ACKNOWLEDGMENT

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Method for Wetland Functional Assessment

DOUGLAS L. SMITH

ABSTRACT

State highway agencies and the FHWA are charged with the construction, operation, and maintenance of transportation facilities. These facilities may have impacts on wetland systems. To provide safe and efficient transportation facilities while protecting wetlands it is necessary to determine the functions a specific wetland may perform and what the impact of a facility on the wetland may be. Until now there has not been any one method for assessing all of the potential functional values of a wetland. A new assessment method developed by the FHWA considers the functions of groundwater recharge and discharge, flood storage and desynchronization, shoreline anchoring, food chain support, fish and wildlife habitat, and recreation. The FHWA method is a flexible qualitative screening process that uses the U.S. Fish and Wildlife Service (FWS) wetland classification system. The method uses three types of analyses: the threshold analysis evaluates a wetland's relative functional values, the comparative analysis compares the relative values of two or more wetlands, and the mitigative analysis compares the relative costs and benefits of mitigative features. The FHWA method, completed in March 1983, is available to state highway agencies and others concerned with impacts on wetland systems. Instructions on the use of the method are provided through a training course developed for highway agencies by FHWA.

Before initiating any new construction involving wetlands, highway agencies are required by federal and state regulations to consider how their actions may affect the wetlands. Agencies need to consider the values attributed to the wetland, how it compares with other wetlands, and how any impacts will be mitigated.

PROBLEM

Highway agencies are mandated to provide safe and efficient transportation systems, but these agencies are also charged with protecting wetland resources. Executive Order 11990, Section 1(a) (1), states that each federal agency "shall provide leadership and shall take action to minimize the destruction, loss, or degredation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities." The executive order also requires agencies to avoid undertaking, or providing assistance for,

new construction in wetlands unless there is no practicable alternative and that any construction undertaken shall include all practicable measures to minimize harm to the wetland. In making decisions, an agency may take into account economic, environmental, and other pertinent factors [Section 2(a)].

Until recently, wetlands were viewed as unproductive wastelands, sources of mosquitoes, and impediments to development and travel. By the mid-1950s, almost 40 percent of our nation's wetlands had been lost to drainage, fill, and construction (2). In the mid-1950s there were 43.8 million hectares of wetlands. By the mid-1970s there were 40.1 million hectares (3). By the late 1960s and early 1970s the perception of wetlands began to change as more was learned about their importance. Since 1969 there have been a number of federal and state laws and regulations that mandate the protection of wetlands (Table 1).

The problem that now faces the FHWA and the states is how to comply with these regulations and still fulfill the charge of providing safe and efficient transportation at a reasonable cost. States need a method to determine

1. The value of a wetland,
2. The significance of any impact, and
3. How to mitigate impacts or find practicable alternatives.

FHWA policy on Mitigation of Environmental Impacts to Privately Owned Wetlands (4) states that the extent of federal-aid participation in mitigating adverse impacts should be related to the importance of the wetland and the significance of the impact. Evaluation of the importance of the wetland should consider the primary functions of the wetland, the relative importance of these functions to the total wetland resources of the region, and other factors such as uniqueness and aesthetics (Section 777.7). Until the development of the FHWA method for wetland functional assessment (5,6) there was no systematic method of evaluating the importance of a wetland or determining whether mitigation is warrented and, if so, to what extent.

WETLANDS RESEARCH PROGRAMS

To assist states and provide the information they need, FHWA initiated its wetlands research program in 1976. One of the first products of the FHWA research and development program was the development of interim guidelines for construction through wetlands (7-9). These guidelines were intended as an interim measure to aid states until more specific information on highway impacts on wetlands could be obtained.

The FHWA also initiated research on the values of tidal flats (10-12). Wetland protection has usually focused on emergent systems often at the expense of tidal flats. Highways have been rerouted through flats to avoid other systems, or tidal flat elevations have been raised and the area planted with emergents to create marsh systems as mitigation. When this has been done, it has been without full understanding of the values being lost. The tidal flats research has provided some of this needed understanding.

