Wetlands Mitigation Banking

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Preface

Wetlands mitigation banking is increasingly a subject of interest among federal, state, and local agencies in Washington State. This report was prepared for the Department of Ecology to provide information and is a basis for guidance to entities considering mitigation banking as an element of a comprehensive wetlands protection program.

The report discusses planning considerations and general guidelines for potential mitigation bank implementation. While summaries of many technical aspects of wetlands compensatory mitigation are provided, detailed scientific review and specific guidelines are beyond the scope of the report.

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Executive Summary

Wetland mitigation banks involve the off-site creation, restoration, and/or enhancement of wetlands to compensate for unavoidable adverse wetland impacts associated with future development. Mitigation banking differs from most compensatory mitigation projects in that mitigation banking is a program created by agencies, non-profit organizations, or private entities. Mitigation banking provides a relatively large compensatory mitigation site(s) to be used to collectively compensate, in advance, for many development projects. More traditional compensatory mitigation measures typically involve individual projects which are constructed by developers concurrent with or following permitted alterations.

Wetland mitigation banks are a recent wetland management strategy being considered by federal, state, and local governments in an effort to protect and restore wetland systems. This is in response to increasing evidence that some case-by-case wetland compensation may not adequately protect wetland functions. Mitigation banks can provide permit applicants and resource agencies with a simpler, less costly, more predictable process of complying with compensatory mitigation requirements. Mitigation banks can theoretically provide higher wetland functions and values than certain smaller, on-site mitigation projects by avoiding habitat fragmentation, by creating larger wetland systems, and by placing the planning and care of the mitigation site into the hands of wetland specialists. Moreover, mitigation banks eliminate the time lag between the permitted wetland impact (and associated loss of wetland functions) and full compensation for the impact.

Because wetland mitigation banking is a relatively new concept in the Pacific Northwest, and because several years are required to create and monitor a mitigation bank, it is too early to accurately assess the effectiveness of many such programs. There is much to learn, however, by analyzing the methods and recommendations of others. In reviewing literature on mitigation banking, there are several key components common to planning and implementing a mitigation banking program. These elements include:

establishment of program goals and objectives;

- identification and selection of bank sites;
- creation of bank operator/interagency agreements;
- establishment of policy for the use of credits and currency;
- establishment of criteria for mitigation bank use;
- development of mitigation options;
- construction of the mitigation bank site(s) as well as maintenance, monitoring, and reporting; and
- development and implementation of a long-term management plan.

Developing a mitigation banking program and designing and implementing a wetland mitigation bank requires significant resources, including funds, land, personnel, and time to coordinate the many concerned parties. The most successful mitigation banks may be those which are designed to meet multiple objectives and will meet these objectives by satisfying regional restoration and creation goals (Riddle, 1988).

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I. Introduction

This report discusses planning components of wetland mitigation banking. The intent of this report is to provide the basis for future discussions guidance on mitigation banking in Washington. This report surveys existing programs, describes applicable mitigation banking components, and makes specific recommendations for assessing mitigation banking options in Washington.

A. Format of the Report

The Introduction is followed by discussions of individual mitigation banking program components, and includes recommendations regarding appropriate alternatives. The Summary and Conclusions (Section III) provides an overview of the rationale for mitigation banking and the effectiveness of existing banking systems. In addition, the status of mitigation banking programs in Washington State is summarized, and general guidelines for implementing a mitigation banking system are provided. A glossary of terms related to wetlands management in general, and mitigation banking in particular, is presented in Appendix A. Appendix B contains summaries of wetland banking programs from various jurisdictions throughout the United States, including an overview of programs within Washington State. Information sources used to collect information for this report are presented in Appendix C.

B. Mitigation Banking Background

Wetland mitigation banks involve the off-site creation, restoration, and/or enhancement of wetlands to compensate for unavoidable adverse impacts associated with future development activities. The concept of mitigation banking was developed in the early 1980s as a mechanism to compensate for unavoidable habitat losses primarily associated with the federal Section 10 (Rivers and Harbors Act) and Section 404 (Clean Water Act) permit programs for wetland development projects (Short 1988a).

Mitigation banking differs from most compensatory mitigation projects in that mitigation banking is a program created by agencies, non-profit organizations, or private entities to provide a relatively large compensatory mitigation site (or sites) to be used to collectively compensate for many, usually unrelated, development projects. More traditional compensatory mitigation measures typically involve individual projects implemented by developers.

An important aspect of mitigation banking is that all compensation is provided in advance. The compensation is constructed, monitored, and determined to be a functioning wetland before impacts to existing wetlands occur. The majority of individual compensation projects are constructed either concurrent with, or following, development activities, and result in functional losses over time until the compensation site reaches maturity (Riddle, 1986). The intent of mitigation banking is to eliminate the time lag between the loss of wetland functional values and full compensation for those losses (Race, 1985; Short 1988b). Mitigation banking is also intended to improve planning and implementation of wetland compensation by increasing public agency

involvement.

Mitigation banking should not be confused with "fee-in-lieu" programs. These latter programs are designed so that developers are assessed an impact fee, which is then used by agencies to create compensation projects. Fee-in-lieu programs, like most individual compensation projects, typically do not compensate for wetland impacts in advance.

C. Compensating for Wetland Losses

The "science" of creating wetlands as compensation for permitted alterations to naturally-occurring wetlands is still in its infancy. Few scientific studies on wetlands creation were performed prior to the 1970s. Mitigation projects undertaken to date have frequently failed; accordingly, many jurisdictions now require greater than 1:1 areal compensation for permitted wetland alterations because of the uncertainty of wetland creation success (Castelle et al., 1992a,b).

The historical lack of ecological success of compensatory mitigation projects stems partly from a combination of factors. Many of these projects have been poorly conceived, with little consideration given to regional wetlands management, and have been neither properly constructed, maintained, nor monitored. Further, there has rarely been an economic incentive for those implementing the mitigation work to ensure its success.

D. Mitigation Banking Advantages and Disadvantages

Proponents of mitigation banks have suggested that banks reduce the costs of mitigation, and permit large, otherwise cost-prohibitive, mitigation projects to be completed (Borsch, 1987). Some authors report that large mitigation projects like those typical of mitigation banks are more useful than several small projects in various locations. Arguably, larger mitigation projects provide more habitat, are easier to create, and prevent cumulative impacts (for example, habitat fragmentation) associated with many small, scattered mitigation projects.

Although there may be advantages to mitigation banking, there are also many potential disadvantages. Opponents of mitigation banking argue that involved agencies invest a great deal of time and money in developing the bank, and that the costs may never be recovered. Because the banking site is developed (and therefore paid for) prior to permitting any of the projects which will be debited against the bank, and because there is no guarantee that a sufficient number of developers will apply for mitigation credits from the bank, it is possible that the bank operator will never recover the initial investment nor the continuing maintenance and monitoring costs.

There are also several ecological concerns about mitigation banking. For example, the same problems which have contributed to low success rates for individual compensation projects will also exist for all mitigation banking programs. In addition, the spatial re-distribution of wetlands

in the landscape and the potential for habitat trade-offs (for example, creating emergent habitat as compensation for forested wetland losses) may result in a reduction of native plant and animal species diversity. These factors are most significant when they are not accounted for in planning and implementing a mitigation bank.

E. Mitigation Banking Implementation

The creation of wetland mitigation banking systems has mostly been limited to federal projects such as offshore oil and gas drilling and highway construction. Recently, however, there has been increased interest in mitigation banks from state and local agencies because, in many instances, on-site compensatory mitigation is infeasible or undesirable because of environmental, economic, or political concerns.

II. Wetland mitigation banking components

An overview of the literature related to mitigation banking indicates that there are several key components common to planning and implementing a mitigation banking program. These elements include: establishment of program goals and objectives; identification and selection of bank sites; creation of bank operator/interagency agreements; establishment of policy for the use of credits and currency; establishment of criteria for mitigation bank use; development of mitigation options; construction of the mitigation bank site(s) as well as maintenance, monitoring, and reporting; and development and implementation of a long-term management plan. For the purpose of this report, each of these components is addressed by outlining pertinent issues and approaches, providing examples, and discussing the benefits and drawbacks of each approach. Recommendations for various alternatives complete the discussion of each component.

A. Program Goals and Objectives

Establishing goals and objectives is the first phase of any mitigation banking program. They help to establish the focus of the program, to allocate funding, and to measure success.

Goals are the broadest intentions of the program. Perhaps the most common goal of mitigation banking programs is to achieve no net loss of wetland acreage or function. Other mitigation banking goals may be to ensure greater regional acceptance of the concept and practice of compensatory mitigation by providing compensatory mitigation options and increased inter-agency involvement.

Objectives are the measures taken in an attempt to reach the overall goals. For example, it may be an objective to provide mitigation banks in particular regions of Washington, so that specific wetland types are conserved.

Establishing a mitigation banking program may be considered a goal in itself, or may be one objective of a broader wetland mitigation program. The following presents alternative goals and objectives.

Considerations

In general, all mitigation banks seek to promote compliance with existing laws, to balance development and resource protection interests, and to prevent a net loss of wetlands. Another common aim of mitigation banks is to combine compensatory mitigation resources to maximize the likelihood of mitigation success. For example, the cost of creating one large wetland at one time is generally much lower than the cost of creating many smaller wetlands over a long period of time; it is more cost-effective to create one 100-acre wetland than 100 one-acre wetlands.

Common objectives of mitigation banks, as reported by Short (1988b), include:

- to restore and enhancing existing wetland habitat types to prevent a net loss of functional and habitat values;

- to preserve and/or create particular wetland habitat types for specific desirable, threatened, or endangered species;

- to consolidate many small compensation projects into one site;

- to balance wetland protection and development interests;

- to preserve bank wetlands in perpetuity through acquisition (or other preservation method), long-term monitoring and management; and

- to promote cooperation and administration among the various regulatory authorities.

Mitigation banks are not designed to allow project applicants to avoid stringent alternatives analyses. This is a significant issue for regulatory agencies who are concerned that without such analyses, otherwise avoidable impacts to wetlands will occur.

