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Proceedings: Second Wetlands Conference

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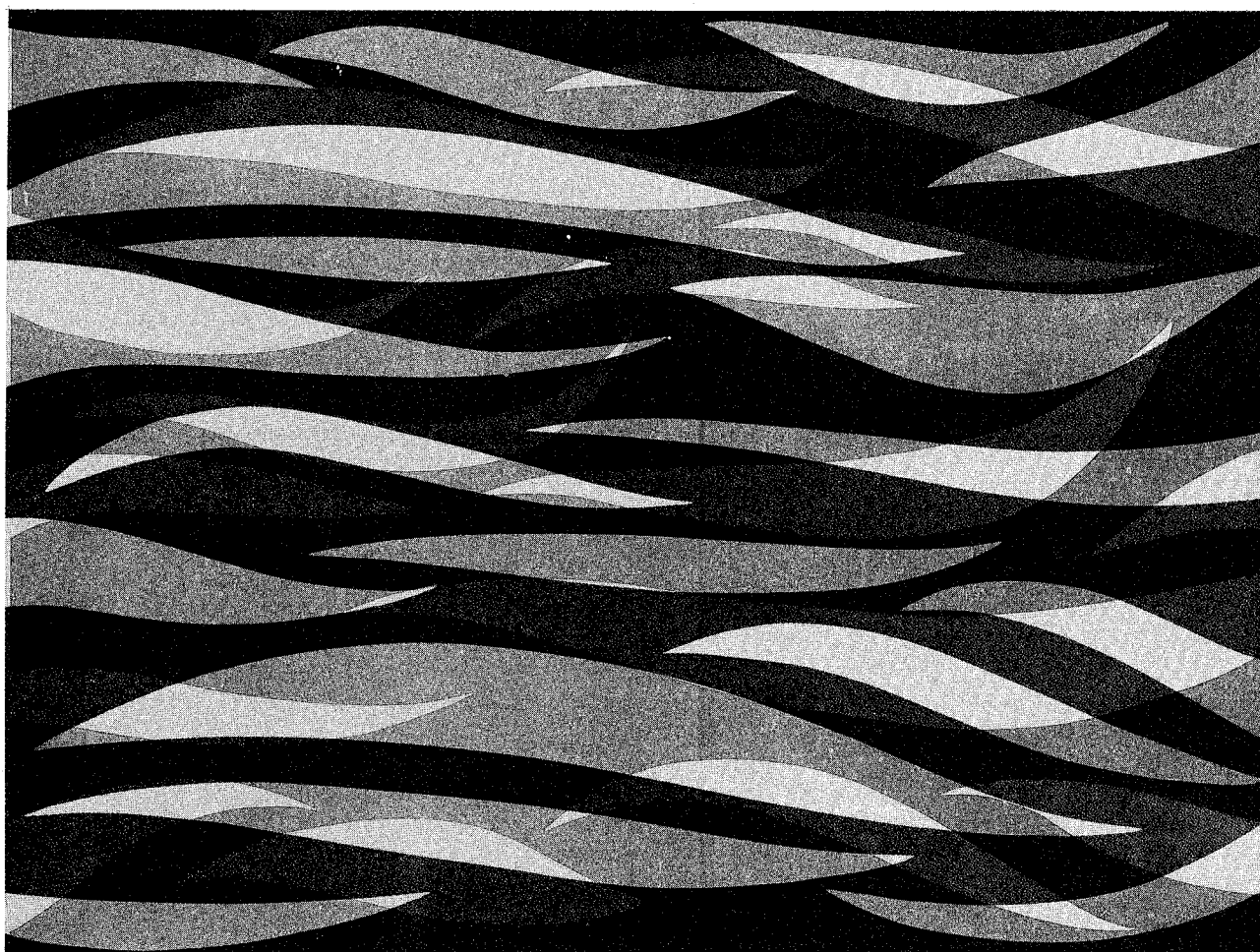
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PROCEEDINGS: SECOND WETLANDS CONFERENCE

Held on January 9, 1974 at Storrs, Connecticut

Report No. 24

October 1975



INSTITUTE OF WATER RESOURCES
The University of Connecticut

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*The University of Connecticut*  
INSTITUTE OF WATER RESOURCES

*Report No. 24*

*October 1975*

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P R O C E E D I N G S :  
S E C O N D   W E T L A N D S   C O N F E R E N C E

January 9, 1974

D E L I N E A T I O N   O F   W E T L A N D S

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*M. W. Lefor, H. H. Ridgeway, and T. B. Helfgott*

EDITORS

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ABSTRACT

Proceedings: Second Wetland Conference

DELINEATION OF WETLANDS

M. W. Lefor, H. H. Ridgeway and T. B. Helfgott, Editors

Under the theme of Inland Wetland conservation, seven edited and reviewed papers concerned with environmental and political science aspects of Delineation of Wetlands are presented in these proceedings. The conference was held on January 9, 1974, sponsored by the Institute of Water Resources at the University of Connecticut and co-sponsored by the Connecticut State Department of Environmental Protection and the U. S. Soil Conservation Service.

The major topics covered are: the identification and delineation of freshwater wetland values; methods of delineating wetlands by means of soil surveys; considerations in the preparation of specialized maps; the use of remote sensing in setting criteria for the management of inland wetlands; practical aspects of field determination of wetland boundaries; public policy implications of Inland Wetlands and Water courses laws; and a legal and constitutional discussion on *The Taking Issue* as it relates to current Acts. The proceedings include illustrations such as maps, reference lists, appendices of Latin and common botanical species names for wetland plants, the National Map Accuracy Standards and a list of conference participants.

Conclusions drawn from the conference include: 1. dollar values can be assigned to wetlands that partially reflect the true value of these resources; 2. soils mapping while convenient due to the extent of service (80% complete in Connecticut) is limited by irregular natural features and dependence on other specialties, such as biology, for drawing lines on maps; 3. Man-induced, seasonal and climatic changes in wetlands can be monitored by remote sensing, however resolution may not meet mapping needs -- the costs of identification and mapping either by remote sensing, soils or biological factors govern the degree of accuracy obtainable; 4. the limited scientific information on wetlands has compounded the legal problems associated with implementing inland wetland conservation laws; 5. *Warning:* Beware of hastily prepared maps; 6. Accuracy of maps cannot be greater than that of base map (1" = 100 feet is suggested as an ideal scale -- National Map Accuracy Standards should be used); 7. the legal conflict between private property and the common good needs careful interpretation; 8. existing legislation on wetlands should incorporate an overall land use policy, reflect biological diversity and wetland functions and just consideration of property owners; 9. legal wetlands definitions that can lead to delineation should consider soils, vegetative, animal and water content criteria as well as natural processes and Man's needs. The proceedings are devoted to the consideration of wetlands for the long term environmental value of these water and land resources.

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PREFACE:

DELINEATION OF WETLANDS

If inland wetlands are to be rationally conserved, they must be defined, delineated, and managed in a way that will preserve their long term functional roles as ecologically valuable resources.

This preface 1) reviews background factors of current interest in inland wetlands; 2) discusses the key technical and practical considerations in the delineation of wetlands; 3) summarizes the basic conclusions distilled from the Proceedings manuscript; and 4) recognizes the contributions of persons and organizations.

The Institute of Water Resources and the University of Connecticut sponsored this conference on the delineation of wetlands, held on January 9, 1974. The important subject of wetlands has received popular appreciation only recently; therefore, the body of information on wetlands, technical and political, theoretical and practical, needed exposure. To effect an information exchange and deepen the appreciation of the problems involved in wetlands delineation, this conference was developed under the aegis of the Institute of Water Resources in cooperation with the Connecticut State Department of Environmental Protection (DEP), the Soil Conservation Service of the United States Department of Agriculture and the Connecticut Inland Wetlands Project, sponsored by the Ford Foundation. An earlier conference at the University of Connecticut, June 20, 1973, emphasized definitions of wetlands.* The proceedings of that conference has been published as Institute of Water Resources Report 21: *Proceedings: First Wetlands Conference -- Definitions of Wetlands*.

This one-day conference was designed to aid in understanding the technical and legal aspects of the boundaries of wetlands with special reference to the inland wetlands of Connecticut and New England. The expert group of contributors was charged to discuss wetlands from a New England regional view; the use of soils and soils mapping for delineating wetlands; remote sensing in wetlands management; practical and theoretical considerations necessary for determining boundary lines; and the legal aspects of wetlands and related water resources.

* A conference largely on the Functional Role of Wetlands was held June 14, 1975.

Background. By being among the first to protect tidal wetlands, the State of Connecticut has taken a leading role in the preservation of vital wetland resources. The Connecticut Tidal Wetlands Act has been taken as a paradigm for legislation in other coastal states such as New York, Rhode Island, New Jersey and Delaware. The uses and values of the salt marsh are much better known than those of the inland wetlands, and therefore, a large body of knowledge was available to encourage the popular and legislative support for tidal wetlands legislation. Inland wetlands are a different matter because scientifically they are less well known.

In Connecticut, the State Department of Environmental Protection (DEP) has been charged with the implementation and enforcement of the Inland Wetlands and Watercourses Act. This precedent-setting piece of legislation attempts to regulate the use of the more than 800,000 acres of Inland Wetlands which constitute some 25% of Connecticut's land area. In comparison, tidal wetlands amount to possibly 20,000 acres.

This series of wetlands conferences represents an effort on the part of the Institute of Water Resources to provide the technical expertise and information necessary for the proper implementation of the Inland Wetlands and Watercourses Act. To be effective, environmental legislation must have substantial technical as well as political backing. Although the available technical competence was utilized during the formulation of the Inland Wetlands and Watercourses Act, a search of the literature on the subject revealed a dearth of comprehensive information. The biological and physical complexity and variability of the inland wetlands ecosystem renders it difficult to define. The first Institute of Water Resources Conference on Wetlands discussed the many ways in which a wetland *can be defined*. This conference discusses the ways in which a wetland *can be delineated*; i.e., how do you know where it is?

Some have remarked, "You know you're in a wetland when your socks get wet," but the picture is not such a simple one. Some lands, the most difficult to define and thus to delineate, should be classed as wetlands because they offer a seasonal role in the hydrological cycle -- they are only periodically wet. Other lands should be classed as wetlands because of the moisture-holding properties of the soil. Although one might not immediately recognize these as the classical swamp, marsh or bog, the current law calls these watercourses. Flood plains are not thought by many to be a type of wetland, but they serve many of the same roles and should also come under the purview of some form of wetlands regulation, if not of an overall land-use policy.

In this wetlands conference, the question is "where do we draw the line around a wetland?" or "where does legally regulated wetland stop and upland begin?" These must be answered carefully for in the law one is faced with meeting the correct, just and constitutional requirements for regulating the property of a private landowner. The nature of the line must be specified and should be readily recognizable in the field should the occasion arise, the method of how that line is drawn either in the field or on the map must be known; and the information on which the decision to put that line in a particular place must be derived and made a part of the regulatory procedure. Property owners have a legal mechanism available to them for the protection of their rights under the constitution. These and many other factors in land use regulation make environmental legislation difficult. Some would say that the Connecticut Inland Wetlands and Watercourses Act was a hastily conceived thing. We disagree however. This volume attempts to add information in a case where the Law was ready for the Land but where the Land was not fully ready for the Law. Technology for wetlands management was not yet in a comprehensive form when the need for the law arose. For example, was a reasonable, fast and technically sound method of wetland delineation known?

Delineation Requirements. The delineation of wetlands requires the identification of the wetland - non-wetland interface line and the locating of other reference lines so that the wetlands boundary can be established and later re-established on the ground. Wetland boundaries can be determined according to hydrologic, vegetative or soils criteria. Techniques for mapping the boundaries include remote sensing and field techniques. These techniques are discussed in several of the papers presented here and are also the subject of some of the papers presented at the first wetlands conference. The problems and costs of fixing or locating of boundary lines using photogrammetric or land surveying techniques to describe the identified line either graphically or mathematically are discussed in several of the following papers.

Connecticut Public Act 155 calls for the use of soil types to affect the delineation of wetlands. The problems associated with this were covered in Mr. David E. Hill's Paper in the first proceedings; he indicated that soil survey experts could identify and locate the boundary line on a map with variations as little as 10 feet when sharp breaks in slope occurred, but variations of 70 feet to 260 feet occurred where slopes were more gradual. This range of errors looms very large when one considers that small parcels of land are included and that the users of the land are further restricted by setback lines and clearance lines from adjoining owners.

The error in the boundary line indicated on the soils map is a combination of the error in deciding where the soil characteristics change; the error in the base map; and the error in judgement by the soil surveyor as to where he is located on the map.

Using air photo interpretation and remote sensing techniques the two basic problems remain the same; Where is the boundary of the wetland on the photograph? How can this boundary be geometrically fixed and reproduced on the ground? Most remote sensing work has concentrated on the identification of the boundary on the photograph. The fixing and describing of this boundary requires additional photogrammetric work which means establishing ground control and the use of additional photo measuring techniques. With the proper ground control, flight height and photogrammetric tools, a line can be mathematically or graphically described to within + 2 feet or less. Accurate mathematical or graphic descriptions can then be established on the ground using standard surveying practice. Note that the two steps are still required: identification of the boundary and the fixing or locating of the boundary. The overall method cannot be more accurate than the accuracy of either of the two parts. The accuracy of the fixing of the line is directly dependent on the ground control and the photogrammetric equipment.

The papers presented at the wetlands conference quote many different scales. The following table should give a feel for what these scales represent on the ground. The scales selected for the table do not include all of the scales quoted, but they represent the general range of values. The values for the columns were selected for the following reasons:

1. One inch is given because many people think in terms of 1" equals so many feet.
2. One fiftieth of an inch (1/50") is the approximate width of a pencil line.
3. One tenth of an inch square (.1") is an estimated minimum size area for a person to identify.

When the land use of a parcel of land that effects a designated wetland is to be changed, a boundary line must be located on the ground. Locating this line is where the land surveyor becomes involved and ultimately most of the inland wetland boundaries will need to be located on the ground. Once the wetland boundary is identified the land surveyor can describe and/or locate the line to almost any accuracy desired. The accuracy

SCALE CONVERSIONS

<u>SCALE</u>	<u>1 in. =</u>	<u>1/50 in. =</u>	<u>.1 sq. in. =</u>
1:1,000,000	83,300 ft. 15.7 mi.	1,670 ft.	1,600 acres 2.5 mi. ²
1:500,000	41,600 ft. 7.9 mi.	833 ft.	400 acres .63 mi. ²
1:250,000	20,800 ft. 3.9 mi.	417 ft.	100 acres
1:100,000	8,330 ft. 1.6 mi.	170 ft.	16 acres
1:50,000	4,160 ft.	83 ft.	4 acres
1:24,000	2,000 ft.	40 ft.	.9 acres 40,000 ft. ²
1:2,400	200 ft.	4 ft.	.01 acres 4,000 ft. ²
1:2,000	167 ft.	3.3 ft.	.006 acres 280 ft. ²
1:1,200	100 ft.	2 ft.	.0025 acres 100 ft. ²
1:1,000	83 ft.	1.7 ft.	.0016 acres 70 ft. ²

of location is primarily governed by cost. The primary problems of the land surveyor are: Who is going to identify the line that determines the limit of the wetland? and, how accurately must the line be located? (A 70 foot zone is hardly a line and may be critical to the land owner.)

Conclusions. Some definitive conclusions can be drawn from this conference:

1. When left in a natural state, wetlands can have considerable dollar value from a viewpoint of wildlife habitat, water supply, flood control and aesthetic value. Some cost data on wetlands can be found in the paper by Larson.

2. Soil mapping is convenient because some 80% of Connecticut has been surveyed by the Soil Conservation Service with modern techniques over the last 20 years. However, problems arise because soil boundaries as natural features are inherently irregular and need to be refined and smoothed for mapping purposes. The technical expertise presently available can identify and locate wetland boundaries to suit almost every legal or scientific need. The costs of identification and mapping, however, govern the degree of accuracy obtained.

3. Wetlands are dynamic components of the natural landscape. Man-induced, seasonal and short-term climatic changes in wetlands can be obtained and monitored using remote sensing techniques; however, resolutions currently available may not always meet mapping needs.

4. The lack of complete scientific knowledge about inland wetlands has compounded the legal problems associated with implementing inland wetlands legislation.

5. *Warning:* Beware of hastily prepared maps.

6. The accuracy of any published map to be used for wetlands delineation cannot be greater than that of the base map from which it is prepared. 1" = 100 feet is suggested as an ideal map scale for accurate wetland delineation but in specific cases a smaller scale map can be acceptable. National Map Accuracy Standards (See appendix 2) should be met at any scale.

7. Reviews by attorneys Post and Losee of the wetlands legislation and especially of *The Taking Issue* are developed and discussed in this conference proceedings.

8. The present laws on wetlands in Connecticut, while commendable in stopping the eradication of these water resources,

suffer from an administratively difficult mechanism, i.e., township vs. state regulation. (There are 169 townships in Connecticut and a DEP staff of about 1 or 2 per dozen towns.) Do the towns administer their wetlands charges the same? No.

9. The wetlands definition in the law is in need of improvement for theoretical and practical reasons: the soils only definition is technically defective -- lines determined by soil, vegetative, animal and water criteria cannot be the same.

10. The existing wetlands law needs to be modified to consider a) an overall land use policy; b) ways to improve the definition to reflect the diverse biological and functional role of a wetland; c) ways to compensate, in some way, those persons limited in developing their land by the long term public benefit in preserving wetlands.

Acknowledgements. The Institute of Water Resources (IWR) at the University of Connecticut has been the major organizing force for this conference. The IWR encourages basic and applied research and helps in the development of technical competence in the field of water resources. The Institute coordinates water-related research to schools and colleges by assisting interested staff members in obtaining financial support, facilities and contacts. Inter-disciplinary cooperation and education are encouraged, participation with federal, state and local government agencies and other organizations is supported. Special lectures, workshops, seminars and colloquia on water problems and policy research are sponsored to encourage technology transfer from the staff and to the outside. The Institute of Water Resources strives to be outreaching, to serve the community, and needs inputs of real practical problems to do this well. There is a need to bring theory and practice together to better manage waters. For the Institute, water is the *thing*; aquatic research and technology transfer the *way*; and multi-disciplinary interactions in and outside of the University of Connecticut is the *means*.

The conference committee who developed this program were Dr. Michael Wm. Lefor, Research Associate at the University of Connecticut, Consultant Biologist for the Connecticut State Department of Environmental Protection, and Chairman of this conference; Dr. Hallas H. Ridgeway, a surveying lecturer in the Civil Engineering Department at the University of Connecticut, and Chairman for the afternoon session; Dr. Paul Bock, Professor of Hydrology and Water Resources, with positions in both Civil Engineering and in the Institute of Water Resources; Mrs. Cynthia M.

Ivey, Inland Wetlands Administrator with the Water and Related Resources Unit of the Connecticut Department of Environmental Protection; Mr. David Lavine, Director for the Connecticut Inland Wetlands Project; Mr. David Losee, an attorney of West Hartford, Connecticut; Mr. Edward H. Sautter, State Soil Scientist of the U.S. Department of Agriculture Soil Conservation Service; Mr. E. Zell Steever, Director, Water and Related Resources, Connecticut State Department of Environmental Protection; and ex-officio, Dr. T. B. Helfgott, Environmental Engineering Program, Civil Engineering Department, Acting Director Institute of Water Resources at the time of the conference, and Dr. W. C. Kennard, formerly The Institute of Water Resources Director.

Recognition is due to the significant contributions of Mr. Paul Marin who received the manuscript and helped draw out some of the conclusions presented.

The typists for the manuscript were Ms. Alice T. Ryan, Ms. Laurie Kile and Ms. Diane K. Tunick; they are to be commended for a fine job.

We hope that the present volume, along with other work on water resources aids the perception of the problems and solutions in wetlands use and regulation.

M. W. Lefor, H. H. Ridgeway and T. B. Helfgott

- Editors.

IDENTIFICATION AND DELINEATION OF FRESHWATER WETLAND VALUES

by

Joseph S. Larson*

Introduction. One of the things that becomes apparent in the study of wetlands management is that delineation and classification of wetlands cannot be rationally separated from consideration of the ultimate use and users of the system devised. To insure that we avoid such separation, it is useful to answer a few basic questions at the outset:

Why Delineate Wetlands? There appear to be two fundamental answers to this question. First, wetlands pose certain limitations to man's activities: surface water and high groundwater. These limit what can be built on the site and the uses Man makes of the soil itself. A second reason for singling out wetlands is the inherent values that wetlands provide to Man. Some of these, such as flood abatement and wildlife habitat, are values for which wetlands are uniquely suited. Given these reasons we can now approach another deceptively simple question.

What is a Wetland? If we define wetlands only on the basis of the limitations they pose to man's activities, we should include all areas where wetness is the prime factor governing wise use of the site. In the broadest sense such a definition embraces the open waters of the oceans to upland slopes where hardpan or shallow bedrock keep the upper soil layers saturated much of the year. Also included would be floodplains of the largest recorded floods.

A more circumscribed wetland definition is one based on a combination of limitations and a recognition of the unique values of wetlands. In field application, the diagnostics are combinations of vegetative indicators and organic soils, primarily mucks and peats. Organic

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soils are usually located in the central portion of the wetland while the vegetative indicators are used to delineate the boundaries that are subject to peak seasonal water levels. This latter concept is the one we have employed in our research. (1, 2)

Wetland Inventory. Clearly, the parameters of a wetland inventory are determined by the initial wetlands definition and this in turn should have been based on the intent of the user. Much debate over what should be included in a wetland inventory stems from a failure to identify the specific needs of the user before drawing lines on maps.

Locating wetlands on maps is relatively simple using modern aerial photography, remote sensing and soil surveys. Deciding where the edges of these wetlands lie is a difficult task and one which increases in difficulty and cost with an increase in scale and accuracy. Again, scale and accuracy depend on the user. In some cases it is sufficient simply to locate wetlands on a continental scale and estimate their total area. At the other extreme is the wetland map requiring scale and accuracy sufficient to document a land use restriction to be recorded in the registry of deeds.

Qualitative Aspects of Wetlands. Leaping over the problem of boundary determination, next I consider here the definition of wetland values since these constitute the justification for the delineation process. In recent years it has been shown that wetlands have value as flood-water retention basins, prime wildlife habitats, sources of water supply and as green space in the visual landscape. Detailed studies of these values have been lacking, and our research has been directed toward identifying specific wetland characteristics which give rise to these values. In addition, we have sought to suggest some ranges of relative values and relate these to an economic scale in the real estate market.

Wildlife Values. An early task was to develop a wetland classification system useful in the Northeast and compatible with other regional systems. Our system is based on the dominant life form of the wetland vegetation, surface water depth and permanence (3, 4). To move from classification to evaluation it was necessary to recognize additional measurable characteristics:

- wetland size
- topographic and hydrologic location
- surrounding habitat types

proportions and interspersions of cover
and water
vegetative interspersions
wetland juxtaposition
water chemistry

With few exceptions, these can be determined from existing maps and aerial photography. Extensive literature review, field experience and consultation with other biologists led us to assign numerical significance coefficients, specifications and ranks to these components (5).

The evaluation system is applied in two sequential phases. Phase I consists of determining whether the wetland has some unique or outstanding characteristic which in and of itself identifies it as a wetland of such merit that it should not be altered in any way. The presence of rare, endemic, restricted or relict flora and fauna, high wildlife use, an outstanding record of scientific research at the site are examples of evidence to support this subjective but essential Phase I decision.

Phase II consists of applying a numerical evaluation approach to those wetlands which do not meet the standards of Phase I. This approach is a consistent, systematic evaluation method. The result is a total numerical score on a scale of about 100 possible values. The numerical values assigned to each component in the system can be altered by any user as new data or experience persuade him to viewpoints other than our own, but we feel that the relative values are consistent with field conditions and experience.

Visual-Cultural Values. Our landscape planners assisted in the development of the basic classification system since it became apparent early in the project that vegetative classes and subclasses, based on the physical life forms of plants, have importance to both wildlife and the visual impression a wetland presents to the human viewer. This proved to be a strong link in our interdisciplinary approach and suggests that the response of man and wildlife to the landscape has interesting similarities.

The key visual-cultural attributes of wetlands are *visual contrast and diversity, recreational carrying capacity and diversity, and educational diversity.* The field characteristics which one measures in the visual-

cultural Phase II evaluation are natural resource variables and cultural attributes (6).

Landform contrast and diversity, wetland edge complexity, size and diversity of associated water bodies, surrounding land use contrast and diversity, wetland type diversity, wetland internal contrast and total size are the natural resource variables. The cultural attributes are educational proximity, physical accessibility and ambient quality. Time did not permit examination of proximity to population centers, but this can be partially covered in Phase I of the overall evaluation.

As in the wildlife evaluation model, each of these variables and attributes has been assigned suggested dimensions with associated numerical ranks and values. Following the Phase I subjective evaluation for outstanding wetlands, appropriate aerial photograph, map and field measurements are taken to produce a numerical score on a range of visual values plus a companion one for cultural attributes. The same cautions and intentions expressed for the wildlife scores pertain here also.

Our intention is that these scoring systems be used by land managers and decision makers who are faced with deciding which wetlands to save and which to trade off for alternative uses. We suggest no cut-off points on the scales of value but we do expect that the scores generated will be used to compare one wetland with others within some logical geographic or political frame of reference. Given scores will have different meanings to a town manager and a state agency head but this in itself should suggest where the primary responsibility for preservation may lie.

