WEST EUGENE WETLANDS: AN EXPERIMENTAL MITIGATION BANK MODEL

by

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A 1988 metropolitan area habitat study commissioned by Lane Council of Governments identified 765 acres of freshwater wetlands in west Eugene on land which is largely zoned for light industrial use. These wetlands are remnants of a once extensive wet prairie ecosystem in the southern Willamette Valley. Under authority of Section 404 of the Clean Water Act of 1977, any future development on these wetlands will require mitigation in the form of wetland creation, restoration, or enhancement to replace lost values.

I propose a pilot mitigation bank be established in the west Eugene vicinity to protect existing wetlands, create new ones, and restore degraded wetlands. The proposed organization, location, and financing of the bank is

based upon an examination of state and federal law, the west Eugene wetland ecosystem, the status of creation/restoration technology, and preliminary data characterizing the west Eugene wetlands.

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CHAPTER I

INTRODUCTION

Topic and Concerns

A 1988 study conducted for the Lane Council of Governments identified 765 acres of wetlands in west Eugene (West Eugene) which may be subject to regulation under Section 404 of the Clean Water Act of 1977 (Lev & Lane Council of Governments, 1988). West Eugene wetlands are the remaining fragments of a once extensive wet prairie in the southern Willamette Valley (Johannessen, Davenport, Millet, & McWilliams, 1971; Kauffman, 1988). During the last one hundred years, this wet prairie has been seriously affected by drainage for agriculture, fire suppression, the introduction of alien species for crops, flood control, and urban encroachment.

In recognition of the ecological importance of wetlands, the Oregon legislature recently passed Senate Bill 3 (1989). The new law strengthens Oregon's regulatory program for wetlands. Section 3 of Senate Bill 3 establishes the following state policies: "maintain a stable resource base of wetlands through the mitigation of losses of wetland resources," and "establish the opportunity to increase wetland resources by encouraging wetland restoration and creation where appropriate."

This thesis is concerned with how West Eugene could be managed to preserve and enhance the wetlands found there. I propose the establishment of a regional mitigation bank for the purposes of protecting rare wetlands, reclaiming altered wetlands, and creating new wetlands. The design of the mitigation bank is based upon an examination of the following questions in the light of current knowledge:

What is the legal status of wetlands?

What are the values of West Eugene wetlands?

How do the local public perceive the values of West Eugene wetlands?

How effectively do wetland creation or restoration projects recover lost values?

What are the prospects for successful wetland creation and restoration projects in West Eugene?

Which West Eugene wetlands should be preserved?

What kinds of wetlands should be created? Where?

Who should administer the mitigation bank and how will it be funded?

Finally, I consider the potential economic and social implications of mitigation banking from the perspective of the environment. A successful West Eugene mitigation bank could become an important model for integrating wetland ecosystems with human economic activities.

Underpinning the subject of wetland conservation is the status of current law, because federal and state legislation and subsequent court decisions have been powerful forces guiding the direction of wetland conservation. In Chapter

II, I examine Section 404 of the Clean Water Act of 1977 which provides the regulatory authority for federal wetland programs, and defines the precise roles federal agencies play in administering Section 404. In addition, I look at Oregon's own regulatory program which, in its turn, attempts to augment the federal program by creating another layer of scrutiny over wetland activities. Finally, I survey how Oregon's statewide planning program currently deals with wetland conservation issues.

In Chapter III, I explore the general subject of West Eugene wetlands in depth. I examine the recent history of local conservation efforts, the West Eugene setting, the types of wetlands involved and their plant communities, the historic wetland landscape, the soils and wildlife, and the management issues at stake. The chapter ends with some preliminary data on how the local public view wetland issues.

In Chapter IV, I investigate the viability of wetland creation and restoration as a management option based upon a review of selected projects. Since the City of Eugene has promoted West Eugene for industrial development, the likelihood of conflict between development and wetland conservation is high. State and local governments may seek to permit development on West Eugene wetlands with the requirement that replacement wetlands are created elsewhere as mitigation. However, the effectiveness of wetland creation must be studied to understand both its risk and potential. Chapter IV concludes with identification of documented procedural and technical problems which plague wetland creation and restoration attempts.

In Chapter V, I discuss the known values of West Eugene wetlands and identify important wetlands which could be preserved and enhanced. In the interest of protecting and increasing the wetland base in the vicinity of West Eugene, I propose a management scheme for West Eugene based upon an experimental mitigation bank.

Why Are Wetlands Important?

Public discussions of the relative values of wetlands are strongly anthropocentric. While wetlands perform an array of "invisible," but essential, ecological functions, their low economic status has been a prime factor in their continued destruction. However, wetlands contribute numerous, demonstrable benefits to society which deserve better consideration in the future.

Kusler (1983) has written that wetlands have value for flood conveyance, flood storage, sediment control, pollution control, fish and wildlife habitat, water supply, aquifer recharge, and habitat for rare and endangered species. Kusler recognized the following values which directly benefit humanity: food and timber production, recreation, historical archaeology, education, research, and open space. Additionally, wetlands serve vital ecological functions; wetlands act to produce oxygen, recycle nutrients, absorb chemicals, and regulate micro- and macroclimates (Tiner, 1984).

While it is easy to acknowledge general wetland values, schemes to evaluate and quantify wetlands are laden with problems. Mitsch and Gosselink (1986) have identified several "generic" problems that evaluation methods must

confront. First, wetlands are multiple-value systems, and it is difficult to equitably compare different values or determine the overall value of the combined whole. In order to rate two dissimilar wetlands, an evaluator must compare and weigh different functional attributes; the outcome may depend more on the evaluator's judgement than the intrinsic ecological value of the involved wetlands. Second, the most valuable products of wetlands benefit the public, but not the private wetland owner. Wetlands support wildlife and perform healthful ecological services, but these products offer no capital return to the landowner. Therefore, regulations that protect privately owned wetlands for public benefit are viewed as being at the owners expense. Third, the value of a wetland cannot be determined simply by its size. For example, as wetlands decrease in area they may become more valuable as wildlife habitat; however, when a wetland reaches a certain minimum size it may no longer support any wildlife. Yet, the ecological value of a wetland has to be based in part upon its interspersion with the total regional ecosystem, because even a small wetland may provide critical habitat for migratory species for a few days or weeks each year. Fourth and last, although commercial values are relatively short-term, wetlands provide values in perpetuity. Once wetlands are altered by draining or filling, subsequent changes in the local hydrology may make development irreversible, and the public benefits provided by these wetlands will be lost forever. Therefore, the long-term implications of development should be considered in evaluating wetlands.

Current Status of U.S. Wetlands

Prior to the Federal Water Pollution Control Act of 1972 over one-half of the original, native wetlands in the continental United States were lost (Tiner, 1984). At the time of European settlement two centuries ago, approximately 215 million acres of wetlands may have existed, but by the 1970s, the wetlands in the mainland U.S. had dwindled to 99 million acres. During a twenty year period from the mid-1950s to the mid-1970s, the annual rate of wetland loss in the U.S. averaged 458,000 acres, including adjustments for wetland creation (Tiner, 1984).

Using the above annual rate of loss to estimate the current acreage of remaining wetlands, an additional 6 million acres may have been altered since the mid-1970s. Thus, by 1988, over 120 million acres of wetlands may have been lost or to some degree functionally impaired--an area 15 percent greater than the entire State of California.

