the systems.

- Georeferencing data problems. GIS systems require more precise location of various types of information in relationship to selected coordinates than various manual analysis techniques (e.g., visually comparing maps) because data must be provided to the computer in a precise geocoded form. Georeferencing is often difficult because wetland information is often at a variety of scales (e.g., NWI maps, soils maps, land ownership maps, flood maps may be only available on unrectified map bases). Data is also typically subject to varying levels of inaccuracy. Human beings can make adjustments for such problems and limitations; computers cannot. For example, a regulator attempting to evaluate a proposed project at a specific site can often, with a little ingenuity, locate this site on varying scales of topographic maps, soils maps, NWI maps, property maps, and air photos and adjust to possible problems with map accuracy. But, a computer cannot.

- Aggregated information problems. There are financial limits to data encoding and computer storage and analytical capabilities despite the large capacity of computers. For this reason, computer specialist

Box 31
GIS Applications in Wetlands and Watershed Assessments

GIS systems can assist area-wide wetland and watershed assessments in several ways:

- **Parcel analyses.** Wetlands and watershed assessment efforts can benefit from the parcel analysis capabili7el analyses.

THE NIAGARA FRONTIER WETLANDS AND WATERSHED ASSESSMENT EFFORT

The Niagara Frontier New York wetlands and watershed management effort illustrates the importance of a sound information base and the role joint information gathering can play in bringing together key actors.

The problems that gave rise to this effort are rooted in the glacial history and topography of western New York. Much of western New York was inundated by glacial Lake Ontario which was much larger than present Lake Ontario. Sediments were deposited on the floor of the Glacial Lake, forming a semi-impermeable, almost level plain with many wetlands and serious flooding problems. Much of this area was at one time used for agriculture but has been slowly urbanized and incorporated into Buffalo and many surrounding towns and cities. Many wetlands have been further drained or filled, but many wetlands also remain, some of them reverting to semi-natural conditions.

Serious conflicts arose in 1989 and 1990 when the U.S. Corps of Engineers began to apply the 1989 Manual for the Identification of Jurisdictional Wetland to these areas. Pursuant to this Manual, large urban areas were considered wetland. However, the Corps of Engineers had inadequate staff and financial resources to carry out individual wetland delineations and to process Section 404 permits. There was huge public outcry, and a congressman from the area held congressional hearings on the problem. A congressman also requested that President Bush establish a moratorium on enforcement of Section 404 regulations for the area.

In 1991, to help address problems and conflicts, several concerned individuals from the environmental and development communities formed a Niagara F

Digitized soil maps have been prepared on a watershed basis for the area by the U.S. Soil Conservation Service (now called USDA Natural Resources Conservation Service). This data is now available in GIS (Geoinformation system) format and can be shared electronically. Air photos were interpreted to identify areas subject to potential federal Section 404 jurisdiction and potential areas for wetland restoration and mitigation sites.

Composite wetland maps have been prepared by the USDA Natural Resource Conservation Service showing wetland boundaries as mapped by both the New York Department of Environmental Conservation and the National Wetland Inventory.

A broad range of information including watershed boundaries has been digitized and made available for GIS use by the USDA Natural Resources Conservation Service and the Erie County Soil and Water Conservation District. AmeriCorps has helped with this effort. This has included, but not been limited to, a GIS-based set of information on wetlands in the Tonawanda Creek Watershed in the northern third of Erie County and the southern third of Niagara County.

A pilot project has attempted to classify wetlands using the Hydrogeomorphic Wetland Classification. A joint New York Department of Environmental Conservation and U.S. Army Corps of Engineers permit application process has been established.

This effort is still a work in progress. However, much has been accomplished.

CHAPTER 5: REDUCING AND COMPENSATING FOR IMPACTS

Approaches for reducing and compensating for ecological impacts in water resources management include:

- *Apply multi-objective management strategies to simultaneously achieve both traditional water resource management and wetland/aquatic ecosystem protection and restoration goals.*
- *e*

CHAPTER 5: REDUCING AND COMPENSATING FOR IMPACTS

In the past, water resources management programs have often conflicted with wetland, riparian, and floodplain protection efforts. Dikes, dams, channelization, levees and other structural projects have often destroyed wildlife habitat and related ecosystems without adequate consideration of the impact of such structures.

On the other hand, political and regulatory concerns about impacts on wetlands and related ecosystems have increasingly blocked water resources projects. Detailed environmental impact statements, as well as a wide variety of regulatory permits, are typically required for construction, dredging and other types of fills or structures in waters. Such permits are not granted if measures are not taken to both reduce and compensate for adverse project impacts on water and wetland ecosystems.

How can these conflicts be avoided or resolved?

Several approaches may be suggested.

MULTI-OBJECTIVE,

Box 33
Factors in Assessment of Project Impacts

- Type of activity
- Size of activity
- Type of wetland and characteristics of the wetland and related ecosystem (functions and values, hazards, etc.)
- Location of activity within wetland/aquatic ecosystem
- Existing condition of the wetland/aquatic ecosystem
- Reasonably anticipated future condition of wetland/aquatic ecosystem (e.g., will hydrology change? will the wetland be there in ten years?)
- The manner in which the activity will be carried out (e.g., use of erosion control measures)
- The time of the y

COMPENSATE FOR RESIDUAL IMPACTS

It is often difficult or impossible to reduce all wetland and related ecosystem impacts. For this reason, wetlands and watershed management programs typically incorporate a variety of measures to compensate for residual impacts. Compensation may take the form of onsite or offsite wetland/aquatic ecosystem restoration, creation or enhancement.

Compensation is an important option if impacts are truly unavoidable. But, there are limitations on scientific knowledge and practical know-how for compensation measures. They should also be approached with care. See Boxes 35, 36. Many compensation projects have failed due to inadequate hydrology, construction, expertise and other problems. Wetland restoration, creation and enhancement is often more of an art than a science.

Some of the lessons learned about successful restoration, creation and enhancement "compensatory" approaches including the establishment of mitigation ratios are summarized below.

Box 35
Compensatory Approaches

Compensation for wetland and related ecosystem losses includes the following options:

- ***Restoration.***

Box 37

Factors Relevant to Mitigation (Compensation) Ratios

Some factors relevant to determination of mitigation (compensation) ratios include:

- **The overall ecological condition (persistence, biodiversity, ecosystem integrity) of the original wetland/floodplain versus the probable ecological condition of the replacemen0.77997 0.72 12.66 re7663.2401**

ONSITE AND OFFSITE COMPENSATION; COOPERATIVE PROJECTS AND MITIGATION BANKS

Impact compensation measures may be undertaken onsite or offsite. Offsite measures may include the use of mitigation banks, which involve the restoration, creation, or enhancement of wetlands with the goal of providing credits for wetland destruction at other locations in the future. Individuals proposing such destruction buy these credits.

A number of local governments have established mitigation banks, including West Eugene, Oregon; Wayne County, Michigan; Snohomish County, Washington; The Harris County Flood Control District, and Volusia County, Florida.

Ecologists and wetland regulatory agencies generally favor onsite and in-kind measures as a first choice rather than offsite mitigation including mitigation banks for a number of reasons. Benefits are kept as close as possible to the original ecosystem and to the original landowners. Existing wetlands may be used to guide in-kind and onsite compensation.