Groundwater Values. Our hydrogeologists explored the suspected relationships between wetlands and groundwater by preparing a new surficial geology map of the state at the same scale as available land-use maps (7). By overlaying the two maps and backed with field examination and existing hydrogeologic survey information they were able to document the correlation between wetlands and surficial deposits likely to produce copious amounts of water (8, 9).

As much as 50 percent of the freshwater wetlands of Massachusetts lie on deposits which may yield an average of up to one million gallons of water per day. At least 60 municipalities have drilled municipal water production wells in or near wetlands. Stratified drift and alluvial deposits account for most of these conditions, but in certain cases where glacial lake clays have been deposited over coarser material these too may be important aquifers.

In an era of growing water shortage wetlands need to be carefully examined for water supply potentials before proceeding with any alteration scheme.

Economic Values. Our economists assumed the task of developing economic values associated with the wildlife and visual-cultural scores as well as the water supply potential. They also explored values for the flood retention role of wetlands (10,11,12).

Monetary benefits for potential water supply were the most direct and relatively easy to estimate. The process consisted of contrasting the cost to a town to drill, pump and pipe water from a wetland to a central distribution point with that of hooking that same point into an existing metropolitan water system located a similar distance from the wetland. Costs for the Metropolitan District Commission (MDC) system which serves Greater Boston were used, as were average well yields and costs. If a well is drilled on a one acre wetland site yielding a million gallons per day, the savings over hooking the town into the MDC system makes that acre of wetland worth about \$52,000 for the water value alone. This is under present MDC rates, which result in an economic loss to the Commission.

Developing economic values to equate with wildlife and visual-cultural value scores required an indirect approach, but we regard this as a decided improvement over previous attempts elsewhere.

The real estate market price of wetlands was used as an indicator of the opportunity cost of preserving them. A public decision to preserve a wetland results in a measurable lost opportunity to do something else with a wetland. In the real world, wetlands are bought and sold in terms of their perceived economic rent potential in altered uses since the wetland in a natural

state generally produces no income to the individual. If the market rate of interest is 7 per cent, a wetland selling for \$1,000 will produce, in an altered use-state, at least \$70 per year after subtracting development costs, such as filling. Market prices for wetlands in Massachusetts during 1970-71 varied from negligible value in remote rural areas to \$70,000 per acre in urban expansion areas. Minimum urban prices were about \$300 per acre.

It was necessary to estimate some wildlife and visual-cultural economic values to compare with the perceived values for altered uses. For both of these the usual market system fails to produce such values but where the market system fails an institutionalized political system can suggest them under certain circumstances. Where the public has instituted generally accepted procedures for the purchase of wetlands for wildlife and visual-cultural values, an opportunity exists for identifying dollar values. Such values can be regarded as a somewhat conservative estimate since we have not attempted a measure of the maximum amount which might have been paid.

For wildlife, we took data on purchases of some 8,000 acres of wetlands by the state Division of Fisheries and Game over a recent three year period. Since these purchases were made from funds generated from sportsman license fees and were spent under the close scrutiny of this largely single interest wildlife group, it was assumed that the prices paid were reasonable. After adjusting for inflation and unusual purchase conditions, we arrived at a maximum capitalized value of about \$1200 per acre for the highest value wildlife wetlands.

The approach to estimating visual-cultural values was based on similar assumptions except that the purchase of wetlands by town Conservation Commissions was used as the political process measure. Each purchase is subject to vote of Town Meeting and the records of 29 municipalities during Fiscal Year 1972 were examined. This produced a maximum, weighted capitalized value of \$5,000 per acre for wetlands of high value for open space and passive recreational qualities.

Flood control values of wetlands are widely recognized but poorly documented. A recent Corps of Engineers report (13,14) recommended purchase of some 8,000 acres of wetlands which serve as natural flood storage areas in the Charles River Basin upstream from Boston. They estimated that by the year 2,000 the average annual flood control benefits, in terms of avoided losses, will be \$647,000 per year. A calculated capitalized value per wetland acre on this basis will be \$1,488.

These various maximum values can be applied to the scales of values for wetlands to produce dollar values associated with relative wildlife, visual-cultural, water supply and flood control values. A wetland which scores highest for all of these has a capitalized value of \$59,900 per acre at 5.375 per cent and \$46,000 per acre at 7 per cent. Wetlands with low wildlife and visual-cultural values and no water supply or flood control value have values of \$700 or \$500 per acre at the respective rates.

Conclusion. It is important to note that these values are generated by wetlands in an unaltered state. Some are values which accrue to the public without the necessity of purchase, and alteration of wetlands would produce measurable loss and damage to the downstream public. Some are values which cannot be realized for the public without purchase. This is the distinction which determines whether a wetland use restriction is a reasonable exercise of the police power of the state or whether it constitutes unreasonable taking without due compensation.

We offer our classification system and the evaluation systems as means to assist decision-makers in managing the future of wetland resources. If our suggested values have any sense of reality they are evidence for the justification of our work and that of many others in the wetland field. They imply that the public benefits to be maintained or acquired in the future are worthy of our continued best efforts.

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Identification of Freshwater Wetlands Values

by

Joseph S. Larson

EDITORIAL COMMENTARY

by

Joseph N. Gill,* Michael Wm. Lefor,** and T. Helfgott⁺

This paper is refreshing in that it takes off the blinders and looks at a very broad approach to identifying and delineating freshwater wetlands. The paper would have been of great utility had it been available when the State of Connecticut was drafting its precedent-setting inland wetlands legislation. Dr. Larson is quite correct in not separating classification from delineation and in not neglecting functional roles of wetlands, and he points out that by using vegetative indicators as well as soil types in wetland identification a more accurate delineation will result. Vegetative indicators are useful in locating wetland boundaries subject to peak seasonal water levels. We concur that the diagnostic tools for dealing with wetlands are a combination of vegetative indicator species and the identification of soils, especially organic mucks and peats, but hydrology and soil water content are obvious but often neglected factors.

It should be axiomatic that everything in Nature has a fluctuating value conditioned by existing external conditions. In discussing this point, Dr. Larson has brought to the fore many of the aspects of wetlands and land-use regulation which might have been ignored by regulating agencies.

Dr. Larson correctly points out that sufficient accuracy is needed to document a land-use restriction when that restriction has to be recorded on the land records. Four additional

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significant points discussed in the paper are:

1. Although it might be possible to delineate and regulate wetlands, these ecosystems, in any holistic sense, cannot be considered as separate from the lands and water-courses which surround them.
2. Wetlands mapping must be done from a definitional criterion and at a scale which suits the needs of the conservator.
3. The mapping of any land area for regulation and/or preservation should be compatible with existing data bases. What do we do if the requisite data base is lacking, as is so often the case?
4. A proper data base should permit correlations which can be used as new information becomes available or when new information needs must support the decision-making process.

Wetlands can be starting points for state as well as regional environmental conservation efforts that should eventually lead to overall land-use planning with large boundaries. Using a regionally applicable definition (e.g., for New England), it could first be possible to have wetlands mapping for small areas such as counties or drainage areas, and then mapping for the entire region. This mapping and land-use conservation can be extended, and correlations and extrapolations to other geographical units from this mapping can be made from significant physical and biological criteria. A knowledge of the physical characteristics and biological occupants of land, the details of which are so often ignored, can open many areas for correct decision-making while adding to discoveries in Science.

Numerically significant coefficients have been suggested in Dr. Larson's paper as a method of rating the value of the wetlands. Rather than saying to all comers that "*a wetland is a wetland is a wetland*, and all violators keep out", the paper points out that every wetland has variables in both its ecological and economic value.

In considering the qualitative values of wetlands, the paper mentions four qualifiers that set such values: 1. flood water retention capacity; 2. wildlife habitat; 3. water supply; 4. green space in the visual landscape.

It should be noted that each of these values can be either plus (beneficial) or minus (deleterious), since wetlands can (1) either take up flowing water or act as non-absorbing surfaces; (2) may or may not be diverse in flora or fauna; (3) can be areas of water recharge or discharge, or areas of loss through evapotranspiration; and (4) be wet enough to either support a dense and diverse vegetation, or so wet as to be a void and anaerobically stagnant area.

Nevertheless, our judgements of wetlands can be improved by putting a value on qualitative measurements that also include wetland size, topographic and hydrologic location, surrounding habitat types, proportions and interspersions of cover and water, vegetative interspersions, wetland juxtaposition, and water chemistry.

In critique, however, one wonders *whose* subjective judgement comes up with the values generated, and there is always the reliance on "experts" who are not always available. The reader of this article cannot duplicate the evaluations made.

Placing a value on these systems requires an interdisciplinary approach in developing evaluation models. By dividing the study into a Phase I subjective evaluation of wetlands of obvious value and a Phase II which uses a numerical evaluation for those wetlands which do not meet the standards of Phase I, the *non-technocrat* town manager and administrator can be in possession of a functional yardstick to assist in the task of wetlands conservation.

In reviewing the economic values of wetlands, the paper points out that water supply aquifers and flood retention capacity are the most obvious values, but that geographic location can result in a negligible value in remote rural areas, and a value of as much as \$70,000 per acre in urban and expanding areas. Even the economic evaluations are variable and subject to inflation and current restraints on development.

Contrary to the opening statement in Dr. Larson's paper, wetlands can be classified from consideration of the ultimate use and users of these systems, based on purely scientific factors drawn from biology, chemistry and physics. But as the paper implies, these may be neither practical nor compatible with the functional role assigned to wetlands. Which approach yields the greater long-term or short-term benefit to the populace?

USING SOIL SURVEYS FOR DELINEATING WETLANDS

by

Lindo J. Bartelli*

Introduction. Wetlands are emerging in ecological value as an important resource closely related to many aspects of the environment. In dealing with wetlands, whether this involves identification, delineation or preservation, we must realize that wetlands are no static things. As most things in nature, wetlands change character with time; some changes occur quicker than others. A roadfill across a northern bog may change the bog ecosystem almost overnight; on the other hand, some lakes evolve into bogs over a timespan of years. One change is induced by people, the other is a natural progression or sequence of events which may be accelerated by Man. The fragile wetlands ecosystem requires a critical protection and prevention program.

A significant part of any preservation program is a workable system for identification and delineation. We must know what wetlands are and where they are. Biologists (1) define wetlands as lowlands covered with shallow and sometimes temporary or intermittent waters. Lakes and ponds with emergent vegetation are included but permanent waters of reservoirs, streams and deep lakes are not. Neither are areas that are wet so seldom or for such a short time that they do not have wet soil vegetation. Most biologists recognize wetlands by the vegetation present. In the Connecticut Inland Wetlands Act the definition reads as follows:

"Wetlands means lands which consist of any of the soil types designated as poorly drained, very poorly drained, alluvial, and flood plain by the National Cooperative Soil Survey, as may be amended from time to time, of the Soil Conservation Service of the United States Department of Agriculture... "Watercourses" means rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs and all other bodies of water."

This definition is tied to the natural soil and eliminates the

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need for a boundary between wetlands and open water. Vegetation is not part of the definition but can be a critical factor in the identification. As in some soil mapping, it can serve as a field clue to predict the occurrence of a wet soil. At a recent workshop on wetlands at the Patuxent Research Center in Maryland, close relations were observed between kinds of soil and plant communities. For example, wild rice is abundant on typic hydraquents, mineral soils high in water and low in salts. As freshwater marsh changes to saline marsh, wild rice is replaced by cattails and sawgrass. These saline soils are classified as halic*hydraquents. Because of the interdependence of soils and natural vegetation, soils can serve as indicators of climax vegetation. The objective of this paper is to show the value of soil surveys for delineating wetlands.

Soil Surveys. A soil survey is a map on which the natural soil is identified and its distribution delineated. In addition, a soil survey includes soil descriptions and predictions of soil behavior. Boundaries of individual soils are plotted on aerial photographs. These photographs show woodlands, buildings, trees and other vegetation. Many times, degrees of darkness on the photographs reflect degree of wetness. These details help in drawing boundaries accurately.

The soils that we map are collections of natural bodies on the earth's surface, containing living matter and supporting or capable of supporting plants in nature. It is the result of the interactions through time, of climate, plants, organisms, parent materials and relief. The soil scientist sees this integrated expression in the soil morphology. He uses these marks of genesis with supportive laboratory analysis to classify the soil. The categories of the soil classification system are conceptual and are defined as precisely as present knowledge permits. These taxonomic units give us common standards for mapping, naming and interpreting soils. They occur in nature as real bodies of soil with properties that correspond to the concepts of the taxa.

The soils that we classify range in surface area from one to several square meters. Thickness or depth is more difficult to define but usually parallels the depth of rooting of native perennial plants. Yet lower soil layers that influence the movement and content of water and air in the soil of the root zone also are considered. Areas are not considered soil if the surface is permanently covered by water deep enough so that only floating plants are present.

Soil is not a static thing. Many of its properties change with time. The pH, soluble salts, organic matter content, soil fauna, temperature and moisture all change with the seasons.

* Halic = salty -Eds.

Even vegetation may change within a short space of time. The change from freshwater vegetation to salt-tolerant grasses in the delta at the mouth of the Mississippi River is an example of saltwater encroachment changing both soil and plant communities within a very short geologic period.

In a soil survey, we view a soil as it is throughout the year, and not what it is like at a given moment; for example, soil moisture regimes are characterized throughout the year. Some very poorly drained soils may not be excessively wet during every part of the year. The soils of the Everglades of south Florida though characterized as very poorly drained, still may not be covered with water during the dry winter months. The poorly drained soils of the west coast can be dry during the dry summer season.

In soil mapping, the representation of a soil area on a map is imperfect to varying degrees, depending on the scale of the map and the nature of the soil. We try to minimize errors in the location of boundaries by defining the soils so that soil boundaries occur at places where there are obvious changes in one or another of the soil-forming factors. This could be a change in vegetation, slope, physiographic position, or rock strata. Often boundaries in nature are extremely irregular. Then, small areas or pockets of other soils are included within the boundaries we draw if they are too small to delineate separately. There are cartographic problems present in making all maps. The map scale determines the amount of soil detail that can be shown on the map; for example, on a map scale of 4" = 1 mile, the smallest area of a particular soil type delineated is rarely less than 2 acres.

Using Soil Maps. A soil map presents an introduction to the behavior of a soil landscape. Predictions for selected uses are made for each soil delineation. As a soil is rated for its potential for growing corn, for serving as a sump for waste disposal, or for a site for an urban development, the soil map is translated into the language of the user. Likewise soil maps can be read for wetland delineations.

The soil moisture regime characterizes the degree of wetness or dryness of the natural soil. A soil with a wet soil moisture regime provides a good basis for defining wetlands, provided people have not altered the natural soil moisture regime. The poorly drained soils of northern Illinois, Indiana and Ohio were once described as worthless swamps, but Man, through drainage, has developed these soils into the most productive of the world. This was done by altering the natural moisture regime. Soil maps may not show these alterations unless special pains are taken to gather this added information during the survey. In a

joint project with the Bureau of Sport Fisheries and Wildlife, the Soil Conservation Service (SCS) is testing various remote sensing techniques for determining where the natural soil moisture regimes have been altered by man. Three pilot studies were selected to represent the Atlantic Coast, the lower Mississippi River Delta and the pothole country of the north-central United States. Soil surveys of these areas have been made and for some, field notes gathered on soil and natural vegetation during the survey also are available. We are researching techniques for delineating wetlands and working on a wetland classification scheme with potential productivity ratings for various kinds of wildlife for each kind of wetland.

Recent developments in soil classification have clarified the definition of wet soils. Soil scientists are defining the normal pattern of soil-water states throughout the year, paying particular attention to that period when soil temperature is high enough for plants to grow. *Soil Taxonomy* (2) defines eight soil moisture regimes which serve as criteria for differentiation among some soils and which are used to characterize others.

This discussion deals with the wet or *aquic** soil moisture regime. These soils are saturated by ground water. A soil is considered to be saturated if water stands in an unlined bore hole at such a shallow depth that the capillary fringe reaches the surface. The *peraquic* soil moisture regime is used for soils in which the ground water is always at or very near the surface. Examples are tidal marshes or closed depressions fed by perennial streams. The following are used to characterize the soil-water classes common in the wetlands of the eastern portions of the United States:

1. Continuously wet - These are the soils with *peraquic* soil moisture regimes. This class includes the wettest of the soils that have been classed as very poorly drained.
2. Usually wet - These soils have *aquic* moisture regimes. Ground water may not be at the surface all the time, for it fluctuates with the season. But the soils are saturated long enough to provide a reducing plant-soil environment close to the soil surface. Soils that are usually wet include most very poorly drained and some poorly drained soils of the typical subgroups of the great groups with *aquic* moisture regimes.
3. Commonly wet - Of those soils with an *aquic* moisture regime, these soils are the least wet. The reducing environment in these soils does not last as long nor does it occur as close to the surface as in the usually wet soils. This class includes the *aeric* subgroup of the great groups with *aquic* moisture regimes. Some poorly drained and some somewhat poorly drained soils are in this class.

* *aquic* = watery, wet. - Eds.

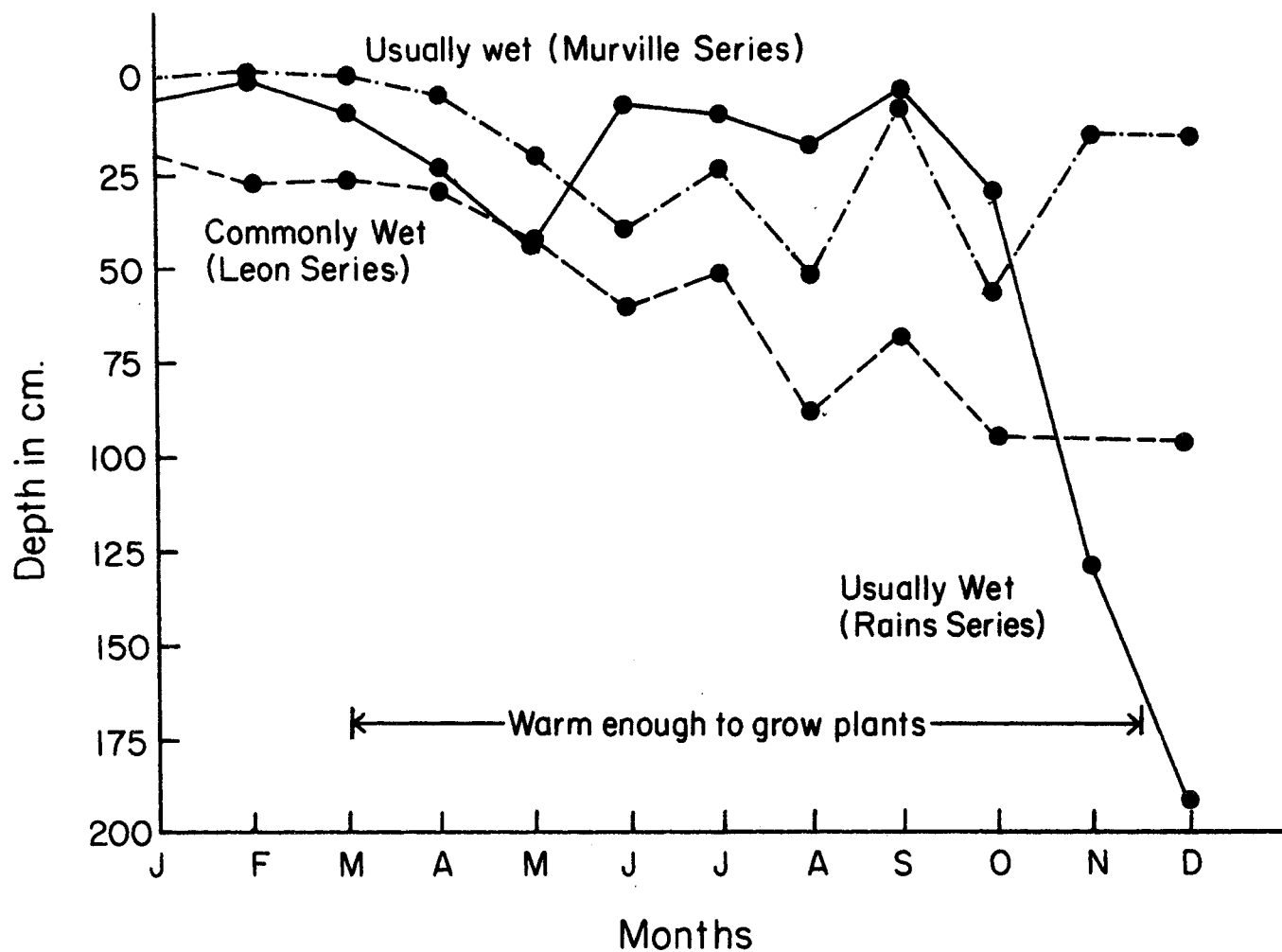


Figure 1. Soil - Water States for Selected Soils (Depth to water Tables by Months.)

In 1973, to better characterize the soil-water states, Nelson and others (3) developed models to predict water table levels over time for soils of the Coastal Plain of North Carolina. Figure 1 displays the soil-water state for various soils in the Lower Coastal Plain of the southeastern United States. Note the variability of saturation in the two usually wet series and the expected difference between the usually wet Leon soils and the commonly wet Murville soils. Other differences noted in the study are the number of periods of saturation and the length of saturation.

A Murville soil, for example, has six periods of saturation at the 25-50 cm depth that last 1 to 7 weeks. One of the Leon soils studied has two periods at the same depth that last 1 to 3 weeks. The natural vegetation reflects this difference. It is mostly Longleaf and Slash Pines on the Leon soils, whereas pond pine dominates on the wetter Murville soils. Sweet and Red bay and *Smilax* are more common on the Murville soils.

The soil survey can serve as the basis for delineating wetlands by providing the user a map of the soils that formed under a water saturated regime. Determination of the present condition, which may reflect Man's manipulation, requires additional investigations. This can be done by either on-site or remote sensing techniques that read the soil condition from the ground cover. Wetland determination becomes an interpretation of the soil map. Any kind of wetland classification can be based on the soil classification and reflect present land use or vegetative cover. If wetlands are to include bodies of water lacking emergent vegetation, the soil map is limited to indicating the location and extent of the lake, pond, or river. Flood-prone areas are delineated on soil maps according to unique soils and physiographic position. These are the areas adjoining rivers, streams, watercourses, bays or lakes that in the past have been covered intermittently by floodwaters. Alluvial soils classified in the suborder of Fluvents and fluventic subgroups of other great groups do occur in areas most apt to flood. Data on high-water boundaries and frequency of flooding are gathered from local knowledge or hydrologic studies.

Wetland classification based only on vegetation may be misleading. The present vegetation may reflect recent climatic accidents, may not be stable, and may not give a true assessment of the potential of the site. Shaw and Fredine (1) recognize the need for information on soil, terrain and other local factors to make most effective improvement in wetlands for waterfowl. These authors predict that those wetlands not in high demand for other uses will have to be developed to full waterfowl potential to maintain present waterfowl populations. An inventory based on only the present vegetation may be inadequate for future planning and development. The soil survey can be used to predict

the recovery time of any biotic community after severe disturbance. In addition, an understanding of the soil genesis and soil characteristics enables the prediction of expected composition of stable communities in the ecosystem. The total inventory, in addition to location and relative importance of wetlands, should show the potential of each delineated area under alternative management systems. Only then can optimum plans for preservation, conservation or development of wetlands be formulated.

Summary. Wetlands, including both soil and water, are a significant part of the natural landscape that have impacts on many facets of the environment. The definition of this natural resource is somewhat confused. Definitions are numerous, reflecting the special interests of various defining groups. Wildlife people concerned with waterfowl define areas on the basis of essential habitat for waterfowl. Marine biologists are swayed by fresh- and salt-water life demands. Hydrologists are concerned with streamflow, ground water recharge, and flooding. The most confusing parameter is the one that separates wetlands from the sea or large lakes.

As the wetlands definition is clarified the soil survey becomes a vital basis in the inventory of wetlands. Remote sensing techniques, coupled with reliable basic data, provide a rational approach for delineating wetlands. Furthermore, the soil survey provides essential data on the soil potential for the various competing uses that are necessary for successful planning and use of wetlands. Soils in the wetlands have many physical and chemical properties that are derived from the environment in which the soils originate. The natural soil is the result of the interactions through time, of climate, plants and animal organisms, parent materials and relief. The data provided by the soil survey is permanent, by our need for knowledge about the soil, and its potential grows as time goes by. The soil survey is not only an essential tool for defining, classifying and delineating wetlands, but it is essential in planning for the use and for the development of a selected use.

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Using Soil Surveys for Delineating Wetlands

by

Lindo J. Bartelli

EDITORIAL COMMENTARY

by

Michael J. Powers* and T. Helfgott*

The paper under review touches on many factors relating to wetlands and wetland delineation using soil surveys. It also comments on the relative strengths of soils and vegetation as indicators of wetland conditions. This review addresses several of the points made in the paper to amplify some points and, hopefully, to clarify some issues for those readers unfamiliar with soils and soils surveys.

At the outset, the paper points out that wetlands, as are all natural ecological systems, are dynamic; the boundaries and processes change with time. The natural changes are relatively slow, measured in time periods of hundreds of years, while changes due to human activities occur in much less time. This dynamic nature of wetlands points up both strengths and weaknesses in the use of soils as indicators of wetlands.