Although wetlands occur within every state in the country, wetlands comprise only a minor part--less than 5 percent--of the total land surface in the vast majority of states (Tiner, 1984, p. 28). The following states currently contain the greatest relative abundance of wetlands: Alabama, Alaska, Arkansas, Connecticut, Delaware, Florida, Georgia, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Mississippi, New Jersey, Rhode Island, Maryland, North Carolina, North Dakota, South Carolina, South Dakota, and Wisconsin. Of these states with considerable wetland acreages, three have the

largest acreages: Alaska, Louisiana, and Florida. In particular, Alaska possesses the greatest concentration of wetlands in the United States, although an accurate inventory is not yet available. If tundra is accepted as wetland, then Alaska is estimated to possess as much as 200 million acres of wetlands--over 53 percent of the state's total land base and twice what remains in the continental U.S. (Tiner, 1984).

The conversion of wetlands for agricultural purposes poses the greatest threat to U.S. wetlands. Tiner (1984, p. 31) attributes the drainage of wetlands for agriculture as responsible for 87 percent of all recent wetland losses. Of the remaining balance, urban development is responsible for 8 percent and miscellaneous development the remaining 5 percent.

Status of Oregon's Wetlands

At present, accurate data delineating the boundaries of Oregon wetlands are not available. The U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) for Oregon is incomplete; data are lacking for areas in the Cascade Range and the Columbia Plateau (Oregon Division of State Lands & Oregon Parks and Recreation Division, 1988). The NWI for Oregon is being prepared using high resolution aerial photographs. When completed, the NWI for Oregon will initially serve wetland managers only as a general guide until inventoried wetlands have been "ground-truthed" (Peters & Harrison, 1988). Furthermore, since the National Wetlands Inventory fails to identify small wetlands less than four acres in size, the NWI will not provide a comprehensive

inventory of Oregon's wetlands (Ketcham, 1988). To date, the State of Oregon has compiled a partial inventory of coastal estuaries based upon interpretation of aerial photography, but this inventory includes detailed maps for only seventeen large estuaries (Oregon Division of State Lands & Oregon Parks and Recreation Division, 1988). In sum, a precise inventory of Oregon's wetlands is not yet available and may not be completed for several years.

A reliable estimate of wetland losses in Oregon's coastal estuaries is not yet available. Boulé and Bierly (1987) attribute Oregon estuarine losses primarily to diking tidal wetlands for agricultural use. According the Shaw and Fredine (1956), the federal Swamp Lands Acts of 1849, 1850, and 1860 actually encouraged the destruction of estuaries and freshwater wetlands as national policy by offering free land to homesteaders who would dike and drain wetlands. The largest Oregon estuaries have been reduced in size by 50 to 95 percent as a result of diking, filling, and dredging (Boulé and Bierly, 1987).

Losses of freshwater wetlands in the Willamette Valley are not well documented. An unpublished analysis by Baker (1981) estimates that the Willamette Valley now possesses as few as 200 acres of an original 150,000 to 350,000 acres of Deschampsia cespitosa wetland prairie (Oregon Division of State Lands & Oregon Parks and Recreation Division, 1988, pp. 45-6).

A statewide assessment of freshwater riparian wetland losses has not been performed (Oregon Division of State Lands & Oregon Parks and Recreation Division, 1988). Frenkel, Wickramoratne, and Heinitz (1984) analyzed aerial photographs to assess vegetative changes from 1972 to 1981

in riparian areas along the Willamette River in Linn and Benton Counties. This study found 80 percent of the recent losses in riparian vegetation along the Willamette River due to agricultural conversion of riparian areas.

In summary, the history of wetland losses underscores the importance of protecting the nation's remaining wetlands. Curbing losses will require changes in the way wetland development is permitted, and an ideological shift in the way we perceive the economic value of wetlands. The current management questions concerning West Eugene wetlands embody at a local level the predicament confronting wetlands all over the nation. Therefore, the significance of what is decided for West Eugene must be understood to have implications for the fate of wetlands elsewhere.

CHAPTER II

SOURCES OF WETLAND REGULATION

In order to explain recent interest in the conservation of West Eugene wetlands, it is first necessary to examine the development of laws intended to promote their conservation. I will examine federal wetland legislation and explore the regulatory roles of the involved federal agencies. Next, I will discuss Oregon's wetland laws and the regulatory role of Oregon Division of State Lands.

Federal Law in the Regulation of Wetlands

Section 404 and the U.S. Army Corps' Regulatory Role

The Rivers and Harbors Act of 1899 first gave the U.S. Army Corps of Engineers authority to regulate dredging, filling, and construction activities in navigable waters of the United States, and prohibited the dumping of refuse into navigable water bodies without permission. Under the 1899 Act, the Corps' confined its jurisdiction to activities which might affect navigation. However by the 1960s, water pollution issues compelled the Corps to reassess the scope of its authority (Natural Resources Law Institute, 1988). The Corps began to evaluate the consequences of proposed acitivites on fish and wildlife in

navigable waters.

In order to face growing concerns over water pollution, Congress enacted the Federal Water Pollution Control Act of 1972 (FWPCA) to eventually eliminate all polluting discharges into "waters of the United States." Section 404 of FWPCA preserved the Army Corps' authority to issue permits to regulate the discharge of dredge or fill materials into U.S. waters. In 1977, FWPCA was amended by Congress and subsequently became known as the Clean Water Act. Originally, the Corps' interpretation of Section 404 was narrowly applied to discharges made in navigable waters--excluding from consideration wetlands which were not periodically inundated by navigable waters (Mitsch & Gosselink, 1986; Natural Resources Law Institute, 1988). However, a decision handed down by the District Court for the District of Columbia in Natural Resources Defense Fund v. Callaway (1975) forced the Corps to modify its definition of "waters of the United States," and expand its jurisdiction to include all waters affecting interstate commerce, disregarding traditional tests of navigability. The effect of this ruling was to put under Corps' jurisdiction any wetland which could conceivably involve interstate commerce. Since even a livestock watering pond plays a role in interstate commerce, this interpretation of Section 404 appears to assert Corps' authority over virtually all wetlands (Natural Resources Law Institute, 1988).

In the aftermath of the Callaway decision, the Corps of Engineers adopted new regulations which expanded the scope of its Section 404 jurisdiction. The Corps' definition of "waters of the United States" was changed

to include freshwater wetlands that are periodically inundated and that support vegetation requiring saturated soil conditions for growth and reproduction. The following definition is currently in use:

> ...those areas that are inundated or saturated by surface or ground water at a frequency or duration sufficient to support, and that under normal circumstances, do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. (U.S. Army Corps of Engineers Definition of Wetlands, 1988)

In part, this definition bases wetland determination upon the presence of plants obligately dependent upon saturated soils for at least part of each year. Since native vegetation has been removed from many wetlands, this definition could fail to recognize areas which possess functional wetland characteristics but presently lack hydrophytic plants. Wetlands converted to agricultural uses may escape regulation by the Corps' under this definition.

The Corps has been reluctant to expand its regulatory activities over non-navigable wetlands, particularly agricultural areas (Tripp & Herz, 1988). In 1986, Major General Hatch, Director of Civil Works for the Army Corps, wrote, "...we are reluctant to make emphatic statements on what Section 404 is or is not in terms of wetland protection" (Manson, 1986, p. 5). Hatch went on to say that the Corps' authority is limited to regulating discharges of dredge or fill materials into wetlands only: ditching, pumping, vegetation removal, and impounding waters are not considered discharges and, therefore, are not subject to regulation.