Shifts in ecological and societal benefits and costs also occur when offsite restoration or creation are used to compensate for impacts. For example, an acre foot of flood storage may be created at an offsite location to compensate for the loss of an acre foot at an original location, but different properties and individuals will benefit from storage at this new location. In addition, the original, downstream ecosystem and landowners will suffer.

A combination of onsite and offsite compensation measures may be optional in some circumstances. For example, in an urban area, stream buffers and greenways may be used to compensate for loss of flood storage and conveyance, and loss of erosion and pollution control. But, it may be more realistic to provide offsite compensation of habitat functions through wetland restoration or creation at another site.

There are practical problems with onsite and
in-kind co6704 Tm(s with onsit98.88657 Tm(in-kin

Box 38
Opportunistic Restoration/Creation/Enhancement

Wetlands/floodplain/aquatic ecosystems can often be created, restored or enhanced at reasonable cost when integrated into other activities, such as:

- **Reclamation of gravel pits and strip-mined lands**
- **Restoration of superfund dump sites (wastes were often in the past placed in wetlands)**
- **Stream bank stabilization efforts (i.e., use of bioengineering techniques)**
- **Construction of stormwater detention and retention facilities**
- **Retrofitting sanitary sewers, stormwater facilities**
- **Construction of farm ponds, other ponds**
- **Repair of damaged or destroyed levees after flood events by setting them back from a river or stream**
- **Large-scale grading and filling for land subdivision, industrial development, construction of roads and other infrastructure (often offers restoration opportunities)**

CHAPTER 6: INTEGRATING WATER RESOURCES MANAGEMENT AND ECOSYSTEM PROTECTION

"Floodplains are natural storage and conveyance facilities, and all stormwater management efforts should be directed toward helping them serve that function."

— From Rooftop to River: Tulsa's Approach to Floodplain and Stormwater Management; May, 1994.

CHAPTER 6: INTEGRATING WATER RESOURCES MANAGEMENT AND ECOSYSTEM PROTECTION

Many communities have adopted five somewhat distinct types of water resources management programs:

- flood loss reduction,
- stormwater management,
- water supply,
- point source pollution control, and
- nonpoint source pollution control.

All five types have traditionally involved construction of various types of structures in water bodies, wetlands and floodplains, although nonpoint source pollution control has also depended upon nonstructural approaches. All structural approaches modify basic hydrologic regimes and have the potential to severely impact wetland/floodplain/riparian ecosystems if measures are not taken to avoid and reduce impacts and if various sorts of compensation re not applied to address residual impacts.

Chapter 6 examines in greater depth these five types of water management programs and recommends strategies for reducing and compensating for ecosystem impacts.

Box 39

Use of Structures in Water Resources/Watershed Management

Construction of Dams

Dams are constructed for:

- Water supply
- Flood control
- Navigation
- Stormwater detention for flood loss reduction
- Creation of farm ponds
- Creation of recreational impoundments
- Stabilization of lake, pond levels
- Wildlife enhancement

Construction of Dikes, Levees, Seawalls

- Dikes, levees, and seawalls are constructed for flood and erosion control.

Channelization, Drainage

Ditching, dredging, channelization and subsurface drainage are undertaken for:

- Flood loss reduction
- Reduction in ground water levels for agriculture
- Conveyance of waste waters, irrigation waters
- Improvements to navigation
- Stormwater management

Erosion Control Measures

Erosion control measures, such as riprap, bank stabilization and groins are undertaken for:

- Stream bank stabilization and control of meander
- Control of soil erosion
- Stabilization of barrier islands and beach

Other Structural Approaches

Other structural measures are constructed for:

- Sewage treatment (waste treatment facilities, piping)
- Water supply (water treatment facilities, piping)

FLOOD LOSS REDUCTION

Overall Approaches

Until 1968, communities relied primarily on flood control structures to red

- Adopt subdi

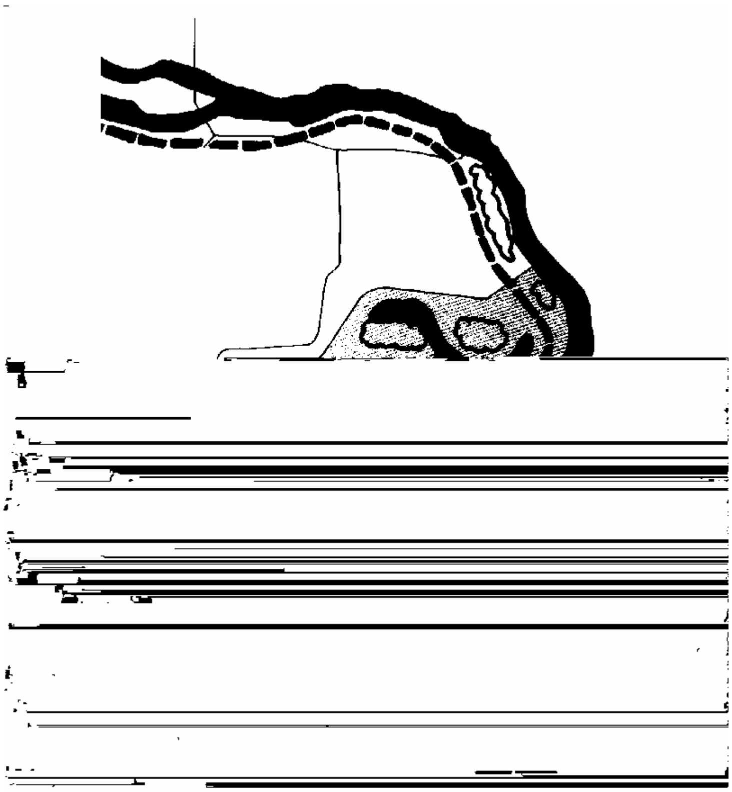
Figure 15

Federal Emergency Management Agency (FEMA) flood map for Lake County, Illino

Box 40

Summary of Traditional Community Flood Loss Reduction Programs

Figure 16
Wetlands and Flood Loss Reduction
Louisa Levee District 8



After the "Great Flood" of 1993 in the Upper Mississippi and its tributaries, The Iowa Natural Heritage Council helped facilitate a buy out for Lousia Levee District 8, six miles from the mouth of the Iowa River. (The levee protection of this 3000-acre parcel had broken 17 times.) This voluntary buyout to reduce flood losses, provide flood storage and restore wetlands was carried out under a cooperative agreement among the Soil Conservation Service, the U.S. Fish and Wildlife Service and the Iowa Natural Resource Council. It has been fully implemented. Source: National Park Service, Floods, Floodplains and Folks, National Park Service, Rivers, Trails, and Conservation Assistance Program (1996).

STORMWATER MANAGEMENT

Overall Approaches

Many mid-sized and larger communities have adopted stormwater management programs that involve above ground and below ground drainage ways and detention areas. Many have also adopted floodplain management efforts that overlap with stormwater management. Floodplain and stormwater management

Box 42
Summary of Traditional Stormwater Management

Goals: The goal of traditional stormwater management has been to reduce urban drainage and flood losses along small creeks and streams (in contrast with floodplain management, which applies to larger bodies of water and larger watersheds). More recent goals include water quality protection and habitat protection. The EPA has adopted stormwater pollution control regulations for cities of more than 100,000 people.

Relevant hydrologic parameters: Information is needed on flood flow volumes and flow paths for flood events, sediment regimes and water quality.

