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ABSTRACT

This material includes student guide sheets, reference materials, and tape script for the audio-tutorial unit on Inland Wetlands. A set of 35mm slides and an audio tape are used with the material. The material is designed for use with Connecticut schools, but it can be adapted to other localities. The materials emphasize characteristics of inland wetlands, role of these areas for human use, and role of these areas in maintaining water quantity and quality, flood control, and sediment control. (RH)

INLAND WETLANDS

GUIDE SHEET #1

Welcome to the audio-tutorial unit on inland wetlands. Before listening to the tape provided with this unit, please read the list of objectives for this unit. When you have completed that task, put slide #1 in the slide viewer, and turn on the tape recorder.

OBJECTIVES: At the conclusion of this audio-tutorial unit-Inland Wetlands I you should be able to:

1. Describe inland wetlands in terms of their biological, geological and hydrological components.
2. Describe the role of wetland areas in maintaining water quanity and quality, flood control and sediment control.
3. Describe the value of inland wetlands as recreational areas, wildlife habitat and educational resources.
4. Use a plant key to classify inland wetland areas as open water, deep marsh, shallow marsh, seasonally flooded flat, meadow, shrub swamp, wooded swamp or bog.
5. Discuss the impact of human activity on wetland functions.
6. Construct a list of wetland functions and describe ways in which each wetland function benefits your community.

Place the tape for Inland Wetlands Part I in your recorder and put slide #1 in the slide viewer. Now procede with the A-T unit!

BE A RECYCLER YOURSELF. WRITE YOUR COMMENTS, NOTES, AND ANSWERS ON SCRAP PAPER INSTEAD OF THESE GUIDE SHEETS. IN THIS WAY, THESE GUIDE SHEETS WILL BE AVAILABLE FOR THE NEXT PERSON IN YOUR COMMUNITY WHO WILL BE MAKING USE OF THIS UNIT.

THIS MATERIAL IS PRINTED ON PAPER MADE FROM RECYCLED FIBERS AT DIAMOND INTERNATIONAL CORPORATION, HYDE PARK, MASSACHUSETTS MILL.

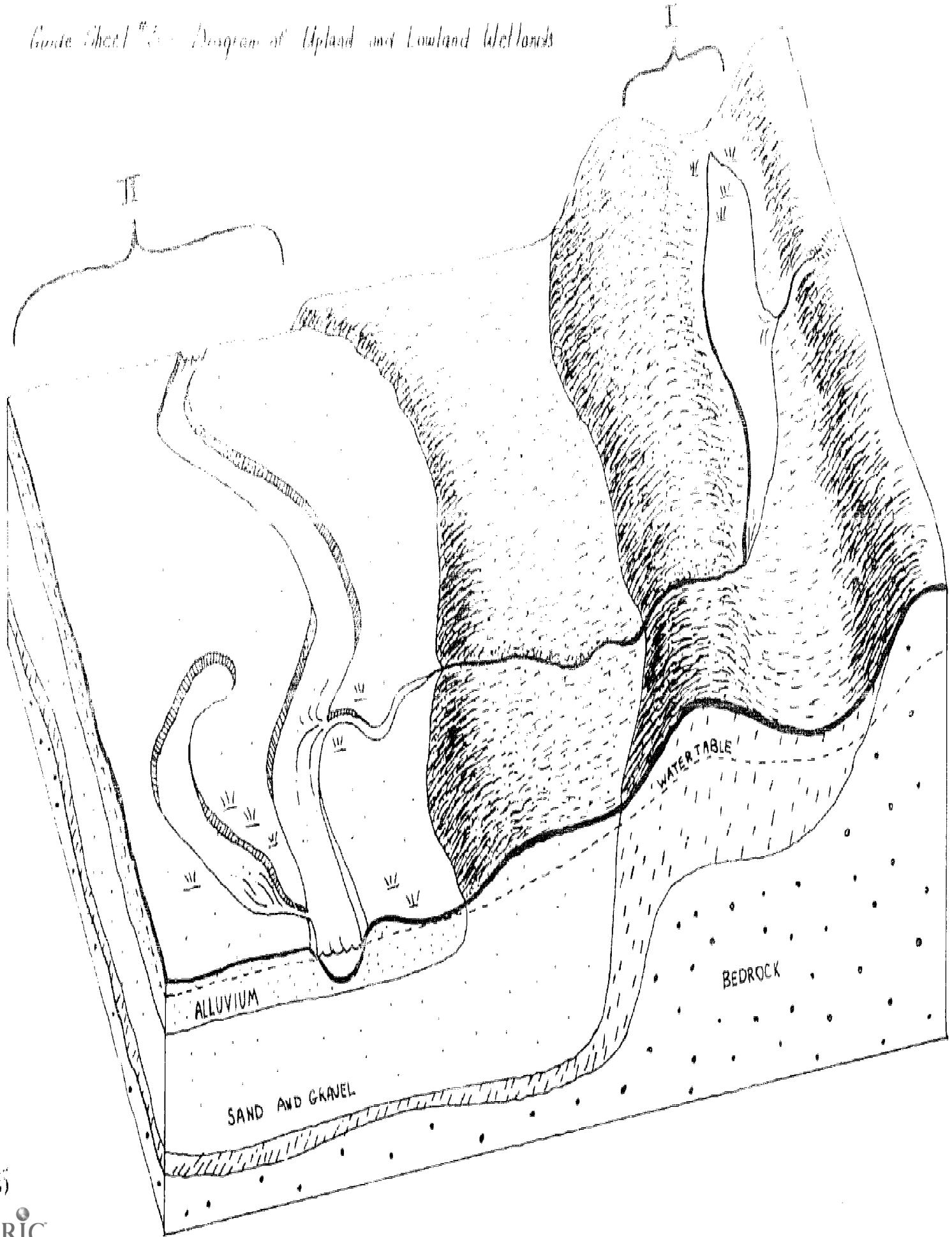
GUIDE SHEET #2

BRAINSTORMING ACTIVITY

At the signal you are to generate a list of all of the factors which you feel are characteristic of wetlands. At the second signal stop writing and we will discuss the list with you.

Feel free to add items to your list during the taped discussion!

Guide Sheet #3 — Diagram of Upland and Lowland Wetlands



GUIDE SHEET #4

A. Water Continuum from Upland Wetland to the Ocean

B. Summary of general inland wetland characteristics

1. Inland wetland areas are more or less regularly flooded areas.

2. The water table in a wetland is above, at, or near the land surface for a large part of the year.

3. A wetland may be described in terms of wetness conditions, soil types and the types of vegetation found in the wetland.

*If you want more time to study this guide sheet, turn off the recorder... when you are ready, turn the recorder back on.

GUIDE SHEET #5

OUTLINE OF INLAND WETLAND FUNCTIONS

1. Inland Wetland areas perform important functions as a component of the hydrologic system.

   a. Wetlands act as ground water discharge areas

   b. Wetlands enhance ground water recharge during floods

   c. Wetlands maintain ground water quality by filtering out impurities

   d. Wetlands maintain surface water flow by releasing water during periods of dry weather.

   e. Wetlands maintain surface water quality by
      (1) Trapping sediment
      (2) Filtering and absorbing pollutants

   f. Flood waters are stored by wetland areas and are gradually released as the levels of streams and rivers go down.

   g. The rate of flow of flood waters and normal water flows are slowed by wetland areas.

2. Wetland areas have an important function in the control of erosion and sedimentation

3. Wetlands are areas of high biological productivity. The availability of nutrients and moisture foster the growth of plants which in turn becomes a food source for animals in the locale.

4. Wetlands are biologically diverse areas. A wide variety of plant and animal species can be found in wetland areas. Wetlands provide excellent wildlife habitat. Rare or endangered species of plants and animals are often found in wetland areas. In studying ecosystems one generally finds that the diversity of the system is highly related to the ecosystems stability.

5. Wetlands provide us with water based as well as non-water based recreational opportunities. Water based activities include swimming, fishing, boating and other water sport. In addition these areas may also be utilized by picnicers, hikers, photographers and cyclists.

6. Educationally, wetland areas are extremely valuable for nature study and scientific research.

7. Wetlands also have aesthetic and historical value for a community. They provide valuable open space, they are pleasant to look at, and they often preserve historic land marks or land sites. In many communities wetlands are unique natural area.

GUIDE SHEET #6

RUN OFF FROM AN IMPERVIOUS SURFACE

When wetlands are used for the development of industrial sites or shopping centers, arrangements must be made to handle the run off that occurs during rain storms. Wetlands have the ability to store large quantities of water, on the other hand impervious surfaces generate large quantities of storm water run off. To illustrate this point, study the following problem.

SCENARIO: You have a 20 acre parcel of marginal wetland that has 800 feet of frontage on a major highway and is 1,089 feet deep. A development group has made an attractive offer for the property, with the intent of filling the area and building a shopping center on the site. Neighbors downstream for the site have expressed concern about the flooding of a small stream that runs across the back of the property.

TASK: Calculate the gallons of run off created during a two inch rainfall if the 20 acre parcel is covered by an impervious surface (i.e. parking lot and buildings).

PROCEDURE: (To calculate cubic feet of water we must multiply length of site in feet X width of site in feet X depth of water in feet)

1. Calculate the square footage of the area
   1,089 feet X 800 feet = 871,200 sq. ft.

2. Convert 2 inches of rainfall to a fraction of one foot
   2 inches/12 inches = 1/6 of a foot of rain

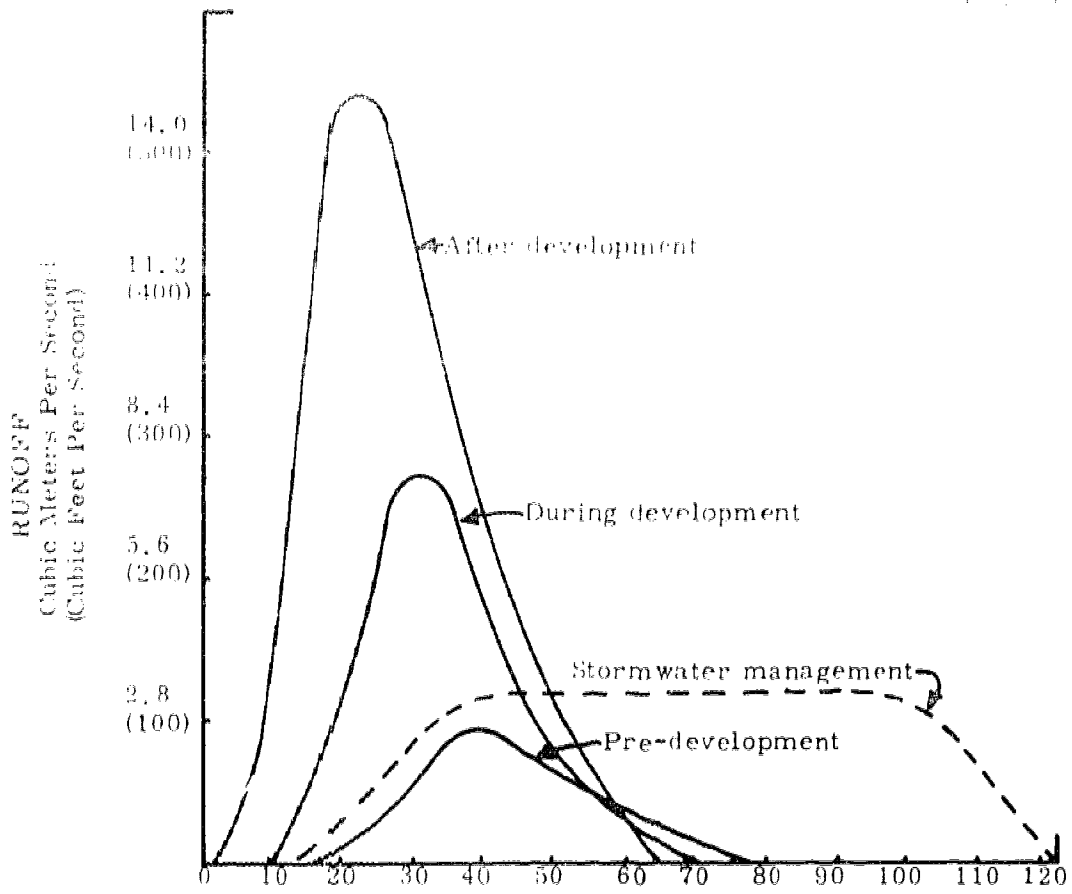
3. Now, to calculate the number of cubic feet of run off from this area, we would multiply.
   871,200 sq. ft. X 1/6 ft. of rain = 145,200 cu. ft. of run off

4. One cubic foot of water = 7.48 gallons, so to convert 145,200 cu. ft. to gallons we must multiply by 7.48 gallons per cubic foot. If you carry out the calculation you will be equal to 1,086,096 gallons.