The characteristics that soils scientists look for in distinguishing "wet" soils from "dry" soils are a result of the chemical processes occurring in the soil. Soils that are commonly saturated with water are usually low in oxygen and this results in what is termed an *anaerobic* condition. Under anaerobic conditions certain ions are notably soluble in water (under *aerobic*, i.e., unsaturated, conditions they are generally insoluble). Being soluble under the anaerobic conditions, these ions are leached from the soil by water. In addition, organic material (leaves, branches, roots, etc.) partially decomposes much more slowly in an anaerobic environment and has more stable intermediates (e.g., organic acids) and odorous constituents (e.g., amines, H₂S, etc.). The soil scientists look for evidence of loss of certain mineral ions and the presence of large amounts

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of undecomposed organic material as indicators of commonly wet soils. It is estimated that these processes may require time spans of generations.

The slowness of the changes in soil characteristics with changes in hydrologic conditions, as outlined above, argues both for and against the use of soils surveys to delineate wetlands. On the negative side, it seems clear that the soils surveys are not likely to indicate changes in recent times due to human activities. This is clearly a problem in that the wetlands conditions created by man-made water retention structures are likely to escape notice if the soils surveys alone are used to identify wetlands. On the plus side we must note that slow response of soils to changed hydrologic conditions means that the soil survey identifies the long-term average hydrologic condition of a site. The soils are insensitive to short term climactic conditions and are accurate predictors of the natural state of human-altered areas.

The reviewed paper gives an enlightening description of how the soil scientist develops a soils survey through field inspection and laboratory analysis. One point should be clarified: this is the use of vegetation in developing the soils survey. Soils are actually classified according to the soils scientist's examination of the soil profile for characteristics such as color, chemistry, texture and horizon depths. The soils scientist uses changes in vegetative cover as clues to the boundaries of particular soils at the site and as indicators of the points at which he is likely to find soil profiles representative of the site. Thus, as the paper indicates, vegetation is used to help map the extent of a particular soil type at a site but is not a determining factor in the actual classification of the soil.

A point that is often raised in criticism of the use of the soils survey for the delineation of wetlands is the imprecision of the soils survey maps. The paper alludes to this problem but does not explain why the maps are in error at some points or how this effects their use in delineation of wetlands. In the paper "Inland Wetlands Soils" presented at the Wetlands Conference held in Storrs, Connecticut on June 20, 1973* D. Hill presented the results of experiments conducted to determine the degree of precision to be expected in soils surveys and reasons for noted inaccuracies. That paper noted that disagreements between individual soils scientists on the location of wetlands boundaries at the experiment site ranged from 70 to 260 feet, depending on the terrain and vegetative cover and pointed out that the variability was largely due to problems the soils scientists had in locating their field points on the map. This particular difficulty can be overcome largely by the employment

* Helfgott, T., M. W. Lefor & W. C. Kennard, Eds. 1974. Proceedings: First Wetlands Conference, Delineation of Wetlands. IWR Rept. 21, University of Connecticut, Storrs, Ct.

of land surveying techniques to accurately transfer points on the ground to the maps.

The degree of imprecision noted above is only critical when specific property boundary disputes arise. When this does occur, it appears that direct field inspection by a soils scientist with the assistance of a land surveyor can resolve the issue. It should be noted also that the current Connecticut statutes for wetlands protection allow the local regulatory agencies to define (and change) the legal boundaries of wetlands within their control, using the soils survey as a guide to the location and extent of such wetlands. This permits these agencies to correct for discrepancies between the soils survey maps and actual conditions at the site. This should largely negate the problem of inaccuracies in the soils survey maps.

There are three reasons why the soils survey is of major importance in the delineation of wetlands:

1. The soils survey is a classification system available that relates directly to the hydrologic condition of the soil.
2. The stability of the soil chemistry as indicative of moisture conditions in the soil makes the soil classification independent of short term changes and climatic accidents -- it tells what the natural character of a site is without the need for long term monitoring of the hydrology of the site.
3. In considering wetlands it seems obvious that the hydrologic condition, the "wetness", of the site is the controlling factor in determining if it is a wetland. A mapping system such as the soils survey, which responds directly to the hydrologic condition of the site, is therefore an appropriate indicator of the occurrence of wetlands.

Further critique comments are related to the discussion on delineation. It is questionable if degree of darkness on a photograph can help draw boundaries accurately since dark spots can be the result of shading, soil chemistry and such.

It is true, as the paper points out, that wetland classification based only on vegetation can be misleading but isn't this also true for classification based on soils alone? How permanent is a soil classification; does it not also change, albeit slowly, over periods of time?

If the Soil Conservation Service soils maps were originally intended for soil conservation and farm use, one wonders about the extrapolation of this type of information and classification to inland wetlands preservation.

Using Soils Surveys for Delineating Wetlands

by

Lindo J. Bartelli

EDITORIAL COMMENTARY

by

Kent A. Healy*

Mr. Bartelli's paper correctly states that the water table can be changed, up or down, by natural processes, including the erection of structures by Man. Although wetlands (land where the water table is high) should be preserved, the paper does not present any reasons for this point of view. This is one aspect of the wetlands question which deserves more thought than it has been given in the past.

The paper has aptly described the information that is available from soils survey maps, and points out that this information concerns primarily the type of soil and the position of the water table at various times of the year. Further, Mr. Bartelli indicates that for many land uses, such as agriculture and wildlife preserves, the position of the water table is very important, and thus soil maps are a valuable tool for land-use planners.

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DEVELOPMENT OF THEMATIC MAPS

by

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Minimum Size and Scale Delineations for Thematic Maps. In the development and production of thematic maps,* one must thoroughly analyze and evaluate the thematic data which is to be shown on the maps. Before a base map can be selected, you must first decide on the minimum size delineations which are to be identified and portrayed on the map. With this decision made, one can then determine the appropriate map scale required to adequately show the minimum size delineations.

The criteria established by the Connecticut Inland Wetlands and Watercourses Act determine several of the variables to be considered in developing base and thematic maps used in planning and enforcing the Act. The governing factor is found in Section 3, Item 4....."minimum lot site shall be two acres".

With this understood, we then move to considering the base and thematic map information essential to portraying the wetlands data. Before finalizing the base map data to be included, one must first decide on the minimum scale delineations which are to be identified and portrayed on the map. Having accomplished this by means of the Act, the appropriate map scale is determined.

Accuracy and Availability. Since we know the minimum size delineations to be shown, a major criterion needed to determine the most suitable map scale, we can then research, review, and evaluate all of the base maps that are available. We must determine if any of the base maps which are available can be used directly as the base or whether they will be used only as a source for the recompilation of a base to fit the needs for the specific projects. The evaluation of the existing base maps is necessary to determine their accuracy and availability, and whether they are government owned, county, state or federal, or privately owned. If privately owned, what are the restrictions, if any, in their use for reproductions?

* See Editorial Commentary for explanations. - Eds.

The accuracy of a base map is a function of its design. How was it prepared and when? Was it photogrammetrically compiled or compiled from some other source maps? In most cases, an available map is only used as the source from which a new base is constructed which then is designed for the portrayal of the specific theme.

Family of Separations. Based on many years of experience in the Soil Conservation Service, we have found it advisable to prepare most base maps using the family of separations concept. This method allows inclusion or omission of various map detail to achieve optimum use of base map information and remain subordinate to the thematic data. This of course, is neither a new nor unfamiliar procedure but is frequently overlooked when producing maps of relatively small areas. This procedure has been followed for many years for maps of large areas that are produced on a national basis. It is seldom used on small projects, however.

Map Details and Data. When developing thematic maps it is advisable, if not mandatory, to start with the very best base that is available or that can be produced using the family of separations concept. One can then use the separations in any combination for any type of thematic map that may be produced in the future. If multi-color maps are required, it is necessary to have the base detail prepared on separate overlays.

If we have completely and thoroughly evaluated the available maps, we can determine the density of the base detail to be compiled for a specific map. The base map should not be so cluttered with detail that it will detract from or overpower the thematic data being portrayed. The most important feature on a thematic map is the theme or specific information indicated by the map title. Other detail is subordinate to the theme. The base detail on a map is primarily for orientation purposes. We have a tendency of overloading base maps with insignificant detail.


This presentation only addressed the "Wetlands" theme, but this same base map may be used to portray some other thematic data or additional data by adding to the original them. The proper portrayal of additional data may require the addition or deletion of base detail. This is possible without significantly increased costs if one prepares a base map using the family of separations concept.

How should the thematic data be shown? Should a good line base map be developed on which the delineations can be overprinted in color, color and shading or cross-hatching, or B&W

Table 1.

COMPARATIVE MAP SCALES AND MEASUREMENTS

The smallest area that is practical to show using a color fill is approximately 1/10th inch square.

□ = 1/10th inch square = 

<u>Fractional Scale</u>	<u>Feet Per Inch</u>	<u>Inches Per Mile</u>	<u>Acres Per 1/10th In. sq. ±</u>
1:1,000,000	83,333.33	0.063	1,594.2
1:500,000	41,666.67	0.127	398.6
1:250,000	20,833.33	0.253	99.6
1:126,720	10,560.00	0.5	25.6
1:125,000	10,416.67	0.507	24.9
1:63,360	5,280.00	1.0	6.4
1:62,500	5,208.33	1.01	6.2
1:50,000	4,166.67	1.27	4.0
1:31,680	2,640.00	2.0	1.6
1:24,000	2,000.00	2.640	0.9
1:20,000	1,666.67	3.168	0.6
1:15,840	1,320.00	4.0	0.4
1:7,920	660.00	8.0	0.1
1:500	41.667	126.72	0.0004

with cross-hatching or screens? The thematic data could also be overprinted on a photographic base. The smallest delineations that are practical to show by color fills are approximately 1/10th square inch. You can see in Table 1 the minimum acreages that can be delineated at various scales.

For position accuracy, you must remember that the line weights at various scales represent several feet. For boundary delineation, the Soil Conservation Service uses a 0.01" line width. To determine the number of feet represented by a line width on the map of 0.01", simply move the decimal point two places to the left using the figures in the column headed "Feet per Inch".

In summary, the following items must be considered when developing thematic maps:

1. You must know the minimum area to be delineated.
2. You must determine the geographic area to be shown on a single map or decide how the area will be divided if multiple sheets are required.
3. Always, if possible, build a base map on the family of separations concept, thereby controlling the density of base map detail to fit the complexity of thematic data.
4. You can then decide on the need for multicolored maps or black and white maps depending on thematic importance, complexity and money available to prepare separations and reproduce accordingly.

Development of Thematic Maps

by

James L. Jacobson

EDITORIAL COMMENTARY

by

H. H. Ridgeway*

A thematic map is a map that emphasizes a specific theme (i.e., roads, drainage basins, forests, wetlands, etc.). It is produced from a base map that controls the accuracy of the thematic map and that contains sufficient information to produce several thematic maps.

The Soil Conservation Service has been producing maps for many years. This paper, by a member of the Cartographic Division, provides excellent advice on the considerations that must be made when developing thematic maps for delineating Connecticut's inland wetlands. The paper lists four items which must be considered when developing thematic maps. To these, one more consideration which should be added is the accuracy of the base map. The accuracy of any thematic map cannot be better than that of the base map. To assure that the accuracy of the base and thematic maps are compatible with the selected scale, they should be required to meet the United States National Map Accuracy Standards** applicable to the published scale. Large scale maps that do not meet the National Map Accuracy Standards imply a map accuracy which does not exist.

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** See Appendix II.

THE USE OF REMOTE SENSING DATA IN THE MANAGEMENT OF INLAND WETLANDS*

by

Virginia Carter**

Introduction. Problems of the management of inland wetlands in the United States are coming into sharp focus in a new era of public concern for the environment. State and local governments, for example Connecticut, Rhode Island, Massachusetts, and Delaware have legislative mandates to inventory and regulate the uses of inland wetlands. On the Federal level, wetland inventory and classification are a controversial and challenging problem. Preservation and protection of unique wetlands is often a Federal task. Wider recognition and better understanding of wetland values have been followed by public concern. Expansion of agriculture, residential housing and industry may destroy vast acreages of valuable natural habitat, potential water supplies, and recreational and scenic areas. The extent to which wetlands can be considered a multiple-use resource remains to be established.

Most of the needs and requirements for informed and effective wetland management on the local, state and national level can be placed in two general categories:

1. *The need for basic research to establish criteria for decision making* is pointed out by the scarcity of current data clarifying the hydrologic relationships of inland wetlands: recharge, discharge, flood storage, and water quality. Only a few local or regional wetland studies have been made, such as those on the prairie potholes by Eisenlohr *et al.* in 1972 (1).

* Parts of this paper were presented at the Management and Utilization of Remote Sensing Data Symposium, Sioux Falls, South Dakota, October 29 - November 1, 1973. Analysis of ERTS data referenced in this paper was supported by NASA Contracts NAS 5-21752 (The American University-UN006), S-70243 AG (The U.S. Geological Survey-IN-385), and NASA 272 (The U.S. Geological Survey-I-414).

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Additional research is also needed on relative wetland values, as exemplified in a recent paper by Gupta (2).

2. *The need for Real-Time information.* Near real-time information systems are needed to provide wetland managers with information for inventory, classification and monitoring of wetlands, and for water-resource management decisions. Remote-sensing data can provide a powerful tool to meet needs in both categories. For example, Gupta's evaluation criteria for wetlands include land-use contrast (what is the surrounding area like?) and land-form contrast (what is the topographic relief in the area?). Both of these parameters can be easily measured by aerial photography or even, in some cases, by ERTS* imagery. Repetitive ERTS imagery or aerial photography can be used to monitor changes resulting from altered patterns of land or water use.

The *advantages* of applying remote sensing techniques to solve problems in the second requirement category are several:

1. reduction of costs and manpower requirements for extensive ground surveys;
2. more rapid completion of inventory or mapping;
3. more efficient monitoring and detection of change; and
4. collection of multipurpose data useful to future projects, including those not under consideration when data collection was planned.

The *disadvantages* of using remote sensing include:

1. the necessity for field checks or ground truth data;
2. the difficulties encountered in scheduling simultaneous ground data collection for subsequent interpretation of the remote-sensing data;
3. the lack of efficient storage and retrieval methods for the large quantities of data generated by remote sensors such as the ERTS-Multispectral Scanner (MSS) or low-altitude cameras;
4. adverse atmospheric conditions precluding the gathering of remotely-sensed data.

Interpretation of Data. Interpretation of remotely-sensed data is based on the spectral characteristics of surface features such as water, vegetation and soil. Texture, geographic location and topographic features also aid the interpretive process. The type of scale of the acquired data depend largely upon the purpose and the detail of the information to be extracted. Ground-truth is usually required, although in the case of satellite data, aircraft overflights can supply much of this requirement. Seasonal data are often needed for identifying wetlands, because the presence of water or wet soil (diagnostic of these areas) can be obscured by vegetation during the growing season. Boundaries of many wetland ecosystems, for example, wooded swamps and fresh

* ERTS = Earth Resources Technology Satellite. Now called LANDSAT I & II. - Eds.

water tidal marshes, are more easily established in the winter. Species composition is best determined in the summer.

To illustrate the utility of remotely-sensed data in inland wetlands management, this paper discusses applications in the Great Dismal Swamp of Virginia and North Carolina and in the Water Conservation District of southern Florida. The latter includes Lake Okeechobee, several water conservation areas and the Everglades National Park. In the case of the Dismal Swamp, the widest possible use was made of existing data. Data for the Florida site are being collected in accordance with a specifically designed project. The information on the Florida studies contained in this paper was obtained from the U.S. Geological Survey investigators.

The Great Dismal Swamp. In 1972, Congress authorized the Department of the Interior to conduct a comprehensive study of the Great Dismal Swamp and the Dismal Swamp Canal. The study is designed to determine the desirability and feasibility of protecting and preserving the ecological, scenic, recreational, historical and other resource values of the Swamp and Canal, and to consider the alternatives for preservation in terms of effectiveness and cost. Consideration must also be given to other potential uses of the water and related land resources for residential, commercial, industrial, agricultural and transportation services. Eight Federal agencies are participating in the investigation, including the United States Geological Survey (USGS) which is responsible for data on water dynamics and minerals. The study is presently being coordinated through the Boston Office of the Bureau of Sports Fisheries and Wildlife (BSFW).

Remotely sensed data available for the Dismal Swamp study include:

1. Black and white quadrangle-centered orthophotographs at a scale of 1:76,000 taken in March 1972 for a USGS mapping project.
2. Color-infrared high-altitude photography flown by NASA RB57 (September 1970) and U2 (December 1972) aircraft, at an approximate scale of 1:130,000. The December 1972 photography was part of the ERTS investigation support data.
3. ERTS black and white and color-composited imagery (scale 1:1,000,000) from the American University Wetland Ecology Study (ERTS-SR0140).
4. Color photographs acquired from low-altitude aircraft during the course of the present study.

The Great Dismal Swamp is a vast wooded swamp (or forested bog) straddling the Virginia-North Carolina border. The Federal Government owns the Dismal Swamp Canal and the Dismal Swamp National Wildlife Refuge, an area of about 198 square kilometers (49,000 acres) recently donated to the Department of the Interior

GREAT DISMAL SWAMP STUDY AREA

VIRGINIA NORTH CAROLINA

PL 92-478

UNITED STATES

DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

BUREAU OF SPORT FISHERIES AND WILDLIFE

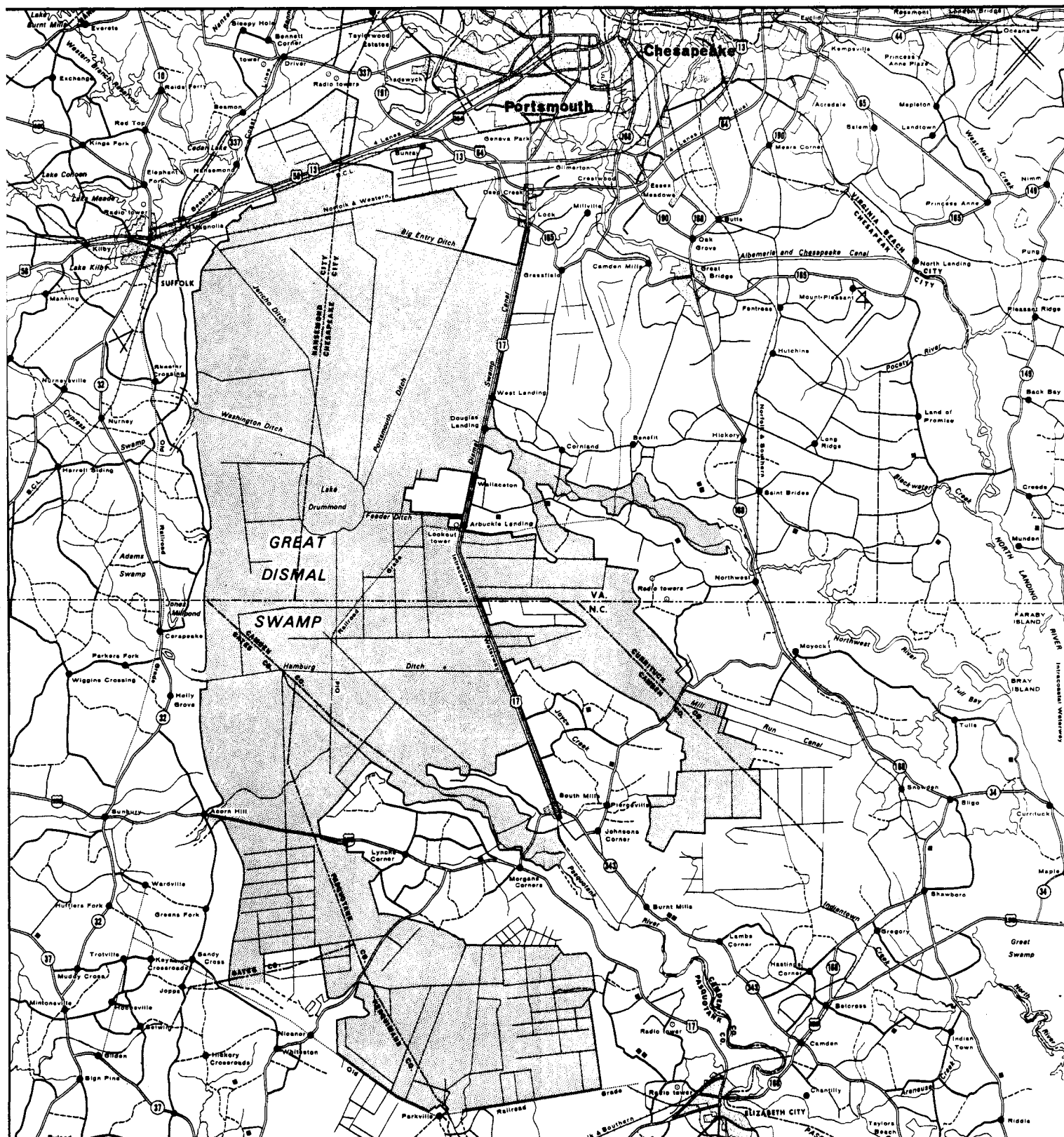


Figure 1.
Great Dismal Swamp Study Area

COMPILED IN THE DIVISION OF ENGINEERING
FROM SURVEYS BY U.S.G.S.

BOSTON, MASSACHUSETTS

JUNE 1973

Scale 0 8000 16000 24000 32000 FEET
Scale Is Approximate

LEGEND

- Primary Study Area
- Water Study Area

by the Union Camp Corporation through the Nature Conservancy. The Swamp has been considerably modified by Man in his attempts at drainage. Surface water in Lake Drummond, about 2 meters deep and 4 kilometers (2-1/2 miles) in diameter, is used for operating the locks on the Dismal Swamp Canal. The lake, drainage ditches, canal and roads can be clearly seen in the color IR photography taken in December 1972. (Figs. 1,6.) Approximately eight photographs at a scale of 1:120,000 are needed to show the entire Swamp and major drainage water courses.

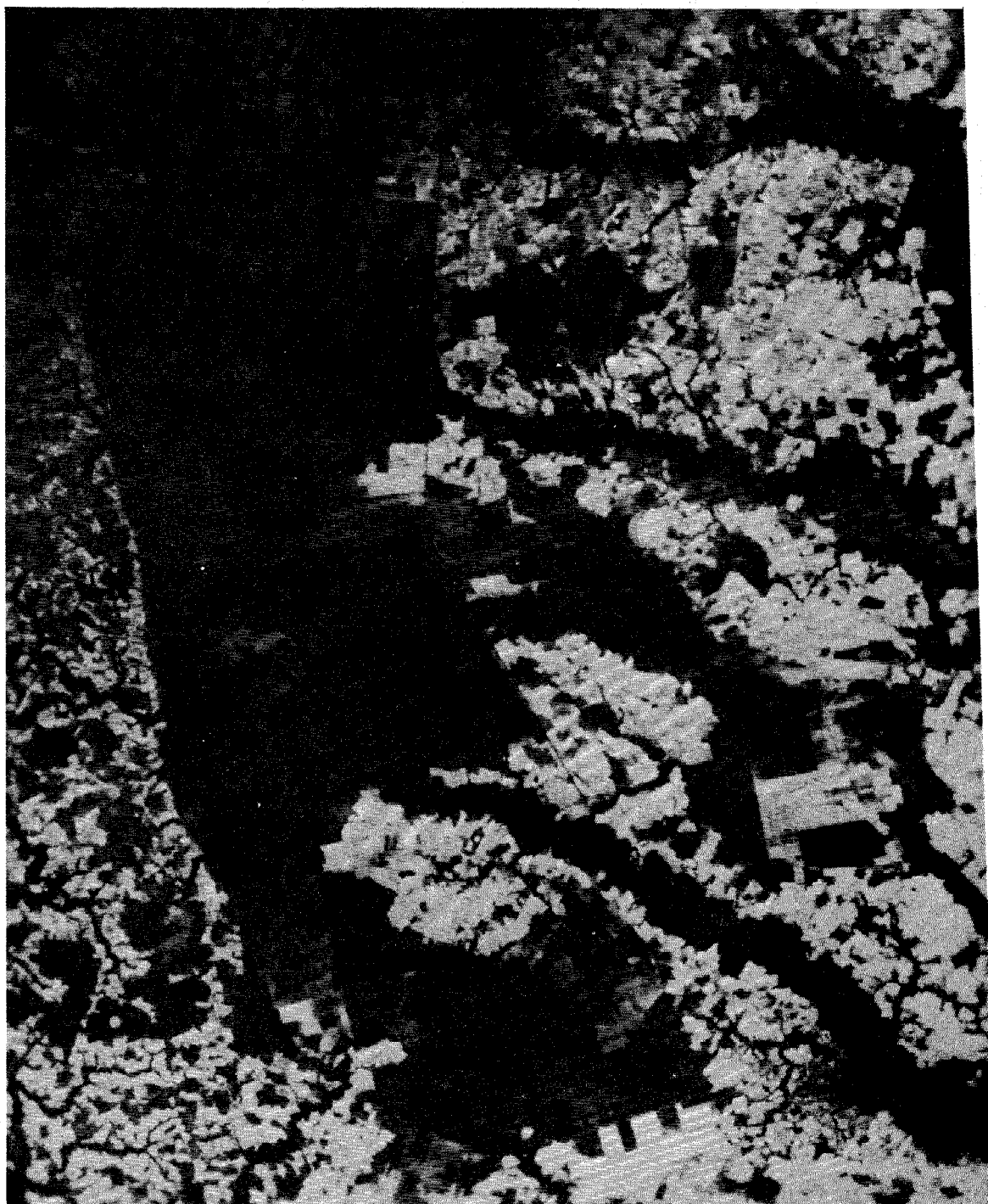
While estimates of the original size of the Swamp have been as high as 4050 square kilometers (1,000,000 acres) the study area recently designated by the BSFW is comprised by approximately 850 square kilometers (210,000 acres) of viable wetland (3). The selection of study areas (Figure 1) by the BSFW using both color IR and the low-altitude black and white photographs along with other information required approximately 3 man-weeks. Black and white orthophotographic quadrangles currently under preliminary stages of preparation by the USGS will provide up-to-date maps of the entire Swamp at a scale of 1:24,000. About 15 of these maps are required for full coverage.