Other important considerations include the following:

1. Jurisdictional issues are likely to arise. For example, a city developing a mitigation banking program would involve several departments such as planning, engineering, community development, public works, and surface water management as well as the city council. In addition, several agencies outside of the city would also have regulatory responsibilities. In Washington, state agencies which may become involved in a banking program include the Department of Ecology, Fisheries, Natural Resources, Wildlife, and Transportation. At the federal level, the Army Corps of Engineers, Environmental Protection Agency, Fish and Wildlife Service, and Soil Conservation Service each have wetlands responsibilities. The goals and objectives of any one of these agencies may not be the same as those of another agency. In some instances, agencies may have conflicting goals and objectives.

2. Implementing a banking program is expensive. The creation of replacement wetlands is costly. Some of the expenses include (1) consultant fees; (2) permit acquisitions; (3) engineering; (4) earth moving; (5) landscaping; and (6) long-term monitoring and maintenance. The economic burden of creating a mitigation banking program must be weighed against the anticipated financial gains from increased development.

3. Not all wetland types may be created with equal certainty of success. For example, forested wetlands are very difficult to create. This is partly due to the long time required for a newly planted forest to reach maturity. As another example, peat bogs develop over hundreds of years; it appears impossible for humans to successfully create a self-sustained bog system. Wetland

creations are not considered successful unless they replace or enhance the functional values of the wetlands which are lost due to development. Therefore, suitable banking sites must be ecologically able to support in-kind wetlands which are functionally equivalent or superior to the wetland which they are intended to replace.

Examples of Bank Goals

The Port of Los Angeles, California, established the Cabrillo Marina bank to facilitate the permit review process; to ensure mitigation for numerous, anticipated small Los Angeles Harbor District development projects; and to preserve, restore and/or enhance estuarine wetland habitat types of recognized importance.

Another bank established by the Port of Los Angeles, the Batiquitos Lagoon bank, had somewhat different goals and objectives, some of which were to: (1) restore tidal influence to the lagoon; (2) preserve or enhance existing fish and wildlife resources; (3) retain and enhance habitat for endangered species; (4) maintain water quality; (5) provide public access to the lagoon shoreline; and (6) ensure that the goals listed above are achieved and maintained in perpetuity.

The Anaheim Bay bank developed by the Port of Newport Beach, California, demonstrated a specific goal: to restore and enhance the wildlife habitat of degraded estuarine wetlands. Specifically, the project focused on preserving and improving habitat for endangered species including the light-footed clapper rail, least tern, brown pelican, and Belding's savannah sparrow.

Recommendations

To date, many compensatory wetlands mitigation projects have been unsuccessful and most existing mitigation banks are too new to properly evaluate. So that mitigation banks do not add to the legacy of unsuccessful compensatory mitigation projects, goals and objectives should be programmatically feasible, ecologically sound, and physically attainable.

At a minimum, the following goals should be stated:

- to encourage cooperation among regulatory authorities;
- to promote no net loss of wetland function or acreage; and
- to maintain or restore historic wetland diversity and distribution.

Objectives should include:

- to expand essential habitat for threatened, endangered, and sensitive species wherever possible;
- to avoid habitat fragmentation due to many small development projects;

- to preserve mitigation banks in perpetuity; and
- to provide monitoring and maintenance of the banking site for an appropriate period.

B. Site Identification/Selection

Site identification and selection begin with establishment of selection criteria (Short, 1988b). Because banking programs often seek to balance economic growth with natural resources protection, selection criteria are best determined by an cooperative review team comprised of agencies, developers, conservation groups, property owners, and others. Examples of criteria include; (1) regional wetland loss trends; (2) predicted rates of loss; (3) regional goals for restoration or preservation of various wetland types; and (4) habitat diversity and creation or enhancement of habitat for desirable species (Riddle and Denninger 1986). Perhaps the most important factors influencing site identification and selection are the program goals and objectives. For example, if a goal is to establish more estuarine habitat, then the site selection process will be directed by that intent.

Selecting mitigation bank sites requires an analysis of the types, distribution, and values of wetlands within the region considering bank program implementation. This analysis is conducted in stages. First, a thorough wetlands inventory must be performed so that all wetland resources are identified. This is important not only to locate candidate banking sites, but also to evaluate the number and total area of wetland existing in the study area to which alterations may be permitted in the future.

The scale of wetlands inventories are determined by the goals and objectives of the banking program, and varies from the size of a single watershed to an entire state.

Wetlands inventories begin with a "paper survey," -- a review of available natural resources maps and other documentation (for example, the National Wetlands Inventory, Soil Conservation Service maps, U.S. Geological Survey topographic maps, and recent aerial photographs). Paper surveys then must be field-checked to (1) ascertain if wetlands are actually located in the same locations in the landscape as they are shown in the paper surveys; (2) identify vegetative communities and wildlife species present in the wetlands; (3) assess the condition of the wetlands (are they pristine? degraded?); (4) evaluate wetland functional values; and (5) assign ratings, or rankings, to all wetlands within the study area. In Washington, many communities have completed paper and/or field wetlands inventories.

Inventory data can be used to determine the types of wetlands which may be created or restored at a mitigation bank site. This information, in conjunction with wetland ratings, accomplishes two purposes. It allows identification of wetlands to which alterations may be allowed in the future, and it allows identification of potential banking sites. Highly rated wetlands are usually good mitigation banking sites unless they can be expanded without harming wetland functions. Low value wetlands, however, are the most likely wetlands to which alterations may be permitted. Because the risk to low rated wetlands from construction is proportionally low, these areas may be good candidates for banking sites as well. Additionally, upland areas with low ecological value

may also be well suited for a mitigation banking site.

After the wetlands inventory is completed and wetland ratings are assigned, potential banking sites are identified. Site identification is constrained by availability of areas possessing the required characteristics that will support wetlands. Wetlands occur in specific geographic positions on the landscape such as river deltas, bay shorelines, lake shores, and coastal areas, and are part of a continuum of ecosystems which are in dynamic equilibrium. Wetlands are important transitional zones between aquatic and upland habitat types. As such, they cannot be created everywhere; their existence depends on a multitude of specific landforms and hydrologic, geologic, and biologic processes. Hence, sites are limited to areas that posses the physical, chemical, and biological characteristics needed to support wetlands.

Suitable mitigation sites are limited because of the number of variables that must be considered. Appropriate sites must be:

- of ample size, as determined by the program goals;
- of relatively low existing function and value;
- ecologically linked with proximal natural areas;
- in a landscape position that can be supplied with sufficient clean water;
- isolated or buffered from disruptive adjacent land uses; and
- available for acquisition.

Good banking sites are those which contain numerous small wetlands which are considered to be of low value because of their size and isolation from each other and other aquatic resources. Connecting these wetlands by converting the intervening uplands will not only increase wetland area, but will likely increase wetland functions and values (and therefore wetland rating). In addition, sufficient area for a wetland buffer must be included in the design.

The most important consideration in creating replacement wetlands is to supply sufficient water. Wetland hydrology controls most biological, chemical, and physical characteristics of wetlands. Because of the importance of wetland hydrology, the best mitigation banking sites are those which have or historically had plenty of available water. An example of an ideal bank site is an area which was historically wetland, but which was converted to upland via drainage alterations such as diking, damming, ditching, or diverting water. If the natural drainage is returned to such areas (for example, by breaching dikes, removing dams, breaking drain tiles or filling ditches), then there is a high probability that wetlands can be successfully re-established in their natural landscape position.

Considerations

The following must be considered in selecting suitable banking sites.

1. Creating a mitigation bank results in tradeoffs among habitat types. This is because wetland habitat types must be created at the expense of non-wetland habitats. While this may accomplish the goal of compensating for wetland losses, the reduction of certain upland habitats may be as environmentally damaging as the loss of particular wetlands. For example, upland areas, even if they were formerly wetlands, would not be considered suitable sites for mitigation banking if they supported sensitive, threatened, or endangered species. Generally, however, resource agencies regard wetlands as needing greater preservation than upland areas. Exchanging disturbed meadow communities, diked river floodplains, and areas dominated by nuisance species (such as Himalayan blackberry) for wetland habitats would be of decided benefit to the environment.

2. Adjacent land uses may have a significant impact on potential candidate sites. High intensity land uses such as industrial facilities, high density housing, and landfills greatly reduce the value of all neighboring natural resources. Ideally, banking sites would be surrounded by unspoiled uplands which would form a buffer around the wetland. Buffers are important as they shield wetlands from pollutant runoff, sedimentation, noise, light, heat, and wind, as well as providing habitat for wildlife which utilize wetlands but which spend considerable portions of their lives in uplands (Castelle et al. 1992c,d).

3. Candidate site ownership and ownership of the adjacent properties are important issues. Landowners may or may not be willing to sell their property for use as a mitigation bank site. If a landowner is unwilling to sell property for mitigation bank use, there may be no means of acquiring the site. While condemnation is a common procedure used to purchase land for highway construction and public utilities, it will be very difficult to demonstrate that creating a mitigation bank is in the public interest.

Even when candidate site owners are willing to sell their land, adjacent land owners may be opposed to the creation of a valuable wetland near their property. This opposition may rise from the adjacent landowners concerns over possible restrictions which may be placed on their property because of the proximity of the wetland. Other landowners may see the adjacent bank as an amenity.

Examples of Criteria Used for Site Selection/Identification

One of the primary criteria used to identify and select the Batiquitos Lagoon bank site in Los Angeles was the speed with which a mitigation plan could be developed and implemented (Riddle, 1986; Short, 1988b). The Batiquitos Lagoon site was a good candidate for creating a mitigation bank because there was existing information on fish and wildlife resources and because of the site's proximity to the impacted wetlands.