If this quantity of water drains into the stream as direct run off, it will raise the height of the stream significantly. Frequently, improper planning for run off from these kinds of developments have led to serious downstream flooding.

GUIDE SHEET 6B

Although the case you have just studied is hypothetical, the problem of increased run off from development and subsequent pollution does exist. There are many cases of once natural streams becoming severely eroded or flooding because of construction activity in their watersheds. By instituting a sound program of stormwater management, runoff can be retained temporarily and the degree of discharge can be effectively maintained in a range that existed prior to development. The following graph compares the quantity of runoff from a site before, during and after development. The dashed line indicates the way in which potentically damaging runoff can be controlled through a stormwater management program.

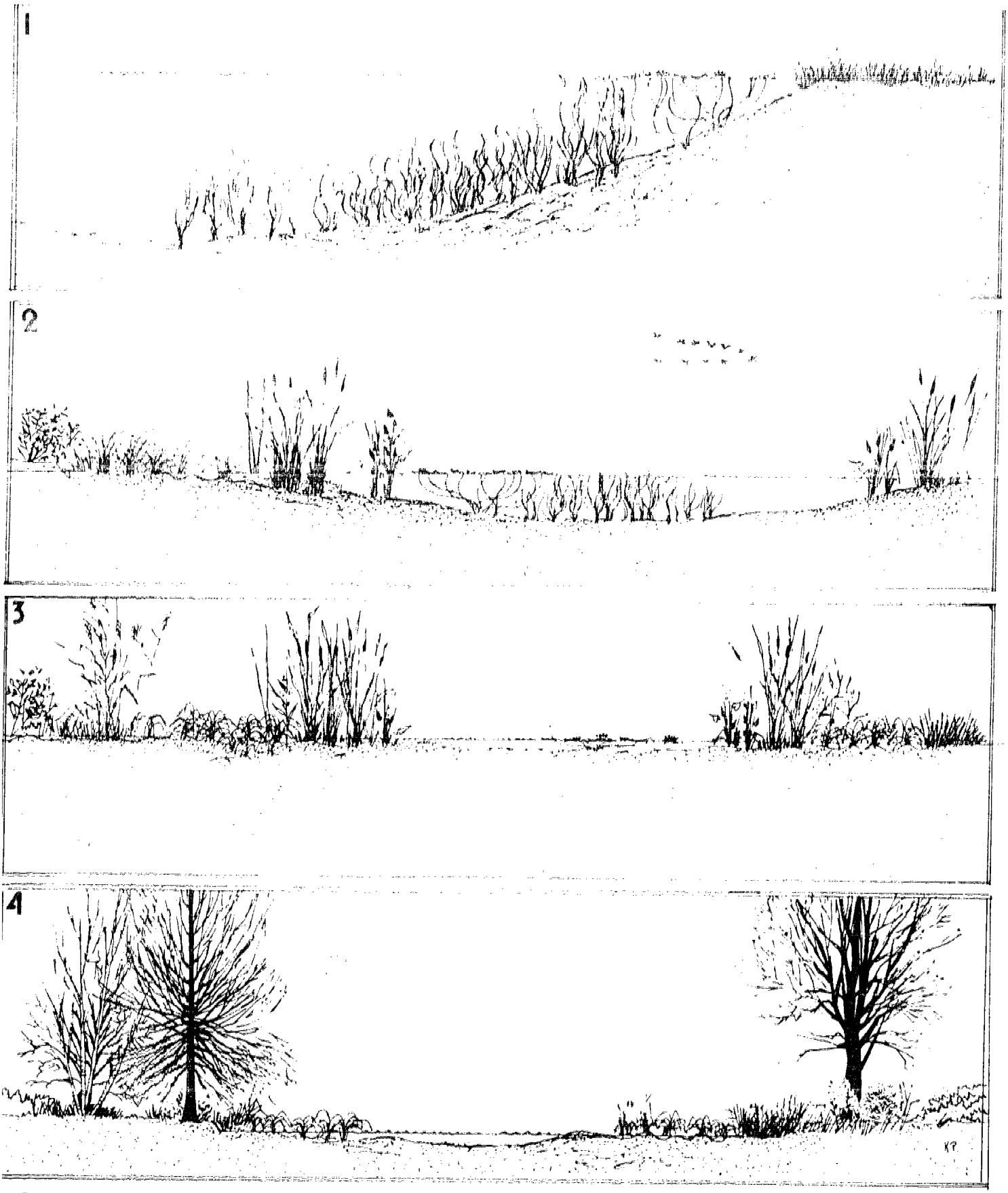


Unit hydrograph (dashed-line) showing stormwater management applied to study area
Source: Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activity EPA Bulletin 430/9-73-007 p/ 109

As you study the graph, there are several important factors which you should observe. In the predevelopment state the peak runoff period occured about 40 minutes after the start of the storm at a level of about 80 cubic feet per second. During development, runoff peaked at about 30 minutes after the start of the storm of a rate of about 270 cubic feet per second. After development runoff peaked at about 25 minutes after the start of the storm at about 540 cubic feet per second. With a stormwater management program the runoff peak was reached at about 45 minutes at 110 cubic feet per and and stayed at the level until approximately 90 minutes after the start of the storm.

Guide Sheet No. 7

CROSS SECTIONS OF INLAND WETLAND CLASSES



Guide Sheet No. 7

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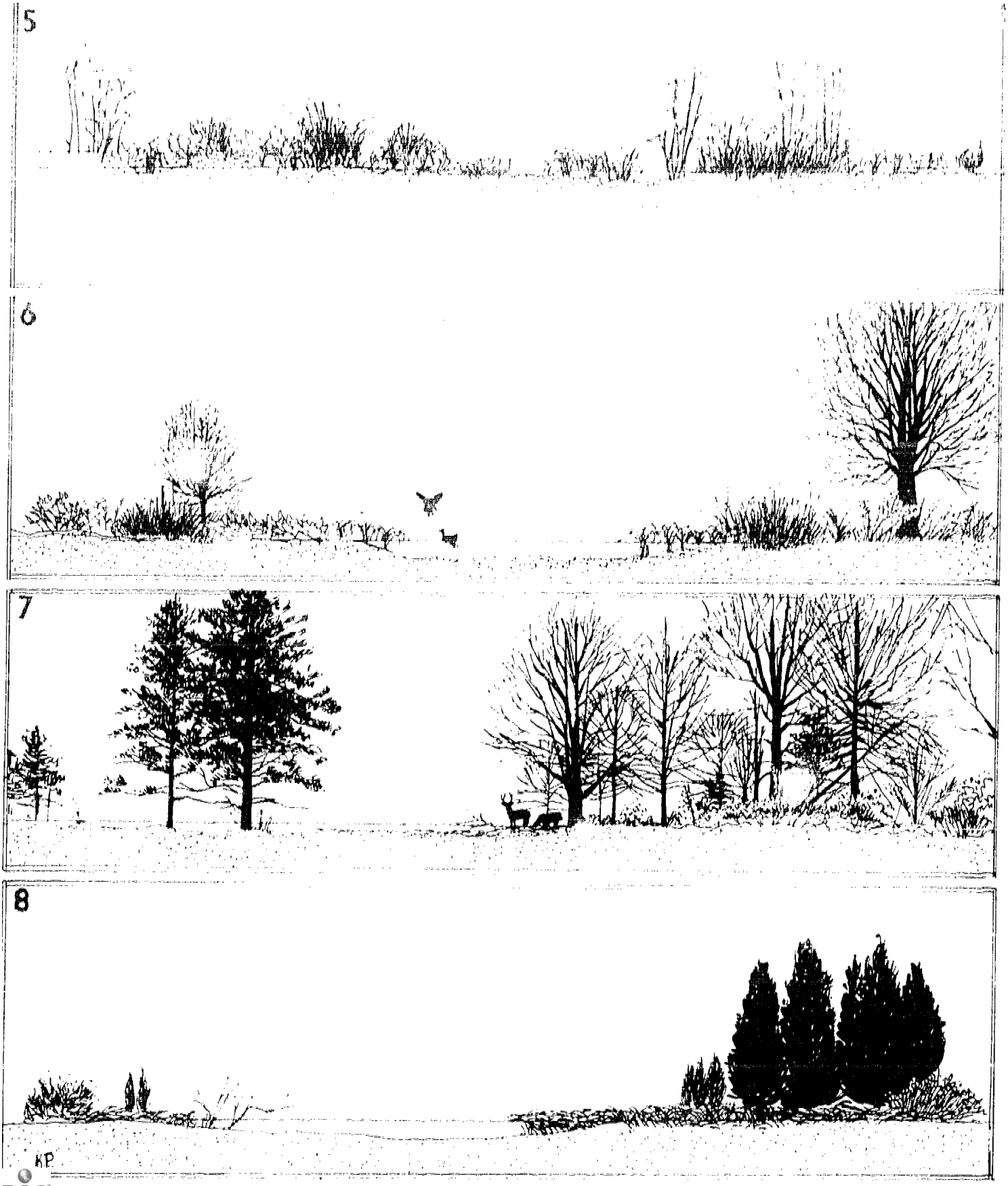

GUIDE SHEET #8 PLANT KEY

C= Common plant P= Present but not abundant

Inland Wetland Plants	Open Water 1	Deep Marsh 2	Shallow Marsh 3	Seasonally Flooded Flat 4	Meadow 5	Shrub Swamp 6	Wooded Swamp 7	Bog 8
1. Wild Celery	C	C	P					
2. Water-Lily	C	C	C					
3. Sedges (tussock sedge)		P	C	C	C	C		
4. Cattails		C	C	P				
5. Arrow-arum		C	C					
6. Bur-reed		P	C	P	P			
7. Grasses		P	C	C	C	C	P	P
8. Rushes (Bulrush)					C			
9. Ferns (Sensitive fern)				P		C	C	
10. Reed		P	C					
11. Skunk Cabbage				P	C	C	C	
12. Buttonbush		C	C	P		C		
13. Highbush blueberry		P	C			C	C	
14. Speckled Alder				C		C	C	
15. Silky Dogwood				C		C		
16. Spicebush				P		P		
17. Meadow sweet				C		C		
18. Cranberry								C
19. Gray birch				C		P	P	
20. Bog Laurel trees								C
21. Red maple				C		C	C	
22. Pin oak				C		C	C	
23. Silver Maple							C	
24. Eastern Hemlock							C	
25. Black Willow				C		P		
26. Tamarack								C
27. Atlantic White Cedar								C

GUIDE SHEET #3

SUMMARY TABLE OF INLAND WETLAND CLASSES

1. OPEN WATER WETLAND - Open water wetlands are characterized by standing water to a depth of greater than 3 feet. The dominant forms of vegetation include submergent and surface vegetation. No emergent vegetation is present.