Extent of programs: Most middle sized and larger cities have adopted stormwater management programs that involve a combination of surface and subsurface stormwater drainage facilities. Most communities also require that subdividers install stormwater drainage facilities. Many require on site detention for storms with specified occurrence interval.

Responsible government agencies: Local planning and public works departments, state floodplain and water quality agencies; the U.S. Environmental Protection Agency, Federal Emergency Management Agency, the U.S. Army Corps of Engineers and the Natural Resources Conservation Service.

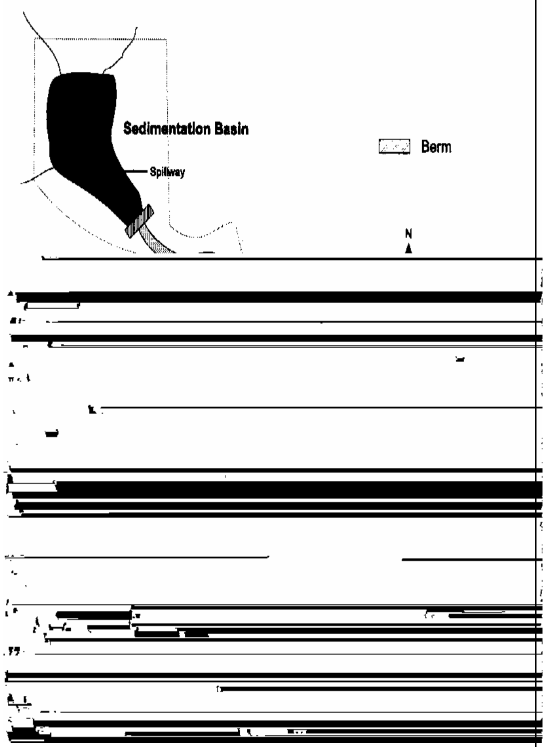
Watershed perspective: Stormwater planning and management efforts have often been carried out on a subwatershed basis. The rational formula, or some variation on the rational formula, is used to compute flows. Future watershed conditions are often assumed in project design.

Benefits of wetland/floodplain ecosystems to stormwater management: Wetlands and floodplains store stormwaters. They may also convey stormwaters. Wetlands and floodplains remove contaminates, litter, and sediments from stormwaters, preventing them from reaching lakes, rivers, and streams. They also remove nitrogen and phosphorous.

Problems, conflicts: Stormwater management may conflict with natural wetland protection and restoration because they involve drainage, channelization, and the establishment of detention areas. Traditional stormwater management practices have threatened smaller, isolated wetlands and wetlands along small creeks and streams. Pollution and sediment discharges into wetlands are another problem.

Figure 18

Wetlands and Stormwater Management
Lake McCarron's Stormwater Treatment System



This system was built in 1985 in Roseville, Minnesota, a suburb of St. Paul. About 85 percent of the runoff from the watershed is routed through this wetland prior to discharge to a lake. A sedimentation basin and low berms were installed in a degraded palustrine wetland, dividing the wetland into five consecutive chamm

Options

How can communities meet source water needs while protecting and restoring wetland and related ecosystems?

1. Protect wetlands and associated ecosystems to reduce nutrients, bacteria, metals and other pollutants. Communities have used a number of approaches to achieve this:

- Adopt stream, lake, well head and septic tank/soil absorption system set back requirements for sources of water supply. They may include zoning, subdivision regulations, building codes and other regulations.
- Acquire lands and create greenways and other open space zones around source water supplies.
- Adopt conservancy zoning for watershed lands that supply water.
- Adopt large, minimum lot size requirements for watershed lands that supply water.

2. Restore wetlands and related ecosystems in watershed areas to reduce pollution, restore and protect water quality. For example, New York City is planning1.02d protect water

Box 43

Summary of Traditional Community Water Supply Programs

Goals: The primary goal of community water supply programs is to meet present and future community water supply needs for industries, homes, agriculture, etc. Some community water supply reservoir projects also have recreational and other values. Additional goals added by some communities (e.g., the New York City Water Supply Program) include flood and erosion protection.

Relevant hydrologic parameters: Information is needed on water quantity (bacteria, viruses, heavy metals, pesticides nutrients, sediment), sediment regimes, average, minimum and maximum flows.

Extent of programs: Most cities and towns have established public water supply programs. The U.S. Environmental Protection Agency (EPA) has adopted a variety of regulations that require communities to protect the quality of surface water and groundwater. EPA has been funding state inventories of public water supply sources including water quality. States have adopted permitting requirements for diversion or pumping of surface water or (in many states) groundwater. Some states and communities have adopted well head and watershed protection regulations.

Responsible agencies: Local public works departments typically construct and maintain water supply systems. Responsible agencies at the federal level include the EPA (protection of water from pollutants); the Department of Housing and Urban Development; the U.S. Army Corps of Engineers; Bureau of Reclamation, and the U.S. Geological Survey. At the state level, responsible agencies include Departments of Natural Resources, water resource agencies, and Departments of Health; at the local level, public works departments, water utilities and water districts play key roles.

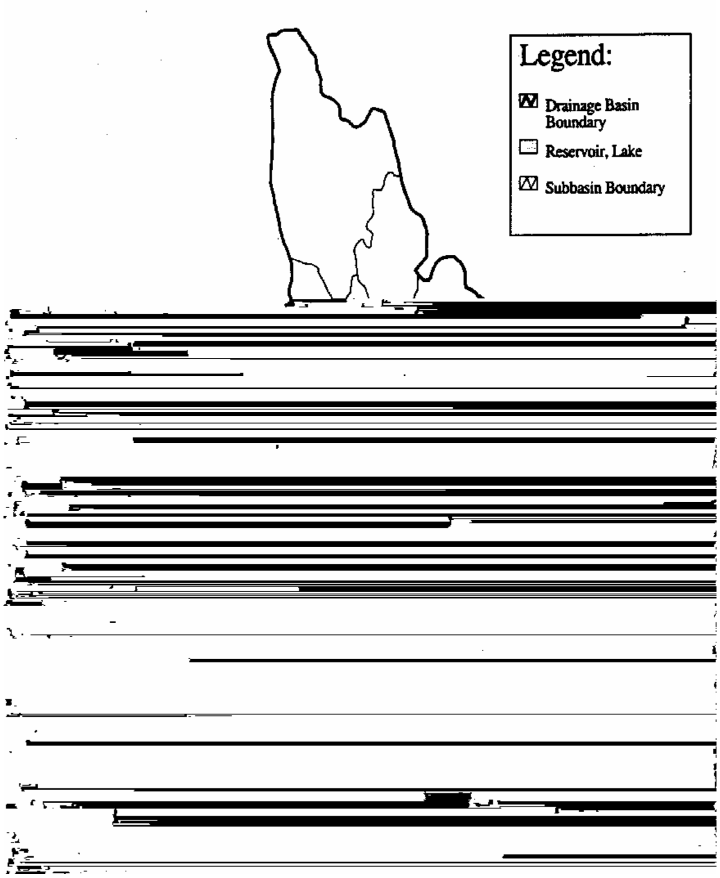
Watershed perspective: Water supply from surface water sources is now typically planned and managed from a watershed or subwatershed perspective. The watershed may be hundreds of acres to hundred or thousands of square miles.

Benefits of wetlands/floodplains ecosystems to water supply: Wetlands can help protect water quality in water supply rivers, lakes, reservoirs in ground water basins by reducing erosion, sediment, nutrients and other pollutants. Some wetlands have been created at the margins of reservoirs to reduce erosion.