ERTS imagery provides the "big picture"; the entire Swamp and its geographical setting are visible on one ERTS frame. Figure 2 is an enlargement of a part of an ERTS-MSS image (#1205-15150-7) taken in February 1973. Comparison of this image with Figure 1, the map of the study area, gives a good indication of the utility of ERTS data in determination of wetland boundaries. Delineation of the study area from this imagery would have required less than 3 man-days. Many of the roads and canals and several vegetation categories can be clearly identified on a 1:250,000-scale enlargement of the ERTS image and a reliable map could be constructed of similar large wetland areas in the future without the need for extensive and repetitive field work or low-altitude aircraft coverage.

Hydrologic Studies. Hydrologic studies will consider water conditions and movement within the Swamp as well as flow into and out of the Swamp by both surface and subsurface routes. Remote sensing data has contributed to these studies in several ways:

1. Both ERTS imagery and aircraft photography show surface drainage patterns. Surface inflow and outflow can be identified and studied. Figure 2 shows the major routes of surface drainage clearly, as streamflow enters the Swamp from the Suffolk Scarp to the west and leaves to the south, east, and north. Once surface drainage channels are located, detailed studies of discharge and water quality can be done as needed.

2. Water distribution and drainage patterns within the Swamp can be observed from photography or imagery taken during the winter, when deciduous trees are leafless. The area of



0 | Kilometers | 20
Scale is approximate



Figure 2. Enlarged ERTS-MSS 7 (2/13/73) winter image showing the Great Dismal Swamp and associated drainage systems.

standing water can be correlated with water level measurements at Lake Drummond. Thematic extractions from ERTS data show standing water beneath trees as well as other moisture conditions. (see *Autographic Theme Extraction System, infra.*)

3. Aerial photography can be used to identify areas for detailed ground water investigation, including locating possible sites for observation wells.

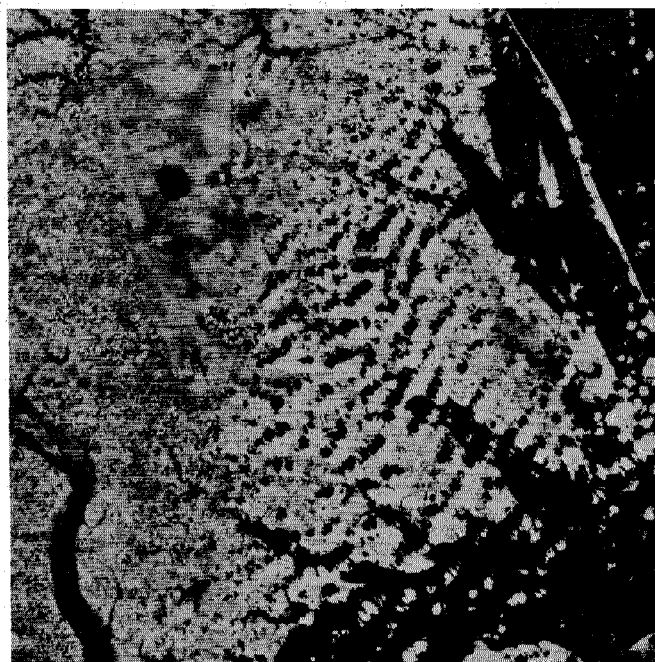
4. High and low-altitude aerial photography and ERTS imagery are useful for vegetation mapping at a scale commensurate with that of the data. The various vegetation communities are associated with differences in water regime and soils, discussed later under *Vegetation Mapping*.

5. It has been theorized that the movement of ground water into the Swamp from the shallow Norfolk aquifer was a factor in formation of the Swamp, and contributes to its present condition. The temperature of ground water is fairly uniform throughout the year. Therefore, surface water tends to be warmer than the ground water in summer and colder than the ground water in winter. For this reason, thermal imagery of the Dismal Swamp taken from a low altitude during the winter could yield important information on areas of ground water outflows. Also, the location and area of surface water determined by thermal imagery could be correlated with concurrent water levels in Lake Drummond to develop a relationship between stage and water-surface area.

Autographic Theme Extraction System. The USGS is developing an Autographic Theme Extraction System to apply photographic and digital processing to images to obtain specific theme isolations which retain the geometry and resolution of the original image. These extractions, or spectral images, are based on distinctive film densities or combinations thereof, and are presently being done on an experimental basis with ERTS-1 and SKYLAB images (4).

ERTS-1 images from October 11, 1972 (1079-15142-5,7), and February 13, 1973 (1205-15150-5,7), were used as the base for a series of wetlands theme extractions in the Dismal Swamp (5). The isolated thematic data are stored in the form of a photographic transparency resembling a high contrast black and white negative. Two or more of the properly processed "negatives" can be combined into a photographic composite to eliminate unwanted or spurious data.

Figure 3 is an enlarged ERTS-MSS-7 positive taken October 10, 1972 of the Dismal Swamp on the North Carolina-Virginia border south of Norfolk, Virginia. Part of Currituck Sound and Great Swamp in North Carolina can be seen to the east. A bend in the Chowan River, including a part of the Chowan Swamp, appears in the southwest corner. Figure 4 is an extraction of



Kilometers
0 20
Scale is approximate



Figure 3. ERTS-MSS 7 (10/10/72) fall image showing the Great Dismal Swamp. Currituck Sound is on the right and the Chowan River appears in the southwest corner.

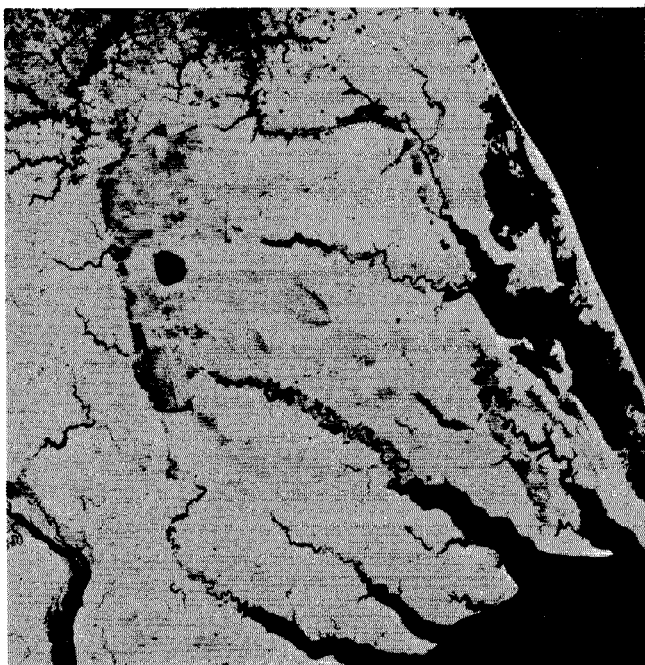


Figure 4.
Theme extraction
showing wettest areas
of swamp, dense white
cedar, and urban
communities of Norfolk
and Suffolk, Va.

0 Kilometers 20
Scale is approximate

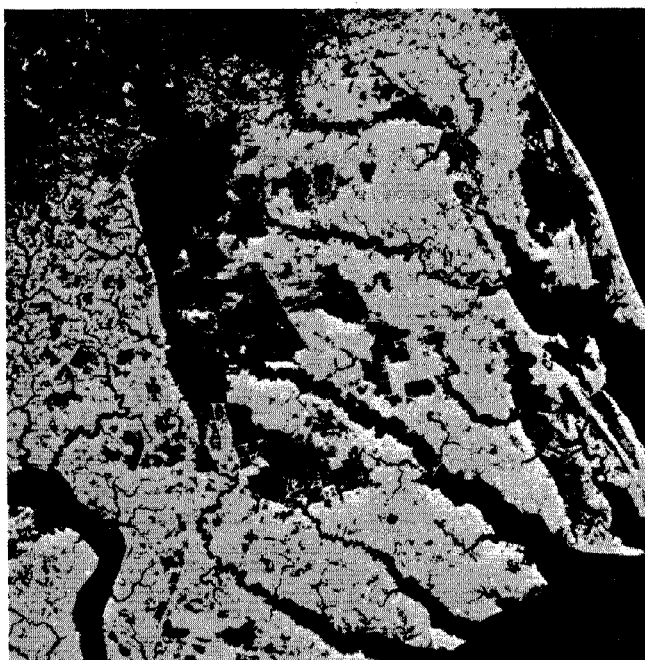


Figure 5.
Theme extraction
showing drier deciduous
or low, flat evergreen
areas where snow
accumulates.

0 Kilometers 20
Scale is approximate



the wettest area of the swamp, dense White Cedar*, and also the urban communities of Norfolk and Suffolk (black). Figure 5 shows the drier deciduous or low, flat evergreen areas within the swamp where snow can accumulate (white).

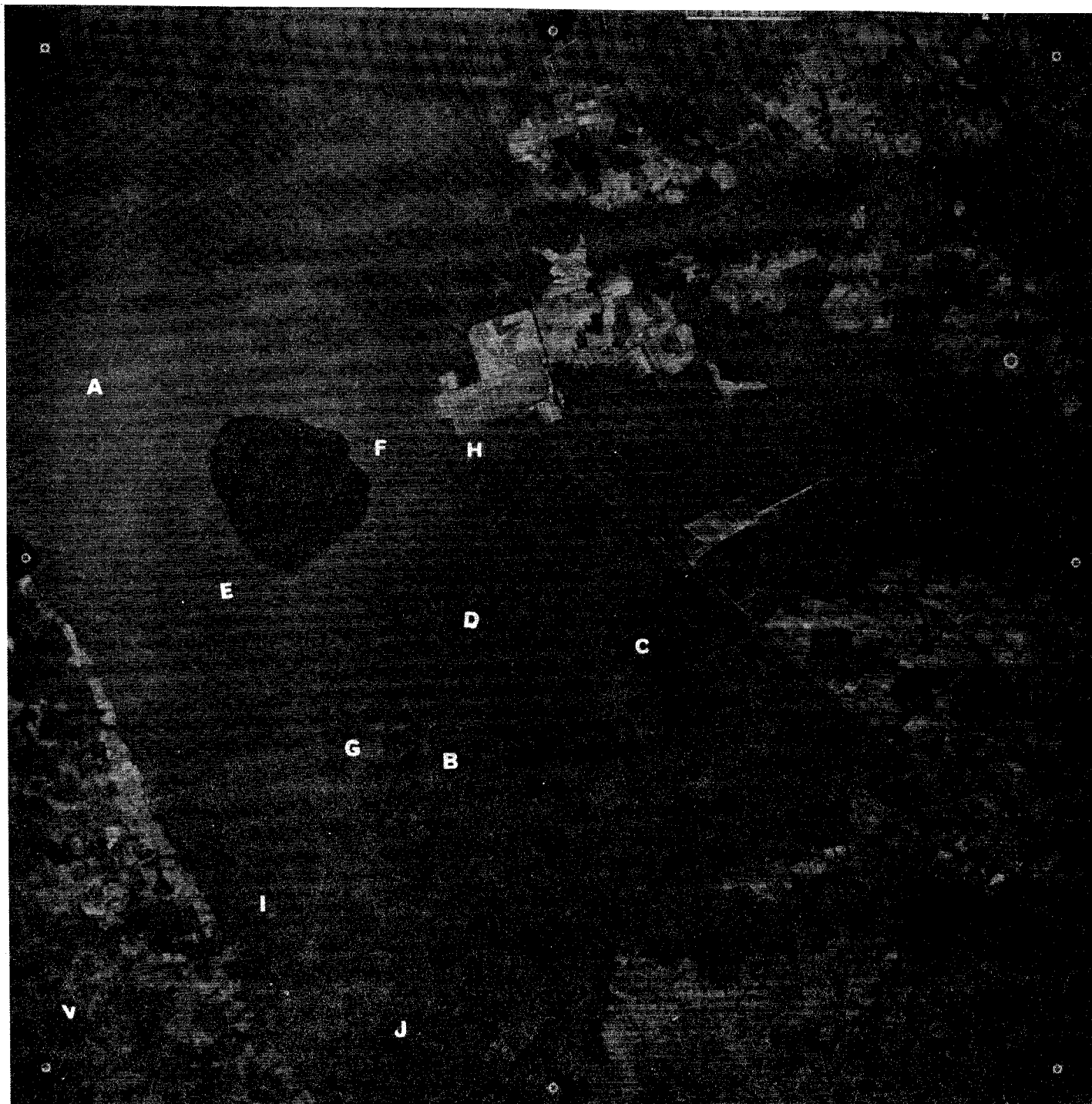
Vegetation Mapping. Use of color infrared (IR) photography for vegetation mapping of wetlands has increased in recent years (6,7). Plant associations with distinct or unique tonal signatures may be identified and mapped to a scale commensurate with the scale of the photography. Where sufficiently extensive plant associations exist, as in the Dismal Swamp, mapping of vegetation types can be done from ERTS imagery or digital data.

The flora of the Great Dismal Swamp is a diverse mixture of northern and southern species. Many plants primarily associated with the swamplands of the Deep South reach their northernmost extent there and in the Pocomoke River Swamp on the eastern shore of Maryland. The Pocomoke River Swamp differs, however, from the Dismal Swamp in being under tidal influence, with a tidal range of approximately 1 meter (8). Distribution of vegetation in the Dismal Swamp is controlled by moisture, soil, and light conditions. However, fire, drainage, and timber cutting have played a dominant role in establishing the present vegetative composition (9). Vast acreages have been logged at least once and are now covered with second-growth plant associations.

Cover typing, or tree mapping, for the Dismal Swamp Study is being done by the U.S. Forest Service using the USGS black and white orthophotographs rectified to an existing topographic map base at a scale of 1:24,000. High-altitude color IR photography is being used to assist and verify the black and white interpretation. Levy (10) and Meanley (11) have indicated that several discrete plant communities exist in the Swamp. Both photography and ERTS imagery provide a useful method for discriminating between deciduous and evergreen species and identifying these plant communities.

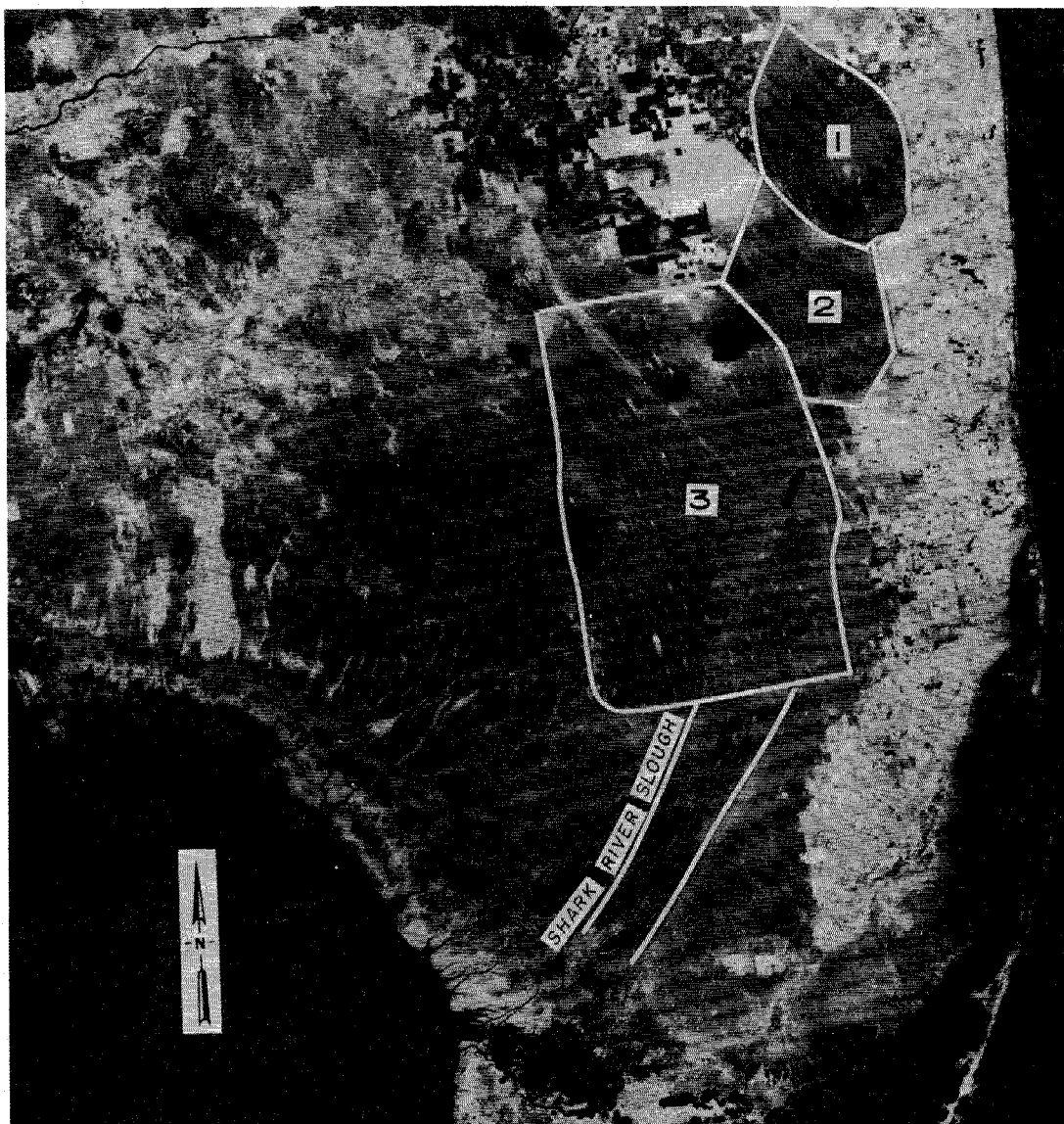
Figure 6 is a copy of a color IR photograph of part of the Dismal Swamp that shows a number of important plant communities. The hydric or deep water swamp (A) is characterized by Cypress, Gum, and Maple growing in as much as 61 centimeters of water during the wetter part of the year. Dense, pure stands of Atlantic White Cedar (B) occupy areas of deep peat with little or no standing water. Large stands of Pine (C) occur both north and south of Lake Drummond. An *Ilex*-Pond Pine association may be differentiated from the pines by its light tone (D). This is a vast, low and relatively open community with scattered trees and is often referred to as an evergreen shrub-bog community. The semi-hydric, or mixed swamp hardwood forest (E), grows in

* Index to Common and Latin species names is to be found in appendix 1.



0 Kilometers 10
 Scale is approximate

Figure 6. Color IR photograph of the Dismal Swamp.
 (A) hydric (deep water) swamp, (B) Atlantic white cedar,
 (C) pine, (D) *Ilex*-pond pine association, (E) semi-hydric
 swamp, (F) mesic forest, (G) revegetating clear-cut area,
 (H) revegetating burn, (I) marsh, (J) mesic "islands."



0 Kilometers 50
Scale is approximate

Figure 7. An ERTS-1 multispectral image, band 7, March 22, 1973, #1242-5240, of south Florida. The areas outlined are: Conservation Area 1, Conservation Area 2, Conservation 3, Shark River Slough, and Lake Okeechobee (southern end can be seen in photo).

wet areas within standing water. Gum, Red Maple, Water Oak, Bay and Yellow Poplar dominate this forest type, and the evergreen understory distinguishes it from the denser hydric forest. The mesic or hammock forest (F) is rather dry and contains Oaks, Beeches, Yellow Poplar, Maple, Pine and Holly.

Areas disturbed by cutting or fire can also be distinguished on the photography. Revegetating, clear-cut areas contain evergreen shrubs and vines mixed with Maple and Pine (G). Recent burns result in a variety of vegetative associations including heavy concentrations of Cane and Honeysuckle in dry areas, and Bulrushes, Grass and evergreen vines and shrubs in wetter areas (H).

Location of Unusual Areas. One useful and important outcome of the study is the identification of unusual areas within the Swamp boundaries. Two such areas were located in the Swamp using the color IR photographs. The first is a small marsh area (I) in which the water table is just below the ground surface. It contains grass and aquatic emergents such as *Typha* spp., *Sagittaria* spp. and *Carex* spp. A large part of the Swamp was covered by this type of plant community some 8,000 - 6,000 years ago according to Whitehead (12). The second area (J) is the driest in the Swamp and possibly represents the highest area originally present in the gently sloping hillside on which the Swamp was formed. These small "islands" in the southern end of the Swamp are underlain by sand and sandy loam with a cover of approximately 5 centimeters (1-2 inches) of roots and leaf litter. Beech trees, Oak, Holly, Pine, Sourwood, Persimmon, and Yellow Poplar form a sparse growth with many blow-downs evident.

South Florida. Water supply for the populous southeastern coast of Florida (2-1/2 million people) depends on retention of water in four major impoundment areas or shallow wetlands less than 1 meter deep south of Lake Okeechobee (Figure 7). These large water conservation areas, containing 3630 square kilometers (896,000 acres), serve also as a water supply for the Everglades National Park. Ultimately, the water discharges into the Gulf of Mexico by slow-moving, unconfined flow through the Shark River Slough. The Big Cypress Swamp near the southwest coast of Florida also supplies a part of the water necessary to maintain the dynamic environment of the Everglades. Droughts reduce the availability of water in southern Florida and management decisions must be based on up-to-date information.

ERTS Data Collection Platforms (DCP's) (Figure 8) in the impoundments, the Everglades, and the Big Cypress Swamp presently transmit near real-time data on water levels and precipitation by satellite relay to the Miami Office of the USGS via NASCOM (13) (Figure 9). These data are analyzed and disseminated to water management agencies such as the U.S. Army Corps of Engineers

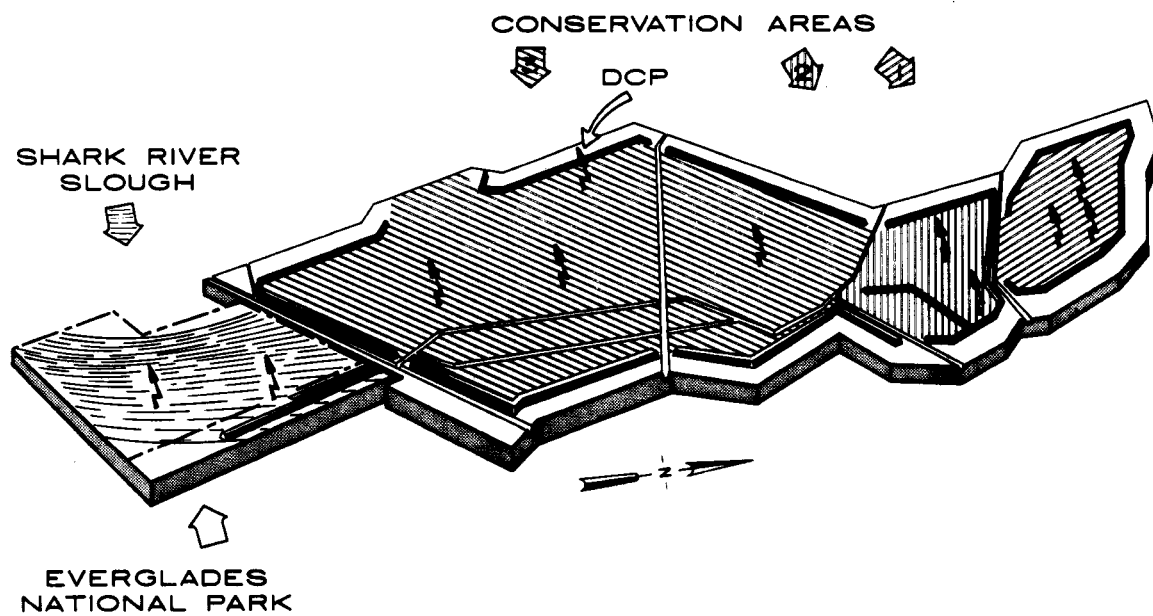


Figure 8. Diagram of the Everglades basin showing locations of the data collection platforms (DCP's) within the three Conservation Areas and the Shark River Slough.