Another example of site selection criteria involves the Idaho Transportation Department (ITD), which is a signatory on a Memorandum of Agreement (MOA) that lists criteria for site location (Tiedemann, 1988). Although considerable discretion is provided to ITD in determining bank site location, site selection is subject to approval by consensus of the other MOA participants. Candidate sites include depleted borrow sites, costly remainders of right-of-way and other publicly owned properties. The agreement stipulates that individual bank sites be located in areas possessing the necessary physical, chemical, and biological characteristics required to support wetland development, and that these sites be located as near as possible to the impacted area(s).

Recommendations

Mitigation bank site selection may be the most critical step in developing a banking program. Considerable expense and interagency coordination is required.

Specific site identification and selection recommendations are as follows:

- wetlands inventories, including field verification and assigning ratings to all wetlands, should be performed;

- low-value non-wetland areas should be identified;

- high quality wetlands should neither be used for banking sites nor for development sites;

- providing wetland hydrology is the most important aspect of successful wetlands creation; the ideal banking site would restore wetland conditions to a historic wetland which has been converted to upland by the removal of an adequate water supply. It is important to ensure an available water source that can be maintained naturally (ie., without control structures);

  preference should be placed on selecting sites that will support wetlands which are functionally equivalent to those wetlands likely to be impacted by development (unless they are degraded) or those types which have been diminished due to historic losses; and

- regional differences within Washington State should be recognized. At a minimum, the state could be divided into coastal, Puget Lowland, mountainous, and Columbia Basin "eco-regions." Within each region, historic wetland losses should be assessed, as should potential development pressure.

C. Bank Operator

The mitigation bank operator is the legal entity established to develop the mitigation bank

program and to create or restore replacement wetlands at the mitigation bank site. The bank operator is responsible for the day-to-day management of the bank site as well as the long-term integrity of the replacement wetlands. The operator's duties include monitoring the biological, chemical, and physical conditions of the created wetland, and summarizing the results in reports to be reviewed by resource agencies, environmental groups, and development associations. If the bank operator is an agency, it may also be the operator's responsibility to issue permits to allow wetland alterations for which compensation will be made within the banking system.

The bank operator is usually specified in a Memoranda of Agreement (MOA). MOAs are legally binding agreements, usually between agencies or groups with regulatory and/or vested interests (for example, the Washington Departments of Ecology, Wildlife, and Fisheries). These documents specify the roles, duties, and responsibilities of each of the parties.

Short (1988b) discussed the use of MOAs. According to Short, MOAs include:

- specific criteria for use, such as determination that project re-design, on-site mitigation, and other off-site mitigation options are inappropriate or infeasible;
- inclusion of, or reference to, comprehensive regional plans and/or other planning documents with similar and related goal objectives;
- definition of the obligations and responsibilities of the participants;
- establishment of an interagency bank overview team;
- definition of the decision making and conflict resolution processes;
- identification of who will hold the title or other legal agreement for bank land(s);
- limits of the use of the bank to a specific geographic area;
- establishment of the size of the bank;
- identification of the standardized methodology to be used in evaluating credits and debits (as well as the accounting process);
- specification of the wetland habitat types that are eligible to be offset by the bank; and
- establishment of monitoring and evaluation procedures for mitigation projects and any related adjustments in bank management or credits.

Additionally, the MOA may establish procedures or restrictions for use of the bank for public

access and eduction.

Considerations

The following is an overview of five types of mitigation bank operators.

1. Resource Agency: One option is for the operator to be a natural resource management agency which could absorb some of the costs of such a program. One advantage of this approach would be that natural resource agencies in Washington already have the expertise necessary to evaluate and assess adverse impacts to the affected environment, and would be more easily able to review the feasibility of a given project or the losses associated with a particular development proposal. However, while the infrastructure is already present in such a scenario, that same infrastructure is often under-funded, overburdened and unable to perform some of its existing responsibilities in a satisfactory manner.

2. Local Government: Another approach is to have a local government operate the mitigation bank. An advantage to this approach is the familiarity that local governments have with the history of the bank site and with other local resources. Further, when banking programs are implemented in response to development or other perceived economic growth pressures, local governments often assume a lead position. A disadvantage of this alternative is that many local governments, particularly from jurisdictions with small populations, have neither the in-house expertise nor the funds to manage a created wetland. Another disadvantage of this approach may be the lack of a larger, regional perspective of wetlands conservation.

3. Private Non-profit Sector: Groups from the private sector may also be bank operators. For example, environmental groups often have the expertise to manage created wetlands. Groups like the Audubon Society and The Nature Conservancy have contributed to numerous wetland creation or restoration projects.
Because these groups do not have vast economic resources, however, funding for the banking program would have to be provided to these organizations. Another advantage of this approach is that having environmentalists involved in a banking program may "balance" the involvement of the development community.

4. Development Association: Another alternative is to have an association of developers operate the bank. The advantage of this approach is that the burden of long-term success would be on the developers; their responsibility for compensating for lost wetland function and acreage would not end upon payment into the mitigation bank. A disadvantage of this approach is that since banking programs are implemented in response to development pressure, having developers managing the compensation site may constitute a conflict of interest.

5. Coalition of Parties: Finally, there may be more than one bank operator. A coalition of regulatory agencies, local governments, and groups from the private sector may be formed so that each faction is responsible for successful wetland creation and bank management.

To form such a coalition, MOAs are used to identify the role of participants and to designate a multi disciplinary mitigation review team composed of state and federal agency regulatory personnel. Salvesen (1990) reported that the mitigation review team's purpose includes assessing the feasibility of mitigation plans, as well as their development, implementation, and enforcement. He indicated that such a team is typically composed of representatives of the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and State fish and wildlife managers. Because of the detailed quantitative and qualitative conditions and stipulations that can be included in a MOA, these documents appear to be an excellent strategy in the achievement of successful wetland mitigation. Furthermore, MOAs foster a forum-like, consensus approach to wetland regulation from a multi-disciplinary, multiple-resource-management viewpoint, rather than a myopic single-interest approach.

Examples of Bank Operators/MOAs

The Astoria Airport bank (Oregon) MOA was signed by the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service, Army Corps of Engineers, the Oregon Department of Fish and Wildlife, the Oregon Department of Land Conservation and Development, and the Oregon Department of State Lands. The MOA established an interagency overview team which has both bank oversight and evaluation responsibilities.

A statewide mitigation bank in Minnesota likewise has a formal MOU. Parties to the Minnesota Department of Transportation Wetland Bank include Minnesota Department of Transportation, USFWS, the Federal Highway Administration, and the Minnesota Department of Natural Resources. Each of the nine transportation districts has an interagency review team that operates the bank within its district. Credit use and evaluation of sites is determined by these teams.

Recommendations

Mitigation bank operators have the ultimate responsibility for maintaining viable and valuable wetlands at the bank site. The following recommendations are made regarding the selection of a mitigation bank operator:

- a coalition of regulatory agencies and local governments should be the bank operator. Local governments should act as the lead agency, and provide regular maintenance and monitoring; state and/or federal agencies should be used in a supervisory and review capacity;

- memorandum of agreements (MOAs) should be used to specify responsibilities of each member of the bank operator coalition;

- community groups should become involved. Qualified members could be trained to perform monitoring and maintenance in the created wetland, maximizing educational opportunities for the public; and

- funding for creating the banking program should be provided by those groups who apply for permits to alter wetlands.

D. Establishment and Use of Credits and Currency

Wetlands mitigation banking somewhat resembles a conventional bank account. The following description of the establishment and use of mitigation banking credits is excerpted from Short (1988b):

> *A developer undertakes measures to create, restore, or preserve fish and wildlife habitat in advance of an anticipated need for mitigation for projected construction impacts. The benefits attributable to these measures are quantified, and the developer receives mitigation credits from the appropriate regulatory and/or planning agencies. These credits are placed in a mitigation bank account from which withdrawals can be made. When the developer proposes a project involving unavoidable losses of fish and wildlife resources, the losses (debits) are quantified using the same method that was used to determine credits, and a withdrawal equal to that amount is deducted (credited) from the bank. This can be repeated as long as mitigation credits remain available in the bank.*

Considerations

There are several means of establishing mitigation credits. Credits may be based upon individual wetland functions, upon a combination of wetland functions, upon an areal basis, or upon cash value.

1. Single Function Crediting: Single function crediting is applicable when the objective of the bank is to provide that one function. For example, if the objective is to provide fisheries habitat for fish species of commercial importance to Washington, then the amount of credit awarded is proportional to the amount of viable fish habitat created. In this example, if other wetland functions are created, but fish habitat is not, then the objective of the banking program is not being met and little, if any, credit would be issued.

2. Multiple Function Crediting: Credit for the creation of multiple wetland functions is awarded in a similar manner as long as the banking program goals and objectives are being met. It is often possible to create multiple wetland functions with a single action. For example, planting dense shrubs in a wetland provides wildlife habitat, water quality improvements, and sun, wind, and noise screening.

3. Areal Basis Crediting: Credits issued on an areal basis are applicable when the program objectives are not based upon specific wetland functions. In such instances, a developer must create functionally equivalent wetlands that are equal to or greater in size than those which are altered. Most jurisdictions that have established replacement ratio standards require greater than

1:1 areal compensation for altered wetlands; currently, replacement ratios of 1:1 to 6:1 are common (Castelle et al., 1992a). It should be noted that higher replacement ratios are usually required to account for both time factors and the risk of failure involved in traditional, case-by-case compensatory mitigation. Mitigation banking substantially reduces these factors.

4. Habitat Value: Since mitigation banking was developed primarily to compensate for fish and wildlife habitat loss, determining bank credits (and debits) has been based primarily upon habitat value. A reliable means of evaluating habitat is therefore necessary to provide consistency in the crediting/debiting process. The most acceptable evaluation methodology is one that is easily understood by biologists and non-biologists, is simple to use, and can be applied with a reasonable expenditure of time and effort (Minnesota Dept. of Transportation, 1987). Brown et al. (publication date unknown) concluded that a habitat-based evaluation methodology will be superior to more conventional methods, such as acre-for-acre tradeoffs or best professional judgement.

Habitat evaluation methods are used to quantify the habitat value increases that occur on the bank site as a result of the up-front compensation efforts. These increases in habitat value constitute the credits associated with the bank (Short 1988b).