Conflicts and problems: Dams and reservoirs have often displaced wetlands and altered the hydrologic and sediment regimes of downstream wetlands. Diversion and groundwater pumping have "dewatered" wetlands or affected wetland water supply. The impact of diversions and groundwater pumping is particularly severe in the West and near urban areas and has led to the adoption of minimum flow requirements in some areas.

Figure 20

Wetlands and Source Water Protection
New York Water Supply



POINT SOURCE POLLUTION CONTROL

Overall Approaches

In 1972 Congress adopted the Water Pollution Amendments, which established a national water pollution control program. These amendments emphasized control of point sources of pollution.

This program resulted in widespread construction of community and industrial pollution treatment facilities during the first twenty years of the program. From 1972-1988 alone, communities and industries spent more than $85 billion to control point sources of pollution. More recently, emphasis has partially shifted from point source to nonpoint source pollution control.

The principal approach for mitigating point sources of pollution and controlling new sources has been the construction of sewage treatment works. Federal construction grants have been broadly available to communities.

Pollution control works typically involve a collection system, primary treatment to remove sediment, biological matter, litter, and other major materials, and secondary and in some instances tertiary treatment to remove a portion of the nutrients and other residual materials.

Increasingly, communities and industries have used various types of tertiary treatment measures to reduce phosphorous and nitrogen. Many communities have created wetlands or used natural wetlands for such tertiary treatment. However, the use of natural wetlands for treatment has been controversial due to the impacts of nutrients, heavy metals and other substances on wetlands and wildlife.

Most states have adopted point source pollution regulations consistent with EPA guidelines, thereby establishing standards for waters throughout a state. A number of states, such as Wisconsin, have adopted water quality standards for wetlands as part of broader processes. Other states, such as Ohio and New York, have similar efforts underway.

Options

How can communities reduce point source pollution while better protecting and restoring wetland and related ecosystems?

1. Construct artificial wetlands for secondary and tertiary treatment of wastes. Many communities have constructed artificial wetlands for the tertiary treatment of wastes. In 1995 Phoenix, Arizona constructed a twelve-acre demonstration wetland to treat wastewater. This wetland is being monitored with the goal of expanding treatment in 2003.

2. Restore wetlands, riparian areas and floodplains located in lakes, streams and estuaries to help intercept pollution before it enters water bodies. For example, wetlands have been restored along streams feeding Lake Mendota in Madison, Wisconsin to reduce sediment and nutrient pollution. Wetlands have also been restored to intercept runoff from feedlet operations.

3. Use alternative treatment techniques for wastes. For example, communities can use land treatment and other methods of disposing of wastes to avoid or reduce discharges into waters.

Box 44

Summary of Traditional Community Point Source Pollution Control Programs

Options

Communities can reduce nonpoint source water quality problems while protecting and restoring wetlands and related ecosystems in the following ways:

1. Protect wetland/floodplain and riparian ecosystems that act as filters and buffers for lakes, streams, creeks, estuaries and the oceans. Communities can protect wetland/floodplain and related ecosystems through a variety of measures. s

Box 45

Summary of Traditional Community Nonpoint Source Pollution Control/Prevention Programs

Goals: The principal goal of community nonpoint pollution control programs is to reduce sediment, nutrients, toxic chemicals and other types of pollution. The more specific goals for nonpoint pollution control efforts are to identify sources of nonpoint pollution and reduce these sources through best management practices, regulations, restoration of wooded buffers and wetlands, erosion control measures and other techniques. Many nonpoint pollution control programs in recent years have included broader objectives, such as protection of flood storage and reduction in erosion.

Some principal information needs: Information is needed about sources of pollution, the quantity and quality of waters, average and minimum flows, wildlife and other use of waters.

Extent of programs: Many local governments have adopted pollution control programs, such as stream buffer requirements, sediment controls, and restrictions on tree-cutting, that address some aspects of nonpoint pollution. Such programs are extensive and highly varied in content.

Responsible agencies: Control of nonpoint sources of pollution has primarily been the responsibility of local planning and zoning departments. Responsible federal agencies include the EPA (primary), U.S. Army Corps of Engineers and Natural Resources Conservati4.2050d p888 Tw 10.98 0 0 10.9

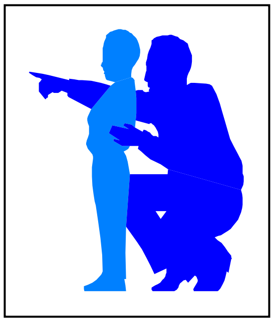
CHAPTER 7:
LOOKING TO THE FUTURE

"While geographic-based planning relies on strong local leadership and is enhanced with state or tribal backing, federal agencies will contribute by strengthening existing assistance programs and developing new ways to provide support." *— Clean Water Action Plan: Restoring and Protecting America's Waters (1994)*

"The land belongs to the people. A little bit to the living; some to the dead, but most to those yet unborn." *— Just v. Marinette County*

"Without an active and ambitious restoration problem in the United States, our swelling population and its increasing stresses on aquatic ecosystems will certainly reduce the quality of life for present and future generations. By embarking now on a major national aquatic system restoration program, the United States can set an example of aquatic resource stewardship that ultimately will set an international example of environmental leadership." *— Restoration of Aquatic Ecosytems, National Research Council, National Academy of Sciences*

"The Green Infrastructure land network is a proposed concept to protect and link Maryland's remaining ecologically valuable lands. These lands would include, for example, large contiguous tracks of forest lands, important wildlife habitats, wetlands, riparian corridors and areas that reflect key elements of Maryland's biological diversity. The proposed network would be linked by a system that connects large contiguous blocks of natural resource lands (hubs) through corridors that encompass the most ecologically valuable areas between these hubs (e.g. areas of high aquatic integrity, wetlands, wildlife migration routes and important forest lands). This concept is not a plan or a mandate to protect these valuable lands but rather it envisions the cooperative efforts of many people and organizations including government agencies, land trusts and interested private landowners."
— The Green Infrastructure Land Network,
Maryland Department of Natural Resources, June 10, 1999



CHAPTER 7: LOOKING TO THE FUTURE

THE WAY FORWARD

Looking to the future, there are compelling scientific reasons for communities to better coordinate or integrate water and land resources management with wetland-related ecosystem protection. Both types of programs depend on the same scarce community water resources. Both need sound hydrologic and ecological information. Both require landscape level surveys and analyses.

There are also strong political and budgetary reasons. Multi-objective, coordinated approaches are the only way to reconcile conflicting goals and programs, and to satisfy diverse constituencies. These approaches can cost effectively ac

GREEN INFRASTRUCTURE

Networks of greenways and buffers along waterways can accomplish many water resource management and wetland protection objectives. For example, Maryland has adopted a “Green Infrastructure Land Network Program” to link all types of ecologically valuable land.

Greenways and buffers do not solve all ecosystem management problems, nor do they make sense in all instances. But, because they simultaneously serve many purposes, they are rationally and economically justified in a broad range of m(ically)Tj10.98 0 0 10.98 203.2907 529.080981 541.68

For example, in 1997 the Nature Conservancy in Florida worked with other organizations to acquire 49,976 acres, 11,000 of which are along the Kissimmee River, to create the Latt Maxcy/Kissimee Prairie State Preserve.