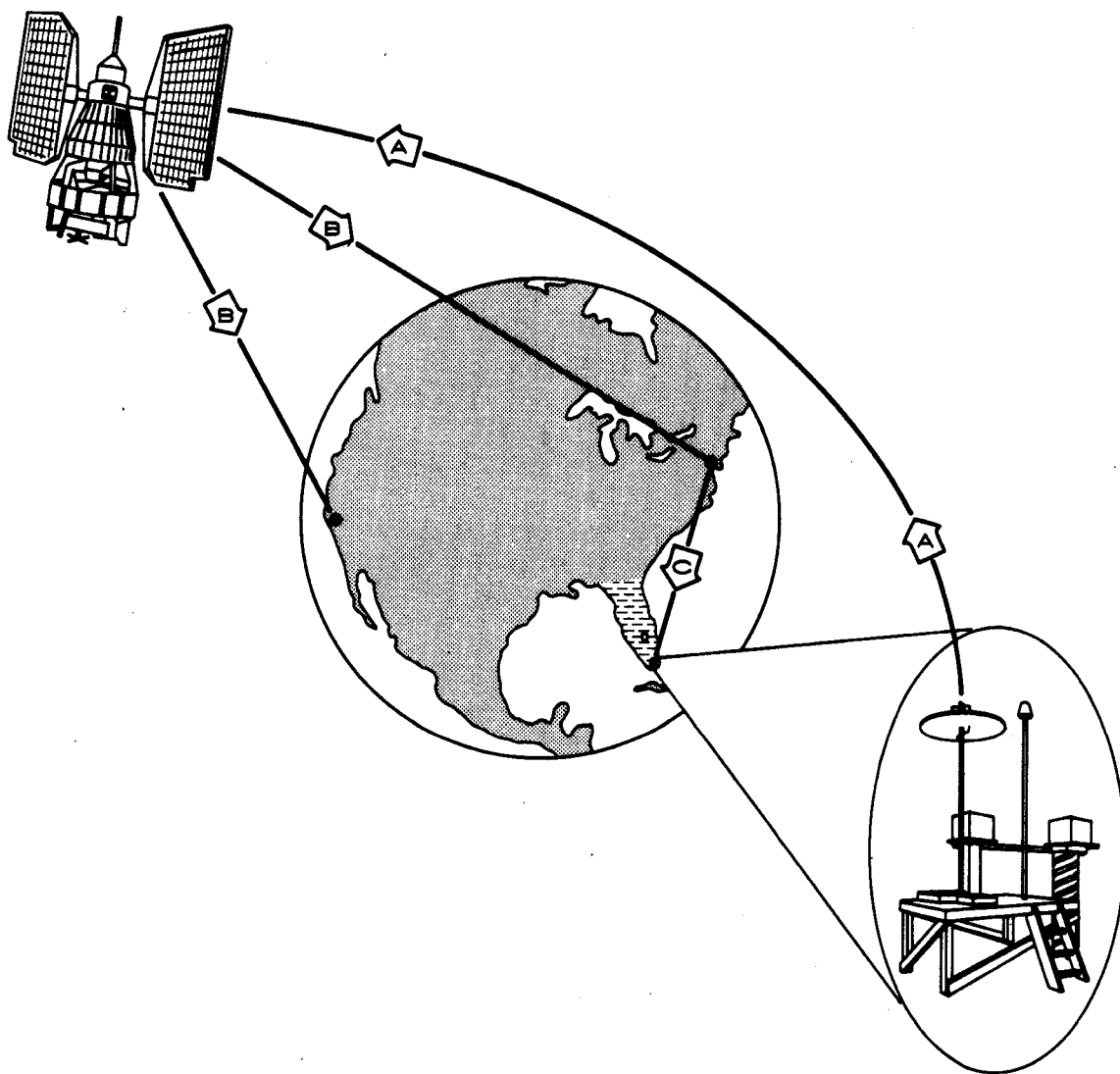


Figure 9. Data are transmitted from the Data Collection Platforms in the Everglades via ERTS-1 (A) to NASA tracking stations at Goldstone, Calif. and GSFC, Greenbelt, Md. (B). The data are then transmitted, via NASA communications network, to the Miami Office of USGS (C).

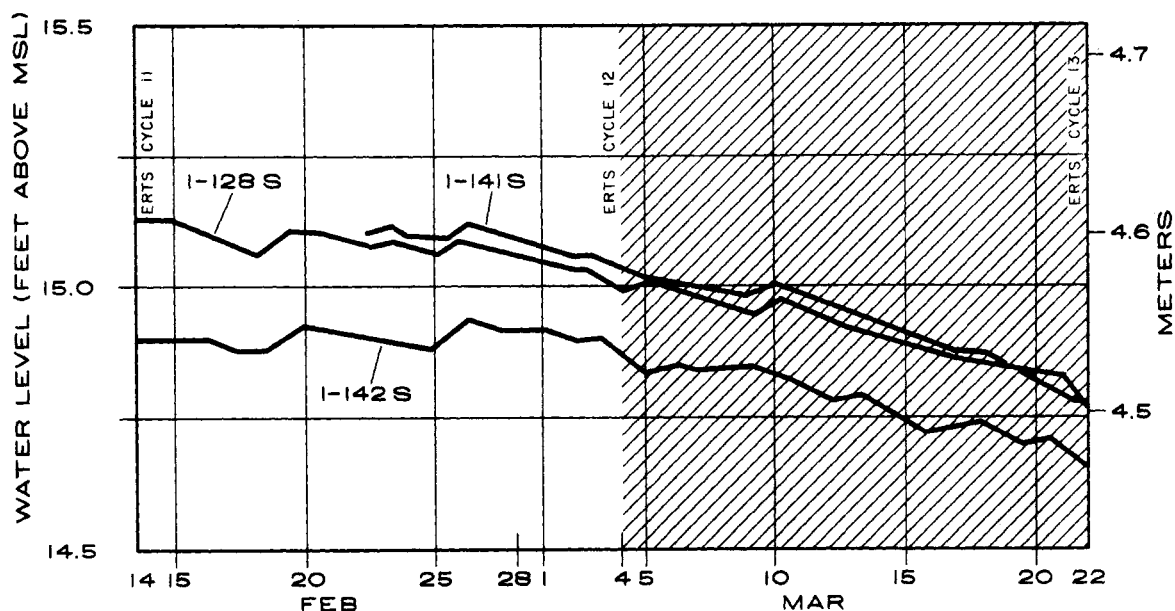


Figure 10. Hydrography compiled from data relayed from three DCP's in Conservation Area 1, February 14-March 22, 1973. During this period there were three passes of ERTS-1 to collect MSS data from Conservation Area 1.

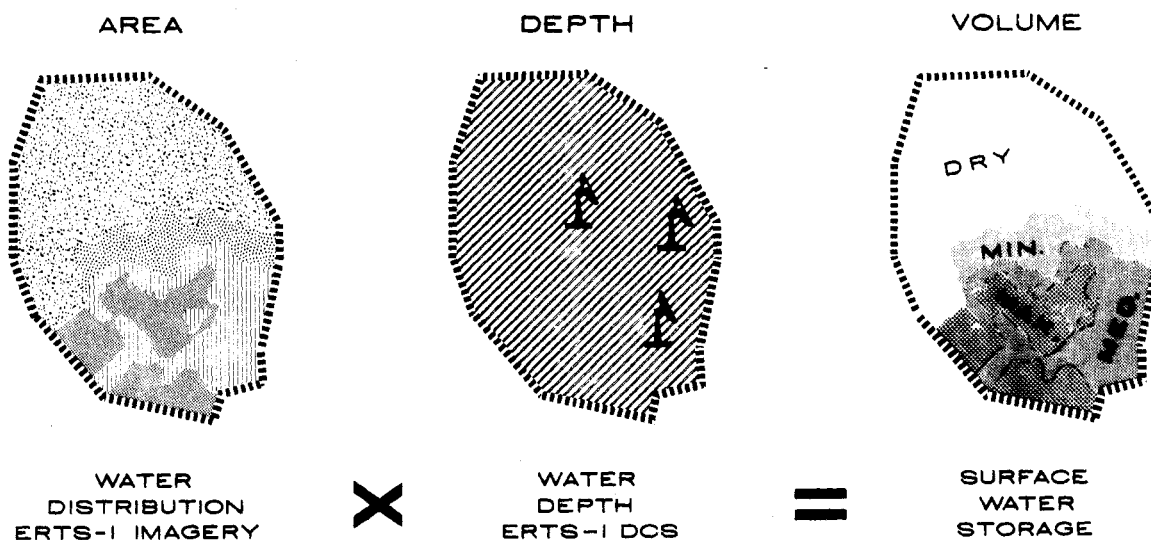


Figure 11. Determination of water storage in Conservation Area 1 by correlating area measurements from successive ERTS-MSS imagery with ERTS DCS data.

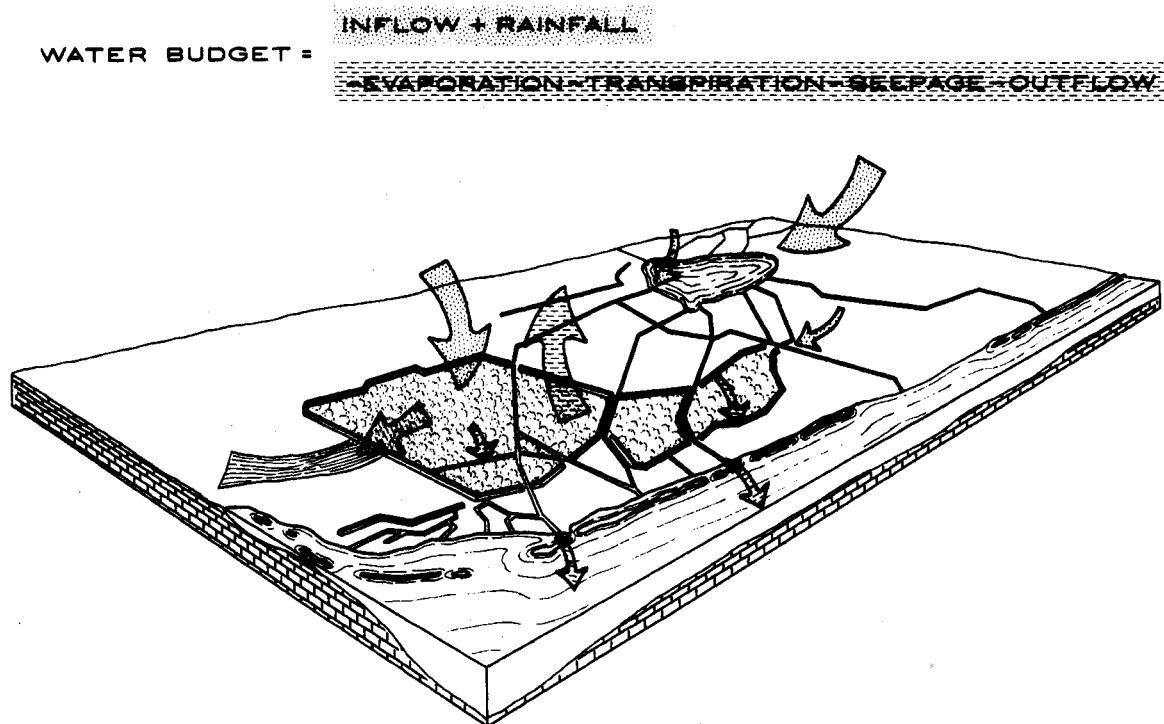


Figure 12. Schematic diagram of a water budget for the Everglades water basin.

(USACE) and the Central and Southern Florida Flood Control District (Figure 10). Weekly or monthly summaries of these data, which are received 5 times daily when the satellite is in range of a NASA tracking station, can also be distributed to agencies as desired.

ERTS-DCP information can be used immediately for water management or correlated with enhanced ERTS imagery to provide water-storage information. This shows the extent of fresh-water inundation. Successive areal measurements related to stage can be used to determine the change in volume of water storage. Water-storage information developed using this system can benefit both the water users of southern Florida and the Everglades by providing a more reliable and timely source of information for decision making. Maintenance of data collection stations is less of a problem with DCP's than conventional types of ground stations because malfunctions are detected immediately.

A primary objective of the Florida ERTS investigation is the development of two prototypic operational models: (1) a water management model, and (2) an ecological model. In Conservation Area 1, just south of Lake Okeechobee, evapotranspiration and seepage were determined using enhanced images and ERTS-DCS data (14). Surface water storage was also determined for the same period (Figure 11). This established the feasibility of development of the water-management model. The expansion of the DCS to include sufficient parameters for calculating water budgets is presently under consideration (Figure 12). The ecological model being developed simultaneously will provide information on the best habitat and reproduction requirements for wildlife in the Everglades.

Summary and Conclusion. ERTS data and aerial photography are proving to be a useful tool for the management of inland wetlands. Remotely sensed data are being applied to specific wetland management needs or requirements for the Dismal Swamp and southern Florida.

ERTS imagery and aerial photography, both color IR and black and white are being used in the Congressionally authorized Dismal Swamp Study for (1) overall selection and verification of study areas, (2) guiding the field collection of data, (3) mapping of vegetation, (4) studying the hydrology, (5) locating areas for intensive study, (6) identifying special interest features and (7) detecting change. Extractions from ERTS data made using the USGS's Autographic Theme Extraction System are aiding analyses of the hydrologic regime of the Swamp and are providing pertinent information to quick recognition and inventory of wetlands from ERTS.

Data Collection Platforms in south Florida wetlands provide near-real time data for water resource managers. Data relayed by satellite can be entered into models to provide predictive water storage information for long-term and short-term decision making. Correlation of DCS data with enhanced ERTS imagery has the potential to provide water budget parameters and input to ecological models.

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The Use of Remote Sensing Data in the
Management of Inland Wetlands

by

Virginia Carter

EDITORIAL COMMENTARY

by

Paul Bock*

The paper calls on vast experience in the applications of remote-sensing to wetland problems. The position from within the U.S. Geological Survey provides the paper with a unique vantage point for our overview of current investigations throughout the country. Thus the paper puts into perspective the relative roles of low and high altitude photography vs. space-borne ERTS and Skylab imagery and black and white photography vs. color IR vs. ERTS multispectral imagery.

The presentation makes the point that no single form of remote sensing is sufficient for the needs of basic research and near real time information related to wetlands management. For the foreseeable future, it seems likely that no single sensor -- that no single data collection platform can provide the requisite wetlands information at the desired spectral and spatial resolutions.

The paper's two examples, the Great Dismal Swamp and the Water Conservation District of Southern Florida, illustrate the variety of remote sensing application techniques to two complex water management schemes. Each area is relatively large (70 and 1400 square miles respectively) and both have the benefit of extensive and recent mapping using aircraft photography and satellite imagery (at scales ranging from 1:76,000 to 1:1,000,000). In the Dismal Swamp study, mapping at a scale of 1:24,000 required

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3 man-weeks using aerial photos, and 3 man-days using ERTS imagery. However, the map scale used for the ERTS imagery was 1:250,000 and only several of the vegetation categories were clearly identified.

The paper briefly mentions the use of airborne thermal imagery to detect temperature anomalies in water bodies -- thus making possible the inferences of sources of cooler ground water entering Dismal Swamp. For detecting of surface temperature fields, a thermal IR channel on the ERTS multispectral scanner (MSS) was originally planned but later eliminated due to unresolved development problems. Present plans call for a low orbit, predawn small satellite to carry a thermal imager (sensing at 10-12 micrometers) with capabilities for studying wetland thermal patterns and other temperature-sensitive hydrologic phenomena.

Present thinking concerning the use of ERTS imagery for wetlands delineation can be summarized as follows. At a scale of 1:1,000,000 (as delivered from NASA) the following wetland parameters can be determined: the marsh water interface, and upper wetland boundary; large plant communities of 100 m² and above (including *Spartina alterniflora*, *S. patens*, and *S. cynosuroides*, *Juncus roemerianus* and *Typha* spp.); tree islands as small as 160 m² and streams as small as 16 meters wide. At a scale of 1:125,000, the marsh-water interface and upper wetlands boundary and successional zones are clearly shown as are smaller communities (less than 25 m² in some cases) of the above species and open, nonvegetated ditches for drainage and agriculture. At a scale of 1:24,000, all boundaries seen at the above scales become blurred.

The Use of Remote Sensing Data in the Management of Inland Wetlands

by

Virginia Carter

EDITORIAL COMMENTARY

by

Ronald Waghorn*

The paper's data from the Dismal Swamp Study gives many insights into the application of remote sensing as a management and planning tool. ERTS imagery and high and low level aerial photography can provide significant increases in data collection from inaccessible areas such as swamps and other wetlands types.

The presentations point out that the data can be used for selection of study areas, vegetation mapping, hydrological studies, and evolutionary changes of specific parameters.

Differences in vegetation and in surface and ground water are prime considerations in delineating wetlands. These parameters can be monitored with color and color infrared (IR) photography from aircraft, using band passing and short band blocking filters to enhance specific vegetation or surface water parameters. The idea of using thermal IR imagery to detect ground water contribution may prove to be very useful. The 8 to 10 μ m region of the spectrum is usually used for detecting thermal gradients in water. If continuously monitored, a wetland could provide information as to whether it is nourished by groundwater or surface runoff. This could be a prime consideration for the definition of of permanent inland wetlands.

The type of information gained from remote sensing can and will help to identify and delineate inland wetlands in Connecticut. On a larger scale, remote sensing can be an important tool in water resource management. Data Collection Platforms (DCP's) as

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used in the Everglades of Florida should be thoroughly investigated and applied wherever possible. When used in conjunction with ERTS imagery data, they provide valuable near real-time knowledge of our wetland hydrology. The presentation points out the need for extensive investigation in the field of remote sensing and subsequent data storage and distribution.

PROBLEMS IN DELINEATING WETLANDS BOUNDARIES

by

Gunther Greulich*

Introduction. "There is a determination to redefine property rights; not to deny man his reasonable rights, but to require that individual use of the land respect the public interest and the common good."

This is what the Los Angeles *Times* said of the passage of California's coastal Zone Conservation Act a little over three years ago- "...to redefine property rights."

Rights vs. Respect; or individual over common interest. Is the public more important than a person's property rights? These arguments are the main cause for problems in delineating wetlands boundaries. The basic question is, where do you draw the line, literally as well as symbolically?

Although many boundary problems appear to be of a technical nature, very few really are. Almost all difficulties are directly caused by or relating to money, sometimes *big* money.

The Problem. Three kinds of money are involved:

1. The money which the land owner expects to gain by developing waterfront property and other wetlands.
2. The money which each city or town must spend to define wetlands under the Act.
3. The money which will be needed for the policing of the Act and the defense of the wetlands.

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Let's review the first category of money on the basis of past experience.

In the past all of us have received in the mail glorious descriptions of golden opportunities to invest in waterfront lots from Florida to Maine. Free dinners, free airplane trips, free weekend stays in luxurious hotels are offered to those who are willing to "take a look", "without obligation", of course.

Developers are at their best when they advertise their products and achievements. Here are some excerpts, educational and revealing, from their literature:

In 1969 a certain firm advertised in the *Boston Globe* with this headline: "The last major island property of its kind in Florida...and it's fast disappearing!" Five years ago Marco Island joined the 20th Century, and most probably all the centuries beyond. "Fishermen knew of Marco Island. Shellers and sun-lovers, photographers, painters, bald eagles, porpoises, etc. Today, under stewardship, Marco Island has achieved the look of tomorrow....\$100,000,000 in sales, many miles of bulk-headed waterways, a Gulf-front hotel, a 4000 ft. airstrip..." and so on.

Another development corporation wrote this in 1970: "We know of a tranquil hidden place on Florida's Atlantic gold coast. A place where there are miles and miles of gentle glistening beaches--tranquil bays--placid fishing coves on inland streams, where there are sparkling waters, clean air--soothing, friendly, beautiful. A place that's been waiting--waiting hundreds and hundreds of years for people to discover it--waiting for the right people to come and enjoy it...We call it Palm Coast."

In 1971 still another land developer offered a "Survival Kit" of information. "This is it...and when the last protected, unspoiled homesite is sold, there'll be nothing like it left in the State of Florida. Thousands of people, like yourself, are thinking about moving to escape the rigors of foul air, bad weather and polluted waters. But the question is, where to go? Florida is receiving some 3,200 new residents every week. With increases of this magnitude Florida cannot escape pollution problems. Most important, Florida's vast coastline, available for development, is almost gone".

The advertising pamphlet boasts that the development has grown from a 550 acre parcel to over 10,000 acres in only 12 years. And that it brought "incredible wealth".

More recently, developments closer to home are being offered for sale. Sebago Lake in Maine, Lake Winnepesaukee in New Hampshire, Queechee Lakes in Vermont, the shores of Cape Cod and so on. The *Hartford Times* has predicted that by the year 2000 people who work in Hartford, Connecticut will live in Hartford, Vermont, presumably to escape the pressures of megalopolis, which by that time will have gobbled up Connecticut.

Connecticut's Inland Wetland Act. About 25% of Connecticut's surface is considered inland wetlands. In other words over 800,000 acres may have been removed from the possibility of development by Connecticut's Inland Wetland Act (Public Act No. 155, 1972). It takes little imagination to foresee the kind of pressure which will be exerted upon the remaining land surrounding these wetlands in the future.

It is against this backdrop that we must view the small amount of money that will be available for the determination of what and where the wetlands are. If that amount seems small, you may be sure that an even smaller amount of money will be spent on the accurate delineation of wetland boundaries.

The boundaries of a swamp or marsh are its greatest weakness and therefore Connecticut's biggest inland wetland problem. It is here most of the arguments will develop and where it will be most difficult to enforce the Inland Wetlands and Watercourses Act. A wetland is most vulnerable along its edges. Greed, financial desperation and sheer ignorance will constantly and continuously nibble away, or should I say "Fill Away"? Here the wetland is open to attack and cannot be protected, mainly, because of the lack of funds.

A wetland is never developed from the inside out. Instead its size is gradually reduced from the outside in. If you cannot accurately define the edges of a marsh or swamp, you cannot protect it. It takes precise, large scale maps to do that job.

Maps. What kind of maps should be used to define and illustrate wetlands? What kind of maps are available?

The U. S. Geological Survey Topographic Maps. The best known and most available maps are the U. S. Geological Survey Quadrangle Sheets (topo maps) prepared, published and updated by the Geological Survey of the U. S. Department of the Interior. These maps show swamps, bogs, marshes, lakes, rivers etc., usually in blue lines and by certain map symbols. There are several problems, however, as far as wetland boundaries are concerned. First, the U. S. Geological Survey (G.S.) map sheet does not define the limits of wetlands. One can only assume that the edge of a swamp, for instance, runs somewhere along the outer fringes of the cartographic swamp symbol, which looks like a clump of grass. (Fig. 1) Secondly, contours are shown in 10-foot intervals. Flood plain elevations cannot be accurately interpolated. The biggest drawback of these maps, however, is their scale of 1:24,000 or 1"=2000 feet.

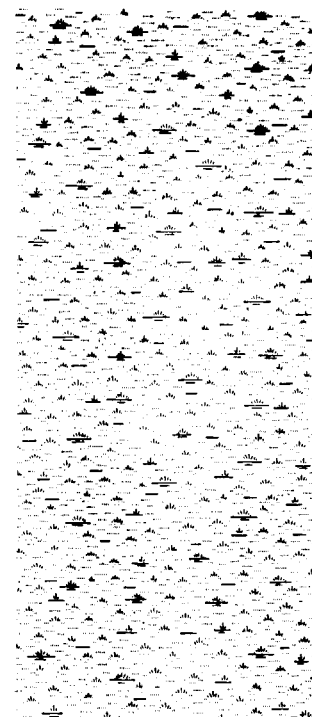


Fig. 1 Swamp Symbols

At the bottom of each sheet there is a statement which says "This map complies with National Map Accuracy Standards".* These are the highest prevailing cartographic standards in the United States. Lines or points shown are plotted to within 1/40 of an inch of true position at best. That means that, if the map were perfect, the boundary of a wetland is in error by at least 50 feet. It could be off by as much as 100 feet. (Plotting error of 50 feet plus scaling error of 50 feet, at best!) As an example, an ordinary No. 2 pencil line drawn on this map is 50 feet wide. A line drawn with a felt tip pen is 75 feet wide. This is quite a distance if one has to argue with a land developer who (by the stroke of a ball-point pen) stands to lose another buildable lot worth of thousands of dollars to him.

Bear in mind that the swamp symbol stands by itself without a boundary. In Massachusetts we have found wetlands where there was no such symbol on the U.S. G. S. Quadrangle sheet and we have found dry ground where the map indicated a swamp.

*See Appendix II.

The U.S.D.A. Soils Maps. Another popular map is the so-called Soils Map, which is discussed in these proceedings by directors of the United States Department of Agriculture (U.S.D.A.) Soil Conservation Service. A representative of the Connecticut Department of Environmental Protection recommended this map at the recent Connecticut Land Surveyors' Convention as a "better-than-nothing" tool which needed much refinement.

Again, the small scale (1" = 2000' or 1" = about 1300') is this map's greatest drawback. Elsewhere in this volume there is a sample map of the soil survey of the Town of Bridgewater, Connecticut. Poorly drained soil areas are shown in red and water is shown in blue.* If you look at this map closely, you will notice that the previously discussed swamp symbol is shown on many areas outside these so-called wetlands as interpreted by the Soil Conservation Service. I would suspect that these swamps also qualify for protection under the Inland Wetlands Watercourses Act, and you would need other sources than the soils map to identify them.

Wetland Plants. Boundaries can be drawn around certain types of plants. It takes at least a botanist in addition to the soil scientist mentioned in the Inland Wetlands legislation for correct classification of the various plant species.

"The fresh-water wetlands can also be recognized by the kind of plants that grow in them." says a booklet prepared by the Connecticut Arboretum and entitled *Inland Wetland Plants of Connecticut*. (1)

I am sure that much argument has developed as to whether vegetation should be made the sole criterion in the determination of wetland boundaries.