2. DEEP MARSH - A deep marsh is a body of water with an average depth of between six inches and three feet. Emergent herbaceous vegetation are dominant in this wetland. Surface and submergent vegetation may also be present. Aquatic shrubs, such as species of willows, dogwoods, and alders, may be present but do not cover more than 50 percent of the area.

3. SHALLOW MARSH - A shallow marsh has a water depth of less than six inches. Water is present above the ground surface throughout the year or may be absent during very dry periods. Marsh herbaceous emergents form the principal vegetative cover in this wetland. Plants common to this area may include cattails and sedges.

4. SEASONALLY FLOODED FLATS - This class applies to extensive river flood plains where flooding to a depth of 12 inches or more occurs annually during late fall, winter and spring. In most years, spring floods subside by early June, leaving the ground exposed. During the summer, the soil is saturated, with a few inches of surface water occurring locally. Dominant vegetation is usually emergent, but shrubs and scattered trees may be present.

5. SHRUB SWAMP - This wetland has an average surface water depth of up to twelve inches. The predominant vegetation is composed of shrubs, commonly species of willows, dogwoods, alders, viburnums, and red maple. Common herbaceous species found in this area include the sedges and sensitive fern.

6. MEADOW - This wetland is characterized by up to six inches of surface water during the winter and spring, or at unusually wet periods. During the remainder of the year the water level is near or at the ground surface. The dominant plant groups usually consist of grasses, sedges, and rushes.

7. WOODED SWAMP - The wooded swamp, like the shrub swamp, also has an average water depth of up to 12 inches. The vegetation here is dominated by tree species. Common trees present may include red maple, American elm, swamp white oak, yellow birch and hemlock. Shrubby species, such as dogwoods and alders, are commonly present. Species of ferns are also common.

8. BOGS - This classification applies to wetlands where the accumulation of sphagnum moss as peat determines the nature of the plant community. Bogs commonly have a floating peat mat which grows outward from the shore over the water surface if open water is present. Due to low oxygen levels and cool soil and water temperature, dead plants remains accumulate rather than decomposing to form muck. Thus, nutrients are bound up and the result is a death of wildlife food.

GUIDE SHEET #1

Welcome to the audio-tutorial unit on Inland Wetlands Part II. To complete this section of the unit you will simply need a pencil, tape recording and guide sheets. Before starting the recorder, study the objectives outlined below.

This unit is designed to:

1. Discuss mankind's impact upon wetlands from a historical perspective.
2. Describe the ways in which wetlands are presently being altered and destroyed.
3. Outline the ways in which citizens and communities benefit from functional wetland areas.
4. Identify economic considerations which are often overlooked in placing a dollar value on wetland acreage.
5. Outline the Inland Wetlands and Water Courses Acts of the State of Connecticut.
6. Permit you to participate in a simulated project involving the development of a wetland area.

GUIDE SHEET #2

ACTIVITIES WHICH HAVE ALTERED AND/OR DESTROYED WETLAND FUNCTIONS

Landfill operations

Residential development

Commercial development

Industrial development

Transmission lines

Highway construction

Railroad construction

Water storage facilities

Hydro electric facilities

Flood control projects

Stream & River channelization

Mining activities

Sand & Gravel operations

Recreational activities

Recreational facilities

Industrial sewage disposal

Sewage treatment facilities

Reclamation for agricultural use.

_____

_____

_____

_____

_____

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GUIDE SHEET #3

A. List some reasons why inland wetlands were attractive areas for industrial development.

(Switch recorder back on)

B. This is a partial list of individual and groups who benefit from the natural functioning of an inland wetland.

1. People who drink clean water whether it be from a reservoir or a well.
2. People who live or work on floodplains.
3. Teachers and students who use wetlands as living laboratories.
4. Researchers who study the components of a wetland ecosystem.
5. Photographers who are fascinated, by the natural beauty of wetland plants and animals.
6. Hunters, possibly 1000's of miles away who rely on wetlands to provide food, shelter and breeding grounds for many varieties of waterfowl.
7. Hikers who enjoy a walk on a wetland trail.
8. Swimmers and boaters who rely on a constant supply of fresh water throughout the dry summer months.
9. Communities that desire to preserve open spaces for the enjoyment of all of their citizens.
10. Historians who might study the role which wetlands have played in the economic, politcal and physical development of a community or region.
11. Archaeologists, looking for information on the lives of our Indian ancestors, who frequently lived next to inland wetlands.
12. Homeowners, secure in the knowledge that flooding waters will be absorbed by an undisturbed wetland system.
13. Farmers with meadow pasture put to good use by grazing herds.

GUIDE SHEET #4

A. Key Questions in Determining Wetland Values.

1. What members of your community benefit from functions performed by wetlands?

2. What price would members of your community be willing to pay for the benefits they derive from the wetlands in your area of the state?

3. Which wetlands in your community are of greatest value to the citizenry?

4. Which wetlands in your community are of least value to the citizenry?

These questions are admittedly very general, but they represent a beginning point for the assessment of wetland values.

B. Questions that have been asked about the regulation of inland wetlands under the Connecticut Inland Wetlands and Water Courses Act. These questions may help organize your thinking as we study the provisions of the Act.

1. What does this act mean to the citizens of Connecticut?

2. What is an inland wetland?

3. Who does the regulating?

4. What kinds of activities does the act regulate?

5. What criteria are used in making a decision on the use of any inland wetland?

GUIDE SHEET #5

AN ACT CONCERNING INLAND WETLANDS AND WATER COURSES

A. Section 1. The inland wetlands and water courses of the State of Connecticut are an indispensable and irreplaceable but fragile natural resource with which the citizens of the state have been endowed. The wetlands and water courses are an interrelated web of nature essential to an adequate supply of surface and underground water; to hydrological stability and control of flooding and erosion; to the recharging and purification of ground water; and to the existence of many forms of animal, aquatic and plant life. Many inland wetlands and water courses have been destroyed or are in danger of destruction because of unregulated use by reason of deposition, filling or removal of material, the diversion or obstruction of water flow, the erection of structures and other uses, all of which have despoiled, polluted and eliminated wetlands and water courses. Such unregulated activity has had, and will continue to have, a significant, adverse impact on the environment and ecology of the State of Connecticut, and has and will continue to imperil the quality of the environment thus adversely effecting the ecological, scenic, historic and recreational values and benefits of the state for its citizens now and forever more. The preservation and protection of the wetlands and water courses from random, unnecessary, undesirable and unregulated uses, disturbance or destruction is in the public interest and is essential to the health, welfare and safety of the citizens of the state. It is, therefore, the purpose of this act to protect the citizens of the state by making provisions for the protection, preservation, maintenance and use of the inland wetlands and water courses by minimizing their disturbance and pollution; maintaining and improving water quality in accordance with the highest standards set by federal, state or local authority; preventing damage from erosion, turbidity or siltation; preventing loss of fish and other beneficial aquatic organisms, wildlife and vegetation and the destruction of the natural habitats thereof; deterring and inhibiting the danger of flood and pollution; protecting the quality of wetlands and water courses for their conservation, economic, aesthetic, recreational and other public and private uses and values; and protecting the state's potable fresh water supplies from the dangers of drought, overdraft, pollution, misuse and mismanagement by providing an orderly process to balance the need for the economic growth of the state and the use of its land with the need to protect its environment and ecology in order to forever guarantee to the people of the state, the safety of such natural resources for their benefit and enjoyment and for the benefit and enjoyment of generations yet unborn.

B. Outline of P.A.73-155 "An Act Concerning Inland Wetlands and Water Courses".

I. Purpose: protection of the public interest, health, safety and welfare of Connecticut citizens through regulation of activities on "indispensable, irreplaceable and fragile" natural resources---inland wetlands and water courses.

II. Wetland Definition: by soil classification "...land...which consists of any of the soil types designated as poorly drained, alluvial, and floodplain by the National Cooperative Soils Survey."

III. Regulation: Permit must be granted for certain land uses. The law does not prohibit use, it only regulates the kind and degree of use.

A. The following operations and activities shall be permitted in wetlands and water courses:
1. Grazing, farming, nurseries, gardening and harvesting of crops.
2. Farm ponds (3 acres or less)
3. Boat anchorage or mooring
4. Uses incidental to enjoyment and maintenance of residential property
5. Construction and operation by water companies of facilities necessary to impound and store water in connection with water supplies
6. Homes or subdivision lots for which a building permit was issued or a subdivision approved as of the effective date of promulgation of municipal wetland regulations.

B. The following operations and uses shall be permitted as a non-regulated use in wetlands and water courses provided they do not disturb the natural and indigenous character of the land.
1. Conservation of soil, vegetation, water, fish, shellfish, and wildlife.
2. Outdoor recreation including play and sporting areas, golf courses, trails, hiking, nature study, horseback riding, swimming, skin diving, camping, boating, water skiing, trapping, hunting, fishing, and shell fishing.

C. Regulated Activities: All other activities which remove material from deposit in, obstruct, construct, alter or pollute an inland wetland must be granted a permit before undertaken.

IV. Regulatory Agency: The Act explicitly encourages municipalities to designate a local agency as the P.A.155 decision making body, preferably not the local conservation commission, but an entirely new regulatory body. If the municipality did not designate such an agency by June 30, 1974, the state Department of Environmental Protection(DEP) became the permit authority.

V. Regulatory Process: A. Adoption of wetland regulations by a community.
B. Maps designating boundaries of regulated areas must be constructed.
C. Applicants submit application to the designated local agency or DEP.
D. Public hearing held at discretion of Agency.
E. Decision rendered within 60 days(longer review time with DEP) of the submission of a completed application.
F. Permit may be granted in whole or part, denied, or contain conditions circumscribing the planned activity.
G. Permittee may appeal decision through court of common pleas.

(When you have completed your study of the guide sheet, turn the recorder back on.)

GUIDE SHEET #6

OUTLINE OF INLAND WETLAND FUNCTIONS

1. Inland Wetland areas perform important functions as a component of the hydrologic system.

   a. Wetlands act as ground water discharge areas

   b. Wetlands enhance ground water recharge during floods

   c. Wetlands maintain ground water quality by filtering out impurit

   d. Wetlands maintain surface water flow by releasing water during periods of dry weather.

   e. Wetlands maintain surface water quality by
      (1) Trapping sediment
      (2) Filtering and absorbing pollutants

   f. Flood waters are stored by wetland areas and are gradually released as the levels of streams and rivers go down.

   g. The rate of flow of flood waters and normal water flows are slowed by wetland areas.

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6. Educationally, wetland areas are extremely valuable for nature study and scientific research.