Similarly, the Nature Conservancy in New York put together a watershed conservation strategy for Great Swamp. Great Swamp is a 6,768-acre wetland in a 62,343-acre watershed. It traverses five municipalities in two counties. The Conservancy is acquiring much of the land and has an aggressive planning and education effort underway for the watershed.

Many local nonprofits have spearheaded local wetlands and watershed planning efforts as well.

REGIONAL PLANNING ENTITITES

Regional planning agencies like the Lane County Regional Planning Agency have the potential for playing stronger roles in community wetlands and watershed management. They have the broad geographical perspective needed for conducting watershed

Box 46
Summary of Community Benefits

Wetlands and watershed planning and management can provide a wide range of community benefits:

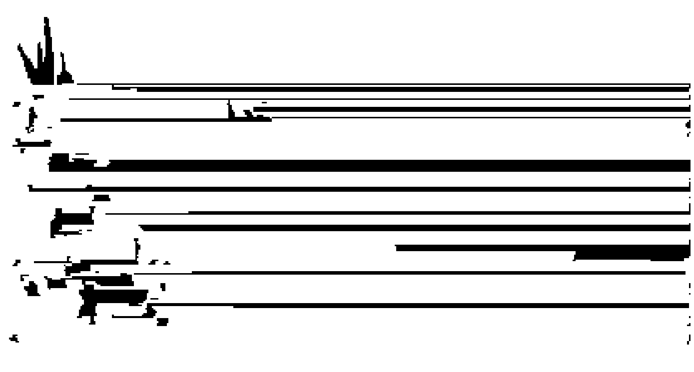
- **Improved implementation of water resources and watershed programs, including flood loss reduction, stormwater management, pollution control and source water management**

- **Improved implementation of wetlands and ecosystem protection and restoration efforts, resulting in better fishing, swimming, bird-watching, canoeing, hiking and outdoor education**

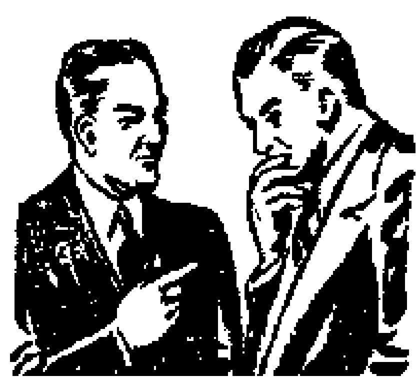
- **Improved community ability to allocate lands for most appropriate uses**

- **Improved protection and restoration of community cultural and natural heritage values**

- **Improved sense of community through decreased conflicts and expanded citizen participation**



APPENDICES



APPENDIX A: SOURCES OF FINANCIAL AND TECHNICAL ASSISTANCE

SEEKING WETLAND EXPERTISE AND TECHNICAL ASSISTANCE

As a preliminary step in seeking wetland expertise, we suggest that you identify your needs as specifically as possible. This may not be so easy at an early stage. Most wetland experts are quite specialized. Experts in wetland vegetation often have little training in hydrology; conversely, w

State Wildlife Agency (or division within an agency). In many states, the wildlife agency is part of a department of natural resources or department of conservation. Waterfowl, fisheries, endangered species, and other experts are typically found here.

State agencies or divisions dealing with water-related lands — e.g., water resources management, coastal zone management, shoreline or shoreland management, floodplain management, rivers management and pollution control. In most states, these are divisions of Departments of Natural Resources or Departments of Environmental Conservation.

State Department of Parks, Recreation and/or Public Lands and Waters. State agencies managing lands, including submerged lands, are another source of technical assistance.

State Departments of Agriculture, Forestry. These state agencies may provide assistance to landowners who seek to better manage their lands, including soil and water conservation, pollution control and sustainable use.

LOCAL GOVERNMENTS

The capability of local governments to provide wetland expertise and technical assistance vari s8n.9837.0s

Academic staff with wetland expertise can

APPENDIX B: USEFUL INTERNET ADDRESSES

The following list of Web sites has been compiled from many sources and appears in alphabetical order.

Association of State Wetland Managers
www.aswm.org

Ducks Unlimited Canada
www.vm.ducks.ca

Ducks Unlimited Canada - Nature Notes
www.vm.ducks.ca/naturenotes

EcoScope
www.wetlands.ca/EcoScope/ecopage.html

Educating Young People About Water
www.uwex.edu/erc/eypaw/

Environmental Law Institute On-line
www.eli.org

Federal Emergency Management Agency (FEMA) **www.fema.gov**

GOSWAMPY - Wetlands Information
www.swampy.org

The Great Lakes Program at the University of Buffalo
www.wings.buffalo.edu/glp/

National Oceanic Atmospheric Administration (NOAA)
www.noaa.gov

NOAA - Nati

U.S. Environmental Protection Agency
(USEPA)
www.epa.gov

University of Maryland Center for Environmental Science
www.umces.edu

WetNet-Texas Wetland Information Network
www.glo.state.tx.us/wetnet

Model Ordinances to Protect Local Resources
www.epa.gov/owow/nps/ordinance/

Smart Growth Online
www.smartgrowth.org/Default.asp?res=1024

WETNET: The Wetlands Network
www.wetlands.ca

APPENDIX C: FEDERAL, STATE AND LOCAL WETLAND REGULATIONS

Regulations are a principal means by which wetlands and watershed management plans and policies are implemented. The following federal, state and local permits are usually required for altering wetlands.

FEDERAL SECTION 404 PERMITS

The Section 404 permit program, adopted by Congress in 1972, is implemented jointly by the U.S. Army Corps of Engineers (Corps) and the U.S. Environmental Protection Agency (EPA); it is the only nationwide wetland regulatory program. The Corps issues individual permits for activities in wetlands, with some oversight by the EPA, which can veto permits. The U.S. Fish and Wildlife Service, National Marine Fisheries Service and the USDA Natural Resources Conservation Services play lesser roles in permitting and, in the case of NRCS, carry

General Permits

Floodplain permits. Over 18,300 local governments have adopted floodplain regulations. These regulations usually include a map showing the boundaries of the 100-year floodplain. In approximately half the communities, more restrictive floodway areas are also shown. Many coastal floodplain maps also designate high hazard areas. In general, regulations prohibit fills and other development in floodways that will increase flood heights. Structures and other uses may be permitted in outer flood fringe areas if they are elevated or otherwise protected to the 100-year flood elevation.

Virtually all coastal wetlands and most wetlands along major rivers and lakes lie within 100-year floodplain areas.

Septic tank/soil absorption field permits. Virtually all states or local governments require a sanitary or septic tank permit for houses or commercial development without sewers. Ty

- **National Flood Insurance Act** (42 USC 4001-4128) allows the Federal Emergency Management Agency (FEMA) to provide federally subsidized flood insurance to communities that adopt regulations in 100-year floodplain areas. These regulations allow flood-protected structures in outer flood fringe, and they control development and fills that may increase flood heights in inner floodways. More than 18,000 communities have adopted floodplain regulations to comply with this act.

- **Endangered Species Act** (16 USC 1531 et. seq.) requires that federal agencies conserve endangered and threatened animal species. It also prohibits any person from killing, harassing or harming a protected species. The federal government is supposed to designate critical habitat for endangered and threatened animal species, and the U.S. Fish and Wildlife Service is expected to prepare recovery plans for them.