Cat-tails are listed on page 8 of the above booklet as "a plant of the marshes." On my way from Boston to Connecticut I noticed a large stand of cat-tails on the west bound lane of the Massachusetts Turnpike past the Route 495 interchange. These cat-tails grow not in a pond,, but 10 feet above the pavement on a steep side slope! As in most anything, common sense must prevail.

* Map - Page 28 - Note change from color to drawn symbols. -Eds.

Earth Resources Technology Satellite Maps (ERTS).* Another experimental mapping program currently undertaken by NASA is called ERTS (Earth Resources Technology Satellite). Television cameras view the same spot on the earth every 18 days. Each photograph covers about 185 kilometers by 185 kilometers of the earth's surface. The resolution of these aerial photographs is 90 meters or 300 feet which makes them unsuitable for precise wetlands delineation such as discussed in this paper.

The Aerial Map. Sooner or later cities and towns must realize that available small scale U. S. Government maps are inadequate for the purpose of controlling wetlands. They will have to decide that they should have a topographical map prepared by a private surveyor or firm. And how will they go about obtaining such maps?

The first thing they will do is "shopping for price". The towns will be talking to a few reputable photogrammetric firms and unfortunately they will think that the firms' fees are outrageously high. More often than not, the towns will also hear from several other mapping firms whose best product is their salesmanship. They will prepare a map for a fee less than what it costs to do the job *right*. This map will make the agency who bought it very happy, because it will show all specified topographic features including wetlands, watercourses and contours. In no way will this map look different from another map which was bought by another town at a much higher cost per acre.

The problem is that neither expert nor layman can tell the difference between a reliable map and a map which has been cleverly composed by a short-cut artist. A map is only as good as it relates to identifiable physical features on the ground and the true relationship to each other.

Unlike goods or materials, a mapping project is a professional service which cannot be sampled before and thoroughly tested after production. It may take years before one discovers that a map is in error because it was poorly controlled by insufficient ground survey. When a town has to go to court with its wetlands map, and it is faced by a professional surveyor or engineer with an accurate large-scale map, proving that the town's contour elevations are three feet in error or that the swamp is really located on the adjacent parcel of land, then the town will find out it should have spent more money on a more reliable map.

*Now LANDSAT I & II. -Eds.

A few years ago there was a help-wanted ad in the Boston papers placed by a "fastest growing" municipal mapping firm looking for *map zappers*. Beware of map zappers. It may be you who gets zapped!

Map Scales. The most common scales for topographical maps compiled by photogrammetric methods are:

1" = 200' with a 5' C.I. (Contour Interval)
 1" = 100' with a 2' C.I.
 1" = 50' with a 1' C.I.

Since a 200 scale map is flown at a higher altitude, it requires fewer stereoscopic models* and less ground control** than a 100 scale map. Actually it covers four times the area and is, therefore, less expensive. In turn, a 50 scale map is much more costly than a 100 scale map.

It is for this reason that most wetland maps have been drawn at a scale of 1 inch = 200 feet. If prepared in compliance with National Map Accuracy Standards, 90% of all features must be within 1/40 of an inch (within 5 feet) of their true horizontal position.

The five foot horizontal accuracy (or better, inaccuracy) can cause some problems when even less accurate assessors' maps have been superimposed on the base map. The resulting distortion may make the difference in a small builder's decision. To build or not to build, that is always the question.

Of more concern should be the remaining 10% of the features which do not fall within accuracy standards. There is no way of knowing which portion of a wetland boundary was drawn in excess of the five foot error and by how much. Only a field survey on a case by case basis will bring proof to this question.

What should really worry a municipality, however, are those bargain maps which were obtained from the lowest bidder and which most likely do not conform to National Map Accuracy Standards at all. Their day in court will come and at great cost to the taxpayer.

*A stereoscopic model is a pair of photographs that will form a three dimensional image. -Eds.

**The scale and accuracy of maps prepared photogrammetrically are determined by accurate ground measurements made prior to the preparation of the map. -Eds.

A map prepared at 1 inch = 100 feet is, of course, more accurate than a 200 scale map. It is probably the ideal map for accurate wetlands determination. Its horizontal accuracy is within 2.5 feet and therefore, sufficient for most any boundary problem.

Some towns buy maps at a manuscript [original] scale of 1 inch = 200 feet to be photographically enlarged to a final map scale of 1 inch = 100 foot. Obviously it is easier to work with a larger map, but it is important that the user be made aware of the enlargement by a simple note on the plan. It is equally important that the buyer of this 100 scale map understands that its accuracy has not been improved. It still retains all the inherent inaccuracies of a 200 scale map such as a five foot horizontal positioning error and is in no way equal to a manuscript 100 scale map.

Even a reliable map can cause problems. Walls and fences are not always shown on an aerial map. Sometimes detail is obscured on an aerial photograph by foliage or branches of trees in wooded sections. Field surveys by laymen can lead to misrepresentation of wetlands (see Fig. 3).

Contour Intervals. Some wetlands, particularly coastal wetlands and flood plains, are determined by a certain contour elevation based on a certain datum plane.

Coastal wetlands are usually defined by a single contour elevation, most likely the extreme high water line. Flood plains may be defined by several different contour elevations for the same river in the same town, depending upon flood stage levels based on local experience.

As mentioned before, a 200 scale map is suitable for a 5 foot contour interval. If National Map Accuracy Standards have been met, 90% of all contours shown will be within 2.5 feet of true elevation. Due to the physical limitations of a stereoscopic image at this scale, only 5 foot contours can reliably be obtained. To develop intermediate contour lines by interpolation in order to fit a certain need produces nothing by an illusion, a false picture.

An original 100 scale map is suitable for a 2 foot contour interval. Ninety percent of all contours should be within one foot of their true elevation according to National Map Accuracy Standards. But remember, a 100 scale map which has been photographically enlarged from

an original 200 scale manuscript is suitable for a 5 foot contour interval only. In a flood plain you may not find five feet of difference in elevation for thousands of feet. It is therefore possible for an agency by arbitrary interpolation of contour lines to inadvertently exclude large areas of wetlands from its control or to inadvertently include large areas of dry land. Either one can be the cause of much aggravation, grief and financial loss.

What to do. How can you protect yourself and your town against irresponsible mapping practices? Here are a few guidelines, mostly based on good common sense.

1. For your project, consider only those surveyors or mapping firms which are headed by professional land surveyors or civil engineers, duly registered by the State of Connecticut.
2. Ask for the name of the registered individual and check him out with the Connecticut Board of Registration of Professional Engineers and Land Surveyors.
3. Insist on the same statement on each map sheet (standard on Geological Survey sheets) regarding compliance with U. S. National Map Accuracy Standards and have the statement signed and sealed by the registered person responsible for the project.
4. Don't ask for bids.* Negotiate with one or several reputable firms and select the one which discusses freely and in a professional manner the pros and cons of different map types and scales.
5. Be alarmed if someone tells you that the science and art of map making is so advanced now that ground control is no longer needed. Terms such as digitizing and analytical control may confuse you. These do have a rightful place in today's photogrammetry when properly applied. Although these processes serve to reduce the number of ground control points (which used to be four per stereoscopic model), they do not eliminate them.
6. Require that the date and negative scale of aerial photography be noted on each map sheet. The ratio between negative and map scales should not exceed 1:6, preferably 1:5.

* The laws of some government bodies require bids. - Eds.

7. All maps should be based on the Connecticut Geodetic Grid System.
8. All elevations should be referred to the Mean Sea Level Datum of 1929.
9. Discuss the budget limitations of your town with the mapping consultant and let him tell you what he can honestly deliver for that money.
10. Recognize that the taxpayers of your town are better served by a good though expensive map prepared in annual stages as budget permits rather than a complete but inferior map at any (low) cost.
11. Meet with other Town agencies which are in need of maps. A good large scale base map is useful to Assessors, Planning Boards, Town Engineers, the Department of Public Works, the Fire Department, the Police Department, the Department of Health, and probably others.

The combined budgets of each agency can make financing of a mapping project less burdensome to the taxpayer.

Cost of Maps. Small scale Government maps are commercially available and very inexpensive.

The cost of an aerial map is also a function of the geometric shape of the area to be mapped. The number of flight lines, the number and efficiency of stereoscopic models, and the extent of ground control all are variables based on the existing geometry of a town. The cost of an aerial map is directly related to its scale. The smaller the scale, the cheaper the map. The following are approximate prices (January, 1974)* and will vary greatly from project to project.

1. U.S. G.S. Topographic Map 1"=2000', may cover an
an entire town - - - - \$0.75 per sheet
2. U.S. D.A. Soils Map 1"=1320' - - \$0.80 per sheet
3. Aerial Maps 1"= 200', ink on mylar
a 24" x 36" sheet covers approx. 550 acres
\$5 per acre

*Substantial increases in photographic prices have occurred since that date due to changes in the availability of petrochemicals. -Eds.

3. Continued-----
- | | |
|----------------------|---------------|
| 1"=100' | a 24" x 36" |
| sheet covers approx. | |
| 130 acres | \$18 per acre |
| 1"= 50' | a 24" x 36" |
| sheet covers approx. | |
| 35 acres | \$40 per acre |

How to Enforce The Inlands Wetlands and Watercourses Act.
 The basic purpose of Public Act No. 155 of 1972 and the 1973 amendment is to "minimize the disturbance of inland wetlands and water courses." To minimize, not to eliminate. Since July 1st, 1974, every municipality is expected to "license regulated activities".

"Grazing and Farming" is a permitted use under the Act. In Massachusetts we have found that cows produce two items in great quantity - milk and manure. The question that has arisen is where to draw the line between fertilizing a meadow and polluting it.

A non-regulated use is *play and sporting areas*. Does this mean that someone could pave a large wetland area for a tennis court?

Although each inland wetlands agency is authorized to establish boundaries most of them are simply not prepared when the first developer comes in and applies for a permit to conduct a regulated activity upon a wetland.

Since the immediately available maps are limited in their usefulness for specific sites, the regulating agency should take advantage of other existing laws in the best public interest. There I refer to the registration laws for land surveyors and professional engineers.

Without additional cost to the public, the regulating agency can simply stipulate that every application for a permit must be accompanied by an accurate plan at a scale of 1"=40' or 1"=50' based on an actual field survey indicating thereon all existing wetlands and property lines. This plan must be accompanied by a copy of a U.S. G.S. Sheet or Soils Map with an accurate plot of locus thereon. Both plans must be sealed and signed by a Registered Land Surveyor.

A reputable surveyor or engineer will not violate the public trust or jeopardize his registration, which is his livelihood, merely to assist a greedy developer in defrauding the public. He knows as a professional that he is liable for his actions and may, therefore, be your best ally in the protection of wetlands. Take advantage of his integrity and his expertise.

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Problems of Boundary Delineation of Wetlands

by

Gunther Greulich

EDITORIAL COMMENTARY

by

H. H. Ridgeway

The Universities, State Agencies and National Agencies have all been well represented in this and the first Wetlands conference. This paper does an excellent job of representing the land surveying profession, a part of the private sector that has played and will continue to play an active role in the establishment of land ownership and land-use boundaries.

The author, who is to be commended for his entertaining and witty candor, emphasized that the wetland boundary problems are not primarily technical in nature, but financial. The financial problems are: 1) the change in land value with a change in land-use, 2) the costs of defining the wetland boundary, and 3) the cost of defending the established wetland boundary. None of these costs are independent of one another.

Very dramatic examples of land value changes with land-use changes were given for large scale development projects in resort areas. While land-use changes of this magnitude will probably not take place in many of the Connecticut towns, the potential for substantial changes in land values is there.

The physical delineation of the wetland non-wetland interface requires both the identification of the interface and the fixing of its location. While the problems associated with the identification may be technical, the fixing of the location is not. Technology is available for fixing the boundary to any desired accuracy. The problem is financial and the cost increases rapidly as the degree of accuracy that is required increases.

The author's estimates of costs as compared to scale give a good indication of the relative costs for preparing maps that meet National Map Standards. These relative costs will be about the same whether the work is done by a private or governmental agency.

The ability to defend the wetland and the cost of defending it will be affected by both the potential for increased value with a land-use change and accuracy with which the wetland boundary is delineated. The money saved in the poor delineation of the wetlands will probably be more than paid for by either the loss of the wetlands or an increased cost in enforcing a poorly established boundary.

POLICY CONSIDERATIONS OF THE CONNECTICUT INLAND WETLANDS ACT

by

Russell Lee Post, Jr.

Chairman, Inland Wetlands Subcommittee
Connecticut State Legislature

Most of the people who attended this conference share a common belief: there is a value in preserving wetlands. There are, however, a number of problems in implementing this belief. Hopefully, if we identify and understand some of the problems in protecting wetlands, we can find better ways of carrying out Connecticut's public policy for them.

Phase One: Some years ago, there was a group of people in Connecticut who had the vision and foresight to realize that inland wetlands are a resource; a fragile resource which we should attempt to protect. One of the first steps in that attempt has now been taken: the State Legislature has made a commitment to protect inland wetlands. The State did not acquire the wetlands, nor did it prohibit their development. The State legislature was persuaded to provide for the preservation and protection of wetlands from random, unnecessary, undesirable and unregulated uses on the grounds that it is essential to the health, welfare and safety of citizens of Connecticut to minimize the disturbance of wetlands by preventing pollution, and by maintaining and improving water quality; so ended phase one.

Phase Two: Phase Two involved the implementation of that public policy. That is where our problems began. As all of us realized how we might be individually affected by the regulation of inland wetlands, we began to resist. There were property owners who argued that they could no longer develop their land to its full economic potential, that this new law limited their potential profits, and therefore the new law should be repealed as an unconstitutional invasion of their right to enjoy their property. Town officials began to realize that decisions on the use of inland wetland areas would be unpopular with both the environmentalists on one hand and the land owners on the other. Taxpayers thought that the implementation of this Act could lead to the condemnation of real estate and the subsequent

drain of tax dollars to pay off large property owners. As these concerns began to crystallize, pressure to repeal the Act and renege on this commitment built up in the Connecticut Legislature during 1973.

Phase Three: Then began phase three, corrective legislation. Legislators faced a choice: repeal the Act or amend it. Problem number one was to clarify the rights of property owners to compensation because of the application of this Act. If no such corrective action were taken, it had become clear that the municipalities would not attempt to enforce the Act. Should the municipalities not assume the responsibility of enforcing the Act, the State would not have the manpower to do so. Thus the Legislature's challenge was to take corrective measures which would permit and encourage municipalities to work with the inland wetland laws and attempt to prevent the destruction of inland wetland areas. Inasmuch as neither the State nor the towns had sufficient funds to pay for the land areas regulated under the Inland Wetlands Act, it became necessary to eliminate any right of compensation to the landowners. The amendments adopted in 1973 were intended to do just this. All references to acquisition and compensation were deleted from the Act. Language was substituted which would allow government bodies to regulate the use of property just the way that local zoning boards may regulate the use of land areas in a town under the police power of the constitution, without payment to the property owners.

A second problem was to make these changes rapidly. Because of the ambiguities in the original act regarding the right of compensation to property owners, there was the very real risk that lawsuits would be instituted which would challenge the constitutionality of the law and claim compensation from the towns. Such lawsuits could take years to be resolved, thus exposing municipalities to considerable risk and discouraging government officials from trying to use the Inland Wetlands Act to protect the fragile resource. The Legislature agreed to make these changes in 1973 to eliminate this possible consequence.

A third problem dealt with the regulatory procedure to be followed under the Act. Under the original Act it was not clear how the Act was to be applied in everyday operation. In 1973 the Legislature agreed to adopt a procedure which would require that inland wetland areas be designated and that the owners of wetland areas so designated obtain permits prior to conducting regulated activities in those areas. The conditions for right of appeal were then carefully described so that town officials and property owners alike would all know their obligations.

An additional problem with the Inland Wetlands and Water Courses Act dealt with the definition of an inland wetland. It is estimated by some that 25% of the area of Connecticut should

be categorized as inland wetlands [or water courses] under the statutory soils definition. It has been argued that the definition is imprecise and should be improved. The 1973 State Legislature deferred to this problem. It was recognized that inland wetland areas are not constant. As the wetlands change, so shall the designation of them change under the Act. The law, as amended, provides for a process whereby local municipal agencies can correct the designation of inland wetland areas as errors are discovered or as the wetlands change. I agreed with a majority of legislators who felt that this process, imperfect as it may be, was the better alternative than to delay the implementation of the Act for months or years until more precise maps could be prepared. Legislators have learned that a delay in implementation of a land regulation act encourages some owners to rush into development. There are some who are anxious to defeat this public policy and maximize their economic return and who would thus take advantage of any delay in implementation. It seemed the wiser course to do the best we could with the imprecise definition originally enacted.

The Future. There will, of necessity, be additional phases to the inland wetlands story. One future consideration may involve changes in the institutional framework we have now established. The current system depends on local municipal agencies to implement the Inland Wetlands Act. This honors the well established doctrine of local autonomy. It seems to me that defining and protecting inland wetlands on a town by town basis is an imperfect system. The wetlands themselves do not honor town lines. I hope that at some point in the future we will consider the regulation of wetlands on a watershed basis; but because this could lead to a regional form of government, it may be many years away.

Connecticut has started to control and protect the wetlands. It has recognized the value of them as a fragile resource. The State has adopted legislation declaring the protection of wetlands to be a public policy. Connecticut has established a governmental framework to carry out this policy, and has corrected the legislation in an effort to make it workable. But we have only started. We have not yet stopped the many destructive processes that challenge the environment. We do not have the broad public support necessary to conserve our natural resources, and it remains the job of all of us to continue our efforts so that the modest start now made can lead to the protection of the environment.

Policy Considerations of the Connecticut Inland Wetlands Act

by

Russell Lee Post, Jr.

EDITORIAL COMMENTARY

by

Michael Wm. Lefor* and T. Helfgott**

The paper has considered some of the historical background and implementational stages of Connecticut's precedent-setting Inland Wetlands Act. The process of "three phases" in the development and implementation of legislation is a common one: identify the need, pass a law, and correct it as time and experience justify. This is especially the case when dealing with an innovative law such as the Inland Wetlands and Watercourses Act. Problems of who shall regulate, state, or municipality; how to define and delineate the wetlands; and how to be fair and just to the property owner were all considered in writing and correcting the law. But who is to say that all of what emerged is correct for the present sociological situation? In the tidal wetlands legislation, the public most directly concerned had become well educated and concerned with those valuable lands before the writing of the Act, and there was a great deal of hard scientific information available to justify the preservation and regulation of the tidal wetlands. This has not been the case with the inland wetlands because of these resources' essentially private nature and vast percentage of Connecticut's total land area [20-25%]. Hard scientific data is largely absent and is only now being obtained.

Evidently some persons in the legislature and elsewhere were concerned enough in advance of a public concern to exercise the curatorial powers of government and pass a law to protect the inland wetlands. The Act has generated, and will continue to generate, a large amount of controversy among the scientific community, private interests, the public, developer, conservationists and elected officials at all levels. There are other ways of defining wetlands. There are other ways of regulating wetlands. No matter what viewpoint is argued on either of those topics, one always returns to the question of the public and private costs of land regulation. For wetlands regulation to be vested solely in the State Department of Environmental Protection or other agency, a large expense is necessary initially in setting up the bureaucracy, performing the mapping to the required legal tolerance, and carrying out the task of interpreting and policing.

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The question becomes one of the degree of commitment to wetlands legislation on the part of government as it reflects the People's wishes. By mandating the State's municipalities to regulate their local wetlands, the question of territoriality of individual landowners and Big Brotherism by the State is diminished, as are the direct costs to the State itself.

Connecticut has probably chosen the correct method of wetlands regulation for the current political climate, and we are all watching the process of refinement of the law to reflect the changes in that climate. Wetlands are only a small part of a larger picture of land-use regulation. These reviewers feel that they are a logical place to start; however, overall land use planning should be an ultimate objective not just of the patch quilt saving of a few niches like the inland wetlands. Nevertheless, as has been said, the Act was a necessary precedent-setting step. It is unfortunate that this statewide land use regulation could not have encompassed the regulated use of all the State's land, but it is a start, and a good one. Nevertheless, modifications of the existing law should follow this start to approach a more ideal piece of legislation. This should include 1) a more overall land use policy; 2) an improvement in the definition to reflect the great biological and functional diversity of the inland wetlands; and 3) some recognition, perhaps a tax break, for those limited in the development of their land property.

THE TAKING CLAUSE OF THE UNITED STATES
CONSTITUTION AND THE CONNECTICUT INLAND WETLANDS
AND WATERCOURSES ACT: A REVIEW

by

Atty. David B. Losee**

Introduction. Although land use regulation raises issues under a variety of constitutional clauses, I wish to concentrate on the clause of the 5th Amendment to the Constitution that appears to pose by far the most significant restraint on the regulation of land use. This is the *Taking Clause*: "...nor shall private property be taken for public use without just compensation."

The complexity of environmental issues is notorious. Why then examine a single point of law covering over 700 years of legal history and hundreds of court decisions? Can one issue be that important?

Just as the analysis of environmental problems demonstrates their interconnectedness, so the search for legal solutions must unify many disparate elements. Any legal solution to an environmental problem must make economic sense, have political acceptability, avoid harmful side effects and allow efficient administration. Solutions to environmental problems are concatenate.

The *Taking issue* is the weak link in many of these chains. All over the country, attempts to solve environmental problems through land use regulation are threatened by the fear that they can be challenged in court as an unconstitutional Taking of property without compensation.

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+The writer wishes to acknowledge heavy reliance upon *The Taking Issue*, a book written by Messrs. Fred Bosselman, David Callies and John Banta for the Council on Environmental Quality. It is for sale by the U. S. Government Printing Office, Washington, D.C. 20402 (GPO Bookstore Stock No. 4111-00017) and is highly recommended to anyone interested in the topic.

When these challenges occur it is not enough to respond that legal environmental questions are interconnected. While breadth of judicial vision is to be encouraged, response to a legal challenge must still be made in the framework of traditional, established legal concepts.

It cannot be claimed that the strengthening of this one link, the Taking issue, is a quick cure for all issues of environmental law. Nevertheless if the challenge posed by the Taking issue can be overcome, I believe it will have a significant impact on our environmental quality and on the implementation of Connecticut's Inland Wetlands and Watercourses Act.

An American Myth: An inviolate right to do as one wishes with one's own land. Many people seriously believe that the United States Constitution gives every man the right to do as he wishes with his land. Foreign concepts such as environmental protection and zoning are new to most landowners. A great number of other people recognize the validity of land-use regulation in general, but believe that such regulations should never be used to reduce the value of a man's land to the point where he cannot make a profit on it. A general opinion is "after all, what good is land if you can't make a profit on it?" The courts have *never* adopted either of these philosophies.

The right to make money buying and selling land is a cherished American folkway and one that cannot be lightly ignored. But in an increasingly crowded and polluted environment can we afford to continue espousing the myth that tells us that the taking clause protects this right of unrestricted use regardless of the impact of that use on society? Obviously not, yet we must not let concern for the environment blind us to the fact that regulations have real economic impact on real people. We must search for legal solutions that will take their interests into account.

History. The concept of Taking originally referred to the seizure of lands by the government and it retained this meaning through the time it was incorporated into the U. S. Constitution and for a century thereafter. Only around the turn of the twentieth century (a period of conflict between free-wheeling growth and expansion and an emerging concern that governmental regulation was needed) did the courts begin to expand the meaning of Taking beyond the original concept.

Until the 1900's, the Law recognized two separate rules regarding governmental powers over land: a duty to pay compensation if land were seized for public use, and a right to regulate the use of land as long as such regulation was reasonably related to a public purpose.

The study of history suggests the possibility of a return to the admittedly unsophisticated (but in retrospect farsighted) idea that was reflected in the original Law of Taking.

In medieval England holding land was a chancy thing at best. The King was entitled to levy on all landowners (in reality, *landholders*) such charges for the defense of the realm as he saw fit, and if these charges were not quickly received, the King literally seized and held the offenders' land in forfeiture. This seemed to cause no great problem yet the landholders needed protection from the powers of the King in times of peace. Consequently, since it was common practice to elect a King by a vote of the Council of Nobles, so it also became the practice to extract from such a King a charter preserving the rights of those nobles. This practice was continued through the Norman Invasions, and was unchanged and reasonably successful until the 1200's and the days of King John. The charter system was subject to greater or lesser abuse depending on the strength of the charter and the popularity of the King. But John, a loser at war and consequently an unpopular king unlike his equally abusive but heroic and highly popular brother, King Richard I, went too far with his charter with too little support. John seized defense lands which then ended up as hunting preserves for himself and his friends. Most especially, John taxed and seized land for a war which never began due to a peace treaty which had probably been arrived at in advance. John kept the tax money and the seized land, and since the nobles had only recently been taxed to ransom, John's brother, Richard I, this pushed them to rebellion. The nobles gathered up their followers and marched on London. John refused to open the city gates but the landowners forced them open anyway, and as a consequence of their revolt, the Magna Carta was signed at Runnymede near Windsor Castle in 1215. The nobles had succeeded in renegotiating their King's contract.

Chapter 39 of the Magna Carta was a Taking clause, providing that: "No freeman shall be arrested, or detained in prison, or deprived of his freehold, or in any way molested; and we will not set forth against him, unless by the lawful judgment of his peers and by the law of the land." In 1216 John died and a trustee for Henry III reconfirmed the Charter. In 1225, Henry III confirmed a new form of the Magna Carta at which time Chapter 39 became Clause 39.