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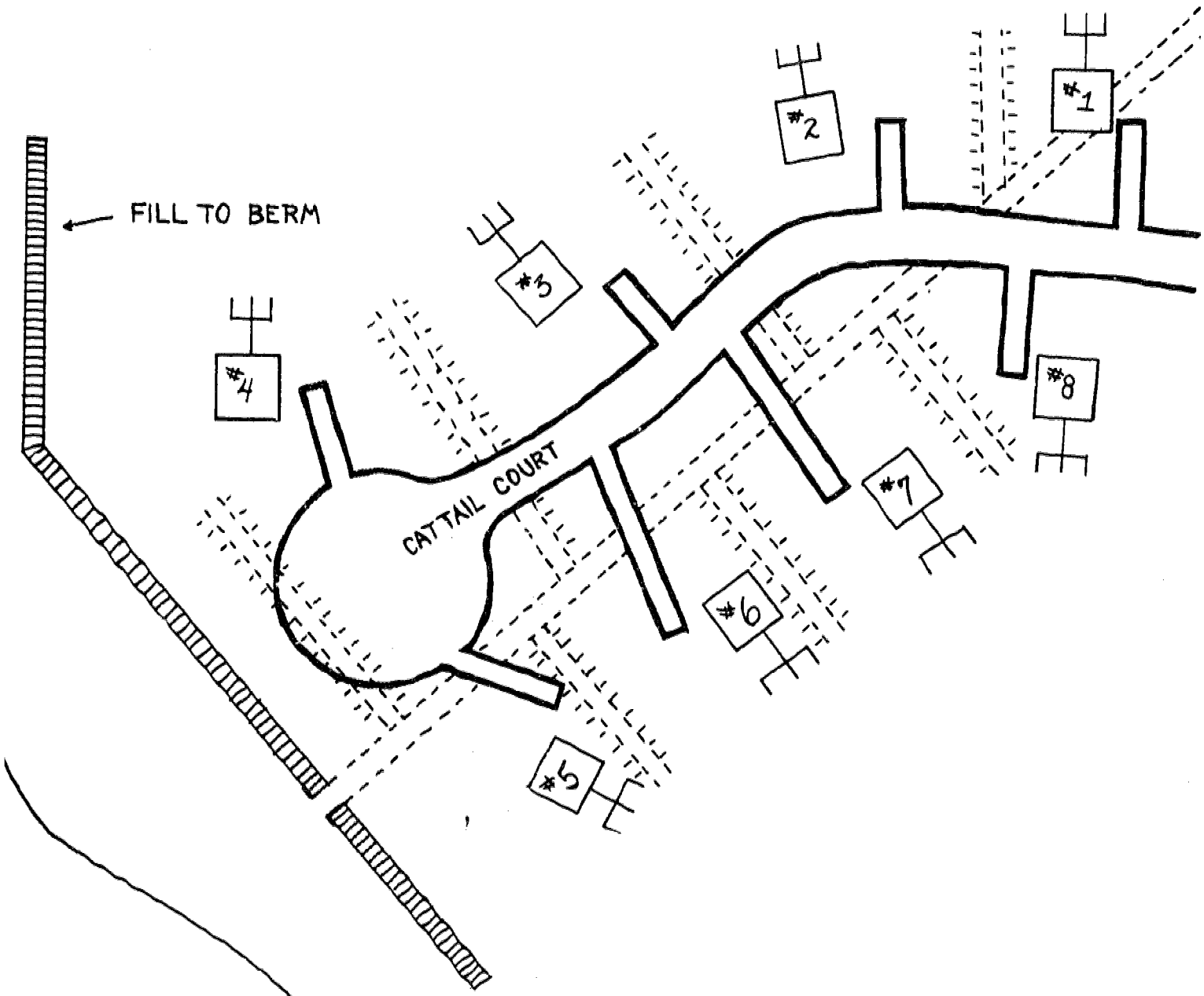
GUIDE SHEET No. 7

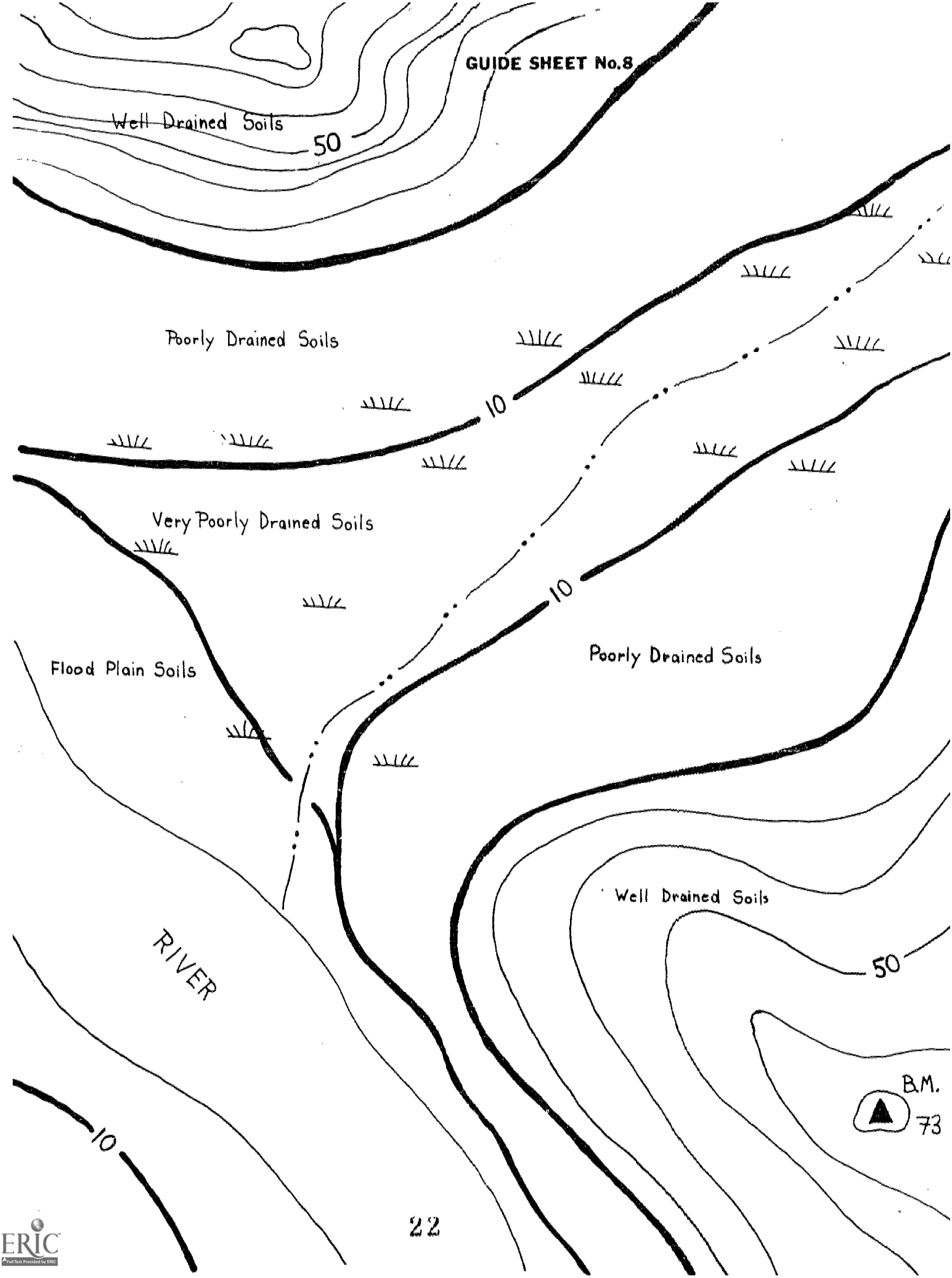
PROPOSED PLAN FOR "MARSH ESTATES"



LEGEND

- Building
- 20' High Concrete Wall
- Septic System
- Road or driveway
- Cement Pipe for Stream Relocation
- Drainage Tiles (Fields)

B.M.
73


GUIDE SHEET No.8
Well Drained Soils
50
Poorly Drained Soils
10
Very Poorly Drained Soils
10
Flood Plain Soils
Poorly Drained Soils
Well Drained Soils
50
RIVER
B.M.
73
10

GUIDE SHEET #9
WETLAND-USE EVALUATION MATRIX

Project: Marsh Estates

1. Project: Planned Unit Development & Quality homes					
2. Water: Public water supply					
3. Sewers: Septic tank with leaching field(on site)					
4. Road: Asphalt with storm drainage to cement culvert					
5. Stream: Relocated in 4' concrete pipe or culvert. Tiles for wetland drainage.					
6. Flood Protection: 20' high reinforced cement wall or berm.					
PROJECT DESIGN / CONSTRUCTION & OPERATION ACTIVITIES / INLAND WETLAND FUNCTIONS	SURFACE EXCAVATION	DRAINAGE ALTERATION	CONSTRUCTION OF IMPERVIOUS SURFACES	STREAM DREDGING &/OR RELOCATION	SEPTIC SYSTEM INSTALLATION & OPERATION
1. Hydrologic:					
a. Ground water					
b. Surface water flow					
c. Surface water quality					
d. Flood storage					
e. Slows flood flow					
2. Soil Erosion:					
a. Soil erosion					
b. Sedimentation					
3. Biologic Productivity:					
a. Wildlife habitat					
b. Wetland ecosystem					
4. Biologic Diversity:					
a. Unique natural area					
b. Rare species					
5. Recreation:					
a. Water based					
b. Non-water based					
6. Education:					
a. Nature study					
b. Scientific research					
7. Aesthetic					
a. Visual diversity					
b. Historic Land mark					
c. Open space					