In a landmark opinion concerning Section 404, the Supreme Court in

United States v. Riverside Bayview Homes (1985) ruled that the Army Corps had acted properly when it required a permit for the filling of wetlands "adjacent" to other navigable waterbodies (Natural Resources Law Institute, 1988). The Supreme Court's decision approved a broader interpretation of federal jurisdiction over wetlands; however, this decision failed to define clearly the Corps' jurisdiction over isolated wetlands unconnected to navigable waters. Presently the Corps asserts jurisdiction over unconnected wetlands on a case-by-case basis. Thereby, the regulatory status of many outlying wetlands remains unclear (Natural Resources Law Institute, 1988).

The Environmental Protection Agency's Oversight Role

The U.S. Environmental Protection Agency (EPA) oversees the Army Corps of Engineers under Section 404 Clean Water Act of 1977. Section 404(b)(1) requires the EPA to promulgate environmental guidelines which would govern dredge and fill permits issued by the Corps, while Section 404(c) endows the EPA with the authority to veto Corps permits altogether, if it found the environmental impacts too serious. The EPA's role as chief interpreter of Section 404 was substantiated by Avoyelles Sportsmen's League v. Marsh (1983) where the court ruled in favor of EPA's delineation of the involved wetland over the Corps' conflicting delineation. In addition, EPA's power to veto Corps' permits was affirmed by the District Court in Bersani v. U.S Environmental Protection Agency (1987) after the EPA moved to stop a Corps' permit to fill Sweedens Swamp in Attleboro, Massachusetts. Therefore, while

the Corps can be characterized as responsible for the implementation of the permit program, EPA has the overall authority for administering the Clean Water Act (Meagher, 1988; Tripp & Herz, 1988).

The definition of wetlands adopted by the EPA in its environmental guidelines, established pursuant to Section 404(b)(1), is identical to the one currently employed by the Army Corps of Engineers. However, as demonstrated in Avolleyes, the EPA and the Corps have employed different technical methodologies to assess and delineate wetlands. The Conservation Foundation (1988), reviewing wetland policy at the request of the EPA, criticized the use of inconsistent delineation methodologies among federal regulatory agencies, and strongly encouraged the EPA and the Corps to work together to develop a consistent methodology. In response to this criticism, the EPA, Army Corps of Engineers, and Soil Conservation Service cooperatively developed a unified methodology for wetland delineation which was formally adopted on January 10, 1989 (Federal Interagency Committee for Wetland Delineation, 1989).

The EPA's Corvallis Environmental Research Laboratory is currently at work on a "Wetland Characterization Method " which will be useful for assessing mitigation projects (Sumner, 1989). Richard Sumner, a member of EPA's wetland research team, portrays the characterization method as a descriptive approach to evaluate created or restored wetlands (Personal communication, July 11, 1989). To evaluate a created wetland, the characterization method will look for the presence or absence of certain biotic

and physical elements normally found in a similar kind of natural wetland. An artificial wetland can then be assessed by an objective comparison to a natural one. Sumner points out that this method does not attempt to assess a created wetland for its relative functional values, such as flood control, habitat, water storage, recreation, or aquifer recharge. According to Sumner, EPA will begin work to develop methods for assessing the function values of wetlands only after the characterization method has been tested and approved. A handbook describing the wetland characterization method, together with the results of nationwide field studies, is expected out in March 1991.

Congressional amendments made in 1977 to Section 404 established a provision which would allow the EPA to give complete control over dredge and fill permits to a state government. In response to this legislation, the EPA in 1979 developed a set of regulations which a state must satisfy to qualify under this program (EPA 404 State Program Regulations, 1988). If a state is accepted under this program, then it could completely assume the Corps' permit-granting responsibilities for all wetlands except traditionally navigable waters and adjacent wetlands (Natural Resources Law Institute; Schell et al., 1988). To date, only the State of Michigan has been able to meet the EPA's criteria for qualification and taken control over its permit program.

In a review of EPA policies, The Conservation Forum (1988) specifically recommended in Protecting America's Wetlands: An Action Agenda that the EPA increase its efforts to delegate federal regulatory authority over wetlands to states which have enacted appropriate legislation and adopted statewide

wetland conservation plans. The EPA's January 1989 Wetlands Action Plan promises to follow The Conservation Forum's recommendations concerning state involvement in wetland protection, and improve their efforts to increase the state and local role in wetlands regulation.

The Fish and Wildlife Service's Advisory Role

Section 1344(m) of the Clean Water Act of 1977 recognizes the U.S.Fish and Wildlife Service (FWS) as a review agency for 404 permit applications, but does not make their recommendations binding upon the Army Corps of Engineers. Additionally, the Corps is obligated by the Fish and Wildlife Coordination Act (1988) to solicit comments from the Secretary of the Interior (who acts through the Fish and Wildlife Service) on any water projects which would have a potential impact on wildlife resources.

The Fish and Wildlife Service was the first federal agency to undertake a nationwide inventory of wetlands. In 1954, Shaw and Fredine published a report entitled Wetlands of the United States (known as Circular 39) which identified wetlands important to waterfowl. In 1974, following passage of the Federal Water Pollution Control Act of 1972, and responding to increased scientific recognition of the critical importance of wetlands, the FWS began the National Wetlands Inventory Project (Tiner ,1984). At present, the National Wetlands Inventory has mapped approximately 60 percent of the continental U.S. and 16 percent of Alaska (Peters & Harrison, 1988).

For the purposes of the National Wetlands Inventory, FWS adopted the

following working definition:

> Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For the purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominately hydrophytes; (2) the substrate is predominately undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year. (Cowardin et. al.,1979, p. 3)

Unlike the definition utilized by the Army Corps and EPA which relies solely on the presence of hydrophytic vegetation as a wetland indicator, the FWS emphasizes three principal parameters: (a) hydrology, (b) hydrophytic vegetation, and (c) hydric soils. This definition provides more flexibility in delineating wetlands because it recognizes that certain wetlands may lack hydrophytic vegetation or hydric soils altogether, but still have the hydrological characteristics of a wetland.

Unified Federal Method for Wetland Delineation

The new federal method for wetland delineation sets mandatory criteria for the identification of wetlands. This mandatory criteria resolves the past technical differences in regulatory definitions used by the EPA, the Army Corps, and the FWS. Under this new delineation scheme, an area must possess the following three characteristics to be identified as a wetland for regulatory purposes: (a) hydrophytic vegetation, (b) hydric soils, and (c) wetland hydrology (Wetland Training Institute, 1989). All three of the above criteria

must now be met for an area to qualify as a wetland subject to regulation under Section 404.

The unified wetland delineation technique also establishes specific methods which must be followed for sampling vegetation, hydrology, and soils. Different sampling methods are provided for offsite and onsite wetland determinations. Offsite determinations are based primarily upon interpretation of aerial photography and existing maps, surveys, and data. However, for onsite determinations, three different levels of sampling intensity are designated: (a) routine, (b) intermediate, and (c) comprehensive. The regulatory agency making the delineation must use its discretion to determine the appropriate level of sampling intensity. A routine assessment only relies upon visual estimates of dominant plant species and cursory soil probes. An intermediate assessment is more intensive; it requires that vegetation data be collected from field transects taken through representative plant communities, and at least one 18 inch auger sample of soil. A comprehensive assessment gathers extensive data on plant communities from sample plots located along transect lines. Transect lines and sample plots are established in such a way as to provide intensive sampling of the involved area. Within each sample plot, the percent cover for each species is determined. Additionally, soils are thoroughly sampled and analyzed to determine their relative extent on a site. The above techniques should improve the accuracy of wetland determinations in the future and should help to minimize interagency conflicts over interpretation.