Subsequently, Henry III proceeded to regulate the use of land in many ways, some of which approximate current zoning efforts, public health standards, and crop and wildlife management. As long as these regulations were designed to promote the public benefit, rather than the personal benefit of the King, justice was not offended.

Later, James I (1565-1625) brought no common law with him from Scotland save the perpetuation of the monarchy. Thus the Stuart Kings became embroiled in a battle with Parliament. Parliament came to the defense of the Magna Carta. Property rights became one of the major issues in the subsequent English civil war. The Royalists lost the war, the supremacy of the Parliament and English common law were not challenged again.

The significance of this is that the supremacy of these rights and principles was firmly established in the minds of those then engaged in the colonization of the New World. The Colonists also inherited, however, a concept of property which permitted extensive regulation of the use of property for the public benefit: regulation that could even go so far as to deny all productive use of the property to the owner if such regulation extended to the public benefit; "...for this is for the public and everyone benefits by it."

The English Experience: Afforesting and Defencing. Chapter 47 of the Magna Carta limited the right of afforesting and defencing (Hunting; Hawking and Fowling, respectively) by the King. This resulted in a large compensation paid by kings such as Henry VIII to those landholders from whom land was taken.

Crops. By the 13th century Nobles could decree what crops could be grown on land controlled by them in a given year. This power was based on common needs and the fact of a servient state.

Urban Land (London). 1189 - Stone parting walls were required to be 16 feet tall and three feet thick. 1297 - Fronts of houses were required to be kept clean; no pig sties were allowed. 1350 - Stone or lead roofs were required to minimize fire danger. 1532 - The Statute of Sewers authorized commissions to govern sewers, seawalls and *watercourses*. The purpose: *flood protection and public health drainage*. 1580 - Queen Elizabeth I pronounced that no new construction within 3 miles of London would be tolerated. 1588 - An act of Parliament proscribed large lot zoning of 4 acres. 1592 - An act provided that conversion of single family dwellings to multi-family dwellings was prohibited. 1604 - Brick or stone construction required. 1620 - Storey and window size regulations were promulgated.

The Early American Experience. The New World abundance of land and the cherished freedom to use it generated a fierce pride in land ownership that was a key element in the frontier spirit of self reliance. Nevertheless only a few years after colonization began, the colonial governments also began to regulate the use of land, and the ensuing pattern of regulation grew to resemble the pattern of land regulation in England rather closely.

By 1631 crops were regulated in Virginia. By 1672 public health and safety laws were erected in Boston in response to the Great Fire. Also in the 1600's Philadelphia adopted a building code. Compensation, however, was provided where land was taken from owners for public roads (Massachusetts); public buildings (Philadelphia); or new towns (Virginia).

It is interesting to note that during the Revolutionary War certain Takings were allowed due to the exigencies of war. These Takings primarily involved supplies and places of storage. The Court said these were allowed during time of war *only* [*Respublica vs. Sparhawk* 1 Dall. 357 (S. Court Pa. 1788)].* "It is better to suffer a private mischief, than a public inconvenience; and the rights of necessity form a part of our law." (1)

Drafting - An Historical Accident? The 5th Amendment to the United States Constitution was drafted by James Madison, strongly encouraged by Thomas Jefferson. Madison's first draft contained no requirement of compensation. This was added by Congress with no reason of record. But it is clear that Madison was the one who induced the Constitutional Congress to add it. It is theorized that Madison, a strong advocate of the landed classes, feared the election of a more egalitarian Congress which might be inspired to nationalize property or equalize holdings for a variety of public purposes. (2)

In any event, one thing is clear. The draftsmen of the 5th Amendment were not troubled by any issue involving regulation of the use of land. Such regulations had been standard practice in England and throughout colonial times, and seem to have provoked no serious controversy. There is no evidence that the Founding Fathers ever conceived that the Taking clause could establish any sort of restrictions on the power to regulate the use of land.

And so the law continued in America, as in England, that if the government seizes land for a public use, compensation must be awarded the property owner. Yet the government reserved the right to regulate the use of the land in private ownership so long as the regulation was reasonably related to a public purpose. This was summarized and best exemplified in the

*Legal references are explained in the bibliography.

landmark case of *Mugler vs. Kansas* [123 U. S. 521 (1877)]. In the mid 1800's Kansas passed a law outlawing the use of any Kansas land for the manufacture or sale of intoxicating liquors. Mr. Mugler owned a brewery. Mugler claimed that he should be compensated according to the 5th Amendment and the *Pumpelly* case, a case where the government flooded a man out of his land and compensation was awarded [*Pumpelly vs. Green Bay Company*, 80 U. S. 166 (1271)]. In the *Mugler* case, Justice Harlan ruled (at pages 667-668) "A prohibition simply upon the use of property for purposes that are declared, by valid legislation to be injurious to the health, morals, or safety of the community, cannot, in any sense, be deemed a Taking or an appropriation of property for the public benefit. Such legislation does not disturb the owner in the control or use of his property for lawful purposes, nor restrict his right to dispose of it, but it is only a declaration by the state that its use by anyone, for certain forbidden purposes, is prejudicial to the public interests."

"The exercise of the police power by the destruction of property which is itself a public nuisance, or the prohibition of its use in a particular way, whereby its value becomes depreciated, is very different from taking property for public use, or from depriving a person of his property without due process of law. In the one case, a nuisance only is abated; in the other, unoffending property is taken away from an innocent owner."

Thus, in Justice Harlan's words, American Law meant that the difference between a police power regulation upon property use and a public Taking of property was not a difference of degree, but a difference in kind.

Holmes Changes the Law. In the case of *Pennsylvania Coal Co. vs. Mahon* [260 U. S. 393 (1922)], Oliver Wendell Holmes rewrote the 5th Amendment on the Taking issue. The nine county northeast corner of Pennsylvania was both densely populated and rich in anthracite coal. Vast areas of land in this region had, at one time, been owned by the coal companies. This land has been sold off to homebuilders with the retention of the right to mine and a waiver of liability for any subsidence or cave-ins. The Mahons, who lived at 7 Prospect Place, Pittston, Pennsylvania, owned such a parcel of land. On September 2, 1921, the Mahons received a letter notifying them to evacuate because mining beneath their home was about to commence.

Since this sort of activity had already caused substantial property damage and personal injury in this region, the Pennsylvania legislature passed the Kohler Act, forbidding mining

in such a manner as to endanger public health and safety. The Mahons went right to court using the Kohler Act. The coal company but merely replied that, first, the law was an improper interference with their rights to contract; and second, that the law was unconstitutional in that it constituted a Taking without compensation.

When this case reached the Supreme Court of the United States, Holmes ignored the contract issue in his decision. The question, he said, was whether the Kohler Act tried to accomplish through police power what could only be accomplished by eminent domain. "When it [regulation] reaches a certain magnitude, in most if not all cases, there must be an exercise of eminent domain and compensation to sustain the act." (3) Thus, in Holmes' view, the difference between regulation and Taking was a difference of *degree* not *kind*. He held the Kohler Act unconstitutional. "The general rule at least is that while property may be regulated to a certain extent, if regulation goes too far it will be recognized as a Taking." (4)

Clearly, *Mugler vs. Kansas* was the law, well established at that point. Why did Holmes decide *Pennsylvania Coal* so differently? It appears that his personal philosophy was always thus, and having declared it so, it could not take change. As early as 1872 Holmes asked if the police power wasn't a term "invented to cover certain acts of the legislature which are seen to be unconstitutional, but which are believed to be necessary." (5) In 1889, sitting on the Supreme Judicial Court of Massachusetts, Holmes stated in *Rideout vs. Knox* [148 Mass. 368 N.E. 390 (1889)]* "It may be said that the difference is only one of degree; most difference of degree is one of the distinctions by which the right of the legislature to exercise police power is determined. Some small limitations of previously existing rights incident to property may be imposed for the sake of preventing manifest evil; larger ones could not be except by the right of eminent domain." (6)

In 1926, the Supreme Court again had an opportunity to deal with the Taking issue in *Village of Euclid vs. Ambler Realty Company* [272 U.S. 365]. Ambler Realty was challenging the comprehensive zoning scheme of the Village of Euclid, Ohio, which restricted Ambler's land, held for industrial development, to a residential use. But the Court avoided the Taking issue,

* A case involving Fence Height Regulation, a zoning-type of regulation governing the height to which fences may be raised within the boundaries of the political unit so regulating.

saying that since no individual lot had been sold and no application for a variance had been denied, the Court could not find grounds that the zoning ordinance, in general, was invalid.

The Experience since the 1920's: The State courts. Given the nature of the balancing test devised by Justice Holmes it is not surprising to find state courts emphasizing that a "taking case" must be decided on its own particular facts.

The balancing test involves so few theoretical elements that after discussing the law the courts often merely repeat clichés in their decisions. As one professor put it, "The judicial calculus involved in the balancing process is discussed in a variety of unilluminating ways." (7)

Connecticut Cases. Subsequent to the 1955 floods, the Connecticut General Assembly established authority for the Water Resources Commission to establish encroachment lines along Connecticut watercourses. No building was allowed within the line without a permit. In one case, the Vartelas family owned land which was occupied by buildings prior to 1955, when the floods destroyed them. Yet the new line allowed building on only 60 square feet of the Vartelas' land. The Vartelases sued, claimed a Taking.

The Connecticut Supreme Court held that there had been no Taking. First, the Statute provided for eminent domain in a proper case and, second, Vartelas did not apply for a permit prior to his suit. Then Mr. Vartelas applied for a permit under Water Resources (now Department of Environmental Protection) Statutes and was turned down. On appeal by Vartelas, the Court upheld the denial saying that the denial was for a particular concrete structure. "The loss of human life and the destruction of property wrought by the floods in August 1955, justified the legislature in conferring upon the Commission broad powers to adopt preventive measures against their repetition...the Commission did not abuse its powers in proceeding by way of regulation rather than by way of eminent domain." (8)

The opposite result was obtained in *Dooley vs. Town Planning and Zoning Commission of the Town of Fairfield* [151 Conn. 304, 197 A.2d 770 (1964)]. The Fairfield Town Planning and Zoning Commission established a flood plain zone which included the Dooley's land. The ordinance prohibited residential construction as well as most commercial construction. The only evidence of flooding presented was "Much of Dooley's property is on good

high ground and was not under water in the 1938 hurricane" [151 Conn. at 308]. In addition, an appraiser testified that the ordinance resulted in a 75% reduction in the value of the land. The Court found the ordinance unreasonable and therefore invalid. But the key to this case was that the ordinance specified which uses were permitted. Most were public purposes: parks, playgrounds, and such. This gave the appearance of hidden eminent domain. Making Dooley provide public recreation for Fairfield without paying him for his land is different from prohibiting him from using his land to public detriment.

The *Bartlett* case is another which gives a first appearance of a stumbling block to the constitutional credence of inland wetlands legislation. The town of Old Lyme amended its zoning regulations to limit the use of tidal marshlands which precluded any use of Mr. Bartlett's land save for a public wharf or canal.

The Court praised the efforts of the Zoning Commission: "Undeniably, the defendant's objective to preserve marshlands from encroachment or destruction is a laudable one. The preservation of our natural environment is of critical concern... The purpose to be served is not the issue on this appeal, however. The issue is whether that purpose can be accomplished in the manner attempted here" [*Bartlett vs. Zoning Commission*, 161 Conn. 24].

Citing *State vs. Hillman* [110 Conn. 92, 147 A. 294]*, the Court acknowledged that zoning regulations are a legitimate exercise of the police power provided they are not such an unreasonable exercise of that power as to become arbitrary, destructive or confiscatory and so unconstitutional.

The Court upheld that the ultimate question was whether or not the amendments which the Commission adopted were so unreasonable as to amount to a Taking. This language echoes *Holmes vs. Pennsylvania Coal*, although the Court concluded by saying that the restrictions were unreasonable, in that they limited Bartlett to uses such as public boat landings which have a benefit for the public. Thus, although reciting the difference in degree formula, the public nature or the available uses of the property is determinative. Again, it appears that *Mugler vs. Kansas* rules from the grave.

Although there are other cases centering on this problem, I should like to move along to some of the most recent cases, one of which is *Rykar Industrial Corporation vs. Commissioner of*

*A Connecticut case on zoning constitutionality.

Agriculture and Natural Resources (Filed April 2, 1971, Argued August 8, 1973, Decision December 11, 1973). Here, Rykar owns 227 acres of marshland in the "Great Salt Marsh" between Stratford and Bridgeport and 365 adjacent upland acres held for future industrial development. This abuts a tidal estuary with a re-emerging marine fishery, commercially viable for the first time in 20 years. It also abuts a public bathing and recreation area. Rykar applied to fill a 227 acre portion of the marsh and dredge, etc. Commissioner Gill denied the application and Rykar appealed this decision. (Note: This is one of the few remaining potential deepwater ports between New York and Boston.) Judge Parskey denied the appeal on December 11, 1973, on the grounds that the denial did not deprive Rykar of access to deep water.

Judge Parskey did comment on the Taking issue. On page IV of his opinion he said, "Only if the regulations are so unreasonable as to become arbitrary, destructive or confiscatory will they be struck down as unconstitutional [*Bartlett vs. Zoning Commission*, 161 Conn. 24, 30; *State vs. Hillman*, *supra*] for in such case the action would constitute, for all practical purposes, a taking of private property for a public use without just compensation [*Dooley vs. Town Planning & Zoning Commission*, 151 Conn. 304, 309]." Am I being terribly optimistic when I say that this hints of the pre-Pennsylvania Coal Law?

Perhaps the most recent case is *Brecciaroli vs. Lufkin*, (Common pleas, Hartford County, decided December 17, 1973, Docket No. 107154). Department of Environmental Protection Commissioner Dan Lufkin denied a permit application by Mr. Dante Brecciaroli for the filling of 5.3 acres of tidal wetlands under the Tidal Wetlands Act (Ref. CGS 22a-30, 1969). The Commissioner said that he would permit a lesser acreage, but not the full amount. Brecciaroli appealed this decision, claiming, among other things, a Taking. The Court held that there had not been a Taking. The court's language is instructive as again it seems to give lip service to *Pennsylvania Coal* and decide the case on the traditional test of whether or not the State was seizing the land for public purpose, constructively or otherwise.

Mr. Brecciaroli had alleged that the Commissioner's action was improper, arbitrary, not supported by the record, an unreasonable exercise of the police power and amounted to a Taking of the plaintiff's land without compensation, contrary to the Constitutions of Connecticut and the United States.

It is axiomatic that all property is subject to the reasonable exercise of the police power [*Jennings vs. Connecticut Light & Power Co.*, 140 Conn. 650, 671], and that the courts will not interfere with a legislative exercise of this power unless the act complained of serves no legitimate purpose or is clearly unreasonable, arbitrary, discriminatory or illegal. [q.v. *Hartland vs. Jensen's Inc.*, 146 Conn. 697, 703; *State vs. Gordon*, 143 Conn. 698, 703]. Further, the courts will not substitute their judgement for the judgement of the legislature in regard to specific legislation which may result in the restricting of the use of private property or in the practical taking of it without compensation, if the issue is debatable. They will regard the validity, wisdom and necessity of the legislation from the standpoint of existing conditions at the time the legislation was enacted [*State vs. Hillman*, 110 Conn. 97, 105].

In this state the "diminution of value" theory enunciated by Justice Holmes in *Pennsylvania Coal Company vs. Mahon* [260 U.S. 393] has been accepted and approved by our Supreme Court. In *Vartelas vs. Water Resources Commission* [146 Conn. 650] the Court sustained the Connecticut State Water Resources Commission's right to deny a property owner permission to construct a particular building within the bounds of state established encroachment lines on his property. The court held that the denial, as related to the specific structure the owner wished to erect, did not necessarily mean that Mr. Vartelas could not build some other building which would serve his purposes and permit him the economic utilization of his property. It added (p. 658) "Until it appears the [an owner] has been finally deprived [by the Commission] of the reasonable and proper use of [his] property it cannot be said that there has been an unconstitutional Taking of property without just compensation." There have been several other decisions recognizing and approving this theory: *Dooley vs. Town Planning and Zoning Commission* [151 Conn. 304]; *Teuscher vs. Zoning Board of Appeals* [154 Conn. 650]; *Samp Mortar Lake vs. Town Planning and Zoning Commission* [155 Conn. 310]. While it has been criticized on several grounds, primarily that it presents a difficult problem of definition, such an issue is no greater than many another in the law where such standards are just and fair and reasonable damages, the reasonable man and reasonable doubt have long been recognized and approved and have led to fair and equitable decisions. All of these justification theories have come into being because courts have understood the necessity of striking a balance between private property rights and the public interest. It has become

increasingly apparent to them that it would impose an impossible burden on the State for the law to insist that it acquire every privately owned natural resource which is threatened with destruction or despoliation by some activity of its owner. As Justice Holmes saw so clearly in 1922, "government could hardly go on if to some extent values incident to property could not be diminished without paying for every such change in the general law." [*Pennsylvania Coal Company vs. Mahon* (260 U.S. 393, 413)]. Mr. Brecciaroli's argument, insofar as it relates to the constitutionality of the statutes involved is therefore rejected.

It is reasonable and in accord with the law of Connecticut that this appellant be allowed some feasible and practical use of his property [*Bartlett vs. Zoning Commission*, 161 Conn. 24, 31]. Nevertheless, the fact that the specific exercise of the police power prevents the enjoyment of certain of the appellant's rights in his property without providing compensation therefore does not necessarily constitute a taking without just compensation [*Triano vs. Zoning Commission*, 155 Conn. 265, 267; *Teuscher vs. Zoning Board of Appeals*, 154 Conn. 650, 657].

The test of a constitutional exercise of the police power must be determined in light of the circumstances shown to exist in the particular case [*Courthouts vs. Newington*, 140 Conn. 284, 289], and the ultimate question here is, was the Commissioner's action in denying this application so unreasonable and confiscatory as to amount for all practical purposes to a taking of the plaintiff's property for a public use without just compensation? [*Dooley vs. Town Planning & Zoning Commission*, 151 Conn. 304, 309].

In the court's opinion, the Commissioner's action did not amount to a Taking in the sense referred to in the *Bartlett* decision. Every legislative restriction of an owner's use of his property represents some loss of his total dominion over it. The court does not interpret the Commissioner's decision as holding that this appellant is precluded from filling any part of his wetland, only that the portion requested is too great in light of the declared legislative policy for these areas. Clearly, if the Commissioner refuses to allow the appellant to fill any of this wetland, a total Taking in the *Bartlett* sense would occur and the State would be required to compensate the property owner.

In an appeal of this kind, this court (Common Pleas) is limited to a review based upon the certified record of the proceedings of the Commissioner, and the legality, reasonableness and propriety of his action [qv. Sect. 22a-34, Gen. Stat.]; and

if it is fully supported by the record and he has not acted arbitrarily, unreasonably or contrary to law, his action must be upheld [*Thompson vs. Water Resources Commission*, 159 Conn. 82, 87].

It would appear from this record that the Commissioner's action was fully supported by a permissible and reasonable view of the evidence presented to him. A study of the evidence shows that a reasonable portion of the appellant's property can be made economically useful by the filling of a lesser portion of the wetland area. A permit allowing this would give the appellant at least three and possibly four usable industrial lots. In respect to rip-rapping* any fill, providing for pollution protection, and any other reasonable requirements needed to protect the public interest, the commissioner, under Sect. 32a-33 has ample authority to carry out his mandate.

After an examination of these proceedings, and of the applicable law, the court finds the commissioner's denial of the appellant's application for this permit to be legal, proper and reasonable, then this appeal is denied.

Again, it seems clear that the Court has recited the Holmes test of 'how far does the regulation go' and decided on whether or not the landowner is limited to public use of his private land.

Other States. The courts of other states have been more direct in dealing with the taking issue. *Turnpike Realty vs. Town of Dedham*, [284, M. E. 2d 891 (Mass. 1972)] is a case in point. The Turnpike Realty Company owned 70 acres of land in the Town of Dedham, Massachusetts, all but 3.4 acres of which were low swampy ground. A town ordinance had established a flood plain district which included this land. It restricted land uses here to those allowed by permit. However, these were fairly wide-ranging uses only. The stated purpose of this ordinance was to protect the public health and safety, prevent future expenses and to conserve open spaces. It was held that since the ordinance was primarily to prevent a public harm an incidental public benefit is permitted. This was so even through an 88% diminution of value was acknowledged!

In the case *Morris County Land Co. vs. Parsippany-Troy Hills* [193 A2nd 232 (1963)] a large swamp of 1500 or more acres known as the Troy Meadows was located mostly on the northeasterly

*A broken stone surface that protects an embankment from erosion.

corner of the Parsippany-Troy Hills, and was a remaining part of what was once Lake Passaic. The plaintiff's property was 66 acres in the lower corner of the meadows. Plaintiff applied for permission to fill his land for an exception to local zoning regulations. These regulations restricted uses of the land, consistent with conservation management.

The New Jersey Supreme Court reversed the lower court conclusion that the local zoning regulation was a reasonable exercise of their power to zone. It held that it was a Taking because the regulation was an excessive abuse of the town's police power. The Court stated:

1) "While the issue of regulation as against Taking is always a matter of degree, there can be no question but that the line has been crossed where the purpose and effect of the regulation is to appropriate private property for a flood water detention basin or open space. These are laudable public purposes and we do not doubt the highmindedness of their motivation. But such factors cannot cure basic unconstitutionality."

2) "Private property may not be taken for public use without just compensation. A zoning ordinance which so restricts use that land cannot practically be utilized for any reasonable purpose, or where the only permitted uses are those to which the property is not adapted or which are economically unfeasible, is ordinarily confiscatory and beyond police power and statutory authorization."

Candlestick Properties, Inc. vs. San Francisco Bay Conservation and Development Commission [Cal. App. 2d, 89 Cal. Rptr. 897 (1972)]. Candlestick Properties bought a parcel of land which was submerged by high-tide waters of the bay with no idea of depositing fill from construction projects. Candlestick alleged that the land had no value for any other purpose. Candlestick was denied a fill permit from the Commission and sought damages for an alleged Taking of its property.

"In short, the police power, as such, is not confined within the narrow circumspection of precedents, resting upon past conditions which do not cover and control present-day conditions...that is to say, as a commonwealth develops politically, economically, and socially, the police power likewise develops, within reason, to meet the changed and changing conditions."

The Court set forth its distinction between the police power and eminent domain:

"However, under the police power, property is not taken for use by the public; its use by private persons is regulated or prohibited where necessary for the public welfare."

The Court conceded the plaintiff's argument that an undue restriction on the use of private property would be as much a taking as appropriating it or destroying it, citing *Pennsylvania Coal Company vs. Mahon*. But the Court expressly found that case inapplicable to the facts before it:

"It cannot be said that refusing to allow [the] appellant to fill its bay land amounts to an undue restriction on its use. In view of the necessity for controlling the filling of the bay....it is clear that the restriction imposed does not go beyond proper regulation, such that the restriction would be referable to the power of eminent domain rather than the police power."

And from Maine, *In the Matter of Spring Valley Development* [300 A. 2d 736 (Me. 1973)] we have the following pronouncement:

"It seems self-evident in these times of increased awareness of the relationship of the environment to human health and welfare that the state may act -- if it acts properly -- to conserve the quality of air, soil and water. To do so the State may justifiably limit the use which some owners may make of their property. We consider it indisputable that the limitation of use of property for the purpose of preserving from unreasonable destruction the quality of air, soil and water for the protection of the public health and welfare is within the police power."

In so holding, the Court emphasized, not the degree of injury with which Holmes had been concerned but the difference between regulation under the police power.

Across the United States courts have generally struck down cases which enrich the government in its proprietary capacity at the expense of an individual landowner. If the government seeks to use its regulatory power to reduce its costs of acquiring land the courts generally disapprove.

The 1970's. In the case of *Zabel vs. Tabb* [430 F 2d 199 (1970)] Chief Judge Brown of the 5th Circuit Court of Appeals used the following language: "We hold that nothing in the statutory structure compels [the government] to close its eyes to all that others see or think they see. The establishment was entitled, if not required, to consider ecological factors and, being persuaded by them, to deny that which might have been routinely granted five, ten or fifteen years ago before man's explosive increase made all, including Congress, aware of civilization's potential destruction from breathing its own polluted air and drinking its own polluted water and the immeasurable loss from a *Silent Spring*-like disturbance of nature's economy."

The Direction of the 70's. In the short period since 1970, Connecticut courts have handed down a large number of cases, virtually all favoring regulation and many seeming to ignore *Pennsylvania Coal*. Rather than survey all these court decisions, I will let one of the most eloquent speak for all:

The State of Wisconsin and County of Marinette passed a statute and an ordinance, respectively, which restricted the use of shoreline land. A Mr. and Mrs. Just wanted to fill their shoreline property and began to do so. The Wisconsin Supreme Court held that the shoreline zoning ordinance of Marinette County, with the exception of special permit situations, prohibits changing of the natural character of lands within 1,000 feet of a navigable lake and 300 feet of a navigable river. (This is so because regulation of land with contiguous water is not unconstitutional by reason of being confiscatory or unreasonable [*Just vs. Marinette County*, 201 N.W. 2d 761 (1972)]). The Court began by describing the traditional test of the Taking clause: "The distinction between exercise of police power and condemnation has been said to be a matter of degree of damage to the property owner. In the valid exercise of the police power [as] reasonably restricting the use of property, the damage suffered by the owner is said to be incidental; however, where the restriction is so great the landowner ought not to bear such a burden for the public good, the restriction has been held to be a constructive Taking even though the actual use or forbidden use has not been transferred to the government so as to be a Taking in the traditional sense." (9)

The Court then quoted Professor Ernst Freund's classic analysis that "the state takes property [to] be eminent domain because it is useful to the public, and under the police power because it is harmful...." (10) Thus if the proposed use of the land would cause "public harm," says the Court, no

compensation need be paid. On the other hand, if the regulation were designated to produce a public benefit it would be beyond the scope of the police power. (Although not cited, the Court's opinion follows closely the framework of analysis by Justice Brandeis in his dissenting opinion in *Pennsylvania Coal Company vs. Mahon*.)