Evaluation summary: Recommendation for permit application

- O Approve project
- O Disapprove
- O Approve with following restrictions

GUIDE SHEET #10

SUMMARY OF POTENTIAL PROBLEMS OF CONSTRUCTION IN INLAND WETLANDS

PROPOSED ACTIVITY	HARMFUL EFFECTS	NATURAL FUNCTIONS THAT MAY BE LOST OR IMPAIRED	INFORMATION NEEDED FOR DECISION
Construction of dwelling on flood plain	Flood hazard and damage Septic system problems: Flooding by high water Leaching of effluent through porous soils and pollution of surface or ground water	Water supply--groundwater quality Flood control--natural storage capacity	Flood protection measures (e.g., floor elevation) Sewage disposal design
Channelization and diking	Downstream erosion due to increased flow velocity Downstream flooding due to elimination of flood plain absorption and faster peak flow buildup	Flood control--natural storage capacity Sediment control--settlement Natural Ecosystem--diversity of meanders for vegetation, wildlife, education Recreation--fishing, hunting, scenic, esthetic value	Storm frequency for design flow of channel and effect on downstream flood hydrograph Composition of fill and channel banks Plans for bank stabilization and re-vegetation Importance of vegetation and wildlife habitat
Roadway and culvert/bridge construction	Upstream flooding due to constriction of flood flows and backup of flood waters Washout of road or bridge	Flood control--channel enroachment +loss of natural storage capacity	Storm frequency for designflow of culvert or bridge Design measures to prevent debris blockage
Filling and housing construction on flood plain and alluvial delta	Flood hazard, on site, increased due to backup from construction of channel Upstream flooding due to backup Channel and bank erosion due to increased flow remaining in channel Pollution of surface or ground water from: septic system effluent leachate from fill material Sedimentation farther out in lake	Flood control--channel encroachment, loss of natural storage capacity, and change in watershed characteristics Sediment control--settlement Water supply--ground water recharge and quality Natural Ecosystem--marsh/swamp habitat Recreation	On-site flood protection measures Effect of encroachment on upstream flood levels Sewage disposal system design Composition of fill Projected volume of channel erosion Measures to stabilize embankments Importance of vegetation and wildlife habitat Importance of groundwater supply "of groundwater to low flow and measures to retain storm runoff"
Parking lot	Concentration of runoff from large impermeable surface Pollution from street runoff: oils, debris, sediment, etc. Frost action on pavement Drainage channel erosion and sediment production due to concentration of runoff	Sediment control--prevention of erosion by rapid storm runoff Water supply--surface water quality and maintenance Flood control--watershed characteristics Natural ecosystem Recreation	Storm drainage design criteria and measures to reduce effects of rapid runoff Impermeable surface area Measures to purify or filter runoff Importance (if any) of area to groundwater recharge
Multi-family housing with parking (E)	Pollution from large community septic system on wet soils,or Erosion and sediment production with sewer system installation Problems associated with parking area (E) Concentration of runoff from roof area	SAME AS ABOVE, plus: Water supply--groundwater quality	Sewage system design (plans) Storm drainage system design (plans) Measures to lower water table Fill plans and composition Impermeable surface area Effects of lowered water table on vegetation and wildlife
Filling and dredging for marina and recreation area	Upstream flooding due to constriction of natural storm drainage Pollution of lake from: septic system effluent leachate from fill materials gas and oil service and spills parking lot runoff sewage discharge from boats Sediment production during dredging and filling	Water supply--surface water quality and maintenance Flood control--channel encroachment--change in watershed characteristics Sediment control--settlement-prevention of erosion by rapid storm runoff Natural Ecosystem--marsh/swamp habitat	Composition and depth of fill Depth and bottom character of dredged area Measures for stabilization of banks Slope of banks or beach area Storm drainage system design Sanitary waste disposal system design Methods for control of: Parking lot runoff Gas and oil leakage

SOURCE: ADMINISTRATIVE HANDBOOK - CONNECTICUT INLAND WETLANDS PROJECT

WORDS WORTH KNOWING

1. AQUIFER. A body of rock or sediment that contains sufficiently porous material to conduct ground water and to yeild significant quantities of water to wells or springs.

2. BEDROCK. The solid rock, commonly called "ledge" that forms the earth's crust. In the report area, it is locally exposed at the surface but more commonly is buried beneath a few inches to as much as 200 ft. of unconsolidated deposits.

3. BIOLOGICAL PRODUCTIVITY. This is the rate of storage of organic matter by plants and animals in the period under consideration.

4. CHANNELIZE. Stream channelization which consists of deepening, widening, straightening, clearing, or lining the existing channels of rivers and streams, is an engineering technique used to control floods, drain wetlands, improve navigation or control erosion.

5. DEP. Department of Environmental Protection. This is the executive branch department in Connecticut that has been charged with implementing environmental laws such as the Inland Wetlands Act and the Tidal Wetlands Act.

6. DIVERSITY. The variety of species present in a biological community.

7. ECONOMIC VALUE. The monetary value a good receives in the market place.

8. ECOSYSTEM. A self-sustaining and self-regulating community of organisms considered in relationship with each other and with their environment.

9. FLOATING PLANTS. Rooted plants with leaves floating on the water surface.

10. FLOODPLAIN. The lowland that borders a river, usually dry but subject to flooding when the stream overflows its banks.

11. GROUND WATER. The water filling pores or cracks in the rocks. That part of the subsurface water that is the zone of saturation.

12. HYDROLOGY. The science of the behavior of water in the atmosphere, on the surface of the earth, and underground.

13. INLAND WETLAND CLASS. A certain wetland type categorized by the water depth and resulting plant life.

14. MEANDER. A naturally occurring bend which a river or stream may develop along its course, often making a series of curves.

15. MOTTLING. Soil characteristic of spots or blotches of different color or shades which usually indicate poor aeration or seasonal wetness.

16. PEAT AND MUCK SOIL. These are deposits of plant material exceeding 3 feet in depth found in very poorly drained areas. Mucks are peaty materials which have decomposed and can no longer be identified as to the type of plant from which they are derived.

17. PERCHED WATER TABLE. Water table of a body of perched ground water. This occurs where an impermeable layer such as clay, exists above the natural water table and this layer acts to prevent or limit the downward movement of water.

18. POORLY DRAINED SOIL. Soils as mapped by the Soil Conservation Service that have a water table that remains within 6 inches of the soil surface durring the wettest part of the year.

19. PONDING. Confinement of water on the surface of an inland wetland. The low permeability of poorly drained wetland soil causes ponding of surface water.

20. RUNOFF. Rain or melted snow that neither sinks into the ground nor evaporates into the air but rushes down slope to the nearest wetland or watercourse (stream).

21. SEDIMENTATION. The process of gravitational deposition of soil & other particles transported by water.

22. SILT. Fine particulate matter suspended in water.

(continued on next page)

23. SOIL EROSION. Movement of soil from one place to another on the earth's surface by water, ice and wind.

24. SOIL PROFILE. The vertical cross sections from the surface down to the underlying unweathered material.

25. STORAGE CAPACITY. The total amount of water a basin may hold. Total storage capacity is related to the slope of the land, the depth of the weathered material and its physical properties.

26. SUBMERGED PLANTS. Plants that grow beneath the waters surface.Most submergents are rooted.

27. SURFACE WATER. Water on the land surface which is visible in lakes, ponds, rivers, streams, and wetlands.

28. WATER HOLDING CAPACITY. The amount of water the soil will hold against the force of gravity, determined by soil texture, organic content and the amount and distribution of soil pore sizes.

29. WATER TABLE. The upperlimit of that part of the soil or underlying rock material that is wholly saturated with water.

BIBLIOGRAPHY

Andrews, W.A.(ed.) A Guide to the Study of Freshwater Ecology. New Jersey: Prentice-Hall, 1972.

A very readable and informative book on freshwater ecology. Even though designed for high school students, it is a valuable resource for the layman.

Connecticut Department of Environmental Protection. An Act Concerning Inland Wetlands and Watercourses. Public Act 72-155.

This is the act that requires each consenting town to appoint a local regulatory group which shall promulgate local regulations regarding activities within designated wetlands.

Connecticut Conservation Reporter. "Inland Wetlands," V, No. 7(March, 1972).

This issue of the Reporter provided the impetus for legislation on Inland Wetlands. An excellent description of the many values of wetlands.

Golet, Francis C. and Joseph S. Larson. Classification of Freshwater Wetlands in the Glaciated Northeast. Resource publication 116 of the Bureau of Sport Fisheries and Wildlife, Department of the Interior, 1974.

A complete description of the wetland classification system used in these units.

Lavine, Dave, et. al. Evaluation of Inland Wetland Water Course Function. Connecticut Inland Wetlands Project, Dead Hill Road, Durham, Ct. 06422.

This is a comprehensive study of Inland Wetlands regulation in Connecticut. It is a must for any citizen working on an Inland Wetland Commission. Includes case studies as well as the rationale behind the law and regulations. Highly recommended.

Other publications of the Connecticut Inland Wetlands Project:

Administrative Handbook for Inland Wetland Agencies. As above.

Identifying Functions of Inland Wetlands. As above.

Implementing Aids for Inland Wetlands and Watercourse Agencies. As above.

Niering, William A. and Richard H. Goodwin. "Inland Wetland Plants of Connecticut," Connecticut Aboretum Bulletin, May 1973.

Another in an excellent series of publications from the Connecticut Arboretum. This pamphlet describes the wetland functions and plants of marshes, swamps and bogs. It is beautifully illustrated.

Proceeding: Wetlands Conference, Report No. 21. Institute of Water Resources, Box U-10, University of Connecticut, Storrs, Ct. 06268.

The proceedings of a conference emphasizing inland wetlands. The conference included papers by experts in geology, hydrology, soils, water chemistry, floristic and faunistic biology, and law. Comprehensive look at Inland Wetland yet understandable to the layman.

Audio Tape Script

Inland Wetlands

Welcome to the industrial park of Manytowers, U.S.A. The site we are visiting consists of several light industries built during the last five years and the remnants of an inland wetland. The factories were built on this site for several reasons: land in this area could be purchased for fewer dollars per acre than other land in this community,...the area is close to major highways,... there is a stream close by for disposing of waste cooling water and treated effluents. In addition the land was of no "direct economic value to the community". The arguments for building on this site were carefully developed, but there were some flaws as we shall soon see...

Slide # split Wetland, Factory

One of the major reasons that the land was available for development relates to the fact that it was a wetland. Once the property was purchased and filled, the factories were built...the industrial park became a tax producing operation for the community and the wetland was destroyed.

As you look at slide # 2 you will see an undisturbed wetland. . . As I traveled from the industrial site to the wetland you are studying in slide #2, a phrase from Ecclesiastes kept running through my mind. . .

Slide #2 Undisturbed Wetland

> for every thing there is a season and
> a time for every purpose under heaven . . .
> a time to build, a time to tear down.

It would seem that as we study the wetland issue, we

[illegible] be willing to objectively consider alternative uses of wetland areas. There are times when wetland areas can be used for specified types of development, there are times when wetlands should be left totally undisturbed.

Before spending [illegible] alternative use patterns for wetlands, let's focus our attention on wetland structure and function.

Inland wetlands have been described by conservationists as one of our most precious resources. Support for this position has come from biologists, hydrologists, ecologists and soil scientists. These and other professionals in land use decision making recognize wetlands as valuable areas that have a multitude of specific values for communities.

Defining inland wetlands presents some problems. There is no single definition which is totally acceptable to all of the individuals who are involved in studying wetland structure and function. To help illustrate this point, please turn to guide sheet #2... We would like to have you brainstorm for about 90 seconds and generate a list on guide sheet #2 of all of the factors which you feel are characteristic of inland wetlands. At the signal you should begin listing factors...after about a minute and a half, turn the recorder back on. Ready to start brainstorming? Then stop the recorder and begin!

Guide Sheet #2 List of Wetland Characteristics

Let's compare your ideas with those of scientists who are involved with wetland studies.

If you were a biologist, you would probably have generated a list of characteristic plants and animals which occupy inland wetlands. The specific plants and animals would depend upon the amount of water on or near the surface of the area, and the number of months per year the water level exists at these levels. Did you consider plants and animals as inland wetland indicators?

If you made any statements about water on or near the surface for part of the year, you would be considering the inland wetland from the perspective of a hydrologist. Hydrologists generally describe how a wetland functions in a water system. In addition, they are very concerned with the role of the inland wetland in maintaining water quality and quantity. Your list should only make reference to fresh water, as inland wetlands contain only fresh water.

Water obviously plays a major role in inland wetland structure and function. One important dimension relates to the interrelationships between the soil and water. Soil scientists define inland wetland areas in terms of soil types. Inland wetland soils are poorly drained. Poorly drained soils have water on the surface, at or close to the surface for a large portion of the year. In slide #3 you can see a soil profile of an inland wetland. Study the slide carefully...(pause 3 seconds) Do you see the gray, brown and almost orange areas in the

Slide #3 Wetland Soil Profile

soil profile?...This type of soil has what is traditionally referred to as a mottled coloration. Most mottled soils are colored various shades of gray, brown, and yellow. The mottled effect is a result of the oxidation and reduction of iron compounds in the soil. Imperfectly and poorly drained soils have poor aeration and are nearly always mottled or gray. Are there any other clues in the slide that indicate that this might be an inland wetland area?....(Pause 3 seconds) Do you see the standing water in the bottom of the hole? The water is only a few feet below the surface...It is a definite indication that this is an inland wetland area. In generating your list of inland wetland characteristics.