In addition to the FHWA research program, studies are being conducted by state highway agencies and through the National Cooperative Highway Research Program. These studies address topics such as the effects on wetlands of highway fills, end-on construction, and highway runoff; and the development of methods for the creation and restoration of wetlands. These research efforts are coordinated by FHWA.

All of this information on wetlands has been incorporated in a wetlands training course for state highway personnel. Almost half of the course is devoted, however, to instruction on the use of the newly developed FHWA method for wetland functional assessment. This is the subject of the remainder of this paper.

APPROACH

As was said before, the main problems facing the states are determining the values associated with a particular wetland and then translating this information into practical alternatives. The determination of values is most often accomplished through consultation with regulatory agencies such as the U.S. Fish and Wildlife Service (FWS) or the U.S. Army Corps of Engineers (Corps). Such determinations are frequently based on a subjective "expert" opinion about the wetland's value. Methods that consider only a limited number of functions, such as the FWS Habitat Evaluation Procedures, are also being used increasingly.

In developing its method, FHWA was looking for a procedure that would concisely and accurately determine functional values attributable to wetlands, be applicable for all wetland types, and use the FWS wetland classification system. These criteria were what was believed was needed to solve a real problem that faces not only highway agencies but everyone involved in wetland management and protection.

About the time FHWA began its work, the Water Resources Council (WRC) was sponsoring a study to evaluate wetland assessment methods. The work was conducted by the Corps. The FHWA used the Corps' work to avoid duplication of effort.

TABLE 1 Representative Federal Legislation and Regulations that Directly or Indirectly Provide Wetland Protection

	Citation
Legislation	
Transportation Act of 1966 [Section 4(f)]	49 U.S.C. Section 1653(f) 23 U.S.C. Section 138
National Environmental Policy Act of 1969	42 U.S.C. Sections 4321-4347
Clean Water Act as Amended (especially Section 404)	33 U.S.C. Sections 1251-1376, 1344
Fish and Wildlife Coordination Act	16 U.S.C. Sections 661-666
Water Bank Act	16 U.S.C. Sections 1301-1311
Endangered Species Act	16 U.S.C. Sections 1531-1543
Regulations and orders	
Protection of Wetlands	Executive Order 11990
Preservation of the Nation's Wetlands	U.S. Department of Transportation Regulation 5660.1A
Mitigation of Environmental Impacts to Privately Owned Wetlands	23 C.F.R. Section 777

The WRC study identified methods that assess wetland functional values. The merits and limitations of each method was identified and the results of the study were published by WRC (13). Table 2 gives the 20 methods reviewed in the study, plus the FHWA method, and one of the functions each considers. Table 3 gives some of the geographic features of each method. The basic approach taken by FHWA in developing the assessment method recognized that although there is a large amount of information lacking for certain functions, a lot is also known. Because of time and monetary constraints, it was decided that the study would rely on existing data to develop the method. The method has been field tested to a limited extent and is being used on highway projects in several states.

THE METHOD

The FHWA method is presented in a two-volume report (5,6). The method is a rapid assessment procedure for screening the functional values of wetlands. The functions covered are groundwater recharge, flood storage and desynchronization, shoreline anchoring and dissipation of erosive forces, sediment trapping, nutrient retention and removal, food chain support (detrital export), habitat for fish and wildlife, and active and passive recreation. The method can be used for all wetland types in the 48 coterminous states, and uses the FWS wetland classification system (14).

Other features of the method are that it is qualitative and results are not based on a series of scores; it can be used to evaluate the importance of a single wetland or compare two or more wetlands; it can be used to assist in selecting practicable mitigative alternatives; and it incorporates social as well as scientific factors into the overall assessment. Assessments can be made using three levels of data: data available in the office, data from cursory field visits, and detailed field data.

Volume I

Volume I is an important and major component of the overall method. In it are background material on the assumptions and decisions used in Volume II. In Volume I the validity of claims regarding the functions of wetlands is examined and what is actually known about each function is discussed. The trade-offs among wetland functions are also described. Conditions that are optimal for one function may not be so for another.