Analysis of the Problems of Section 404

The lack of coordination among federal regulatory agencies is one of the greatest weaknesses of the 404 program. The regulatory specifications required by the Army Corps for a dredge and fill permit often differ significantly from those required by the EPA or the Fish and Wildlife Service. This situation has resulted from the past practice of agencies employing different functional definitions of wetlands and delineation methodologies. For the private owners of potentially regulated wetlands, this inconsistency in definitions and delineation is a source of both confusion and frustration; multiple permits may be required and the process can be extremely time consuming; while one agency may be supportive, another is critical and imposes different permit conditions (The Conservation Foundation, 1988; Schell et. al., 1988).

Baldwin (1987) writes that the jurisdictional tension which exists between the Corps, EPA, and FWS essentially reflects philosophical conflicts over wetland policy. The Corps has tried to curtail the need for 404 permits under the Reagan Administration, because it has not viewed Section 404 as a program to protect wetlands. Alternately, in the absence of explicit federal legislation protecting wetlands, the EPA, Fish and Wildlife Service, and the National Marine Fisheries Service have embraced the Section 404 program as the best means of decreasing wetland losses (Baldwin, 1987). However, the best available data indicate that wetlands are still being lost nationwide at an alarming rate (Tiner, 1984; Office of Technology Assessment, 1984).

Therefore, the existing federal regulatory situation has been inadequate to protect wetlands from destruction, and the recommendations offered by The Conservation Foundation (1988) to improve federal efforts may only prove effective if conscientiously implemented by government agencies at all levels. However, acknowledging these past failures, the EPA has recently adopted the goal to achieve "no overall net loss" of the country's remaining wetlands and "restore and create wetlands, where feasible, to increase the quality and quantity of the nation's wetlands resource base" (U.S. Environmental Protection Agency, January 1989, p. 4).

The State of Oregon's Wetlands Program

Oregon belongs to a group of states which conduct regulatory programs in conjunction with federal agencies (Glubiak, Nowka, & Mitsch, 1986). The centerpiece of Oregon's wetlands conservation program is its Removal-Fill Law (1987). The Oregon Removal-Fill Law charges the Division of State Lands (DSL) with the responsibility of administering a permit program for wetland alterations. Oregon's approach was modeled on the 404 program of the Army Corps; however, Oregon's program is far more comprehensive because, unlike the 404 program, it regulates any removal or fill over 50 cubic yards in size and requires an individual review of each application (Ketcham, 1988).

Section 404(e) of the Clean Water Act of 1977 allows the Corps to exempt from individual review particular kinds of permits, referred to as nationwide or general permits. Nationwide permits exempt from review certain

catagories of discharge or fill activities, such as small bank stabilization projects, minor road construction fills, or fills resulting from bridge building (U.S. Army Corp of Engineers Nationwide Permit Guidelines, 1988). Therefore, while the Corps may grant a permit for certain activities without individual review, the 1987 Oregon Removal-Fill Law requires DSL to review every removal or fill application (Or. Rev. Stat. § 541.625).

In order to ensure compliance with both federal and state law, an Oregon applicant must apply for a permit simultaneously to DSL and the Army Corps of Engineers. The Corps makes its own determination on a permit under Section 404. The Oregon Removal-Fill Law (1987) grants DSL the discretion to withhold or issue a permit. When acting upon a permit application, DSL must consider the state's policy goal to conserve the waters for navigation, fishing, and recreation against the public benefits to be derived from the proposed project. DSL may impose on the permit whatever conditions it deems necessary to conserve the state's water resources (Or. Rev. Stat. § 541.625 (5)).

The 1987 Oregon Removal-Fill Law contains a specific provision requiring mitigation as a permit condition for dredge and fill from estuaries (Or. Rev. Stat. § 541.626). While mitigation under this law was specifically intended for coastal estuaries, DSL's Ken Bierly has written that this law "also applies by fiat to fresh-water areas" (1987, p. 197). The law defines estuary as:

> a body of water semi-enclosed by land and connected with the open ocean within which salt water is usually diluted by fresh water derived from the land. "Estuary" includes all estuarine waters, tidelands, tidal marshes and submerged lands extending upstream to the head of tidewater. (Or. Rev. Stat. § 541.605(4))

The Oregon Removal-Fill Law (1987) defines mitigation as:

> the creation, restoration or enhancement of an estuarine area to maintain the functional characteristics and processes of the estuary, such as its natural biological productivity, habitats and species diversity, unique features and water quality. (Or. Rev. Stat. § 541.626 (1))

However, this law allows a great deal of discretion to waive the mitigation requirement if the proposed dredge or fill project has a demonstrated public need and mitigation is not feasible (Or. Rev. Stat. § 541.626(4)). In April 1984, DSL published Estuarine Mitigation The Oregon Process, a set of administrative rules which define the method to determine mitigation requirements (Oregon Division of State Lands, 1984).

In 1987, the Oregon Wetlands Mitigation Bank Act became law. This law set as its guiding policies to:

> (1) Promote, in concert with other federal and state programs as well as interested parties, the maintenance and protection of wetlands;
>
> (2) Improve cooperative efforts among private, nonprofit and public entities for the management and protection of wetlands;
>
> (3) Offset losses of wetland values caused by activities which otherwise comply with state and federal law in order to create, restore or enhance wetland values and functions. (Or. Rev. Stat. § 541.555)

The Act empowered DSL to establish a wetlands bank through the selling of credits in the bank or the acceptance of land in exchange for mitigation credit (Or. Rev. Stat. § 541.557). DSL was additionally authorized to fund wetland restoration or enhancement projects, as well as wetland monitoring and scientific research activities. To date, the Oregon legislature has not provided

the funding or the direction necessary to implement the mitigation program (Bierly, 1989).

In December 1988, a draft of the Oregon Wetlands Priority Plan (OWPP) was released jointly by the Oregon Division of State Lands and the Oregon Parks and Recreation Division. This planning document was prepared in response to Section 303 of the Emergency Wetlands Resources Act (1986) which requires the State of Oregon to assess, on a yearly basis, wetlands that should receive priority consideration for acquisition. Section 303 makes the Oregon Wetlands Priority Plan a prerequisite for federal approval of Land and Water Conservation Fund monies for the development of state recreation facilities. In order to meet Section 303 requirements, OWPP attempts to:

a) identify the state's role in planning and regulating wetlands;

b) identify the effectiveness of existing wetlands protection mechanisms;

c) identify existing wetland resources;

d) identify historical and current factors affecting the loss or degradation of wetlands;

e) develop a mechanism for identifying priority wetlands resource areas for acquisition; and

f) prioritize wetland types for acquisition. (pp. 3-4)

At present, OWPP can only comply with the above Section 303 requirements in a general way, because Oregon still lacks a complete inventory of its wetlands, and the relative functional values of its wetlands are not yet clearly understood (Oregon Division of State Lands & Oregon Parks and Recreation Division,

1988).