Did you mention anything about upland or lowland areas? If so, you would be using terms that geologists utilize in describing an inland wetland area. Geologists divide wetlands into two basic categories: upland and lowland wetlands. Turn to guide sheet #3. On Guide Sheet #3 Try and locate the upland and lowland wetlands on the diagram. (Pause 5 seconds) Have you found them?...If you study the diagram carefully some of the differences between upland and lowland wetlands will become apparent....The wetland labeled with a Roman Numeral I is representative of an upland wetland.

Guide Sheet #3 Diagram of Upland & Lowland Wetlands

Background Music

Upland wetlands occur when the water table intersects the land surface. Look at the diagram...and follow the water table line from the

right hand edge of the diagram to the left edge. Make note of the areas where the water table comes close to or intersects the soil surface? (3 second pause) Remember, when the water table intersects the land surface, or is very close to the land surface we have proper conditions for a wetland.

In addition to providing information on the water table, the diagram also describes the material underlying the wetland. In the upland area the bedrock is close to the land surface. Bedrock is impermeable to water and thus retards water drainage in this area.

The wetland area labeled with Roman Numeral II is representative of a lowland wetland.

Make note of the fact that the water table intersects the soil surface in this lowland wetland. In lowland regions we frequently find glacial deposits of sand, gravel, silt and porous soils underlying the wetland. These permeable materials often produce semicontinuous ground water reservoirs called aquifers. These aquifers provide major water holding areas. They provide significant quantities of water to wells and springs. The major water collection and storage areas of a community consist of surface waters, aquifers, and inland wetlands.

Now turn to Guide Sheet #4...(Pause 3 seconds) Study

Guide Sheet #4

the diagram at the top of guide sheet #4 carefully...From this diagram we can see that wetlands are part of a major geologic-hydrologic system which forms a water continuim including wetlands, upland ponds and streams through lowland wetlands, lakes and rivers, into estuaries, coastal marshes and ultimately flowing out into the ocean. If you would like to spend some time studying guide sheet #4, turn off the recorder until you are ready to continue. (Interlude 2 seconds)

Let's summarize what we have determined so far by reviewing the list at the bottom of guide sheet #4. Inland wetland areas are more or less regularly flooded areas, where the water table stands above, at or near the land surface for a large part of the year. These areas may be described in terms of their wetness conditions, soil types and the types of vegetation which can grow in these regions.

Guide Sheet #4 Summary list.

Now let us turn our attention to the role that wetlands play in the total community. The value of the complex wetlands system cannot be overestimated. Inland wetlands help tame floods; keep streams and rivers flowing; and act as overflows for the ground water system. Wetlands also function to maintain and improve the quality and quantity of the water you drink. Inland wetlands function

to provide you with these and many other valuable services free of charge. To emphasize the importance of wetlands to the community, we have prepared a list of the major wetland functions on guide sheet #5. Turn to guide sheet #5 and read through the outline of inland wetland functions. Turn the recorder off while you are studying the outline...turn us back on when you are ready to continue. (5 second musical interlude) The major functions of inland wetlands include regulation of water quantity and quality, flood control, sediment and erosion control, biological productivity and diversity, recreation, education as well as aesthetic and historic considerations. All of these wetland functions are subject to alteration if the wetland is disturbed.

Guide Sheet#5 Outline of Inlan Wetland Function

Bring up background or insert musical interlude

The functions outlined in Guide Sheet #5 are functions which apply to undisturbed wetland areas. If a wetland has been affected by agricultural, recreational, residential or industrial activity, then some, or all of these wetland functions may be altered. Major changes in wetland structure in turn has an impact upon the wetlands ability to perform its "normal" functions.

Of all wetland functions, probably the most significant for mankind is their role in the hydrologic system. Wetlands minimize seasonal fluctuations in water table levels, they provide a place for water to expend its energy during periods of high water and in turn, they tend to release water during periods of drought. In addition, they filter sediment and some contaminants out of water supplies.

Ground water, that is the water beneath the land surface, is extremely important to our communities both in terms of quality and quantity. Ground water plays an important role in maintaining well water supply and stream flow between rainfalls and during long periods of drought. The quality and quantity of ground water depends upon both natural and man influenced conditions which effect wetland areas.

Wetlands do have a pollution neutralizing capability. Wetlands near industrial sites and heavily developed residential areas often receive great quantities of inorganic and organic materials. The wetland, as a biological system will utilize

and concentrate many of these materials. Recent scientific studies have documented the ability of swamp or marshes to trap or alter pollutants carried in water. It is important to note that there is a limit to the pollutant neutralizing or cleansing capabilities of biological communities. Pollutant loads in excess of plant uptake, and of sufficiently toxic nature, cannot be utilized and subsequently become lethal elements within the system. When pollutants overload the wetland's ability to purify ground water, the ground water becomes contaminated.

In addition to the biological entrapment or alteration of pollutants, wetlands entrap silt laden waters and permit the silt load to settle out. In the process, many pollutants adhere to the sediment particles and settle out with the silt. Extremely heavy sediment coming from erosion and construction activities can fill and destroy wetland areas.

Another major contribution of wetlands to the community relates to their ability to reduce flood damage. Inland wetlands reduce the impact of floods through their ability to slow and store flood waters, and to slowly discharge the water over a period of several weeks or months. In reservoir systems this particular wetland function increases the total water storage capacity of the system.

The construction of industrial sites, shopping centers, and residential housing on wetlands increases the potential for flood damage in two ways. First, it reduces the ability of the wetland to store flood waters and secondly, it places buildings in areas most likely to be affected by wetness or flooding. A more detailed discussion of the effect of urban and suburban development on flood flows can be found in the audio-tutorial unit on hydrology.

The ability of wetlands and watercourses to reduce both natural flood flows and increased flows due to urbanization stems from their ability to slow the downstream rush of water. In Slide #4 you can see a large quantity of water that is spread out on the wetland surface.

Slide #4 Slide of Flood Wetlan

Most wetlands soils are not very porous. This coupled with the high water table in wetland areas prohibits the rapid infiltration of flood waters so water spreads out over the wetland surface and forms temporary reservoirs. This condition, technically known as ponding, is visible here in slide #4 in this slide. A 6 inch rise in the water level over a 10 acre wetland places 1,500,000 gallons of water in storage with no permanent harm to vegetation.

To the contrary if wetlands are destroyed the water which they ordinarily would hold now becomes run off and the water moves into storm sewers or adjacent streams.

On guide sheet #6 you will find a problem and an illustration which demonstrate the impact of development upon the water absorption capabilities of wetland areas. Work through the problem on guide sheet #6. Stop the recorder while you study your calculations, then, turn the recorder back on. (pause 5 sec.)

Surprised by the quantity, of run off from the shopping center. Now, can you see why some wetland areas must be kept functional to absorb this run off!!! (Pause)

Natural vegetation and stream meanders, or the bends in the streams, also slow flood waters through physical resistance or friction. Soil erosion by water and the resultant sedimentation are often overlooked as problems resulting from suburban and urban development.

Erosion and sedimentation occur as a direct result of construction activities which remove vegetative cover and increase storm run-off. Storm run off and peak flows from urbanized areas greatly exceed that of agricultural or forested areas due to the impermeability of asphalt and concrete. As forests are cut agricultural lands developed and natural drainage channels constricted, the need for protective wetland buffers becomes more imperative. Wetland areas can help prevent flooding by absorbing or holding runoff unless of course, they become developed too

Slide #5 Wetland choked with sedimer

Inland Wetlands decrease the speed of flowing water and subsequentl function to remove and immobilize sediment. Flooding and erosion caused by construction often severely overload wetland systems. The wetland shown in the slide #5 has been choked with sediments. The wetland vegetation is no longer able to retain these sediments properly. The next storm may dislodge the sediments you see in slide #5 and carry them downstream. Protection of wetlands from severe sedimentation is of major concern to all.

Sediments from soil erosion may fill up reservoirs; increase water turbidity; fill in storm drainage systems; decrease the amount of dissolved oxygen available for aquatic organisms and create many other problems.

The role of wetlands in agriculture provides an interesting springboard to consideration of the biological productivity of these unique areas. Many wet meadows provide a good source of pastures for livestock. But, unfortunately in many New England States, declines in farming have resulted in the abandonment of many of these productive pastures. As a result these areas have reverted to their original wetland functions and along with other wetlands play an important role in supplying water and suitable habitat for many types of plants and animals. An inland wetland provides wildlife with an abundance of clean water, food and shelter. In addition it provides ideal growing conditions for a wide variety of plant species.

Wetlands contribute immeasureably to the productivity of fisheries and wildlife. Many species of migrating birds depend directly upon our wetlands as breeding grounds and feeding areas. The condition of wetlands in one community can ultimately effect bird populations in areas thousands of miles away. Biological productivity is by no means limited to larger forms of wildlife and fisheries. Countless micro - and - macroscopic plants and animals depend directly and indirectly upon wetlands for water, food and habitat.

Many wetlands represent unique natural areas. Slide #6

Slide #6
Bog

will show you an open water bog.

Many plants found here in the bog are rare.

The bog is extremely fragile. The Floating Mat that you see in the central portion of the slide can easily be trampled. Unfortunately, careless visitors to the bog often destroy many of the unique organisms they have come to observe. Bogs such as the one you are observing are unable to recover quickly from destruction or overuse.

Wetlands are of great recreational value. As population numbers increase, more and more people will be making use of our waterways for recreational purposes. Inland wetlands play an obvious role in maintaining the quantity and quality of bodies of standing water, rivers and streams.

Wetlands may be used recreationally for activities such as fishing, boating, hunting, bird watching, picnicing, hiking, and photography. In slide #7 you will see a wetland that is used by a model flying club as a flying field. By careful management, wetlands can be used for recreation and still perform their natural functions.

Slide # 7 Flying Field o Wetland

Pristine wetlands, now rapidly on the decline, provide a measure of environmental quality in the form of open space. These wetlands have become sanctuaries where modern man can escape the pressures of urban living.

Inland wetlands are also extremely important to our educational systems. These unique living laboratories furnish school students and other citizens of the community with resources for research and education in ecosystem structure and function.

The ability of the wetland to provide this service depends directly upon people. As the wetland becomes progressively utilized its usefulness for ecosystem research is compromised. Instead of furnishing baseline scientific data the wetland thus becomes a testimonial to our inability to live in harmony with our environment. Ironically, observing man's impact on wetlands still provides an educational benefit.

Wetlands obviously fulfill many roles in our communities. They are valuable as open space areas and they provide pleasant aesthetic areas for recreation. While providing the community with visual and aesthetic benefits, wetlands also maintain an adequate supply of water, they prevent flooding or reduce the impact of flood waters and they constantly function as a water purification system.

Up to this point in the Wetlands unit, we have talked about the structure and function of wetlands in general terms. At this point, we will focus our attention on specific wetland plants and classes. This section of the unit may be especially useful if you become involved in identifying wetland areas in your community. The plants are good indicators of both the ground water condition in the area and the soils underlying the area.