Credits are usually evaluated and determined using the Habitat Evaluation Procedure (HEP) established by the U.S. Fish and Wildlife Service; the Wetland Evaluation Technique (WET), developed primarily by P.R. Adamus for the Federal Highway Administration; or an equivalent method. HEP is a species-specific method developed to rate habitat quality and quantity in order to quantify the impacts of changes made through land and water development projects. It has been used as a tool to document baseline information on habitats as a gauge for future habitat alterations (HEP Manual, U.S. Fish and Wildlife Service).

The advantage of HEP is that it is well-known among biologists and has been widely used. A disadvantage of using this method is that HEP requires specific intensive training; many jurisdictions may not have staff who are certified to perform HEP analyses. It is also both time consuming and costly, and is not very flexible to modification or adaptive information. Using HEP for the evaluation of small wetlands may not be cost effective. Additionally, HEP analyses are not comprehensive measures of wetland functions and value.

WET is a comprehensive assessment of function and value, but it lacks quantitative rigor. The functions and values of most wetlands fall into the "moderate" category, making it difficult to compare wetlands. WET also lacks regional specificity and doesn't account for Washington's wet season/dry season climate and the differences between eastern and western Washington.

5. Mitigation Fees: A final approach is to assign credits on a "mitigation fee" basis. In this scenario, a mitigation bank is created, either by using public funds or through the private donations to an environmental organization. Once viable wetland has been established on the banking site, permit applicants can pay a mitigation fee based on the habitat replacement

requirement and the unit cost for the bank (Riddle and Denninger, 1986). The mitigation fees are calculated so that once all credits for the bank have been issued, the bank operator will have been completely reimbursed for the costs of operating the site. The total price that must be recovered by the bank operator includes land acquisition, wetlands creation (planning and construction), maintenance, monitoring, and long-term managerial costs. Wetland assessment procedures such as HEP, WET, or an equivalent may be used to calculate the cost/credits.

Covering long-term management costs is one of the greatest challenges within a mitigation fee system. While anticipated costs are built into the mitigation fees, care must be taken so that unanticipated future costs may be covered. Short (1988b) suggested that a portion of the mitigation fees be designated for an annuity account from which the bank operator can draw funds over the life of the bank.

Another problem with mitigation fee banks is the difficulty in securing the funds to create the banking program. The price of establishing a mitigation bank may be well beyond the budget of either a private developer, a public agency or an environmental organization. Although the mitigation fee structure is designed so that all costs are recovered, the recovery period may require years. In addition, Short (1988b) noted that "mitigation fee banks appear to be particularly susceptible to the public perception that permits are being bought and sold. Because of this potential public perception, creating a mitigation fee bank with public funds may be especially difficult.

One advantage of mitigation fee banks is that developers would be able to anticipate how much compensatory mitigation will cost based on the fixed charge for mitigation credits (Riddle, 1986).

Mitigation fee banks are not the same as "fee-in-lieu" programs, which are not considered an appropriate means of providing compensatory mitigation. With fee-in-lieu programs, project sponsors pay, at the time of wetland loss, into an accumulating fund to be used to establish compensatory wetlands at a later date. With fee-in-lieu programs, the lag time between wetland loss and full compensation may be years; mitigation fee banks are established well in advance of permitted wetland losses. Furthermore, fee-in-lieu programs place the burden of locating and acquiring a site, as well as designing, constructing, and managing the compensations site on the public sector. Finally, because compensation costs cannot be accurately forecast, there are the serious risks that the impact fee would be insufficient to compensate for lost wetland resources.

Examples of Use of Credits and Credit Restrictions

The Tenneco La Terre bank in Louisiana relies upon a multi-disciplinary, interagency review team to determine bank credits (Soileau, 1984; Soil Conservation Service, 1987; short, 1988b). Credit establishment is restricted to in-kind replacement mitigation of unavoidable habitat losses within the same hydrologic unit. Mitigation credits are determined by the review team, based on analysis using a version of HEP. Surplus credits can be sold or traded to other developers to mitigate

unavoidable development impacts. Sale or trade of credits must be approved by the review team.

The Ports of Long Beach and Los Angeles, California, have restricted the use of mitigation credits within the respective boundaries of their districts. The Virginia Department of Highways and Transportation cannot use estuarine credits to mitigate adverse impacts to freshwater wetlands (Beuter, 1986).

Recommendations

Mitigation credits are the "currency" of a banking program. The following recommendations are made regarding the use of mitigation banking credits:

- credit allotment should be based on specific wetland functions and values;
- HEP, WET, or some other standard wetland habitat evaluation technique, should be used to assess wetland functions and values;
- wherever feasible, wetland functions and values should be quantified. While flood flow attenuation, groundwater interactions, and some other wetland functions are difficult (if at all possible) to quantify, others such as water quality and wildlife usage can be measured; and
- mitigation fee banking should be considered only if large sums of money can be committed at the outset of the program, AND only if some means can be established of ensuring that money will continue to be available for the life of the bank site, perhaps through a revolving fund.

E. Criteria for Use

Mitigation banking programs are designed to compensate for permitted wetland impacts from projects where on-site mitigation is either infeasible or undesirable from a wetlands resources perspective. This section summarizes information on the criteria used for determining which projects or wetland impacts may be offset through a mitigation banking system.

The criteria for identifying wetlands impacts which may be offset through a banking program fall into two categories: ecological and regulatory.

When on-site compensation is not feasible, off-site (and potentially out-of-kind) compensation for wetland impacts may be ecologically sound if the wetlands to be altered are small, isolated from other aquatic resources, and have been highly degraded. Under these circumstances, "trading" several small, low value wetlands for one large, high value wetland can increase regional wetland functions and values.

One approach to identifying the number and distribution of wetlands which meet these criteria is

through a wetlands inventory (see Section II.B). Wetland ratings may be used to identify wetlands which are candidates for inclusion in the banking program. For example, perhaps only wetlands with the lowest rating may be considered for inclusion in the program. Ultimately, however, it will be up to the project proponents to demonstrate that no other options exist and that compensation for particular wetland alterations would best be accomplished through mitigation banking.

Regardless of whether such wetland tradeoffs have the potential to enhance wetlands resources, no wetland impact can be offset through a banking program if regulations prohibit the impact. Regulatory criteria for determining which wetland impacts may be offset through a bank include consideration of federal, state and local wetlands and water quality standards. For example, if a federal Clean Water Act Section 404 permit to fill wetlands (issued by the U.S. Army Corps of Engineers) is required, an important criterion will be an alternatives analysis. This analysis must demonstrate why the proposed wetland alteration is (1) necessary (ie. water dependent), and (2) preferable to a different or lesser wetland alteration. Section 404 permit applicants must first seek to avoid all adverse impacts to wetland, then to minimize wetland impacts, and finally, to compensate for unavoidable impacts. The U.S. Army Corps of Engineers does not consider a likelihood of successful compensation to be a reason to permit wetland alterations (USEPA, 1989). Therefore, no wetland loss can be offset through a mitigation banking program if alterations to that wetland are not permitted.

Examples of Criteria for Use

Generally, the bank operator establishes the criteria for use, and incorporates these into a legally binding MOA. Following are several specific examples of mitigation bank use criteria.

The Astoria Airport bank use criteria identify some of the typical issues and concerns used to restrict bank use, which include the following:

- projects must be approved by appropriate state and federal wetland regulatory agencies and must be found consistent with the Oregon Coastal Zone Management Plan;
- only projects that demonstrate all practical means to avoid, eliminate, or mitigate on-site impacts are eligible for consideration;
- the bank can only be used for mitigation impacts in the Columbia River Estuary;
- some credits are reserved to mitigate future port and harbor development project impacts (remaining credits are available to other applicants);
- only projects that have unavoidable and necessary impacts, and are approved under the local comprehensive plan, are eligible for consideration for bank credits;
- only projects that cannot be mitigated on-site can use the bank;

- mitigation requirements for proposed projects must comply with adopted rules developed by the Oregon Department of State Lands; and

- a habitat relative value system is used in debiting the bank (eg. each credit for 1 acre of habitat and a relative value of 1.0 costs $3,000) (Oregon Division of State Lands, 1987).

Borsch (1987) recommends that banked credits only be used for:

- projects in which on-site impacts have been minimized through design;

- where mitigation at the project site is infeasible due to conflicting uses; and
- the project requires a wetland/waterfront location to fulfill its purpose.

Recommendations

Criterion for use determine which wetlands (i.e. candidate wetlands) may be altered and subsequently compensated for at the mitigation banking site. The following recommendations are made regarding establishing criteria for use:

- only projects that have unavoidable and necessary impacts should be considered for incorporation in a banking program;

- only projects which meet all regulatory requirements should be considered for incorporation in a banking program;

- all feasible and ecologically sensible means of on-site compensation must be explored before use of a banking system is considered;

- candidate wetlands should be comprised of the same habitat type(s) as the bank site, so that compensation will be accomplished in-kind;

- the candidate wetlands should be in the vicinity of the compensation site. Ideally, the candidate wetlands and the bank site should be located in the same watershed, especially if water quantity and quality issues are of primary importance;

- if habitat availability is the primary concern, then the candidate sites should be near enough to the bank site so that wildlife can become established at the bank site, but far enough away so that development activities do not adversely impact the bank site; and

- wetlands which are small, isolated, and degraded (hence, of low value) should be candidates for use of a mitigation bank so that permitting alterations to these wetlands are "exchanged" for one large, high value wetland.

F. Mitigation Options

A fundamental concern of any type of compensatory mitigation strategy is the generally poor record of "successful" projects, and the subsequent net loss of wetland acreage and function. A recent report (Florida Department of Environmental Regulation, 1991) examined compensatory mitigation effectiveness and showed that only 27% of the compensation projects reviewed were ecologically successful. In that study, only 12% of all freshwater compensatory mitigation projects were considered to be successful; the percentage for tidal wetlands was somewhat higher at 45%. This is especially alarming since the majority of wetland fill permit applications made in Washington State are for non-tidal freshwater wetlands. It is further discouraging to note that these numbers were generated from a survey of mitigation projects in Florida, where the art and science of wetland restoration, enhancement, and creation is presumably more advanced than areas such as the Pacific Northwest, which have considerably less wetland area.