The Court noted that Wisconsin's lakes and rivers were originally clean, and said that the State has an obligation in the nature of a public trust to "eradicate the present pollution and to prevent further pollution." It found that the regulation ought to prevent harm to "the natural *status quo* of the environment," and was not designed to produce benefit for which compensation would be required.

The Court went on to emphasize that lands "adjacent to or near navigable waters exist in a special relationship to the State."

"What makes this case different from most condemnation or police power zoning cases is the interrelationship of the wetlands, the swamps and the natural environment of shorelands to the purity of the water and to such natural resources as navigation, fishing, and scenic beauty. Swamps and wetlands were once considered wasteland, undesirable and not picturesque. But as the people became more sophisticated, an appreciation was acquired that swamps and wetlands serve a vital role in nature, are part of the balance of nature, and are essential to the purity of the water in our lakes and streams. Swamps and wetlands are a necessary part of the ecological creation and now, even to the uninitiated, possess their own beauty in nature." (11)

As a result, the Court continued, man can no longer do with his land as he likes - in fact, public rights can be protected by means of the police power even if it means private lands are restricted to their "natural" uses.

"The changing of wetlands and swamps to the damage of the general public, but upsetting the natural environment and their natural relationships is not a reasonable use of that land which is protected from police power regulation." (12)

Elaborating on this natural use concept, and focusing on the broad public purpose to preserve the natural condition of the area, the Court held:

"It seems to us that filling a swamp not otherwise commercially usable is not in and

of itself an existing use, which is prevented, but rather is the preparation for some future use which is not indigenous to a swamp. Too much stress is laid on the right of an owner to change commercially valueless land when that change does damage to the rights of the public." (13)

"The Justs argued their property has been severely depreciated in value. But this depreciation of value is not based on the use of the land in its natural state but on what the land would be worth if it could be filled and used for the location of a dwelling. While loss of value is to be considered in determining whether a restriction is a constructive Taking, value based upon changing the character of the land at the expense of harm to public rights is not an essential factor or controlling."

The Marinette Court commented on the case of *Pennsylvania Coal vs. Mahon*. Focusing on that portion of Holmes' opinion that warns of the "danger of forgetting that a strong public desire to improve the public condition is not enough to warrant achieving the desire by a shorter cut than the constitutional way of paying for the change," the Court attempted to distinguish the case;

"The observation refers to the improvement of the public condition, the securing of a benefit not presently enjoyed and to which the public is not entitled. The shoreland zoning ordinance preserves nature, the environment, and natural resources as they were created and to which the people have a present right. The ordinance does not create or improve the public condition but only preserves nature from the despoliation and harm resulting from the unrestricted activities of humans." (14)

Effect on Connecticut's Act. The effect of the Taking issue on the Connecticut Inland Wetlands and Watercourses Act should be minimal. It should have the effect of compelling local agencies to remain within the bounds of reason when deciding cases. But it is unlikely that a court will find the act unconstitutional.

There are three major reasons. First, it has been argued, and I would argue, that Holmes was wrong, that he ignored precedent, that he seized an issue that he had been itching to write about and imposed his own personal philosophy on the course of Anglo-American jurisprudence.

Secondly, courts in other states such as Wisconsin and Massachusetts have taken bold steps away from the *Pennsylvania Coal Case*. Bad cases are sometimes overruled. This is dramatic but statistically unusual. Most bad cases fade into disuse; they die a lonely death. This may be occurring to the *Pennsylvania Coal Case*.

Thirdly, the Connecticut Inland Wetlands act is designed with a "remand" provision should, on appeal, a court find that a local agency has acted imprudently. The purpose of the act is clearly stated and its public health and safety goals are clearly set forth. The act was drafted to prevent harm, not to acquire land.

This places, however, a burden on the local agencies charged with administration of the act. They must be careful to regulate within the purposes of the act. They must be sure that their findings and rulings are supported by the record established at the hearing, just as in zoning cases. The Department of Environmental Protection and other agencies have provided a great deal of information. It must be used.

Conclusion. America now stands at a similar point in her history with regard to environmental legislation as it stood with regard to social legislation at the time of U. S. Supreme Court Justice Louis Brandeis. Our knowledge of the social, economic and environmental relationships of various uses of land has become increasingly sophisticated and complex, but unless this knowledge is brought to the attention of the courts and legislatures they will make decisions on the basis of outmoded concepts dating from a simpler age. Does a proposed development look like other developments in the area? Does it have any resemblance to the types of land use that have been considered to be "nuisances" since the earliest days of the common law? These traditional tests seem horridly inadequate to resolve complex ecological questions. But unless the courts are presented with sound factual evidence supporting the need for land use regulation, it is these ancient tests that are likely to prevail. Fewer and fewer cases are likely to be decided by emotional appeals to the myth of the Taking clause. More and more are going to depend on highly complex factual issues that may involve a number of

scientific disciplines. The side which best masters the facts will succeed. In recapitulation:

A) The Connecticut Inland Wetlands Act raises the question of the *Taking Issue*.

B) The *fear* of the Taking clause is a more serious problem than actual court decisions.

C) There is little historical basis for the idea that regulation can constitute a Taking.

D) The most recent cases are strong tools and generate momentum for strong regulations.

The Taking Clause of the
United States Constitution and the
Connecticut Inland Wetlands and Watercourses Act

by

David B. Losee

EDITORIAL COMMENTARY

by

Clifford Davis*

The growing legislative concern with the protection of our environment, witnessed by the growing number of states enacting wetlands legislation, (15) has led to an exponential explosion of related legal research and writing. (16) Many of these writings, however, are so lengthy or specialized that they are known only within narrow circles. One such work is the 1973 volume written for the Council on Environmental Quality by Messers. F. Bosselman, D. Callies and J. Banta, entitled *The Taking Issue - An Analysis of Constitutional Limits of Land Use Control*. Its exhaustive treatment of the central legal issue in land use legislation makes it a uniquely valuable resource for everyone concerned with legislation such as the Connecticut Inland Wetlands Act. Its very strengths, however, make it less accessible. In his article, Mr. Losee has performed a valuable service by summarizing this treatment, and adding recent Connecticut citations such as *Brecciaroli v. Lufkin*. (17) The publication of Mr. Losee's paper by the Conference brings to those in other disciplines a quick view of the legal history of the ultimate legal question: How has the line been drawn between valid regulations and takings?

The signal contribution of Mr. Losee's paper and the Conference is that such publications should help persons in other disciplines become aware of the legal background. When this happens, non-law inputs can be magnified through interaction with the legal concepts. This possibility of interaction suggests a caveat about this treatment. Its emphasis is on legal history. It does not consider the interaction of law, and, for example, general history or economics.

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The functions of history are enjoying what may be profitable self-analysis at the hands of such authors as J.H. Hexter (18), and the economics of resource management has been explored by authors such as Ciracy-Wanthurp (19). Perhaps history and economics can give us help in appraising the effect of the interdependence of resources such as land and, especially, some way to appraise the effect of abundance and scarcity on the extent of valid governmental regulation of resources such as wetlands. It is possible that the permissible extent of governmental regulation may expand in periods of scarcity. We need to know more about this possibility, and what other disciplines can tell lawyers. The publication of this piece increases the interaction of law and other disciplines, and invites a fuller consideration of the legal aspects by non-lawyers.

David B. Losee

Explanation of Legal References. A case name, for example *Just vs. Marinette County*, followed by a number-letter sequence such as 56 Wis. 2d 7, 201 N.W. 2d 761 (1972), is the proper citation for a case decided by a court. It is decipherable as follows: Whereas the Justs were perhaps named Ernest and Jane and the full name of the case may have been "Ernest and Jane Just vs. Marinette County, Wisconsin Board of Water Resources," the *official name* assigned to the case by the court in its official text or its decision by which name the case is to be known thereafter, is *Just vs. Marinette County*; hence the *underline*. The first set of numbers and letters, 56 Wis. 7, reads, "Volume 56 of the Wisconsin Reports, page 7." Page 7 is the page on which *Just vs. Marinette County* begins. As this is the official report, edited and authorized by the court, it follows immediately after the official name of the case. The second group of numbers and letters refer to an *unofficial* set of volumes reporting the same case, here, 201 N.W. 2d 761. This is Volume 201 of the *Northwestern Reporter*, Second Series, page 761. Such unofficial reporters are produced by national publishing houses and operate on a "Key Number" system keyed to points of law. This system allows a researcher to trace a point of law from a Wisconsin case such as *Just vs. Marinette County* to Connecticut cases on the same point by finding the proper "Key Number" in the *Atlantic Reporter*, an unofficial reporter by the same publisher as the *Northwestern Reporter*, covering the Eastern or "Atlantic" region. Finally, the date at the end of a case is the year in which the decision is *rendered* (often quite different than the year in which the litigation arose). There may be three or more volumes cited after the name of the case. All are unofficial except for the first one cited.

1. *Respublica vs. Sparhawk*, 1 Dall. 357 (S. Court. Penn. 1788), page 362.
2. Oscar and Mary Handlin, *The Popular Services of Political Authority*, page 336.
3. *Pennsylvania Coal Co. vs. Mahon*, 260 U. S. 393 (1922), page 413.
4. *Ibid.*
5. 6 Am. L. Rev. 141-142.

6. *Rideout vs. Knox*, 148 Mass. 363 (1889), page 372.
 7. Van Alstyne, *Taking or Damaging by Police Power: The Search for Inverse Condemnation Criteria*, 44 So. Cal. L. Rev. 1, 39 (1971).
 8. 153 A2d., 825.
 10. E. Freund, *The Police Power*, 546 (1905).
 11. 201 N. W. 2d., 769.
 12. 201 N. W. 2d., 768.
 13. 201 N. W. 2d., 770.
 14. 201 N. W. 2d., 771.
- Clifford B. Davis:
15. Conn. Gen. Stat. Ann. Sects. 22a-28 to 22a-35 (Supp. 1972) (tidal wetlands) and Sects. 22a-36 to 22a-45 (Supp. 1972) (inland wetlands); Del. Code Ann. tit. 7, Sect. 7001 (Supp. 1972); Ga. Code Ann. Sect. 45-136 to 45-147 (Supp. 1972); Me. Rev. Stat. Ann. tit. 12 Sects. 4701-09 (Supp. 1972); Md. Ann. Code art. 66, Sects. 718-730 (Supp. 1972); Mass. Gen. Laws Ann., ch. 130, Sects. 22-27 (Supp. 1971) repealed and amended C. 789, Sect. 1-6 (1972) (pollution of tidal wetlands); Minn. Stat., Sect. 105.485 (Supp. 1973); N. H. Rev. Stat. Ann., Sect. 483-A:1 to A:5 (Supp. 1972); N. C. Gen. Stat. Sect. 113-229, 230 (Supp. 1971); R. I. Gen. Laws Ann., Sect. 2-1-13 to 2-1-17 (Supp. 1972); Va. Code Ann. Sect. 62.1-13.1 (Supp. 1972); Wis. Stat. Ann., Sect. 59.971, 144.26 (Supp. 1973).
 16. Discussion of particular state acts: Note, *Legislation - The Delaware Coastal Zone Act*, 21 Buffalo L. Rev. 481 (1972); Note, *Regulation and Ownership of the Marshlands: The Georgia Marshlands Act*, 5 Ga. L. Rev. 563 (1971); Note, *Land Use Management in Delaware Coastal Zone*, 6 U. Mich. J. of L. Reform 251 (1972); Abbott, *Some Legal Problems Involved in Saving Georgia's Marshlands*, 7 Ga. St. B. J. 27 (1970); Clineburg and Krahmer, *Law Pertaining to Estuarine Lands in South Carolina*, 23 S. C. L. Rev. 7 (1971); Raci, *Estuarine Land of North Carolina: Legal Aspects of Ownership, Use and Control*, 46 N. C. L. Rev. 779 (1968); Wood, *Wisconsin's Requirements for Shoreland and Floodplain Protection*, 10 Nat. Res. J. 327 (1970). Discussion of the role of counsel: *State vs. Johnson*, Me., 265

A. 2d 711 (1970), 46 A.L.R.3d 1414 (1972); Halperin, Conservation, Policy and the Role of Counsel, 23 Me. L. Rev. 119 (1971); Wilkes, Constitutional Dilemmas Posed by State Policies against Marine Pollution - The Maine Example, 23 Me. L. Rev. 143 (1971); Note, Maryland's Wetlands: The Legal Quagmire, 30 Md. L. Rev. 240 (1970); Walker and Cox, Virginia Water Policy: The Imprecise Mandate, 14 Wm. & Mary L. Rev. 312 (1972).

Also: Anno: Conservation: Validity, Construction, and Application of Enactments Restricting Land Development by Dredging or Filling, 46 A.L.R.3d 1422; Note, The Wetlands Statutes: Regulation or Taking?, 5 Conn. L. Rev. 64 (1972); Note, Coastal Wetlands in New England, 52 Boston U. L. Rev. 724 (1972); Note, State and Local Wetlands Regulation: The Problem of Taking without Just Compensation, 58 Va. L. Rev. 876 (1972); Note, The Public Trust in Tidal Areas: A Sometimes Submerged Traditional Doctrine, 79 Yale L. J. 762 (1970); Comment, Coastal Land Use Development: A Proposal for Cumulative Area-Wide Zoning, 49 N. C. L. Rev. 866 (1971); Heath, Estuarine Conservation Legislation in the States, 5 Land and Water L. Rev. 351 (1970); Shoenbaum, Public Rights and Coastal Zone Management, 51 N. C. L. Rev. 1 (1972); Sax, The Public Trust Doctrine in Natural Resources Law: Effective Judicial Intervention, 69 Mich. L. Rev. 471 (1968); Teclaff, The Coastal Zone - Control over Encroachments into the Tidewaters, 1 J. of Maritime Law and Commerce 241 (1970); and Grad, *Environmental Law*, Mathew Bender 1971. See also *Report of the National Water Commission, Coastal Zones and Estuaries*, pp. 28-32.

Cf. Sax, Takings and the Police Power, 74 Yale L. J. 36 (1964) and Sax, Takings, Private Property and Public Rights, 81 Yale L. J. 149 (1971); Michelman, Property, Utility, and Fairness: Comments on the Ethical Foundations of "Just Compensation" Law, 80 Harv. L. Rev. 1165 (1967).

17. Common Pleas, Hartford Co., Dec. 17, 1973 Docket #107154.

18. Q. V. J. H. Hexter, *The History Primer*. Basic Books, N. Y., 1971.

19. Ciriacy-Wantrup, *Resource Conservation Economics and Policies* (U. of California Press, 1952).

[Based on material prepared for Volume Seven, *Waters and Water Rights* (R. Clark ed.), published by the Allen Smith Company Indianapolis, Indiana 46202. - C. B. Davis]

THE DEPARTMENT OF ENVIRONMENTAL PROTECTION'S

INLAND WETLANDS RESPONSIBILITIES:

SUMMARY OF OPENING REMARKS

by

Theodore B. Bampton*

The Inland Wetlands and Watercourses Act. The Act concerning Inland Wetlands and Watercourses**, Public Act 155, was passed in 1972. The Connecticut State Department of Environmental Protection (DEP) is generally charged with the supervision of administration and enforcement of this Act, which recognized the need to protect inland wetlands and watercourses from unnecessary and undesirable uses. The key phrase which should be stressed is: "from unnecessary and undesirable uses". The Act emphasizes regulation by the State's towns, with the State acting in cases where the towns default on the responsibilities for regulating their wetlands and watercourses. This first measure, the Inland Wetlands Act, was amended the following year by Public Act 73-571 in order to remove some of the more obvious problems. To some extent it did; however, from DEP's viewpoint, the amendment further delayed the time that the Department is to assume regulation of inland wetlands areas in the event that the towns defaulted. If a town has not promulgated the necessary regulations for protection of the inland wetlands within its boundaries, the DEP may take over this task as of 1 January 1974. As a practical matter, the DEP is not in a position to do so now [Jan. 1974] and shall not only act in cases which are absolutely and unquestionably major and which might have a significant environmental impact on the State's inland wetlands. It is mandatory that DEP take

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** Full Text of this legislation is given in the Appendix to the First Wetlands Conference Proceedings, IWR Report No. 21 - Institute of Water Resources, University of Connecticut, Storrs, Connecticut 06268.

over the regulation of inland wetlands and watercourses as of 1 July 1974 in the event that the towns have not assumed this responsibility.

The Inland Wetlands and Watercourses Act indicates that the delineation of wetlands is to be based on soil types, consisting of the soil classes of poorly drained, very poorly drained, alluvial and flood plain as defined by the National Cooperative Soils Service of the United States Department of Agriculture. Watercourses, a completely different thing, are defined as rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs and other bodies of water, both natural and artificial. Each town was authorized, through its local boards of commissions, to appoint a body to promulgate regulations to protect their inland wetlands in conformance with regulations established by the State.

Problems and Progress. At this point, what is the progress and what are some of the problems and concerns? First, a very large land area is involved. The present law encompasses somewhere between 20 - 25% of the total land area of the State of Connecticut, or some 800,000 acres. Some towns, such as the Town of Suffield, have as much as 50% of their land area in legally qualified wetlands. Second, there are several levels of apprehension as to intentions. As one might imagine, the State and its agent, the DEP, are suspect in the eyes of the towns and the towns are suspect in the eyes of their individual landowners, so we immediately have a basis for disagreements. Third, the true roles of the towns are not fully recognized by the towns. Many of them seem to feel that somehow the State will "bail them out", or that DEP is going to mediate their disputes and be the Great White Father to them -- this is not the case. When the towns finally take on their regulatory responsibilities, those responsibilities shall be theirs and solely theirs. The State is merely going to oversee the entire program, and should not try to do the job of wetlands regulation for the towns.

DEP has finally prepared regulations after a long series of public hearings and virtually continuous revision. These regulations were sent to the Legislature's Regulations Review Committee on 18 December 1973. That body had 60 days in which to make a decision on the proposed regulations. Further, these regulations contain a "grandfather clause" for those towns which enacted regulations prior to the official adoption of the State regulations. Therefore, if a town has a set of regulations which have been approved, these can remain valid.

Based on some figures of 7 January 1974, I believe that the Towns in Connecticut may not be fully recognizing their responsibilities. This is a sort of status report. There are 169 towns in Connecticut, and 91 have designated some local board

or commission to regulate inland wetlands and watercourses.* This leaves 78 without regulating agencies. Of the 91, only 13 have accepted approved regulations. Twenty-six additional towns of the 91 are working on their regulations. Another 26 towns are at least working on some aspect of the problem. As of this meeting, at best we could have 130 towns in which the wetlands shall not have been regulated by July 1 1974, and at worst 156. Somewhere in these statistics I believe that as of July 1, 1974, the State of Connecticut shall have to act on behalf of 80-100 towns.

The last thing to be mentioned is that there are still problems in the laws governing the regulation of inland wetlands. One of the concerns voiced by many people in many disciplines is the delineation of the inland wetlands. How is this done? How can this best be done? Each discipline seems to have its own preferred course of action. Who is right? One of the purposes of this conference is to evaluate the techniques which are available to us for delineating wetlands, and to perhaps arrive at some conclusions as to which may be the best method. The DEP is not biased in this matter and your thinking should not be warped in any way by the fact that we have a law which says that inland wetlands delineation shall be done by soil types. If the ecologically concerned community can convince DEP that these delineations should be done by some other means, I think DEP will be willing to recommend necessary changes in the law to the Legislature for action. The DEP does not plan to recommend any legal changes in the wetlands laws during the 1974 Session of the General Assembly, however.

* As this goes to press, 136 towns have established a regulating agency. - Eds.

APPENDICES

EQUIVALENTS OF SCIENTIFIC AND COMMON NAMES*

(In text order)

Lindo J. Bartelli:

Wild Rice	<i>Zizania aquatica</i> L. (Gramineae)
Cattails	<i>Typha latifolia</i> L.; <i>T. angustifolia</i> L. (Typhaceae)
Sawgrass	<i>Cladium jamaicense</i> Crantz (Cyperaceae)
Long-leaf Pine	<i>Pinus palustris</i> Mill. (Pinaceae)
Slash Pine	<i>P. elliottii</i> Engelm. (")
Pond Pine	<i>P. serotina</i> Michx. (")
Sweet Bay	<i>Magnolia virginiana</i> (Magnoliaceae)
Red Bay	<i>Persea borbonia</i> (L.) Spreng. (Lauraceae)
Smilax	<i>Smilax</i> spp. (Liliaceae); Greenbriar, Catbriar

Virginia Carter:

White Cedar; Atlantic W. C.	<i>Chamaecyparis thyoides</i> (L.) BSP. (Cupressaceae)
Cypress	<i>Taxodium distichum</i> (L.) Rich.; <i>T. ascendens</i> Brogn. (Taxodiaceae)
Gum	<i>Nyssa sylvatica</i> Marsh.; <i>N. aquatica</i> L. (Nyssaceae)
Maple	<i>Acer rubrum</i> L. (Aceraceae); Red Maple
Pine	<i>Pinus</i> spp. (Pinaceae)

* *fide* Radford, A. E., H. E. Ahles, & C. R. Bell, Manual of the Vascular Flora of the Carolinas. Univ. N. Carol. Press, Chapel Hill 1968.

Ilex	<i>Ilex</i> spp.; native Hollies
Pond Pine	<i>Pinus serotina</i> Michx. (Pinaceae)
Water Oak	<i>Quercus nigra</i> L. (Fagaceae)
Bay	<i>Magnolia</i> spp. (Magnoliaceae)
Yellow poplar	<i>Liriodendron tulipifera</i> L. (Magnoliaceae)
Beech	<i>Fagus grandifolia</i> Ehrhart (Fagaceae)
Cane	<i>Arundinaria gigantea</i> (Walter) Muhl. (Gramineae)
Honeysuckle	<i>Lonicera</i> spp. (Caprifoliaceae)
Bulrushes	<i>Scirpus</i> spp. (Cyperaceae)
Sourwood	<i>Oxydendrum arboreum</i> (L.) DC. (Ericaceae)
Persimmon	<i>Diospyros virginiana</i> L. (Ebenaceae)
<i>Spartina alterniflora</i>	Saltwater cord grass (Gramineae)
<i>S. patens</i>	Salt meadow grass (")
<i>S. cynosuroides</i>	Tall cord grass (")
<i>Juncus roemerianus</i>	Rush; Black grass (Juncaceae)
<i>Typha</i> spp.	Cattails (Typhaceae)

UNITED STATES NATIONAL MAP ACCURACY STANDARDS

With a view to the utmost economy and expedition in producing maps which fulfill not only the broad needs for standard or principal maps, but also the reasonable particular needs of individual agencies, standards of accuracy for published maps are defined as follows:

1. Horizontal accuracy-for maps on publication scales larger than 1:20,000, not more than 10 percent of the points tested shall be in error by more than 1/30 inch, measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, 1/50 inch. These limits of accuracy shall apply in all cases to positions of well-defined points only. "Well-defined" points are those that are easily visible or recoverable on the ground, such as the following: monuments or markers, such as bench marks, property boundary monuments; intersections of roads, railroads, etc.; corners of large buildings or structures (or center points of small buildings); etc. In general what is "well-defined" will also be determined by what is plottable on the scale of the map within 1/100 inch. Thus while the intersection of two roads or property lines meeting at right angles would come within a sensible interpretation, identification of the intersection of such lines meeting at an acute angle would obviously not be practicable within 1/100 inch. Similarly, features not identifiable upon the ground within close limits are not to be considered as test points within the limits quoted, even though their positions may be scaled closely upon the map. In this class would come timber lines, soil boundaries, etc., etc.
2. Vertical accuracy, as applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming horizontal displacement within the permissible horizontal error for a map of that scale.
3. The accuracy of any map may be tested by comparing the positions of points whose locations or elevations are shown upon it with corresponding positions as determined

by surveys of a higher accuracy. Tests shall be made by the producing agency, which shall also determine which of its maps are to be tested, and the extent of such testing.

4. Published maps meeting these accuracy requirements shall note this fact in their legends, as follows: "This map complies with the national standard map accuracy requirements." *
5. Published maps whose errors exceed those aforesated shall omit from their legends all mention of standard accuracy.
6. When a published map is a considerable enlargement of a map drawing ("manuscript") or of a published map, that fact shall be stated in the legend. For example, "This map is an enlargement of a 1:20,000-scale map drawing," or "This map is an enlargement of a 1:24,000-scale published map."
7. To facilitate ready interchange and use of basic information for map construction among all Federal mapmaking agencies, manuscript maps and published maps, wherever economically feasible and consistent with the uses to which the map is to be put, shall conform to latitude and longitude boundaries, being 15 minutes of latitude and longitude, of 7-1/2 minutes, or 3-3/4 minutes in size.

* Wording of accuracy compliance statement reads "This map complies with national map accuracy standards" in revision of June 17, 1947.

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