OWPP sets out the following general criteria for nominating a wetland for acquisition:

1) There is documentation of historical losses of the type(s) involved,

2) There is a potential threat of future impacts to the type(s) involved,

3) There is potential for restoration of wetland values,

4) The local comprehensive plan identifies protection of the resource, and

5) The site is identified by other federal or state programs for protection or acquisition. (p. 65)

According to OWPP, wetland sites which possess at least three of the above criteria would be considered a high priority for acquisition. Actual selection of wetland sites for acquisition will not occur until a statewide wetland inventory is completed, and local comprehensive land use plans have identified specific wetlands for protection.

In July 1989, the Oregon legislature passed Senate Bill 3, making a number of significant regulatory changes to the state's wetland program. First, Senate Bill 3 formally adopts the definition of wetlands currently used by the Army Corps and EPA (see page 12) for statewide regulatory purposes. Second, under the new law, DSL is required to conduct and maintain an inventory of the state's wetlands; wetland inventory maps must also be provided to local governments for planning purposes. Third, DSL is empowered, for the first time, to grant general authorizations for catagories of removal-fill activities

which result in minimal environmental impact. Fourth and of special significance to West Eugene wetlands, the new law authorizes local governments to develop wetland conservation plans which, once approved by DSL, will designate local wetland areas for protection, conservation, or development. Local wetland conservation plans are required to provide for full replacement of planned wetland losses through mitigation. Finally, "normal" farming or ranching activities are exempted from removal-fill permit requirements when these activities take place on historically altered wetlands. Importantly, Senate Bill 3 promotes the role local governments play in wetland management and help to make mitigation an integral part of the removal-fill permitting process in freshwater wetlands. While mitigation itself does not directly assure better wetland protection, mitigation does impose a cost upon wetland alteration activities which, in some circumstances, may act as a deterrence.

Despite Oregon's efforts to establish a wetlands management program, this program has not escaped criticism. Ketcham (1988) has analyzed both Oregon's regulatory and planning programs for wetland protection and offered suggestions for improvement. According to Ketcham, Oregon first needs to develop a comprehensive inventory of its wetlands before useful planning can take place. Next, DSL needs to begin assessing the cumulative impacts of the successive removal-fill permits it issues. Then, DSL should intensify requirements for wetland mitigation projects and adopt a "no net loss" policy for state wetlands. Additionally, DSL needs to initiate a stronger monitoring

program for permitted mitigation projects. Also, the statewide planning program should provide better guidance to local governments for the protection of wetland resources. Federal and state agencies need to improve coordination of their wetland programs to eliminate interagency conflicts. Finally, the Oregon Department of Fish and Game should establish wetland and habitat protection standards for use by state and local governments (Ketcham, 1988). If these recommendations were incorporated into the existing regulatory framework, then wetland conservation in Oregon could be improved and administration made more effective.

Summary

Section 404 of the Clean Water Act gave authority to the Army Corps of Engineers to regulate the discharge of dredge and fill materials into waters of the United States. Several recent court decisions have expanded the Corps' jurisdiction to include virtually all waters of the U.S. While the Corps has permitting authority, Section 404 placed the EPA in an oversight role; EPA is empowered to review and veto Corps' permits, and it is required to set standards and guidelines for the federal wetlands program. The power-sharing arrangement among federal agencies created by Section 404 of the Clean Water Act has been a source jurisdictional conflict. In acknowledgement of past problems, new interagency cooperation policies have recently been adopted by federal regulatory agencies. The Oregon wetlands program is operated in addition to the federal program and is subject to EPA's oversight and approval.

The State of Oregon has passed a series of laws to regulate the removal and fill of materials from coastal and freshwater wetlands. Oregon has recently passed legislation intended to improve the state's protection of wetlands and strengthen the role local governments play in wetland conservation.

CHAPTER III

WEST EUGENE WETLANDS

Introduction

This chapter will examine West Eugene wetlands in detail. First, the story of local conservation efforts will be told. Second, I will review the current state of knowledge about West Eugene wetlands: the physical setting, the vegetation, the historic prairie landscape, the soils, and the wildlife. Third, I will survey the management issues at stake and introduce some preliminary data concerning local public opinion on wetlands issues.

Conservation History of West Eugene Wetlands

Until quite recently, few realized the historical and ecological significance of West Eugene wetlands. In fact, they were scarcely perceived as wetlands at all, but instead as poorly drained lands of marginal value. The discovery of rare, native prairie at Willow Creek set in motion a change in public perception. Other events followed which heightened public understanding of both the extent and quality of wetlands in West Eugene. Today, a major part of West Eugene is understood to be wetland subject to federal and state regulation. As yet, their full extent is unknown, and their true functional values may not be grasped for

years to come. The following relates how West Eugene came to be viewed as a significant wetland area.

In 1977, the City of Eugene conducted an inventory of open spaces, scenic and historical areas, and natural resources within the urban growth boundary, in order to comply with Goal 5 of Oregon Statewide Planning Goals (1984). The city was growing and local planners, city officials, and interested citizens were contemplating how that growth should take place. Some undeveloped land on the edge of Eugene along Willow Creek, henceforth called "Willow Creek," was being considered both for inclusion within the growth boundary of Eugene and for future residential development. Willow Creek was privately owned and consisted of about 200 acres of scrubby, tangled ash forest and wet grassland. Since it was relatively undisturbed, it afforded habitat for wildlife in an otherwise developed urban and agricultural setting.

In April 1978, two important events occurred which were to circumscribe the future of Willow Creek. First, Willow Creek was recognized by the Lane Council of Governments (L-COG) as having vegetation and wildlife deserving protection (Lane Council of Governments, 1981). Second, a rare plant, Aster curtus, was discovered on the site. Two additional rare plants were identified soon after: Bradshaw's lomatium (Lomatium bradshawii) and Erigeron decumbens var. decumbens, once thought to be extinct. These plants were part of a once extensive wet grassland community found in the Willamette Valley which was dominated by tufted hairgrass, Deschampsia cespitosa (Franklin &

Dyrness, 1973). Since a substantial community of Deschampsia was also present at Willow Creek, this site was recognized as a vestige of the original Willamette Valley prairie wetland. Citizens and public organizations such as the Lane Audubon Society, The Nature Conservancy, 1000 Friends of Oregon, and League of Women Voters urged local government officials to protect Willow Creek from residential development, proposed in the August 1980 version of the Eugene/Springfield Metro Area Plan (Metro Plan) (Lane Council of Governments, 1981).

In 1981, the Oregon Land Conservation and Development Commission (LCDC) reviewed the August 1980 Metro Plan for compliance with statewide planning goals. Between 1974 and 1976, Oregon Statewide Planning Goals (1984) were adopted to guide local governments in developing comprehensive land use plans as part of the Oregon Statewide Land Use Planning Program (1973). Of the nineteen statewide planning goals adopted, four goals implicitly address wetland conservation: Goal 5 (Open Spaces, Scenic and Historical areas, and Natural Resources); Goal 15 (Willamette River Greenway); Goal 16 (Estuarine Resources); and Goal 17 (Coastal Shorelands). LCDC concluded that the August 1980 Metro Plan was unacceptable with respect to Goal 5 and its treatment of Willow Creek (Eugene, Springfield, & Lane County, 1987). In order to comply with LCDC's evaluation, L-COG, in conjunction with the cities of Eugene and Springfield, reassessed the significance of Willow Creek as habitat containing rare plants. While this reassessment reduced the Willow Creek site from 190 acres to 105 acres, it recommended that the reduced site be protected

for its rare plants and wildlife, recreational possibilities, and scientific values. Additionally, it proposed strategies for transferring the site to The Nature Conservancy for future management (Lane Council of Governments, 1981).