Wetland types are ranked according to their importance to various functions. These rankings are based on a synthesis of the literature and are qualified to reflect regional differences or the scarcity of support data. Cause-and-effect relationships that link potential changes in each wetland function to specific highway activities are identified. There is a discussion of the variable sensitivity of different wetland types to the impacts of construction.

A thorough understanding of the material in Volume I is important. It will enhance the value of the assessment and help ensure that management decisions based on an evaluation are practical and realistic.

Volume II

Volume II contains the assessment method. This method is made up of three separate procedures: threshold analysis (procedure I), comparative analysis (procedure II), and mitigative analysis (procedure III). The threshold analysis is used in all assessments using the method. The other two procedures are used if further assessment is desired.

The threshold analysis is used to estimate the relative functional value of a specific wetland. If more than one wetland is being assessed, the method is used to evaluate each wetland separately. Procedure I needs to be completed before procedure II or III is conducted. Procedure II is used after procedure I has been applied to compare, more closely, two or more wetlands.

A wetland's value, as reflected in procedures I and II, has three major components: opportunity, effectiveness, and significance. The result of the interaction of these is termed "functional significance." Opportunity is the chance a wetland stands of fulfilling a particular function. Effectiveness is the probability of a wetland being able to maxi-

TABLE 2 Functional Assessment Methods and Criteria Measured[a]

	Citerion				
Method	Habitat	Hydrology	Recreation	Agriculture/ Silviculture	Heritage
A. Brown et al., 1974	Yes	NA	NA	NA	NA
N. Dee et al., 1973	Yes, IT	Yes, IT	NA	Yes, IT	Yes, IT
E. Fried, 1974	Yes	NA	NA	NA	NA
G. E. Galloway, 1978	Yes, IT	Yes, IT	NA	NA	Yes, IT
F. C. Golet, 1973	Yes	NA	NA	NA	NA
T. R. Gupta and J. H. Foster, 1973	NA	NA	NA	NA	Yes (scenic)
H. V. Kibby, 1973	NA	Yes, WQ, PP	NA	NA	NA
J. S. Larson, Ed., 1976	Yes	Yes	NA	NA	Yes
Maryland Department of National Resources, undated	Yes	NA	NA	NA	NA
R. T. Reppert et al., 1979	Yes	Yes	PJ	PJ	PJ
P. W. Shuldiner et al., 1979	Yes	Yes	NA	NA	NA
Stearns, Conrad, and Schmidt, 1972	NA	Yes	NA	NA	NA
R. C. Smardon, 1972	NA	NA	Yes (rec. c.c.)	NA	NA
R. C. Solomon et al., 1977	Yes, IT	Yes, IT	Yes, IT	NA	Yes, IT
U.S. Army Corps of Engineers, 1980	Yes	NA	NA	NA	NA
U.S. Army Corps of Engineers, 1972	Yes, IT	Yes	Yes (day use)	Yes, IT	Yes, IT
U.S. Department of Agriculture, 1978	Yes	Yes (flood control)	Yes	Yes (forest management)	Yes
U.S. Fish and Wildlife Service, 1980 (HEP)	Yes	NA	NA	NA	NA
Virginia Institute of Marine Sciences, undated	Yes	NA	NA	NA	NA
B. H. Winchester and L. D. Harris, 1979	Yes	Yes	NA	NA	NA

Note: NA = not addressed, IT = interdisciplinary team, WQ = water quality, PP = primary productivity, PJ = professional judgment, and rec. c.c. = recreational carrying capacity.

[a]Adapted from Frayer et al. *(3)*.