Several studies have evaluated wetlands compensatory mitigation success in Pacific Coast states. For example, Kunz et al. (1988), in reviewing wetland compensatory mitigation in Washington, found that 100 acres of wetlands were created as compensation for the loss of 152 acres of naturally-occurring wetlands. Fonseca (1990) found that there was only a 50% vegetation survival rate for wetland restorations. One San Francisco Bay study found that 2 of 58 compensatory mitigation projects were ecologically successful (Eliot, 1985).

Considerations

There are three major compensatory wetland mitigation options: restoration, enhancement, and creation. These may be formally defined as follows: "Restoration" entails returning a wetland from a disturbed or totally altered condition to a relatively pristine or pre-disturbance condition; under extreme circumstances, particularly disturbed areas may no longer be classified as wetlands. (The restored wetland is at different wetland site from the site of the permitted alteration to distinguish this type of compensation from "rectification" described under the State Environmental Policy Act and by the Council of Environmental Quality.) "Enhancement" means to increase one or more functions or values that an existing wetland possesses. Examples of functions and values include flood control, water quality improvement, habitat provision, and passive recreational opportunities. "Creation" involves the conversion of a persistent upland area into a wetland. (This presumes that the area has not recently been a wetland; otherwise such actions would be considered to be a restoration). (Lewis, 1990)

Restoration projects have been successful where the requisite hydrologic characteristics were returned to the disturbed site (Kusler and Kentula, 1990). This often requires removing fill material, breaching dikes, re-opening tide gates, breaking drain tiles, or allowing abandoned water courses to flow once again. A frequent problem in wetland restoration is the intrusion of unwanted plant species which became established while the mitigation site was upland, but which may persist in or about wetlands. Typical nuisance species in Washington State include reed canary grass, Scot's broom, soft rush, velvet grass, purple loosestrife, and Himalayan blackberry.

Like restoration, wetland enhancement generally has a better chance for success when designed properly since wetland hydrology already exists on-site. Enhancement is only appropriate, however, for seriously degraded wetlands which possess few functions or values (Kruczynski,

1990a,b). It is important to recognize that existing, difficult to replicate functions (wildlife habitat and water quality protection) may be more valuable than "desirable", easy to replicate functions (waterfowl habitat).

To date, artificial wetland creation has been only moderately successful (Eliot, 1985; Kunz et al., 1988; Florida Department of Environmental Regulation, 1991). The limited success of wetland creation has been attributed to a number of factors, including inadequate specific permit conditions by which to evaluate success (Mason and Slocum 1987; Garbisch 1990), failure of regulators to provide sufficient enforcement and monitoring of mitigation measures (Kunz et al., 1988), controversial definitions of success (Zedler and Weller, 1990), loss of habitat diversity (Quammen 1986) and others. Over-steepened slopes, which result in poor vegetation establishment, erosion, and sedimentation, have been blamed for mitigation failures (Reimold and Cobler, 1986; D'Avanzo, 1989; Kruczynski, 1990a). In many instances, creation projects have been deemed "successful" (by the permit applicant) within one year of construction. This is misleading, because at best, an agency may consider a one-year-old wetland to be progressing toward ecological success. This is because many compensation sites may initially appear to be successful, only to fail after a few years.

Assessing ecological success is complicated because while some wetland types can fully develop in a relatively short time span (within several decades), others require significantly longer periods to mature (Golt, 1986). For example, forested wetlands mature over the course of decades to centuries, and bogs form over millennia. Until full maturity is attained, created wetlands cannot fully replicate all functions and values possessed by their naturally-occurring counterparts. In general, many wetlands specialists have expressed concern regarding the comparability of replacement wetlands to natural wetlands (Shisler and Charette, 1984; Eliot, 1985; Golet, 1986; Diel and Deis, 1986; Thom, 1990).

Finally, because of the difficulties in establishing certain habitat types (such as forested wetlands), there is a concern amongst wetland experts that while "no net loss" of wetlands may be achieved on an areal basis, there will be a net loss of particular types of wetlands, and therefore a loss of wetland functions and values.

Examples of Mitigation Options

Numerous articles have been published regarding wetlands restoration, enhancement, and creation projects (Kusler and Kentula, 1990). A summary of these projects is beyond the scope of this report, but thorough compendia of compensatory wetland mitigation literature are available (for example, Kusler and Kentula, 1990; Castelle et al., 1992a,b).

Recommendations

Wetland scientists have developed numerous recommendations for successful wetland restoration, enhancement, and creation. General guidelines for successful creation of wetlands include the following:

- identify and evaluate existing site conditions, particularly hydrology and soil biochemistry;

- provide adequate water (of a quality that meets appropriate regulatory standards) to maintain wetland hydrologic conditions in perpetuity;

- formulate detailed plans on plant sources, planting density, plant tolerances and requirements, and proper grading of slopes;

- identify specific criteria which can be used to measure ecological success of the project, for example, plant survival, bio-mass, soil biochemistry, and wildlife usage;

- establish natural reference wetlands to evaluate success in achieving functional equivalency;

- establish specific permit conditions to evaluate success, monitoring and contingency plans, and implementation and enforcement of permit conditions;

- restore, rather than create or enhance wetlands, although a combination of restoration, enhancement, and creation should be considered; and

- include contingency plans in every banking program. The most likely types of bank site failure should be identified, and appropriate remedial action should be specified.

G. Long-Term Management

A mitigation bank operator is responsible for the short-term management of a banking program, from creating the banking program to constructing the compensation site, depositing credits and deducting debits to mitigation accounts, and maintenance and monitoring of the site until all credits have been withdrawn.

Once all credits have been withdrawn, ongoing mitigation banking activities include monitoring, maintenance, and remedial actions. Without these measures, compensatory mitigation may be only temporary and thus ineffective. These measures comprise the long-term management issues of a banking program. This section summarizes several approaches to the long-term management of banking programs.

Considerations

The long-term mitigation bank manager may either be the original bank operator, or it may be another agency or conservation group.

One advantage of retaining the original bank operator as the long-term manager is that the original operator would be familiar with the bank site and its history (including any problems which have occurred). The funding mechanism, monitoring and maintenance protocol, and procedures for reporting to regulatory agencies will be well established by the time all mitigation credits are issued. A disadvantage of retaining the original bank operator for public agencies may be the inability of the program to absorb unexpected cost increases as well as an overall lack of resources.

When the long-term manager is a public agency, there may be a greater public cost if the expenses for bank operation increase beyond those levels which were taken into account when the credits were withdrawn. If the long-term manager is a non-profit group, then unexpected public expenses are not likely to be incurred. This is because most non-profit or conservation groups have considerably lower operating costs than do public agencies. In addition, entrusting long-term management to conservation groups results in a greater perceived and realized involvement for the community.

In order to provide regulatory compliance during that period in which mitigation credits are being withdrawn, and to provide for the long-term ecological success of the bank site, the short-term operator team could include representatives of the conservation group to which long-term management will be entrusted. Thus continuity in monitoring, maintenance, and remedial action will be preserved in perpetuity.

Examples of Some Long-Term Management Strategies

The Batiquitos Lagoon mitigation bank (Port of Los Angeles) in southern California used a unique and innovative approach for long-term management of bank lands. Private property rights were acquired by the City of Carlsbad, California by purchase of permanent easements or fee title. Ownership was transferred to the California State Lands Commission, which then leased the property to the California Department of Fish and Game to be managed in perpetuity. Funding for long-term monitoring and maintenance of restored and created estuarine wetlands is provided for the first 30 years by receipt of $15 million for deposit in an escrow account from the Pacific Texas Pipeline and Transportation Company and the Port of Los Angeles prior to project construction. In addition, the Port of Los Angeles is required to establish a separate interest bearing account concurrent to establishment of the escrow account, which will be used to finance monitoring and maintenance after the escrow account funds are depleted.

Restored estuarine wetlands associated with the Astoria Airport mitigation bank are to be managed in perpetuity by the Oregon Division of State Lands (ODSL) (OSDL, 1987). Title to the lands was conveyed to ODSL by the Port of Astoria upon bank construction, as provided in the MOA. ODSL is responsible for conducting habitat enhancement actions required to achieve planned habitat enhancement objectives. Management of Astoria Airport Lands was designed and developed to be consistent with the Oregon Coastal Zone Management and the Columbia River Regional Management Plans. The bank, which is a pilot project, was established with federal funds which are no longer available (Short, 1988b).

Recommendations

Long-term management of mitigation banks begins at construction and continues long past withdrawal of all mitigation credits. Long-term management activities center on monitoring, maintenance, and remedial actions. The following recommendations are made for long-term mitigation bank operation:

- both public agencies and conservation groups and/or private nonprofit groups should be involved with mitigation bank management;

- public agency involvement should decrease after all mitigation credits are withdrawn, but agencies should always be responsible for overseeing regulatory compliance; and

- conservation group involvement should increase as the banking program enters the long-term management phase. Monitoring, maintenance, and remedial actions should be their responsibility from the outset of the program.

H. Construction, Maintenance, Monitoring, and Reporting

The format for this section represents a departure from that of those above. Because every potential mitigation banking site will have a different array of biological, chemical, and physical characteristics, it is impossible to identify construction and maintenance alternatives which may be applicable in all cases.

Further, there are few alternatives regarding monitoring and reporting other than establishing the periodicity at which these activities should occur and the particular aspects upon which these efforts might focus. Both of these components must be directly related to the program goals and objectives.

For example, if the objective was to create bird habitat, then the monitoring program would focus upon habitat features and bird populations; for migratory birds, reports could be issued at the end of a migratory period. For resident bird populations, reports could be issued during spring a fall to report mating a fledgling success.

Rather than presenting a discussion and alternatives analysis of these banking components, only general recommendations for construction, maintenance, monitoring, and reporting will be summarized.