The Willow Creek controversy generated the first public recognition of the presence of relic, prairie wetland in West Eugene. However, recognition of the existence of numerous wetlands in West Eugene did not develop for several years. In 1985, Valley River Center developers applied to the City of Eugene for a permit to fill certain areas along the Willamette River (S. Gordon, personal communication, July 7, 1989). The city issued a conditional use permit, but the Army Corps of Engineers and Oregon Division of State Lands identified the involved area as a wetland which required both a federal 404 permit and a state removal-fill permit. The Lane County Audubon Society objected to the issuance of federal and state permits, citing the area as important avian habitat. The ensuing debate over Valley River Center's expansion into nearby wetlands prompted LCDC in 1986 to grant L-COG money to initiate a preliminary a review of the adequacy of the 1977-78 Goal 5 inventories of Eugene and Springfield.

In 1987, Ester Lev conducted the preliminary Goal 5 assessment for L-COG. In the course of this inventory, she found four wetland sites in West Eugene located upon industrially zoned land (S. Gordon, personal communication, July 7, 1989). Since a significant part of West Eugene is zoned for industrial use, Lev's wetland discoveries suggested serious land management conflicts. Following Lev's discovery, local governments placed a

special emphasis on identifying other wetland sites in West Eugene, as well as the rest of the metropolitan area.

In 1987-88, L-COG contracted Ester Lev to conduct a Goal 5 inventory of the entire Eugene/Springfield metropolitan area for wildlife habitat and preliminary wetland identification (Lev & Lane Council of Governments, 1988). This inventory identified a total of 765 acres of wetlands in West Eugene which may be subject to federal and state regulation (Lane Council of Governments, 1988).

Based upon Lev's 1988 inventory, West Eugene was designated by the City of Eugene as a special area for wetlands study. During the summer of 1989, a detailed field inventory of West Eugene was undertaken by L-COG to assess and delineate wetlands subject to federal jurisdiction (Lane Council of Governments, 1989a). The results of this 1989 study will form the basis for future management decisions affecting the wetlands of West Eugene.

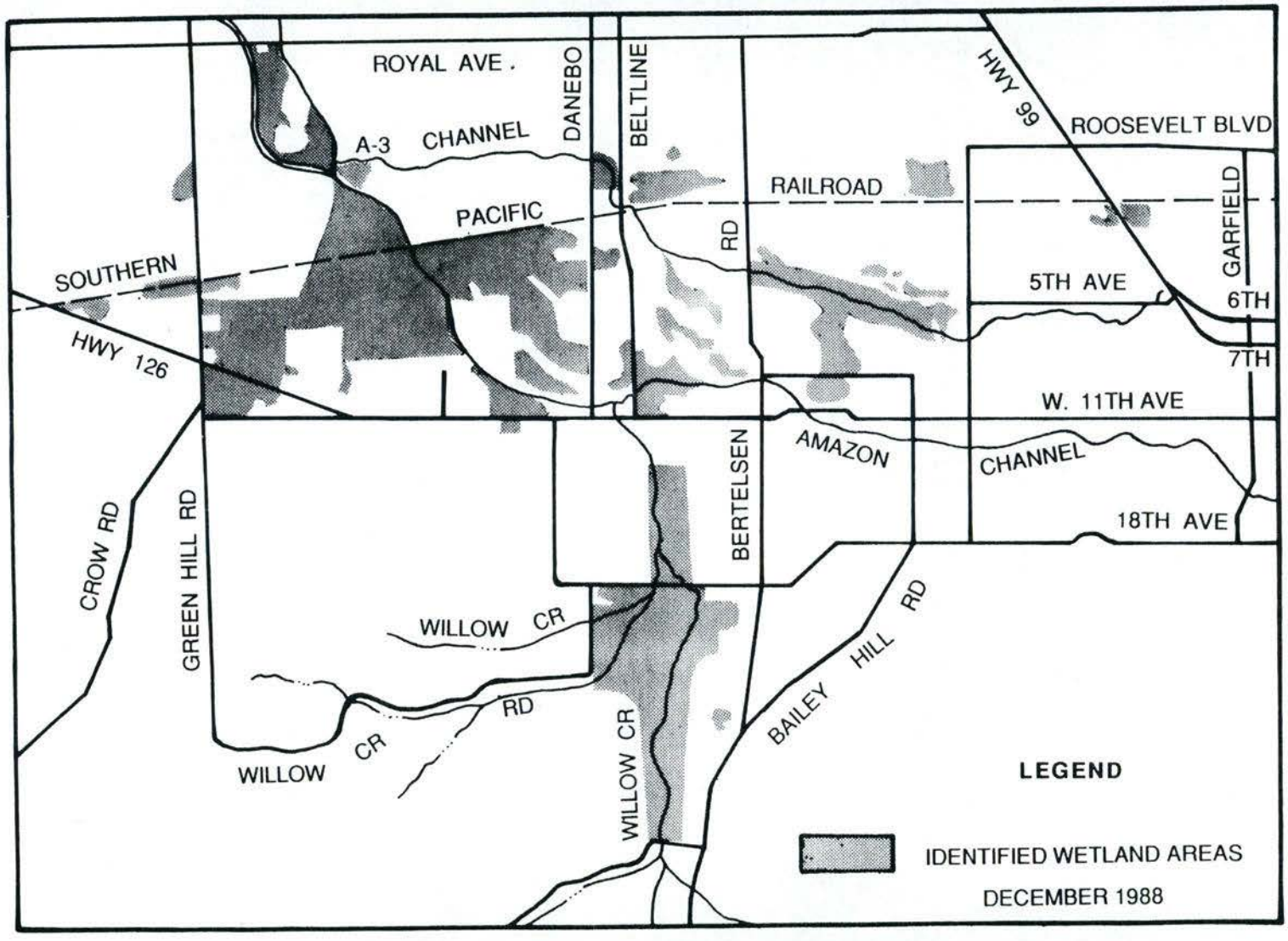
The purpose of the West Eugene Wetlands Special Area Study is to delineate wetlands using methodologies approved by the EPA and Army Corps, ascertain their relative functional and social values, and identify areas suitable for use as mitigation. Private consultants were contracted to conduct the necessary field inventories and map wetland boundaries (Lane Council of Governments, 1989a). Based upon the findings of this study, a draft wetlands management plan will be written by L-COG for West Eugene which will, once adopted by the City of Eugene, become part of the Metro Plan. The management plan is intended to distinguish which wetlands should be

protected from those that may be developed.

The West Eugene Wetland Ecosystem

The Physical Setting

West Eugene (see Map 1) was designated as a special study area by the City of Eugene for the purposes of wetlands identification and inventory. The primary study area includes the known concentration of wetlands in West Eugene (S. Gordon, personal communication, July 7, 1989). A larger study area is being examined for possible mitigation sites. The larger area extends westward to Fern Ridge Reservoir and northward along the old Amazon Channel to the airport. The primary area generally encompasses low-lying areas, below 400 feet in elevation, which are located along the Amazon Channel and the upland drainage basin of Willow Creek. Within the primary area exists seasonally wet grasslands, bottomland forests, shrub-swale marshes, permanent ponds, streams, and the historic floodplain of the Amazon Channel (Lane Council of Governments, 1988). A large part of this area was added to Eugene in the 1950s and was used primarily for industrial purposes. Today, the area north of West 11th Avenue is largely zoned for a mixture of light and heavy industry, while portions of West 11th Avenue are zoned commercial. The southwestern part of the study area is largely dedicated to residential and agricultural uses. Although the area has been significantly altered by human use, it mostly remains undeveloped, open space.