Pittman-Robertson and Dingell-Johnson Acts (16 USC 669-669I; 16 USC 777-777K). Under these acts states and territories receive up to 75% funding for comprehensive fish and wildlife resource management plans, as well as restoration and management projects. These programs are funded by excise taxes on fishing and hunting sales.

Coastal Wetlands Planning, Protection and Restoration Act (16 USC 3951-3956) authorizes the U.S. Fish and Wildlife Service to make matching grants to coastal states to acquire, manage, restore and enhance wetlands. The act focuses primarily on Louisiana's wetlands.

North American Wetlands Conservation Act of 1989 (16 USC 4401-4413) makes grants available to states and private organizations for wetland conservation partnership projects that further the goals of the North American Waterfowl Management Plan and international migratory bird treaties. Ordinarily, acquired land becomes part of the National Wildlife Refuge System.

FEDERAL FUNDING FOR PROTECTION AND RESTORATION OF WETLANDS BY PRIVATE PROPERTY OWNERS

Water Bank Act of 1970 (16 USC 1301, et. seq.) provides funding for farmers in participating states in the form of annual rental payments, for up to 10 years, for protecting and restoring inland, agricultural wetlands and adjacent uplands that are important to migratory waterfowl.

Conservation Research, Conservation Easement and Wetlands Reserve Provisions (Food Security Act of 1985, Public Law 99-198, Title XII; Food Agriculture, Credit and Trade Act of 1990, Public Law 101-624) provides cost-sharing and rental payments (10-15 years) to farmers for protection and restoration of farmed wetlands. This program is designed to protect wetlands, highly erodible uplands and filter strips adjacent to wetlands.

Wetland Reserve Program (16 USC 3877a-373871) was authorized by the 1990 Farm Bill, which provides financial incentives to landowners for protection and restoration of up to 1 million acres of wetlands through easements ranging from 30 years to permanent. This program applies to farmed or converted wetlands, adjacent buffers and riparian areas linking wetlands.

Watershed Protection and Flood Protection Act (16 USC 1001-1009) authorizes the Natural Resources Conservation Service to provide financial and technical assistance to local governments carrying out projects for watersheds smaller than 250,000 square miles. The 1990 Farm Bill amended this program to allow 50 percent federal cost-sharing for the acquisition of perpetual easements in wetlands and floodplain areas for flood prevention and conservation purposes.

Farmers Home Administration Wetland-Related Programs (7 USC 1985, 1987) may forgive loans ection Act (1

APPENDIX E: RELEVANCE OF HYDROLOGIC CHARACTERISTICS TO ECOSYSTEM PROTECTION AND WATER RESOURCE DEVELOPMENT

Many types of hydrologic and hydraulic information are relevant to both ecosystem management and broader water resources/watershed management. Some include:

1. **Average water levels and depths**

4. Quantity of water

Relevance to wetlands/floodplain/aquatic ecosystem protection and restoration: The total quantity of water flowing through a wetland and related ecosystem is often less relevant than average depths, maximum and minimum flows, and hydroperiod to flora and fauna. Quantity of water, which is also affected by velocity, vegetation, etc., is relevant to wetland flood storage, flood conveyance and pollution control functions.

Relevance to broader water resources management: The total quantity of water passing a particular point along a river or in a reservoir, groundwater aquifer, or other system is relevant to flood and erosion hazards. It is also important in determining the water supply (reservoir storage), pollution control and recreation potential.

5. Water Velocity

Relevance to wetlands/floodplain/aquatic ecosystem protection and restoration: High velocity water often destroys wetland, floodplain, and riparian vegetation and causes o7 Tw 1 10.98 0 0 10etland, fl

Function/value:
Convey flood waters

Value: Reduce flood heig

Function/value:
Reduce erosion by slowing velocity of water and by binding and retaining soil

Value: Reduce erosion property losses, ecological damage, and sedimentation of lakes, streams, reservoirs, estuaries and other wetlands**.**

General discussion: Vegetated floodplains and wetlands may reduce erosion in a broad range of contexts by slowing the velocimds

Function/value:
Provide natural crops and timber

Value: Produce natural crops of commercial and recreational value, such as cranberries, blueberries, salt marsh hay, timber and wild rice.

Features determining function/value:

- Water salin

Function/value:
Prevent and treat pollution

Value: Prevent and treat pollution in lakes, streams, estuaries, coastal and ground waters.

General discussion: Many wetlands and some floodplains/riparian areas serve two related functions:

- Prevent pollution from entering water bodies — Wetlands and vegetated floodplains intercept and trap debris, toxics, nutrients and other pollutants, which would otherwise reach water bodies from

Function/value:
Provide habitat for fish and shellfish

Value: Provide sport and commercial fisheries, food, recreation, cultural value and food chain support.

General discussion: The importance of coastal and estuarine wetlands to fish and shellfish are well known coastal and estuarine wetland functions/values. The importance of freshwater wetlands to northern pike spawning and other fish is also well recognized.

Features determining function/value:

- Fish/shellfish capacity of adjacent waters (depth, salinity, water quality, velocity c

Function/value:
Provide habitat for amphibian, reptile, mammal and insect species

(Note: this overlaps with other types of habitat.)

Value: Provide ecological, heritage, recreation, aesthetic and cultural values.

General discussion: Wetlands and floodplains provide critical habitat for many amphibians, reptiles, mammals and insects. Functions/values depend not only on wetlands/floodplain/riparian area characteristics, but also relationship to uplands and deepwater habitat because most amphibians, mammals and reptiles spend only a portion of their time in wetlands.

Features determining function/value:

- Water depth, velocity
- Water level fluctuations
- Water quality
- Salinity
- Sediment regimes
- Vegetation types, density
- Size of wetland/floodplain
- Edge ratio of wetland/floodplain
- Relationship of wetland to other wetlands, floodplains, water bodies, and upland habitat, availability of corridors and passageways between wetland and other habitat
- Presence or absence of buffers

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Function/value:
Provide habitat for waterfowl species

(Note: this overlaps with habitat.)

Value: Provide food, recreation, aesthetic, economic and cultural value.

General discussion: Waterfowl nesting, resting and feeding were some of the most widely recognized functions of wetlands. Adjacent floodplains and riparian areas may also be important nesting and feeding areas. The prairie pothole wetlands and wetlands in various flyways are particularly important. Because waterfowl fly from wetland to wetland, they can make use of many types of isolated and semi-isolated wetlands not used by other forms of wildlife that de

Function/value:
Provide habitat for birds

(Note: this overlaps habitat.)

Values: Ecotourism, recreation, education and research.

General discussion: In the past 20 years, bird watching has become a widespread activity, with bird watchers often outnumbering E8

Function/value:
Provide habitat for endangered or threatened species of plants and animals

(Note: this overlaps with other habitat categories.)

Value: Protect gene pools; provide ecotourism, birdwatching, research and education.

General discussion: Many endangered or threatened plant or animal species depend on wetlands, floodplains and riparian areas. Some spend their entire lives in wetlands; others only use wetlands some of the time. Therefore, upland and deep water habitat, and the connections between wetlands and these other habitats, are very important. Connections are also important for providing refuge during droughts and periods of fluctuating water levels. Because of the sensitivity of many of these species and their narrow ecological niches, it is particularly important to protect not only habitat, but also water regimes.