<u>Recommendations</u>

The following is a summary of measures recommended by wetlands scientists regarding these mitigation banking components (Kusler and Kentula, 1990).

Successful construction strategies include:

- perform clearing and earth moving activities during relatively dry periods so that soil erosion, surface runoff, and sedimentation are minimized;

- re-vegetate exposed soil surfaces as soon as practical so that soil erosion, surface runoff, sedimentation, and weed invasion are minimized;

- import hydric soil material from the natural wetlands which will be altered to the compensation site. This will provide proper biochemical soil conditions and a wetland plant seed bank. Care should be taken not to import seeds of unwanted

wetland plant species such as reed canary grass or purple loosestrife;

- design the final grading so that permanent wetland hydrologic conditions are created or restored;
- provide frequent supervision from qualified professionals during construction to ensure plans are properly implemented or to recommend modifications; and
- establish adequate upland buffers as a part of the bank site (Castelle et al., 1992c,d).

Important maintenance components include:

- remove unwanted, invasive plant species;
- remove sediments from settling ponds (if installed);
- water plants during times of drought, especially during the first several years of the bank's existence;
- establish adequate upland buffers around the bank site (Castelle et al., 1992c,d);
- remove trash; and
- repair fencing on periphery of site (if installed).

Monitoring of the following factors should be included:

- plant species diversity, percent cover, height, and mortality rates;
- water quality, especially pH, dissolved oxygen, heavy metals (lead, copper, mercury), nitrate, and phosphate. Water samples should be collected from all inflows and outflows and from representative open water areas; soil solutions or pore water from sediments should also be included;
- water quantity during the growing season;
- wildlife usage, especially if wildlife or fish habitat creation is a goal of the banking program; periodic HEP analyses of other appropriate evaluation procedures may be appropriate;
- frequent monitoring should occur for at least 5 years after the banking site has

been completed; subsequently, monitoring should continue at less frequent intervals; and

- water samples should be collected following storm events at least 3 times during each of the first 5 years, and at least annually afterwards.

Reporting standards should include the following:

- summarize the progress of the banking program to provide a means for concerned groups other than the bank operator to assess the relative success of the site, and to document potentially successful mitigation strategies which others may wish to emulate. The results of the monitoring protocol should be summarized in reports which should be made available to regulatory agencies, researchers, conservation groups, development associations, and the general public; and

- if all success criteria are not being met, all or portions of contingency plans should be implemented.

III. Summary and Conclusions

A. Rationale for Mitigation Banking

Wetland mitigation banks involve the off-site creation, restoration, and/or enhancement of wetlands to compensate for unavoidable adverse impacts associated with future development activities (Short, 1988a). Mitigation banking may be appropriate in circumstances where on-site compensation for alterations to wetlands is either infeasible or ecologically undesirable. However, alterations to wetlands should not be permitted simply because a compensation site may exist. As with all mitigation, every effort must first be made to avoid all wetland impacts wherever possible and unavoidable impacts should be minimized, rectified or reduced.

Wetland mitigation banks represent the most recent wetland protection mechanism being considered by state and local governments in an effort to help minimize impacts to wetland systems and to achieve restoration goals. It has become evident that case-by-case wetland protection may not preserve overall function (Castelle et al., 1992a). In other words, current wetland protection methods are not meeting stated policy objectives such as "no net loss." The Federal Highway Administration has worked to implement no net loss of wetlands as a means of compliance with federal and state wetland protection legislation. State departments of transportation are also actively addressing the issue. The Idaho Transportation Department has developed guidelines and is debating the issue, and is developing three large banking sites (Tiedemann, 1988).

State governments have expressed a high degree of interest in wetland mitigation banking, yet very few have begun to implement banking programs. For instance, Maryland and Delaware, states which currently have comprehensive wetland protection programs, have developed policies directing future mitigation banking programs, but have not currently developed those programs. The California Department of Fish and Game has developed draft guidelines, but the state legislature has not created policy or funding for implementation of these guidelines. Most state and local jurisdictions contacted for this report expressed interest in the concept of wetland mitigation banking, yet very few have started to address the issue in any substantive way. Funding and guidance seem to be the most important components limiting current wetland mitigation banking programs (see Appendix B).

B. Effectiveness

Because wetland mitigation banking is a relatively new concept, and because several years are required to create a mitigation bank once a decision to implement a banking program is reached, it is too early to accurately assess the effectiveness of many such programs. On a smaller scale, the effectiveness of individual mitigation projects is often difficult to evaluate. Many follow-up studies of permitted wetland alterations have found low rates of compliance with mitigation requirements (Eliot, 1985; Kunz et al., 1988; Florida Department of Environmental Regulation, 1991). For example, the five-year Florida Department of Environmental Regulation (DER) study found only 6% of all permits to be in full compliance (Florida DER, 1991).

Although mitigation banks can provide a coordinated programmed approach to wetland restoration, creation, and enhancement projects, they are a relatively new mitigation tool (Short 1988a). Most banks have not been monitored long enough to determine if they are ecologically

successful. In some cases, lack of provision for long-term monitoring and evaluation has made assessment impossible. Of eight mitigation banks reviewed by Short (1988a), one bank could be classified "successful"; three more demonstrated "some degree of success"; there had been no monitoring and therefore no determination was possible on one bank; and the remaining three banks were too new to adequately assess success.

Many compensatory mitigation projects have failed due to the fundamental administrative and technical difficulty for wetland scientists and planners in creating, restoring, or enhancing wetlands. These problems are not unique to individual compensation projects and affect mitigation banking as well. Few studies have directly addressed banking systems; many scientific investigations, however, have been performed on individual compensatory wetland mitigation projects. The results of many of these mitigation projects are not encouraging: many such projects have failed to produce viable wetlands; others which have been termed "successes" by their proponents have been established too recently to obtain a true assessment of their replication of wetland functions and values.

Some of the common factors cited in failed mitigation include poor planning, lack of specific mitigation goals and objectives, failure to implement and enforce permit conditions, and a general lack of knowledge of wetland functions and processes (Kusler and Kentula, 1990). Some wetlands are too complex or too poorly understood from an ecological perspective to be constructed (e.g., forested wetlands and bogs). Restoration projects have often failed because proposed mitigation was not properly implemented or maintained following construction and planting.

Many public policy specialists consider mitigation banking to be a manifestation of agencies' collective failure to preserve individual wetlands where they occur naturally in the landscape. There is a concern, especially among environmental groups and many wetland scientists, that the creation of wetland banks will relieve developers and farmers of the responsibility of implementing successful mitigation projects; thus mitigation banking should be employed as a last option, when on-site compensation for unavoidable or otherwise unmitigable impacts is either infeasible or not desirable from a natural resources perspective (Nelson, 1990). As an unnamed respondent to a recent survey of wetland public policy (Nelson, 1990) stated, "[b]anks that simply finance public purchase of other wetlands still result in a net loss of wetlands. Banks should be designed to restore or create equivalent amounts of wetlands. I know of no instances where a bank is being used to compensate for agricultural conversions." Another respondent commented, "[I]f the economics are there for the conversion [from wetland to upland], any mitigation charge will just be another cost of doing business. I have not seen that acre-for-acre 'mitigation' or 'mitigation banking' has deterred any wetland conversion project."

C. Mitigation Banking in Washington

Few communities in Washington are actively implementing mitigation banking programs (see Appendix B). Those that are (for example, the City of Auburn) are at least partially located in riverine floodplains.

Historically, these floodplains contained a continuous series of large, high quality wetlands. Drainage "improvements" (such as diking and ditching) within the floodplains and the surrounding hillslopes have altered the natural hydrology so that many historic wetlands are now uplands.

Further, many of the remaining wetlands are relatively small (less than 1 acre) and have become isolated from other aquatic resources. Development and neglect has also degraded many of these wetlands so that they are of low functional value.

These cities, and potentially other communities in similar physiographic settings, are candidates for mitigation banking programs because: (1) developers will continue to propose projects which would impact their small, degraded wetlands; (2) on-site compensatory mitigation for disturbances to these low value wetlands is not always feasible or desirable from a wetlands and wildlife perspective; and (3) large areas which were historically wetland may still be available for restoration as compensation for unavoidable wetland impacts.

Mitigation banking may also be appropriate for Washington public works projects such as highway construction or road re-alignments. Projects like these may impact several small wetlands or several small portions of large wetlands. On-site compensation for these impacts would necessarily place the replacement wetlands near roadways; off-site compensation may afford opportunities to place buffers between wetlands and roadway disturbance.

D. Guidelines for Successful Mitigation Bank Creation

This final section outlines the process necessary to establish a successful wetland mitigation banking system. Short (1988b) developed a flowchart for determining when mitigation banking is appropriate. In this approach, the following questions are asked.
If the answer to each of these questions is "yes," then banking should be considered as a mitigative strategy:

- Do the projects for which the mitigation bank is being established require federal and/or state wetland permits, or are they small federal projects?
- Will there be several small projects involved with unavoidable losses that would be difficult or impossible to mitigate on an individual basis?
- Are other mitigation possibilities limited or nonexistent?
- Will the permit applicant(s) support off-site mitigation?
- Will the expected expenditure of time and money be worth it in terms of what will be gained from a mitigation perspective?
- Will the projects be planned and strictly operated in accordance with applicable federal and state regulations?
- Is there a commitment from all involved parties that the bank, once established, will not be used as a substitute for proper project planning or as assurance of blanket approval of future permit application?

A critical step, therefore, in developing a wetland mitigation bank is to determine if there will be development projects for which compensation for unavoidable or otherwise unmitigable wetland impacts could best be made via such a program. In order to determine the degree to which future

development may adversely impact wetlands, a wetlands inventory must be completed. The wetlands inventory map should be overlaid with a zoning map to identify potential areas of conflict (land zoned for development which has been identified as wetland). The field component of the wetlands inventory should also identify potential bank sites.