MAP 1. West Eugene wetlands study area

Wetland Plant Communities

Wetland plant communities in West Eugene can de divided into four basic types: prairie grassland, marsh, ash swale, and wooded riparian bottomland. The first two types undergo seasonal flooding for extended periods of time each year. Marshes are generally submerged throughout the year, although saturated soil conditions are sufficient to support emergent vegetation. Wooded riparian bottomlands are areas with moist alluvial soils which experience occasional flooding. However, dams and other water control structures upstream from Eugene have reduced the incidence of spring floods which used to occur in West Eugene. While these four communities can be characterized as distinct, in actuality they intergrade so that in the field a community may exhibit aspects of more than one type.

The West Eugene prairie grassland community was historically dominated by Deschampsia cespitosa (Kauffman, 1988; Kagan, 1980). Today, remnants of this Deschampsia dominated community still exist. In this community are found two species of rushes (Juncus patens and Juncus acuminatus) and a woodrush (Luzula campestris). Several types of sedges (Carex) are also typically present: golden-fruited (C. aurea), woolly (C. lanuginosa), slender (C. lasiocarpa), and slough (C. obnupta). Additionally, two species of wild oatgrass (Danthonia californica and D. unispicata) are characteristic of this type of prairie. Into this grassland community, the following introduced grasses have become widespread: alta fescue (Festuca

arundinacea), Orchard grass (Dactylis glomerata), sweet vernalgrass (Anthoxanthum odoratum), Kentucky bluegrass (Poa pratensis), velvet grass (Holcus lanatum), western witchgrass (Panicum occidentale), colonial bentgrass (Agrostis tenuis), and little quaking-grass (Brizia minor) (J. Kagan, 1989, personal communication, May 5, 1989; Kagan, 1980; Lev & Lane Council of Governments, 1988; Lev & Zika, 1988). Low, wet areas may be dominated by introduced reed canarygrass (Phalaris arundinacea). On disturbed sites large areas have succumbed to species of vetch (Vicia spp.) and Himalayan blackberry (Rubus discolor) (Lev & Lane Council of Governments, 1988).

Of special botanical interest is the presence of certain rare, endemic flowers on relic prairie sites in West Eugene. Bradhaw's lomatium (Lomatium bradshawii) was listed as an endangered species by the U.S. Fish and Wildlife Service on September 30, 1988. A daisy (Erigeron decumbens var. decumbins) and an aster (Aster curtus) are two threatened prairie species. Timwort (Microcala quadrangularis) and Cusick's checkermallow (Sidalcea cusickii ssp. purpurea) are also becoming scarce wildflowers as their habitat disappears (Zika, 1989).

The marsh community can be characterized by the presence of common cat-tail (Typha latifolia), needle spikerush (Eleocharis acicularis), bulrush (Scirpus spp.), rush (Juncus spp.), and sedge (Carex spp.) (Lev & Lane Council of Governments, 1988; Lev & Zika, 1988; Weller, 1987). Phalaris arundinacea has come to dominate in many areas which are transitional between marsh and wet prairie.

Ash swales are characterized by Fraxinus latifolia which may be regarded as the dominant climax species for wet bottomland prairie where fire has been suppressed (Moir & Mika, 1972). The Fraxinus are intersperced with hawthorn (Crataegus douglasii), black cottonwood (Populus trichocarpa), willow (Salix spp.), and native or introduced cherry (Prunus spp.). Plants which are common in the understory of ash swales include: rose (Rosa nutkana and other Rosa spp.), Carex spp., Juncus spp., spike-rush (Eleocharis spp.), and common camas (Camassia quamash) (Frenkel & Heinitz, 1987; Lev & Lane Council of Governments, 1988; Lev & Zika, 1988).

Wooded riparian areas are distinguished by Douglas fir (Pseudotsuga menziesii), big-leaf maple (Acer macrophyllum), vine maple (Acer circinatum), Populus trichocarpa, Oregon white oak (Quercus garryana), alder (Alnus spp.), western flowering dogwood (Cornus nuttallii), hazelnut (Corylus cornuta), Fraxinus latifolia, and Salix spp. (Claggett, 1988; Lev & Lane Council of Governments, 1988). In the understory are found Oregon grape (Berberis aquifolium and B. nervosa), spiraea (Spiraea douglasii), western serviceberry (Amelanchier alnifolia), snowberry (Symphoricarpos albus), cascara (Rhamnus purshiana), elderberry (Sambucus racemosa and S. cerulea), Rubus spp., Rosa spp., and swordfern (Polystichum munitum) (Habeck, 1961; Lev & Lane Council of Governments, 1988; Lev & Zika, 1988).

The Historic Prairie Landscape

Today's West Eugene was once part of a extensive prairie-oak savannah

landscape which occupied the Willamette Valley. Prior to European settlement, the Willamette Valley supported plant communities strongly influenced by fires which were set by aboriginal inhabitants--the Kalapuyas (Habeck, 1961; Johannessen, Davenport, Millet, & McWilliams, 1971). Early pioneer accounts of the Willamette Valley recorded the great size and frequency of fires set by the Kalapuyas (Boyd, 1986; Johannessen et al., 1971; Reynolds, 1977). Boyd (1986) speculated that the Kalapuyas set fires to aid in deer hunting and in the harvest of tarweed (Madia spp.) seeds. Fire was also beneficial for stimulating the production of important aboriginal foods such as camas bulbs (Camassia quamash), berries (Rubus spp.), acorns (Quercus spp.), and hazelnuts (Corylus cornuta); additionally, fire may have favored plant species used in basket-making and to prepare soils for tobacco cultivation (Boyd, 1986; Kauffman, 1988; Reynolds, 1977). Conceivably, the Kalapuyas used fire to manage grasslands as habitat for deer and migratory birds which overwintered in the Willamette Valley (Boyd, 1986). In sum, fire played a critical role in the subsistence economy of the Kalapuyas; periodic fire was required to maintain the prairie grassland ecosystem. The prairie vegetation of the Willamette Valley described by early pioneers resulted at least in part from the ecological relationship of the Kalapuyas with their environment.

Johannessen, Davenport, Millet, and McWilliams (1971) have deduced the historic vegetation patterns of the southern Willamette Valley based upon an analyses of aerial photographs, early survey records, written accounts, and contemporary observations. Prairie dominated the valley landscape;

woodlands flourished in riparian bottomlands, swales, and along the steeper slopes. Isolated oaks (Quercus garryana and Quercus kelloggii) and Pseudotsuga menziesii on the prairie probably resulted from establishment in special local environments (e.g., former dwelling places, trails, poor soils, rock outcrops, rises) or simply by accident (Johannessen et al., 1971). Dense thickets of Fraxinus latifolia occurred in wet swales. Riparian bottomlands supported Pseudotsuga menziesii, Grand fir (Abies grandis), Acer macrophyllum, A. circinatum, Populus trichocarpa, Alnus spp., bittercherry (Prunus emarginata), Salix spp., Cornus nuttallii, Fraxinus latifolia, and Quercus garryana (Habeck, 1961; Johannessen et al., 1971).