Features determining function/value: A large number of features are relevant to the ability of wetlands, floodplains and ri

Function/value:
Recharge ground water

Value:

Function/value:
Discharge ground water

Value: Prevent damaging increases in ground water levels; maintain water levels and flow regimes

General discussion: Many depressional, slope, lake, estuarine and river fringe wetlands, floodplains and riparian areas are ground water discharge some year. If a wetland or floodplain is filled, reducing ground water discharge, ground water levels in the fill and surrounding landscape may rise. Basements may flood, and septic tanks and soil absorption systems may stop working, among other problems.

Features determining function/value:

- Wetland/floodplain/riparian area surface water elevation versus groundwater elevation in nearby upland areas (piezometric surface)
- Outlet level
- Permeability and porosity of soils

Wetland/floodplain/riparian area types: Riverine and some lake, coastal and estuarine fringe.

Difficulty in evaluating: Discharge may be directly observed in some instances (e.g., springs in wetland/floodplain), but is otherwise difficult to evaluate.

Sources of information: NWI maps (overall water regime, wetland type), topographic maps, well logs and USGS maps.

Red and yellow flagging (some features to look for):

- Visible springs
-

Function/value:
Modify micro-climate

Value: Reduce temperatures in nearby areas.

General discussion: Wetlands and floodplains along with other open spaces moderate temperatur

ECOLOGICALLY AND MORE BROADLY ENVIRONMENTALLY BASED FUNCTIONS/VALUES

(Humans enter the picture — accessibility and other factors).

Function/value: Provide recreation, ecotourism opportunities

Value: Health, economic value, fisheries, ecotourism

General discussion: Recreation is one of the most important uses of wetlands and related water and floodplain resources. Some common water-based recreational activities include fishing, canoeing and boating; land-based recreation includes bird and nature watching, and hiking or biking along trails.

Features determining function/value: A broad range of wetland/floodplai

Function/values:
Provide historical, archaeological, heritage and aesthetic experiences

Function/Value:
Provide education and interpretation opportunities

Value: Educate students at all levels

General discussion: Many types of education and nature interpretation are carried out in wetlands and floodplains at K-12 and adult education levels. These range from observation of frogs and birds to sophisticated restoratiola

Function/value:
Provide scientific research opportunities

Value: Advance scientific knowledge, improve understanding of natural systems.

General discussion: Schools, universities, resource agencies and nonprofit organizations carry out a large amount of scientific research in wetlands and, to a lesser exx

APPENDIX G: WETLAND FUNCTION/VALUE ASSESSMENT METHODS

Rapid and more detailed function and value assessment techniques have been developed specifically for wetlands or developed for other uses and applied to wetlands and floodplains. Some include:

RAPID ASSESSMENT APPROACHES FOR FUNCTIONS/VALUES

WET and similar matrices analysis approaches were used extensively in t

Some field surveys may involve the use of named techniques or approaches, such as application of the 1987 U.S. Army Corps of Engineers manual for the Delineation of Jurisdictional Wetlands. Formal use may be made of transects and sampling procedures. More often, field surveys primarily involve visual observations, with note-taking and photographs rather than named assessment methods.

- **Hydrologic and hydraulic models (e.g., HEC, TR 20 others).** Regulatory agencies or landowners/consultants can use a variety of hydrologic and hydraulic models to investigate flood conveyance, flood storage, erosion control, wave attenuation and other hydrologic functions/values. They can also use the models to determine flood and erosion natural hazards at a site and determine the impact of a proposed activity upon flood, wave and erosion hazards.

For example, the Rational Formula, variations and computerized models can be used to com

Data necessary for these models is often expensive to obtain since detailed topographic and hydrologic (e.g., steam gauging) information is needed. However, use of Global Positioning Systems and other techniques reduces the cost of detailed topographic information. In addition, hydrologic information gathered for floodplain management, stormwater management, and other purposes can often be used for assessment of activities in wetlands, including wetland functions/values.

- **Stream hydrologic/geomorphic assessment approaches (e.g., Rosgen).** Regulatory agencies can use several models to evaluate the morphology and condition of streams to help determine functions/values and restoration and management needs. The models evaluate the condition of streams versus natural streams in terms of stream slope and form. These approaches are increasingly used to determine possible erosion, f a Geographic Information System. South Carolina Water Resources Commission Report No. 178, USEPA Report No. EPA904-R-94-001.

- **Assessment of overall ecological processes ("functions") through HGM.** The HGM wetland assessment method was formally proposed by the Corps of Engineers and other federal agencies for use on Section 404 regulatory permits (see work plan published in the Federal Register, August 16, 1997. See also Appendix D of Assessment Technical Report 3 for more detailed discussion). So far, the Corps has published two documents in addition to this action plan, describing this approach in greater detail.

One is a procedural HGM document: Smith, D., A. Ammann, C. Bartoldus and M. Brinson (1995) An Approach for Assessing Wetland Functions Using Hydrogeom

APPENDIX H: WHAT CAN BE LEARNED ABOUT WETLANDS FROM THEIR OVERALL TYPES?

The functions and values and other characteristics of wetlands/related resources are complex and varied. Nevertheless, some assumptions about wetland and related waters/floodplain and riparian ecosystems are possible with regard to functions/values, ownership and natural hazards. The categories of wetlands established in the Hydrogeomorphic Assessment Method — Lake Fringe, River Fringe, Coastal/Estuarine Fringe, Slope 44 0 10.98 405.47638 586.267s

Natural hazards, impact of activities on other lands. Riverine, lake fringe and coastal/estuarine fringe wetlands and related lands are often characterized by moderate to severe natural hazards, such as flooding and

CHARACTERISTICS BY WETLAND TYPE
(OVERALL HGM TYPE)
(Note: this does not strictly follow the HGM classes)

River Fringe Wetlands

Settings: In rivers, creeks, stream beds, river banks or floodplains. Riverine wetlands are particularly extensive along large, low gradient rivers but also occur as broken thin bands or ribbons in and along many smaller perenn

- Wetlands along smaller creeks are particularly susceptible to watershed changes that affect flow rates and water quality.
- Many riverine wetlands have been partially isolated from adjacent waters by levees.
- Many riverine wetlands are subject to severe flooding, with resulting temporary removal of vegetation and de

- Water supply protection
- Erosion control
-

Common Functions/Values:

- Fisheries and shellfish
- Water-based recreation
- Pollution prevention and treatment
- Wave retardation and erosion control
- Shorebird habitat
- Waterfowl habitat

Some Special Characteristics Relevant to Assessment:

- Tidally controlled, at least to the high tide line
- Periodically flushed by hurricanes and coastal storms

Susceptibility of Hydrology to Change: Coastal estuarine wetlands have a constant source of water—the ocean and tides. But, they are susceptible to human influences, such as diking and channelization. They may be particularly susceptibile to climate change and sea level rise where coastal and inlandll550.67926 Tm(clim)Tj10.5 0 0 10.5 310.9

Some Functions/Values:

- Habitat for mammals, reptiles, amphibians and end[redacted]ered species
- Pollution prevention
- Erosion control
- Bird habitat

Some Special Characteristics Relevant to Assess[redacted]

- Dependent upon ground water discharge and, to [redacted]
- Large numbers throughout landscape in humid and [redacted]ountain states
- Many isolated from other waters and wetlands during normal hydrologic conditions

Susceptibility of Hydrology to Change: High due to land uses such as grazing, development and drainage.