Turn to guide sheet #7 on Inland Wetland Classes and place it next to guide sheet #8 A-Plant Key. Put the guide sheets together in front of the slide viewer. (Pause 3 sec.) Guide sheet #7 is a graphic representation of the eight Wetland classes developed by Francis Golet and Joseph Larsen. This system is used by the U.S. Dept. of Interior in their wetland classification system. The numbers found next to each plant will correspond to the number and name of the plant on guide sheet #8. If a plant on this

Guide Sheet #7 Inland Wetland Classes

Guide Sheet #8 Plant Ke

list is found in one of the wetland classes listed across the top of the sheet you will find either a C or a P in the appropriate box. The letter C indicates that the plant is commonly found in that wetland class. But it does not mean that this is always the case. The letter P indicates that a particular plant may be present in that wetland class but is not usually abundant.

Slides are provided of each wetland class so that you will be able to compare the drawing to an actual wetland. If you need, or want additional time to study the guide sheets or slides in this section, simply turn off the recorder until you are ready to go on!!!

Gross differences in wetland types are most easily identified by observing the amount of surface water and indicator plants found in the area. These differences will be used as the basis for distinguishing between the wetland classes.

Take a look at slide #8. (three second pause). What wetland class would you predict this to be? If you predicted an open water class you are correct! The open water class is number 1 on your wetland class Guide Sheet. This wetland has water approximately three feet deep. Notice the water lilies growing on the waters surface with roots attached to the pond bottom. An open water class may also have only submerged plants such as wild celery. This type of wetland provides nesting and feeding habitat for a variety of animals.

Slide # 8 Open water class

Slide number 9 is representative of a deep marsh. Look at the slide and try and identify the dominant plant type...Of course, cattails!!! Cattails are the dominant form of deep

Slide #9 Catta

marsh vegetation. You can see them located in the foreground of this slide. Deep marsh wetlands belong to class two on your classification sheet. This inland wetland class provides valuable water fowl habitat. Water fowl use these areas for mating, nesting, breeding and the raising of young.

Slide #10 depicts a shallow marsh...(wetland class #3). Shallow marshes most generally contain soft stemmed herbaceous plants. Do you see any common characteristics in wetland classes 2 & 3? (Pause) Once again, the common plant here is cattails. The distinction between shallow and deep marshes is based on water depth only.

Slide #10 wetland class-3

The next slide number 11, is an aerial view of a flood plain along the Quinnipiac River. Vegetation which grows here is well adapted to periodic flooding and the accumulation of sediments. Scattered shrubs and trees are also found in this wetland class. The most common trees are red maples, willows and pin oaks. All of the larger trees are located on the higher ground.

Slide #11 Aerial view of Q River Plain

Now look at Slide #12. (pause 3 sec.) The meadows pictured in slide #12 occur primarily on agricultural land where mowing or grazing prevents the growth of trees or shrubs. Such a wetland may have a impervious layer such as hardpan beneath. Hardpan prevents the downward flow of water. (Pause) Now look at slide #13...(Pause 3 sec.)

Slide #12 Grazed Wetland Meadow Slide

A high water table usually favors certain shrubs such as found in wetland class #6 over the trees found in a wooded swamp (Wetland Class #7) The organic deposits underlying both of these classes are shallow. Shrub swamps include vegetation such as alders, silky dogwood, highbush blueberry

Slide#13

Notice the shrubs along the margin of the open water. and swamp azaleas. The wooded swamp pictured in slide #4. is flooded only during the spring. Red maples are now the common tree found in this slide of an abandoned meadow. Shrubs such as spicebush or speckled alder may eventually grow beneath the trees. Wooded swamps offer great songbird diversity because of the different vegetation levels. These wetlands are also important to wildlife such as deer, raccoon and oppossum.

Slide # 14

Wooded Swamp - Red maples

Slide # 15

Bog slide

The bog pictured in the final slide illustrates a unique ecosystem. This bog developed in an old glacial lake. The yellow trees in the center of the slide are tamaracks. Tamaracks, which grow on the Floating Mat of moss, will slowly cover all the open water. As the mat moves across the lake plant debris accumulates beneath it and fills the lake. Some bogs in the Northeast are beyond the floating mat stage and have evolved into forests.

Atlantic White Cedar is commonly found in New England Bogs. Many herbs and shrubs which grow on and around the bog are found in no other ecosystem.

This completes the Inland Wetland Unit Part I. The other side of this tape addresses the issue of inland wetland regulation in Connecticut and includes a hypothetical case study.

(Turn Recorder Off)

Wetlands have proved to be an economically valuable resource to communities as water storage and water purifying areas. In addition, wetland areas are of great aesthetic, educational and biological value. Having outlined the various contributions wetlands make to communities, it might seem that communities would be extremely protective of these areas...this is not the case. Wetlands have been systematically used for land fill sites and assorted forms of development because of their relatively low dollar cost in comparison to surrounding ıct- land.

Many studies, much legislation, great expense and plain hard work have been expended to preserve and regulate these irreplaceable resources. Still, irrepairable damage continues and insensitive attitudes persist. The opponents of wetland regulation argue that without development, wetlands are economically non-functional. Unfortunately, they have overlooked the many tangible and intangible benefits which wetlands provide for a community. Wetlands do have vital functional benefits that can be measured in dollars and cents. Many of these benefits are outlined in part I of this wetlands unit.

Let's assess man's impact upon wetlands from a historical perspective...

The destruction of inland wetlands began when the colonists first settled this country. Rivers and streams provided early American settlers with the means of transportation and a constant supply of inexpensive power. As a result

communities sprang up on the lowlands and floodplains along river corridors. To protect the property of the settlers, levees were built to control flood waters. As time progressed, swamp land was drained for farm land and for a variety of types of construction. In many areas of the country, the farming of these former wet soils has contributed significantly to the production of grain and livestock. In addition, since colonial days manufacturing plants built beside our rivers and streams have played a major role in our expanding economy. Many waterways have been modified to benefit transportation, manufacturing and other industry.

Changes in these wetland areas have provided definite economic benefit, but there have been costs associated with development as well. In many cases valuable wetland area have been modified without any knowledge of the ultimate effect of the alterations. As a result, many wetlands have been destroyed and their potential contribution to communities has been eliminated . Turn to guide sheet #2 (pause 2 sec.)...#2

On Guide Sheet

we have generated a list of activities which have altered or destroyed wetland areas. The list is not exhaustive. You may want to add some activities to the list. Turn off the recorder while you review guide sheet #2 (Pause 3 sec.)

Guide Sheet #2 List of activities destroying wetlands

First of all, inland wetlands have been used as landfills because they were considered to be useless idle land. This activity has lead to the contamination of ground water in many communities. This aspect of wetland usage will be discussed in more detail in the unit on hydrosystems.

Inland wetlands have also been extensively drained and filled for residential, commercial or industrial development. Besides destroying the natural functions provided by wetlands, construction activities have resulted in soil erosion, sedimentation and increased rate of rain water run-off.

Homes or other buildings constructed on drained or filled wetlands.

are apt to provide homeowners with some unpleasant surprises. Consider the plight of the homeowner whose house was constructed on a wetland soil known as peat and muck. To make the site buildable the wetland was drained. As the soil dried it began to shrink and the foundation of the house responded to the changing soil condition by settling. This settling or shrinking condition is termed subsidence. Subsidence results in cracked morter, cracked and tilted walls and sloping floors. Although the cost of land in this area was low and invited development, the initial savings has been more than off set by the cost of repairing damage caused by subsidence .

There are additional problems which often surface when wetlands are used for housing development. Because of the high water table in wetland areas, basements in houses built on wetlands are often flooded. In addition, the high water table inhibits the proper operation of septic systems causing sewage to be carried to the surface or into on-site wells, thus contaminating the water supply. Before developing wetland areas for housing, a careful analysis should be made of the developments impact upon the wetland, and the wetlands future effect upon housing built on the wetland.

Large tracts of wetlands have been used for industrial development. Development of these wetlands requires that they be drained and/or filled before construction can

begin. Since filling these areas is costly, there must be some interesting reason for building industrial plants in these areas. Turn to guide sheet #3A (Pause 2 sec.). On Guide sheet #3A make a list of some reasons which you feel might explain why wetlands have been chosen for industrial development. Before starting your list, turn the recorder off...Turn the recorder back on when you are ready to continue.

Guide Sheet #3

Now that you have considered why industrial parks have been earmarked for inland wetlands, let's compare your list with some of the factors which developers feel encourages this type of land use decision. If we discuss issues which you haven't listed, add them to your list.

First of all, inland wetlands are generally large, level tracts of land. This eliminates the problems associated with constructing plants and warehouses on hillsides. In addition, few people enjoy living next to an industrial park, so by placing the park on a wetland away from the rest of the community few people will be offended. In this way, industry can be out of sight - out of mind but still providing valuable tax dollars.

From an economic stand-point, inland wetlands can often be purchased at a relatively low price, even after the added expenses of draining and filling the wetland have been considered. In many communities, wetlands are the last undeveloped parcels of land which can be zoned for industrial development. These are a few of the major reasons for developing wetlands. Did you have any additional considerations?

let's take a look at local zoning practices -have you considered the role planning and zoning practices play in this scheme?

Planning and zoning policies often encourage industrial use of inland wetlands by earmarking these areas for only industrial development. To complement this practice zoning boards frequently fail to set aside enough other land for industrial use. Thus, industrial concerns often have little choice in deciding which land to develop.

As you can see, the past and present human impact on the inland wetland ecosystems has occured because the value of these areas in an undisturbed state is not understood or valued by the community. It has only taken a few decades to dramatically alter and destroy many of these valuable complex ecosystems. Wetlands must be mangged as part of an entire hydrologic system. They can not be treated as isolated units. We can not afford to destroy these areas without assessing the environmental and economic impact of such action.

One of the factors which encourages wetland development, is the comparatively low purchase price of these areas. Recognizing the importance contributions which wetlands make to a community, what do you feel causes wetlands to have such low values compared to other pieces of land in a community?

Well, part of it relates to the fact that wetlands are different from other parcels of land..they are frequently considered to be wet, useless pieces of ground and are thus sold for relatively low prices. Unfortunately private market prices do not reflect the full value of these resources to society. This results from

the fact that the full dollar value which a functioning inland wetland represents to society is difficult to estimate. How do you place a dollar value on wetlands that are providing us with an abundant supply of clean water or protecting our homes from the tragic and costly damages created by raging flood waters? What do you charge the teachers, hunters, fishermen, bird watchers, photographers or hikers for the privilege of using an inland wetland for their recreation? How do you balance the books by saying that a wetland is valuable to our community as open space? How much money should we allocate for providing a new home and breeding ground for many species of wildlife that rely on inland wetlands for all of their needs?

There are many intangible benefits which any wetland represents. Each one has obvious value, but the true dollar value is difficult to determine.

When a selling price is agreed upon between a wetland landowner and a buyer, can the owner and the buyer be expected to make a decision that will make maximum use of the wetland as a community asset? How can they be expected to make a decision based on the highest social benefit if neither the landowner nor the developer face the full social costs of development?