Because one of the advantages of a mitigation bank is that all compensation is accomplished in advance, the bank site must be purchased and replacement wetlands must be established on the site. Therefore, funding must be found to provide for the initial land purchase; for the creation of restoration, creation, or enhancement plans; for the actual construction costs; for maintenance, monitoring, and reporting; for remedial actions in the event that difficulties arise in successfully establishing a functional wetland; and for personnel to administer the permitting process which will allow project proponents to pay into the bank itself.

The following is an example of a mitigation bank development outline used to create a wetland mitigation bank in Portland, Oregon (Shirey, 1991):

- retain consultant team comprised of wetland specialists, hydrologists, and landscape architects;
- form Technical Advisory Committee composed of landowner, developer, regulatory, and conservation interests;
- inventory wetlands;
- evaluate wetland functions and values;
- determine high value wetlands to be preserved;
- determine moderate to low value wetlands to be enhanced for mitigation or filled for development;
- locate mitigation bank site; and
- protect mitigation sites by using eminent domain.

Mitigation banks can provide permit applicants and resource agencies with a simpler, more predictable process for complying with compensatory mitigation requirements. Further, mitigation banks can theoretically provide higher wetland functions and values by avoiding habitat fragmentation, by creating larger wetland systems, and by placing the planning and care of the mitigation site into the hands of wetland specialists.

Designing and implementing a wetland mitigation bank requires tremendous resources, including funding, land, personnel, and time to coordinate the many concerned parties. The most successful mitigation banks are those which are designed to meet the specific mitigation needs of a particular jurisdiction and will meet these needs by satisfying regional restoration and creation goals (Riddle, 1986).

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Appendix A: Glossary

Bank Developer or Operator: a legal entity established to acquire land, to create or restore and maintain wetland habitat upon that land, and to operate said land as a mitigation bank.

Best Management Practices (BMP's): physical, structural, and/or managerial practices that, when used singly or in combination, prevent or reduce pollutant discharges.

Buffer: a designated area along the perimeter of a stream or wetland which is regulated to control the negative effects of adjacent development from intruding into the aquatic resource.

Constructed Wetland: a facility that exhibits wetland characteristics but was constructed for the express purpose of performing a utility need, such as a sedimentation pond, and is not eligible for mitigation credit or subject to the jurisdictional requirements of federal and state wetland law.

Created Wetland: for the purpose of receiving mitigation credit, the alteration of soils, hydrology, and plants to produce a wetland where no wetland previously existed.

Enhancement: an improvement in the functions and values of an existing wetland.

404 Permit: a permit issued by the U.S. Army Corps of Engineers under Section 404 of the federal Clean Water Act which authorizes an activity (filling) within water of the United States, including wetlands. A 404 permit usually requires compensation or mitigation adverse impacts.

In-Kind Compensation: compensation for lost wetland habitat with a replacement wetland of the same habitat type.

Mitigation Bank: a single contiguous parcel of land consisting of non-wetland habitat which has undergone those physical changes necessary to create and optimize the acreage and quality of wetland habitat on the site. The express purpose of creating the wetland is to provide mitigation credits to offset future adverse impacts to wetlands from approved projects elsewhere.

Mitigation Credit: a unit of measured area or other appropriate currency supporting wetland function and values not pre-existing at the bank site prior to bank development.

Mitigation: (as per WAC 197-11-766):

- Avoiding the impact altogether by not taking a certain action or parts of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its

implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;

- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;

- Compensating for the impact by replacing, enhancing or providing substitute resources or environments: and/or

- Monitoring the impact and taking appropriate corrective measures.

Out-of-Kind Compensation: compensation for lost wetland habitat with a replacement wetland of a different habitat type.

Project Proponents: public and private entities acting on their proprietary or management capacity which have received all of the permits or other clearances necessary to implement a project which would unavoidably and adversely impact wetlands and who seek to compensate for the loss of the wetland acreage or function through participation in a mitigation bank.

Regional Permit: a general permit issued to a local governmental entity by the U.S. Corps of Engineers. Once issued, the regional permit authorizes the local government to issue individual wetland impacts permits to those areas identified for development.

Restoration: to improve a disturbed or altered wetland by returning wetland parameters which may be missing. The restoration may return an original wetland habitat or may alter the wetland for some other desired outcome.

Section 404 Permit: see "404 Permit".

Appendix B: Existing Mitigation Banking Programs

Following are summaries of existing state and local wetland mitigation bank programs. It became evident in the early stages of this project that very few state or local jurisdictions had developed wetland mitigation banking programs. It also became obvious that the concept of centrally located larger wetland rehabilitation or creation projects is a shared goal of these jurisdictions as they attempt to implement particular wetland protection legislation. Often policy objectives of "no net loss" or "retention of existing functions and values" continue to be compromised or threatened by large projects such as highway construction or by increased development pressure. The implementation of wetland mitigation banks may help ease some of this pressure and help realize policy objectives. As wetland costs escalate and available land for creation becomes more scarce, wetland mitigation banking and restoration efforts seem to represent the next stage in the development of wetland protection programs. Implementation of wetland mitigation programs has been slow due to the fact that wetland creation success is still very uncertain, and there appear to be few wetland mitigation banking programs in existence with a track record of significance. Initial funding is also a considerable obstacle for many jurisdictions.

Mitigation banking programs exist at the federal, state, and local level. Following is a summary of major banking programs.

A. Federal Programs

Federal Highway Administration: Of the federal agencies contacted for this study, the Federal Highway Administration (FHWA) is taking the most active role in mitigation banking. The FHWA provides funding for highways throughout the United States and is therefore a major project proponent. Many of these highways impact wetlands, and consequently, the FHWA has been proactive in wetland mitigation issues.

For example, the FHWA funded the early development of the wetland assessment technique by Paul Adamus. Currently, the FHWA is involved in a major wetland mitigation study being carried out by the National Cooperative Highway Research Program (NCHRP) under the auspices of the National Academy of Sciences (Jeff Homann, URS Consultants, Planning and Environmental Systems, Cleveland, Ohio, pers. comm. 4/91). FHWA's approach to wetland mitigation banking is primarily to support and possibly fund state transportation departments' banking programs. The agency has no internal guidelines on mitigation banking.

The agency's five-year re-authorization legislation this session contains provisions for advancing federal aid to states for mitigation banks. There is presently no federal funding available, and the state transportation programs which are involved in banks are funding their own programs.

According to a senior FHWA official (Contact: Dr. Larry Foote 612-296-1637), Minnesota has the most advanced program in the nation, followed by Louisiana (Contact: Vince Pizzolato 504-929-9190) and North Carolina (Charles DesJardins, U. S. Federal Highway Administration, Environmental Quality Branch, pers. comm. 4/91).

B. State Programs

California: The California Department of Fish and Game (DFG) is developing a policy on wetland mitigation banking (DFG Guidelines for the Establishment and Use of Wetland Mitigation Banks, December 1989 draft). Guidelines are being prepared in response to a Wetlands Resources Policy adopted by the Fish and Game Commission in January 1987. The policy states that the Commission shall seek to provide for the protection, preservation, restoration, enhancement and expansion of wetland habitats.

DFG recognizes that it is not always possible to avoid impacting wetland habitat, and that on-site mitigation is at times either infeasible or undesirable from a biological perspective. To promote consistent treatment of off-site mitigation alternatives, DFG will require its personnel to adhere to the guidelines. Any deviations from the guidelines will require prior authorization from the Director of the Department of Fish and Game.

The guidelines do not yet represent DFG policy, but the Department generally prefers the mitigation banking approach to mitigation as opposed to project-by-project review. In the latest draft of the guidelines (November 1990), DFG is requiring that the mitigation bank area be located within 40 miles of the site where wetlands will be impacted. Mitigation ratio requirements are 2:1 (two acres of wetland must be restored or enhanced for each one acre which is impacted). This standard has been reduced from 3:1 in the earlier draft.

DFG is considering a new idea of allowing only 1:1 mitigation when an individual private or public project proponent establishes and operates its own bank. This solution is preferred because DFG believes that the administration and implementation of the bank would be superior in quality to a cooperative venture among agencies and proponents (Glenn Rollins, State of California, Department of Fish and Game, Wildlife Management Division, pers. comm. 4/91).

The guidelines contain detailed standards and criteria for bank establishment, pertaining to financial arrangements, project-specific operation and monitoring plans, conditions for the use of the bank, cost of compensatory mitigation credits, special provisions if sensitive species are present, administrative requirements, and special provisions for vernal pools. Among these standards are provisions that mitigation banks contain no less than 50 acres of newly-created wetland habitat, and that the bank area be adequately buffered from "the effects of foreseeable future adjacent land uses."

Use of a mitigation bank cannot result in a net loss of either wetland acreage or wetland habitat values. Mitigation must be "in-kind" wetland habitat unless the Director determines, on a case-by-case basis, that the resource is better served by "out-of-kind" wetland habitat. Coordination with other resource management agencies, such as the U. S. Fish and Wildlife Service, is required

where appropriate.

The ultimate fate of the guidelines is not known. A bill proposed in the California state legislature this session would require DFG to adopt administrative regulations for mitigation banks. One possible outcome of a formal rule-making process would be compromises to the current requirements proposed in the guidelines. Guidelines endorsed by DFG at the department level would allow DFG more flexibility in interpreting and applying the mitigation banking program.

Delaware: The draft Freshwater Wetlands Act is currently being reviewed for approval. This proposed regulation strives for no net loss of the state's remaining freshwater wetland base, and where feasible, for an increase in the quantity and quality of Delaware's freshwater wetlands. Compensatory mitigation banking may be authorized under the proposed act, but the Act does not address any standards or criteria for a banking program.

A Wetlands Management and Conservation Plan would be prepared by the state Department of Natural Resources and Environmental Control within 18 months of the adoption of the Freshwater Wetlands Act. The plan would include possible sites for compensation banking where restoration, creation, and enhancement could be implemented, and would also establish standards and criteria for the establishment, licensing, and operation of compensation banks.