Restoration Potential: Varied. Relatively high for partially drained (as opposed to filled) slope wetlands where the ground and surface water regimes are intact. However, restoration pote

Some Special Characteristics Relevant to Assessment:

- Many isolated during normal hydrologic conditions, not during times of floods
- Many altered, partially drained and partially filled
- Most are sinks and particularly susceptible to sedimentation, pollution
- Highly dependent upon runoff from the immediate watersheds

Susceptibility of Hydrology to Change: Moderate to great (depending upon the circumstances). Flats are quite susceptible to change because they depend on watershed runoff and ground water levels, which change due human influence (land clearing, development, drainage, dams, etc.). They are also susceptible to pollution and filling by sediment. They are, in general, sinks. Many are also susceptible to direct intrusion by dogs, cats, fills, lawn-moving, agriculture, etc. because of their small size, location in proximity to development activities and lack of buffers.

Restoration Potential: Varied. Relatively high for only partially drained (as opposed to filled) wetlands. However, restoration potential is poor where wetlands are filled or subject to high sedimentation or pollution rates.

Data Availability: In general, poor.

- Poorly identified on wetland maps because maps do not show smaller wetlands and these wetlands are difficult to spot on aerial photos.
- Flood maps almost never available for such wetlands.
- Surface water elevations and records are almost never available for such wetlands.

Depressional Wetlands

Settings: Wide range of settings, but mostly in the northern tier of glaciated states (kettleholes, potholes). Here there are millions of depressions in glacial till and moraines created by melting ice blocks during the retreat of the glaciers. Some depressional wetlands have also been created by solution (karst), wind action (Sand Hills of Nebraska), erosion and deposition (oxbows, vernal pools), and human activity (e.g., gravel pits,). Some depressional wetlands depend almost entirely on surface runoff (e.g., vernal pools); others depend on ground water (e.g., potholes), and many depend on a combination of ground and surface runoffs (e.g., potholes).

Wetland Regulatory Jurisdiction: Some depressional wetlands are subject to the individual Section 404 permits. Some depress

Some Functions/Values:

- Habitat for mammals, reptiles, amphibians and endangered species
- Pollution prevention
- Erosion control
- Bird habit

Some Special Characteristics Relevant to Assessment:

- Dependent on ground water discharge and surface runoff
- Large numbers throughout the land

APPENDIX I: GLOSSARY, ACRONYMS

Adjacent Wetlands: Wetlands that border, are contiguous to, or neighbor another body of water and have a hydrological connection to that body of water.

Alternatives Analysis: The regulatory requirement contained in most wetland regulations that activities be located on upland rather than wetland sites, unless there are no practical alternatives.

Assessment: Gathering and analyzing data and2.91ef0 0 .99805 Tm(n)Tj10.5 (G)Tj10.5 0 0 10.5 29j10.5

Floodway: That portion of the flood-prone zone along a river or stream that is needed to convey a specified (e.g., 100-year flood) with only a specified (usually one foot) rise of water level above the height of an unconstricted flood.

Functions: Used in a technical sense to mean normal or characteristic natural processes that ta

Out-of-kind Mitigation: Mitigation in which lost wetland functions and or/values are replaced by a wetland of a different type.

Project Alternative(s): Different ways in which a given project can be carrie

APPENDIX J: RECOMMENDED READING

(Note: not all are cited in this guidebook.)

Landowner Assistance

Arkansas Game and Fish Commission. 1995. Landowners Guide to Voluntary Wetland Programs in Arkansas

Georgia Department of Community Affairs. Landowners' Guide to Wetlands and Watersheds. Office of Coordinated Planning, Atlanta, Georgia

Texas Parks & Wildlife. Wetlands Assistance Guide for Landowners. Austin, Texas

U.S. Department of the Interior. 1992. Wetlands Stewardship. Washingtonnds St

Federal Interagency Floodplain Management Task Force. 1995. Protecting Floodplain Resources: A Guidebook for Communities. Washington, D.C.

Federal Interagency Floodplain Management

State Wetlands Plan. 1995. Dealing With Wetlands In Minnesota: Questions & Concerns From Around the State About Issues For a State Wetlands Conservation Plan. Project Reprot #1. Minnesota Department of Natural Resources, St. Paul, Minnesota

Tip of the Mitt Watershed Council. 1992. Michigan Wetlands Yours to Protect: A Citizen's Guide to Local Involvement in Wetland Protection. Second Edition. Conway, Michigan

U.S. Army Corps of Engineers. 1995. Floodplain Managment Assessment of the Upper Mississippi River and Lower Missouri Rivers and Tributaries. St. Paul, Minnesota

U.S. Army Corps of Engineers. 1993. Flood Proofing - How to Evaluate Your Options

U.S. Department of the Interior. 1993. Riparian Area Management: Process for Assessing Proper Functioning Condition. Bureau of Land Managment, Denver, Colorado. Tech. Ref. 1737-9

U.S. Department of the Interior. 1991. A Casebook in Managing Rivers for Multiple Uses. National Park Service, Washington, D.C.

University of Minnesota. 1994. Recovery and Resettlement A First Look at Post-Flood Recovery Planning Issues in the Upper Mississippi River Valley. Design Center for American Urban Landscape, College of Architecture and Landscape Architecture. Minneapolis, Minnesota

Wolf, R. Raccoon River Watershed Project. West Des Moines, Iowa

Education

Briuer, E. 1994. The Young Scientist's Introduction to Wetlands. U.S. Army Corps of Engineers, Vicksburg, Mississippi

Environmental Conern, Inc. and The Watercourse. 1995. WOW! The Wonders of Wetlands. St. Michaels, Maryland and Bozeman, Montana

Creation and Restoration Guidance

Apogee Research, Inc. 1994. National Wetland Mitigation Banking Study: An Examination of Wetlands Program

U.S. Environmental Protection Agency. 1992. Restoring and Creating Wetlands: A Planning Guide for the Central States Region: Iowa, Kansas, Missouri, and Nebraska. Region 7, Wetlands Protection Section, Kansas City, Kansas

Watershed Planning/Management Guidance

Ministry of Natural Resources. 1993. Integrating Water Management Objectives Into Municipal Planning Documents. Ontario, Canada

Ministry of Natural Resources. 1993. Water Management On A Watershed Basis: Implementing an Ecosystem Approach. Ontario, Canada

Ministry of Natural Resources. 1993. Subwatershed Planning. Ontario, Canada

Napa County Resource Conservation District. 1994. Napa River Watershed Owner's Manual: A Framework for Integrated Resource Management. Napa, California

River Federation. 1994. Institutional Frameworks For Watershed Management Programs: Profiles and An

Terrene Institute. 1993. C

U.S. Environmental Protection Agency. 1996. Chesapeake Bay Communities-Making

Jensen, K.C. and C.O. Martin. 1994. Guidelines for Placement and Management of Wood Duck Nest Bozes in Wetland Habitats. USACOE, Vicksburg, Mississippi. WRP Tech. Note FW-SW-4.1.

Mitsch, W. J. and J. G. Gosselink. 1993. Wetlands Second Edition. Van Nostrand Reinhold, New York, New York

Morrish, W. R. and C. R. Brown. 1994. Planning To Stay. Milkweed Editions, Minneapolis, Minnesota

Platts, W. S., C. Armour, G. Booth, M. Bryant, J. L. Bufford, P. Cuplin, S. Jensen, G. W. Lienkaemper, G. W. Minshall, S. B. Monsen, R. L