How can we close this gap between a selling price established in the development market and a price which reflects all the dollar values a wetland brings to society? (Pause 2 sec.) This is not a simple question to answer. As a matter of fact, many people in universities and government agencies are attempting, but have not yet succeeded, in answering these questions. Why is finding the answer so difficult? Let's explore that question by looking at a list of wetland beneficiaries. Turn to guide sheet 3B, turn off the recorder, and review the list of wetland beneficiaries. (Musical interlude - 5 sec.) Guide Sheet 3B

In reviewing the list, did you find categories which describe ways in which you benefit from wetlands? All of us are wetland beneficiaries whether we are conscious of the fact or not! After discovering all of the hidden benefits a wetland provides it is difficult to understand why anyone would allow them to be destroyed without first assessing the impact of planned development on the wetland site. Look at the list again and try to place a dollar value on each benefit which you derive from wetlands...Write these dollar values in the right hand margin of the guide sheet. (Pause) If you need more time, turn the recorder off until you are ready to proceed.(Pause)

What is the total value of the wetlands to you? (Pause) Would you be willing to pay to continue to receive these benefits if the cost was charged on an annual basis?

A summary of the key questions about wetland values is provided for you on Guide Sheet 4A. (Pause 3 sec.)

Guide Sheet 4 Question on wetland values

Who are the beneficiaries of wetland function? What are the beneficiaries willing to pay for these benefits? Which wetlands provide the greatest benefits and which ones provide the least? Think through the questions on Guide Sheet 4A.

There are no easy solutions to the problem of inland wetland value assessment. But, we can begin to close the value gap by understanding the intangible benefits we are enjoying and potecting the source of those benefits.

We must establish a balance between short term profits and long term environmental deterioration. It is very difficult to take a long term view when inflation is reducing the value of every dollar we earn, yet a long term perspective is absolutely necessary for sound planning purposes.

In response to increased pressure upon Connecticuts wetlands, the state legislature has taken a significant step toward the proper long term management of our wetlands. In May of 1972, Connecticut Public Act 73-155, the Inland Wetlands and Water Courses Act, was passed by the legislature and signed into law by the Governor. On July 1, 1974 the Act went into effect.

Since approximately 20 percent of the land in the state of Connecticut comes under the regulatory powers of this act, a large number of questions surfaced. These questions are summarized on guide sheet 4B.

What does this act mean to the citizens of Connecticut? What is an inland wetland? Who does the regulating? What kinds of activities does the act regulate? What criteria are used in making a decision on the use of any inland wetland?

These are the major questions which immediately came to the minds of many wetland landowners as they became aware of the law. The initial response was mixed. Many landowners feared that all development on or bordering wetlands would be stopped. Some conservationists felt that the wetlands were finally preserved for posterity. Both groups were wrong.

The Inland Wetlands Act was designed to regulate wetland usage...not to preserve wetlands. By following the guidelines set forth in the act, communities can see to it that their wetlands are used for the community. Some activities will be prohibited on wetlands while others will be permitted. In all cases, proper review procedures will prevent improper usage of this valuable resource. In order to convey the feelings of the Connecticut State Legislature concerning the value of these wetland areas and the importance of their regulation, we have included Section 1 of the Act at the top of Guidesheet #5. Follow along as we read through this important statement.

ide Sheet 5

AN ACT CONCERNING INLAND WETLANDS AND WATER COURSES

A. Section 1. The inland wetlands and water courses of the State of Connecticut are an indispensable and irreplaceable but fragile natural resource with which the citizens of the state have been endowed. The wetlands and water courses are an interrelated web of nature essential to an adequate supply of surface and underground water; to hydrological stability and control of flooding and erosion; to the recharging and purification of ground water; and to the existence of many forms of animal, aquatic and plant life. Many inland wetlands and water courses have been destroyed or are in danger of destruction because of unregulated use by reason of deposition, filling or removal of material, the diversion or obstruction of water flow, the erection of structures and other uses, all of which have despoiled, polluted and eliminated wetlands and water courses. Such unregulated activity has had, and will continue to have, a significant, adverse impact on the environment and ecology of the State of Connecticut and has and will continue to imperil the quality of the environment thus adversely effecting the ecological, scenic, historic and recreational values and benefits of the state for its citizens now and forever more. The preservation and protection of the wetlands and water courses from random, unnecessary, undesirable and unregulated uses, disturbance or destruction is in the public interest and is essential to the health, welfare and safety of the citizens of the state. It is, therefore, the purpose of this act to protect the citizens of the state by making provisions for the protection, preservation, maintenance and use of the inland wetlands and water courses by minimizing their disturbance and pollution; maintaining and improving water quality in accordance with the highest standards set by federal, state or local authority; preventing damage from erosion, turbidity or siltation; preventing loss of fish and other beneficial aquatic organisms, wildlife and vegetation and the destruction of the natural habitats thereof; deterring and inhibiting the danger of flood and pollution; protecting the quality of wetlands and water courses for their conservation, economic, aesthetic, recreational and other public and private uses and values; and protecting the state's potable fresh water supplies from the dangers of drought, overdraft, pollution, misuse and mismanagement by providing an orderly process to balance the need for the economic growth of the state and the use of its land with the need to protect its environment and ecology in order to forever guarantee to the people of the state, the safety of such natural resources for their benefit and enjoyment and for the benefit and enjoyment of generations yet unborn.

The regulated areas discussed in the Act include inland wetlands or water courses as defined in the act. Inland wetlands are all soils that are very poorly drained, poorly drained, alluvial, or floodplain as categorized by the National Cooperative Soil Survey of the Soil Conservation Service, U.S. Department of Agriculture. Water courses are all water bodies,

natural or man-made, including rivers, lakes, streams and ponds. Swamps, bogs and marshes are also specifically included in the definition of water courses.*

A regulated activity is an activity on an inland wetland or water course involving removal and deposition of material, obstruction, construction, alteration or pollution of a regulated area.

A permitted use is an activity which is allowed on a regulated area either as a right (e.g., farming) or allowed provided the activity does not distrub the natural and indigenous character of the land.

To gain a better understanding of the act study Guide Sheet 5B. Turn the recorder off while you study the provision of the Inalnd Wetland Act. When you are ready to continue, turn the recorder back on.

Guide Shee 5B

Now that you are familiar with the basic provisions of the InJand Wetlands Act, let's briefly consider some of the problems local regulatory agencies and DEP are faced with in administering the Act.

The first basic problem is boundary deliniation. Where do we draw the

lines indicating wetland boundaries? Using soils as a means of defining a wetland boundary does not eliminate all the problems. Boundary deliniation is difficult even with a detailed soils map, because of the map scale used and mapping errors. To appreciate the problem, consider the fact that a soil boundary line on a detailed soils map represents a strip of ground about 25 feet wide. To compound this problem, detailed soils surveys have only been completed for 80 percent of the state of Connecticut. The remaining 20 percent is being surveyed at a rate of 200,00 acre per year and the entire state will be mapped by 1980.

Administration of the Inland Wetlands Act is made difficult because the act is a unique piece of legislation. It does however represent a new and effective tool for land use planning...One issue the Inland Wetlands Act raises, focuses on public attitudes towards governmental control. Where do we draw the line between private and public rights? Up pops the age old question should private individuals have the right to have complete control over their property, or should the government be able to regulate a private citizens use of his land for the overall good of society? It seems apparent that there is now a need for private citizens and government to join forces in managing lands that have great public and private values. Under the guidelines of the Inland Wetlands Act, the best interests of all parties concerned with wetland utilization are weighted. Finally, when a decision is made, it represents objective decision making, not emotional protectivism or blind profiteering.

In an effort to permit you to gain a real insight into the land use decision making process we have designed a simple simulation. You are to review a hypothetical project that has been proposed for development on an inland wetland. As chairman of the Inland Wetland Commission of Wetford,

Connecticut you must make a decision as to whether or not the proposed project should go ahead or should be prohibited. To assist you in your planning, we have prepared a summary sheet on inland wetland functionson guide sheet number 6. If you are not familiar with the material on guide sheet 6 stop the recorder and study the guide sheet. When you are ready to continue, turn the recorder back on. (Pause 5 sec.)
Now that you are familiar with the function of inland wetlands, turn your attention to Guide Sheet #7 & 8.

In your role of Commissioner, you have just received a set of plans for construction of a subdivision of quality homes called "Marsh Estates". The construction plans are printed on Guide Sheet 7. Guide Sheet 7 is in overlay form so that it can be superimposed over Guide Sheet 8. Guide Sheet 8 is a map of the site. (slight pause) Use the map on guide sheet # 8 to delineate the wetland areas on the site plan.

Guide Sheet 6

Guide Sheet 7

A matrix which you will use in your evaluation is found on guide sheet #9. Have you been able to locate all of these guide sheets?...Turn the recorder off for a few minutes and review the material on guide sheets 7,8,9. When you are ready to continue, turn the recorder back on.

Guide Sheet 9

Well, here we go...let's begin by reviewing the site specifications as outlined in the proposed plan on guide sheet #7. As we go through the list of specifications, locate them on the site plan.

The project will consist of eight quality built homes. This number permits each home to be surrounded by adequate open space and will easily accommodate the required septic fields. Each house will have a septic tank with leaching fields.

There will be an asphalt road, "Cattail Court", with a cul-de-sac. The road will go through the center of the development.

to keep flood waters away form the development during high flow periods.

As you study each of the design characteristics think of the construction activity which must take place to reach the goals outlined in the plan. The construction operations are listed across the matrix in the center of the page. (Pause) On the left border of the matrix at the top of the page you will find a list of project design considerations. Each design consideration will involve some construction activity. Go down the list of project activity and check off each part of the project design which requires either excavation of filling. Stop the recorder while you carry out this task. (Pause)

The next activity involves the identification of drainage requirements. Check off any of the parts of the project design that require changes in the natural drainage pattern found on the map. (Pause 5 sec.) In order to get a true picture of drainage, include all aspects of the project design which require construction of impervious surfaces. This will include rooftops and pavement. (Pause 3 sec. Another aspect we must not overlook is stream dredging and relocation. These are important on-site activities and should be considered. Finally, parts of the project design which require the installation or operation of a septic system must be analyzed-Review what you have done...if necessary stop the recorder for a few minutes...while you study over this section of the Guide Sheet.

Now that you have completed the initial part of the evaluation you must consider what total effects the project will have on each of the natural wetland functions listed on the left border of the matrix at the bottom of the page Turn recorder off and review Guide Sheet 6 to familiarize yourself with each of the wetland functions.

Now you must consider each activity listed in the central construction column and analyze what effects each one of those activities will have on the ability of the wetland to perform its

Start by assessing the impact of surface excavation on each wetland function. Use a minus sign to indicate a negative effect, a plus sign for a positive effect and a zero for no effect. You may elect to write in modifiers such as major or slight to reflect the degree of impact. Take all the time you need in making your decision on this permit application. Total up the pluses and minuses This is not a test: it is only a way of helping you to understand the entire inland wetland "concept". There are no right or wrong decisions. Turn off the recorder while you complete this activity. When you are ready to continue, turn the recorder back on. (Pause)

Now that you have completed the matrix. Decide whether or not the project should be approved, disapproved or approved with restrictions. Compare your matrix to the matrix prepared by another member of your group or community. See how your analysis differs from theirs and discuss these differences in an effect to see how you both arrived at your decision.

Some of the real problems posed by specific kinds of activities are outlined for you on guide sheet #10. At the conclusion of the unit, you may want to study the chart and reevaluate your decisions on the Marsh Estates site plan.

As you can see, there are many factors to be considered in analyzing proposals for the utilization of wetlands. By now, you have at least a surface understanding of the issues. For more detailed information on the subject please refer to the books listed in the bibliography. Good luck in your future wetland regulation activities.