Idaho: The Idaho Transportation Department (ITD) developed the framework for establishing a mitigation bank as a result of the direction given by Executive Order 11990, "Protection of Wetlands." ITD was able to develop a fully executed MOA on mitigation banks, entitled "Memorandum of Agreement for the Development and Use of Wetland Bank in Idaho." Signatories to the agreement include the ITD, FHWA, U. S. Army Corps of Engineers, U. S. Environmental Protection Agency, U. S. Fish and Wildlife Service, Idaho Department of Fish and Game, Idaho Department of Water Resources, Idaho Department of Lands, and Idaho Department of Health and Welfare (MOA 1987).

The MOA cites numerous federal and state authorities for its implementation, including the Clean Water Act, National Environmental Policy Act, Executive Order 11990, Preservation of the Nation's Wetlands (DOT Order 5660.1A), and other authorities. The MOU then establishes areas and activities for which wetland banking may be considered, criteria for location and development of a wetland bank, criteria for use of a wetland bank, evaluation methods and other implementing measures.

In addition, ITD has developed detailed operating procedures which result from the MOA and are intended to further define and implement the MOA. In general, 1:1 mitigation is required, but this may be either increased or decreased on a case-by-case basis. In accordance with FHWA policy, "in-kind" wetland replacement outside of roadway right-of-way is acceptable only when "in-kind" replacement within the right-of-way is impossible or "extraordinarily expensive." The "Habitat Evaluation Procedure" (HEP) is used as an indexing tool for mitigation banks and for evaluating compensation credit values. WET II analysis is used to evaluate less obvious functions and values of potentially impacted wetland sites.

At this time, ITD has three mitigation bank areas identified and in the process of development. One of the areas is a 150-acre fish and game management area. A dike was installed and an additional well was provided to help regulate water levels. Unfortunately, this enhancement project has been the victim of recent drought in the area. The on-site well was not installed to augment this lack of water, so rehabilitation of the marsh has been slowed. Enhancement at this site is estimated to cost approximately $233.00 per acre. Another enhancement site is located in a severely overgrazed wet meadow. Cattle exclusion and natural recovery combined with the WET monitoring program is the management program at this site; this site is estimated to cost $500.00 per acre. The third site is a 21.1 acre creation project within an abandoned borrow pit. This area has been graded to specifications at this time and seeding is scheduled for the fall of 1991. Costs are estimated to be $559.00 per acre.

At this time, no claims have been filed through the Idaho Transportation Departments Mitigation Bank Program. These banks are designed to receive banking credits from areas throughout the state. Guidelines for the location of wetland banks state that they should be as close to the proposed impact as possible and within the same hydrologic basin. Guidelines further state that the same sector of the public affected by the impact should be compensated by the bank (R.B. Tiedemann, Idaho Transportation Dept., pers. comm. 4/91).

Maryland: Wetlands in the state of Maryland are regulated by the Department of Natural Resources through the Non-tidal Wetland Protection Act (1989). It is the goal of this act to achieve overall no net loss of wetland acreage and function, and to strive for a net resource gain in non-tidal wetlands. Mitigation banking may be authorized under the Act, but no precise plan has been established. Mitigation banking may be approved only if it is determined that creation, restoration, or enhancement of any on-site or off-site non-tidal wetlands is not feasible. Mitigation bank sites are subject to numerous standards which apply to all proposed mitigation projects; these include specific compensatory mitigation replacement ratios, development of specific success criteria, and comprehensive monitoring plans.

Monetary compensation may be accepted in lieu of mitigation if it is determined that compensatory mitigation for wetland losses is not a feasible alternative and the permittee or person conducting an activity must prove, through an extensive investigation, that compensatory mitigation is not feasible. Funds provided by the project proponent go into the Non-tidal Wetland Compensation Fund. These funds may be used only for the creation, restoration, or enhancement of non-tidal wetlands. Monetary compensation fees would be based on costs anticipated in the construction of certain mitigation projects, taking into account the size and type of wetland being lost.

Oregon: As of this writing, the only specific authority which has been identified for establishing wetland mitigation banks in Oregon is contained in the Administrative Rules for Estuarine Mitigation in Oregon Estuaries (OAR 141-85-256(17), which acknowledges mitigation banks as an option. According to an official at the Oregon Department of Transportation, mitigation banking has not yet come to fruition in Oregon, although it has been discussed and debated

(Pieter Dykman, State of Oregon, Department of Transportation, Salem, pers. comm. 4/91).

The City of Eugene is currently coordinating with numerous state and federal agencies in the West Eugene Wetlands Study, which may result in the establishment of a mitigation bank; the study is still in the early stages of development (Debra Evans, City of Eugene, Public Works, pers. comm. 4/91). The result of this activity will be the creation of a wetlands Special Area Management Plan (SAMP). This plan is intended to allow areas which have a large percentage of wetlands to achieve a balance between development and wetlands conservation. As part of a SAMP, the U.S. Army Corps of Engineers issues a "regional permit" to a municipality. The regional permit authorizes a municipality to issue individual wetland impact permits to those areas identified for development by the SAMP. The creation of a wetland bank is an integral part of the SAMP development process (Ken Brunner, Corps of Engineers, pers. comm. 4/91).

Oregon has also been experimenting with a mitigation bank in Clatsop County in the Young's Bay area. The goal is to restore 36 acres of tidal wetlands which have been lost primarily to agricultural diking. The Oregon Division of State Lands (ODSL) has been exploring a cooperative arrangement with the Port of Astoria, which owns the parcel. The state would like to buy the land from the Port, and relocate the dike which is cutting off tidal circulation to the wetland. The state would then sell the mitigation credits.

ODSL staff state that they have learned from this project that since restoration is still in the experimental stages, the best way to derive wetland protection and ecological value from mitigation is for the public to operate the banks (Bierly 1987a,b). In addition, ODSL has found that the piecemeal approach to mitigation on a project-by-project basis has not resulted in significant ecological values. Mitigation banks offer the potential for managing a larger parcel in a more scientific manner, thereby resulting in greater compensation to the public for lost wetland values (Bierly 1987a,b).

C. Programs in Washington State Counties

None of the seven counties (King, Kitsap, Pierce, San Juan, Snohomish, Thurston and Whatcom) contacted had any mitigation banking policies in place. Representatives from the counties thought that banking was a good idea, but most were still involved in perfecting basic requirements for wetlands protection. Those counties, such as King County, that have recently developed a sensitive areas ordinance, do not anticipate making any amendments in the near future.

D. Programs in Washington State Cities

Of the ten cities reviewed (Auburn, Bellevue, Bellingham, Des Moines, Everett, Redmond, Renton, Tukwila, Federal Way, and Kirkland), two have integrated compensatory mitigation banking into their regulatory programs. A third, Bellingham, has included mitigation banking and fee-in-lieu mitigation in its proposed wetlands protection program. Chris Spens (City of Bellingham, pers. comm. 3/91) is in favor of banking, because it allows for alternatives to on-site compensatory mitigation when buildable space is already very limited. Fees paid in lieu of compensatory mitigation will be assessed by the city based on the value of wetlands being lost and the costs associated with replacing those values.

The City of Auburn, in conjunction with the City of Kent, is working with the U.S. Corps of Engineers to develop a mitigation bank. No precise plan has yet been established. The City of Mill Creek is also identifying potential sites for creation of a mitigation bank. The City of Everett recently adopted an Environmentally Sensitive Areas ordinance which contains provisions for mitigation banking.

No other cities contacted had any mitigation banking policies. Most of these cities are just beginning to address mitigation for loss of wetlands. While no individuals expressed opposition to the concept of mitigation banking, none of the cities have formal policies on banking at this time.

Appendix C: Information Sources

Information was obtained from a review of published literature as well as from oral and written personal communications. The following sources of information were utilized:

Computer Search Programs:
AFSA; Enviroline; Water Resources; NTIS; Pollution; Life Sciences; AGRICOLA; and Biosis.

On-line library collections:
University of Washington libraries: Natural Sciences; Fisheries; Forestry; Engineering; and Architecture.

Existing Bibliographies:
King County Sensitive Areas Ordinance Bibliography (1990); Wetland Mitigation Replacement Ratios: An Annotated Bibliography (Castelle et al., 1992b); Wetland Buffers: An Annotated Bibliography (Castelle et al., 1991c); Wetlands Protection (USEPA Bibliographic Series, 1988).

Research Centers:
Natural Resources Research Institute (Duluth, MN); Center for Wetlands (University of Florida, Gainesville); School for Oceanography (Louisiana State University, Baton Rouge); College of Forest Resources (University of Washington, Seattle); College of Forestry (Oregon State University, Corvallis).

Washington State Agencies:
Department of Ecology; Puget Sound Water Quality Authority; Department of Fisheries; Department of Transportation.

Federal Agencies:
Federal Highway Administration; U.S. Fish and Wildlife Service; U.S. Soil Conservation Service; U.S. Forest Service; Environmental Protection Agency; U.S. Army Corps of Engineers.

State Agencies:
California Department of Fish and Game; Oregon Department of Transportation; Idaho Transportation Department; Maryland Department of Natural Resources; Delaware Department of Wetlands and Aquatic Protection.

County Planning Departments:
King; Kitsap; Pierce; San Juan; Snohomish; Thurston; Whatcom.

City Planning Departments:
Auburn; Bellevue; Bellingham; Des Moines; Everett; Federal Way; Kirkland; Redmond; Renton; Tukwila.

Professional Organizations:
Association of State Wetland Managers; Environmental Law Institute.

Environmental Organizations:
Audubon Society; Conservation Foundation; Geraldine R. Dodge Foundation.

Individuals Contacted:
J. Hoffmann, URS Consultants, Cleveland, Ohio; G. Rollins, California Dept. of Fish and Game; P. Dykman, Oregon Dept. of Transportation; D. Evans, City of Eugene Public Works; R.B. Tiedemann, Idaho Transportation Dept.; Ann Redmond, Florida Dept. of Environmental Regulation; P.E. Shirey, Portland Development Commission; A.D. Laderman, Ph.D., Swamp Research Center, Woods Hole, Massachusetts; R.R. Lewis, Lewis Environmental Services, Inc., Tampa, Florida.