TABLE 3 Summary of Geographic Features of 20 Wetland Evaluation Procedures and the FHWA Method [adapted from Lonard et al. *(13)*]

Citation	Inland[a]	Coastal[b]	Regional Application[c]	Widespread Application[d]	Use
A. Brown et al., 1974	Yes; a variety of inland wetland types	NA	Developed for wetlands in Arkansas	Must be modified for widespread application	Can be used to assess a single wetland site; can be used to rank similar or dissimilar wetland types
N. Dee et al., 1976	Used for water resource development projects on rivers or river systems; could be modified for wetlands	NA	Applicable	Applicable	More useful for an assessment of a single wetland area
E. Fried, 1974	Applicable to freshwater wetlands and wetland restoration projects	Developed for tidal wetlands but has not been used for that purpose	Developed for wetland acquisition studies in New York	Must be modified for use in other regions	More useful for ranking wetlands
G. E. Galloway, 1978	Applicable to a variety of wetland types	Applicable to coastal wetlands and estuaries	Applicable	Applicable	Applicable for use in inland and coastal areas
F. C. Golet, 1973	Applicable to a variety of wetland types	NA	Developed for Massachusetts and useful in the general region	Applicable but must be modified for use outside the Northeast	Applicable for use in inland and coastal areas
T. R. Gupta and J. H. Foster, 1973	Applicable	NA	Developed for Massachusetts and useful in the general region	Applicable but must be modified for use outside the Northeast	Applicable for use in inland and coastal areas
H. V. Kibby, 1978	Applicable to wetlands adjacent to rivers	NA	Applicable	Applicable	More useful for a narrative evaluation of a single wetland site
J. S. Larson, Ed., 1976	Applicable	NA	Developed for Massachusetts and useful in the general region	Applicable but must be modified for use outside the Northeast	Applicable for both requirements; comparison of wetlands in same general region
Maryland Department of Natural Resources, undated	NA	Applicable	Developed for Maryland and useful in the general region	Must be modified for use in coastal zones outside the region	Applicable for both requirements, but comparisons must be made of wetlands in the same salinity regime
R. T. Reppert et al., 1979	Applicable	Applicable	Applicable	Applicable	Applicable for use in inland and coastal areas
P. Schuldiner et al., 1979	Applicable	Applicable	Applicable	Applicable	Applicable for an assessment of a single wetland
Stearns, Conrad, and Schmidt, 1979	Applicable	Applicable	Applicable	Applicable	Applicable for use in inland and coastal areas
R. C. Smardon et al., 1972	Applicable	NA	Developed for Massachusetts and useful in the general region	Applicable but must be modified for use outside the Northeast	Applicable for use in inland and coastal areas
R. C. Solomon et al., 1977	Applicable, but developed for Water Resources projects	Possibly applicable, but developed for Water Resources projects	Applicable	Applicable	Applicable for use in inland and coastal areas
U.S. Army Engineer Division, Lower Mississippi Valley (HES), 1980	Applicable, but developed for Water Resources planning projects	NA, but salt marshes will be evaluated in future revision of procedure	Ecosystems in the lower Mississippi River Valley	Can be modified for use in other regions	Developed to be used in comparing project impacts or alternatives on existing and future "without"
U.S. Army Engineer Division, New England, 1972	Applicable, but unique to eastern Massachusetts	NA	Applicable for specific study site in eastern Massachusetts	NA	Not easily modified to assess and rank several wetlands
U.S. Department of Agriculture, 1978	Applicable	Applicable	Developed for Massachusetts and useful in general region	Can be modified for use in other regions	Applicable for use in inland and coastal areas
U.S. Fish and Wildlife Service, 1980	Developed for inland terrestrial and aquatic habitats	Not extensively applied to estuarine systems, but concepts may be applicable	Applicable	Applicable	Useful for evaluating baseline conditions and impacts in a single wetland; also designed to rank habitats according to wildlife values
Virginia Institute of Marine Science, undated	NA	Applicable to tidal wetlands	Developed for tidal wetlands in Virginia	May be difficult to modify for use in other coastal regions	Applicable for use in inland and coastal areas
B. H. Winchester and L. D. Harris, 1979	Applicable	NA	Developed for freshwater wetlands in Florida	Could be modified and used in noncoastal wetlands of the southeastern coastal plain	Applicable for use in noncoastal wetlands
P. Adamus, 1983	Applicable	Applicable	Developed for use nationally	Applicable	Can be used to assess a single wetland site; can be used to compare two or more wetlands; can be used to assess mitigative measures

Note: NA = Not addressed.

[a] Can the procedure be used to evaluate a variety of inland wetland types?

[b] Can the procedure be used to evaluate a variety of coastal wetland types?

[c] Was the procedure developed for regional use?

[d] Was the procedure developed for widespread application?

mize the opportunity given it to fulfill that function. Significance considers the degree to which the performed function is valued by society. Figure 1 shows the relationship of these components within the method.

There are two basic steps in procedures I and II. First, the evaluator answers three series of questions or "predictor inventories." One series is used to evaluate opportunity and effectiveness, the second addresses significance, and the third reviews impact-related factors. Second, the responses to the predictor inventories are evaluated using interpretation keys to arrive at a rating for functional significance. Figure 2 shows a flow diagram of procedures I and II.

Procedure III is more of a bookkeeping method for evaluating mitigative alternatives. The procedure requires that a functional effectiveness rating for each wetland be determined for both preconstruction and postconstruction conditions, with and without each mitigative alternative. It also requires data describing the projected cost of each alternative. The procedure provides a means of comparing various mitigative alternatives to allow selection of the alternative that accomplishes the mitigation desired at the least cost. It also provides a way of making informed trade-offs between functional and mitigation costs.

Use of the Method

Two of the major questions that have come up concerning the method are: what does the method really tell you, and how and when do you use the method?

The method does not provide "the" answer or make decisions. Figure 3 shows a completed "Summary Sheet D" for a wetland evaluation. This is the final distillation of the assessments in procedure I or II. It provides an assessment of the wetlands functional significance for each function and the sensitivity that would be affected. On the basis of this information decisions can be made concerning the functional values of that wetland, its potential for impact, and the practicable alternatives for mitigation. The decision, however, about what must be done is made by the individuals or agency using the method not by the method. The method only helps ensure that all aspects of the wetland have been considered.

The method should be used as early in a project as possible. It is an excellent tool to aid in coordinating with other agencies. The method can be used by highway and regulatory agencies as a rapid screening process for sensitive areas and areas that are of special concern.

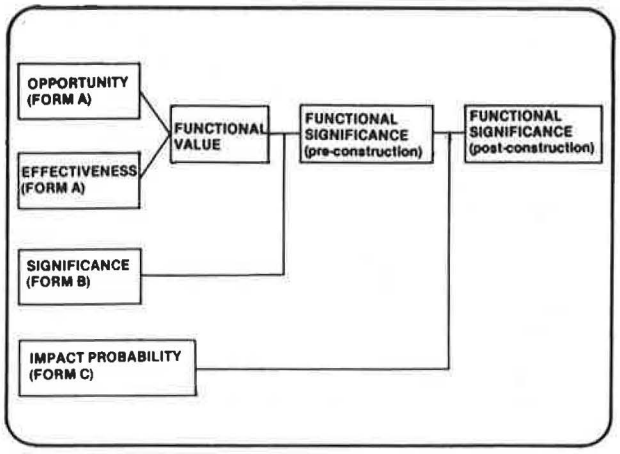

FIGURE 1 Relationships among concepts that determine wetland value *(6)*.

Summary

The FHWA method provides a flexible way of assessing the functional values of wetlands using a variety of data types that best suit the situation. The method may look imposing when first encountered but, if the user takes time to become familiar with it, the method becomes relatively easy to use.

The method is not perfect. Problems range from correcting typographical errors to possibly changing some of the assumptions made in areas where specific information may be lacking (e.g., groundwater). The FHWA and the Corps are working together to make many of these needed changes. In addition, long-range research needed to help answer some of the more difficult question is being assessed by the Corps and others. When FHWA first began the development of the method, it was considered a first step and not a one-time effort.

FUTURE DEVELOPMENT AND IMPLEMENTATION

Updating the method is already under way. Before the method went to print, draft copies were reviewed by state highway agencies, other state and federal agencies, and individual experts. A major result of the review process is that the FWS and the Corps have become interested in using the FHWA method as a basis for what may become a national assessment method. Agencies such as FWS and the Corps recognize the FHWA method as the best available tool.

In May 1983 several agencies jointly sponsored a workshop to review the method. As a result of the workshop an interagency coordinating committee was established to coordinate the future development of a national assessment method and other wetlands research issues.

It is too soon to know exactly how the future updating of the method will progress. The FHWA and the Corps will be working together during the next 2 years in an effort to update and refine the method. It is hoped that other agencies and private organizations will actively participate in the future development of the method and in the needed long-term research.

Developmental Needs

There are both long- and short-term modifications that need to be made. Some of the short-term modifications include

1. Rewriting ambiguous questions,
2. Conducting a sensitivity analysis of questions and throwing out unnecessary questions,
3. Adding questions to address areas not adequately covered, and
4. Computerizing the method.

The main long-term effort is to continue updating technical areas for which information is lacking.

Implementation

It is not the intent of FHWA to mandate the use of this or any other procedure for impact assessment.

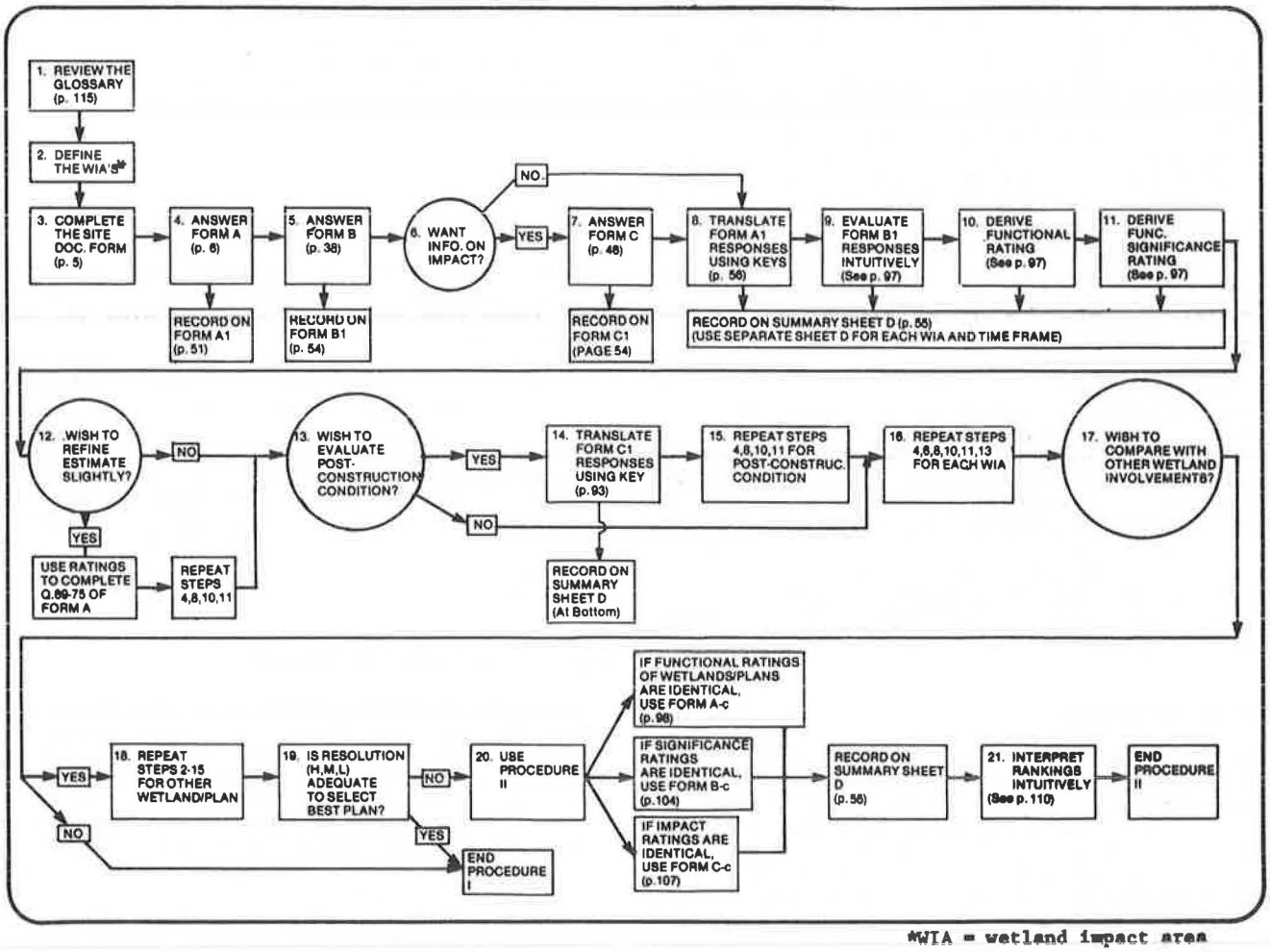

FIGURE 2 Flowchart for procedures I and II *(6)*.

In the development of the method, FHWA is providing assistance to the state highway agencies. Therefore, the method is offered to the states as a tool for their use. The FHWA is offering training courses to help the states begin to use the method.

Two state conservation agencies are adapting the method for use. Several other states have expressed an interest in using the method. Through the increased use of the method and its adoption by other agencies, and the interagency coordination of its future development, it is hoped that a national method for wetland functional assessment will emerge within 5 years.

Copies of the FHWA two-volume method are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The cost of Volume I (stock number 050-001-00266-3) is $6.50, Volume II (stock number 050-001-00267-1) costs $6.00.

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BASIN Interior Drainage Area WIA _____ PROJECT I-284

EVALUATION TIME FRAME (PRE/POST) Pre MITIGATION PLAN # _____

FUNCTION	EFFECTIVENESS	OPPORTUNITY	FUNCTIONAL RATING	SIGNIFICANCE	FUNCTIONAL SIGNIFICANCE
GROUND WATER RECHARGE	HIGH	HIGH	HIGH	MODERATE	HIGH
GROUND WATER DISCHARGE	LOW		LOW	MODERATE	LOW
FLOOD STORAGE	HIGH	HIGH	HIGH	HIGH	VERY HIGH
SHORELINE ANCHORING	HIGH	LOW	MODERATE	MODERATE	MODERATE
SEDIMENT TRAPPING	HIGH	HIGH	HIGH	MODERATE	HIGH
NUTRIENT RETENTION					
LONG-TERM	HIGH	HIGH	HIGH	MODERATE	HIGH
SEASONAL	MODERATE	HIGH	HIGH		HIGH
FOOD CHAIN SUPPORT					
DOWNSTREAM	LOW		LOW	MODERATE	LOW
IN-BASIN	MODERATE		MODERATE		MODERATE
FISHERY HABITAT					
WARMWATER	MODERATE		MODERATE		MODERATE
COLDWATER	LOW		LOW	MODERATE	LOW
COLDW.RIVERINE	LOW		LOW		LOW
ANADROMOUS RIV.	LOW		LOW		LOW
SPECIES _____					
WILDLIFE HABITAT	MODERATE		MODERATE		HIGH
GENERAL DIVERSITY	MODERATE		MODERATE		HIGH
WATERFOWL GP.	MODERATE		MODERATE	HIGH	HIGH
WATERFOWL GP. SPECIES Gt.Blue Heron	MODERATE +		MODERATE +		HIGH +
SPECIES Pied Bill	LOW		LOW		LOW
SPECIES Grebe					
ACTIVE RECREATION					
SWIMMING	LOW				
BOAT LAUNCHING	LOW				
POWER BOATING	LOW		LOW	MODERATE	LOW
CANOEING	LOW				
SAILING	LOW				
PASSIVE RECREATION AND HERITAGE				MODERATE	MODERATE
IMPACT VECTOR RATING	HIGH				

FIGURE 3 Completed Summary Sheet D *(6).*

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