A detailed reconstruction of the historic grassland communities of the Willamette Valley is impossible because the prairie has been drastically altered by fire supression, drainage changes, agriculture, livestock grazing, invasion by exotic species, and toxic spraying (Franklin & Dyrness, 1973; Johannessen et al., 1971; Kauffman, 1988; Reynolds, 1977). However, two prairie communities have been recognized in the modern Willamette Valley. Deschampsia cespitosa characterizes wetland prairie sites, while a Poa-Agrostis community is found on somewhat drier sites (Frenkel & McEvoy, 1983; Moir & Mika, 1972). The Deschampsia community was once widespread in West Eugene and is the most relevant to this study

Recent Changes in Vegetation

Fire suppression drastically modified the composition of vegetation in the

Willamette Valley. Johannessen et al. (1971) describe the invasion of trees and shrubs onto former prairie lands following the suppression of fire, and the encroachment of Pseudotsuga menziesii into areas once occupied by oak woodlands and prairie. The poorly drained swales become overtaken by Fraxinus latifolia, exotic fruit trees (Pyrus spp.), Spiraea douglasii, and Rosa spp. which shade out herbaceous vegetation (Johannessen et al., 1971; Kauffman, 1988).

In the absence of recurrent fire, Fraxinus latifolia appears to invade Deschampsia wetland prairie and eventually becomes the dominant species (Kagan, 1980; Moir & Mika, 1972). Fraxinus succession inhibits the growth of many herbs, and Fraxinus eventually supercedes Deschampsia prairie. Once established, the roots of F. latifolia may break through the soil hardpan responsible for creating seasonally wet conditions, thereby permanently altering the local hydrology (J. Kagan, personal communication, May 5, 1989). If the soils no longer permit seasonal flooding, then the whole wetland prairie plant community may be changed irreversibly to woodland.

Agriculture introduced a variety of legumes and grasses into the Willamette Valley which compete with native plants. In 1919, a study by Nelson in the Salem, Oregon area identified a total of 106 species of grasses, but only 51 species were thought to be native grasses--the other 55 species had been introduced.

Reynolds (1977) prepared an excellent study of the development of grass seed farming in the Willamette Valley, documenting the introduction of

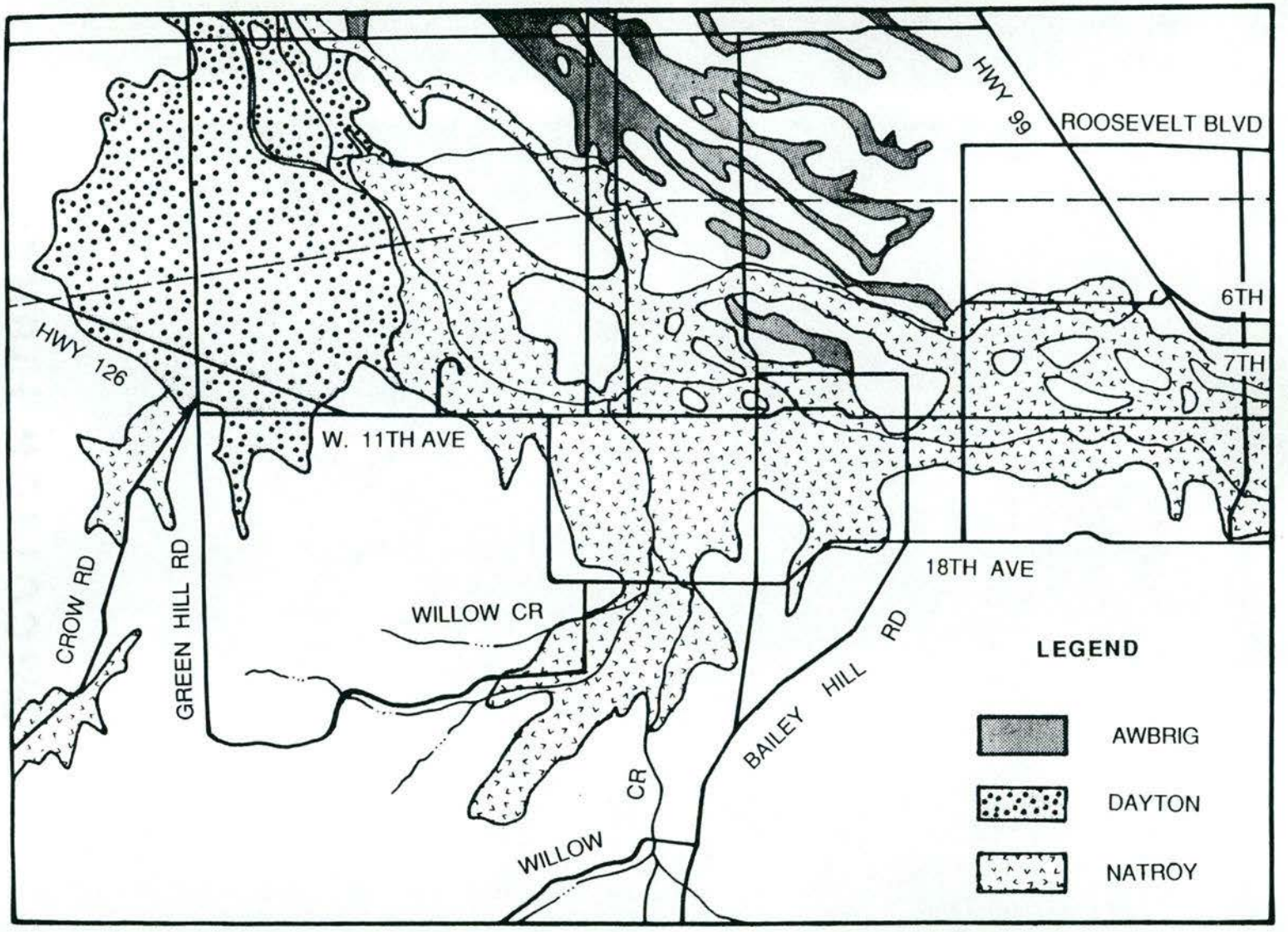
many alien agricultural plants. According to Reynolds, four species of clover (Trifolium) were introduced, two of which grew well on wetlands: white (T. repens) and alsike (T. hybridum). Beginning in 1870, several species of vetch (Vicia) were introduced by farmers and grown for seed: common (V. sativa), hairy (V. villosa), Hungarian (V. pannonica), and purple (V. atropurpurea, not recognized by Hitchcock & Cronquist, 1987). Timothy grass (Phleum pratense) was originally brought from the eastern United States and sown for hay. Other grass species introduced for seed and hay production were from Europe: cheat (Bromus secalinus and B. tectorum), orchard grass (Dactylis glomerata), Kentucky bluegrass (Poa pratensis), velvet grass (Holcus lanatus), meadow foxtail (Alopecurus pratensis), redtop bentgrass (Agrostis alba var. alba), creeping bentgrass (Agrostis alba var. palustris), colonial bentgrass (Agrostis tenuis), alta fescue (Festuca arundinacea), Italian ryegrass (Lolium multiflorum), and English ryegrass (Lolium perenne).

Today, introduced species are firmly established in the plant communities of the Willamette Valley. Many are aggressive colonizers of disturbed habitats and able to tolerate a variety of stress conditions. A number of introduced grasses and shrubs have successfully invaded the remaining Deschampsia prairie wetlands and become an integral part of that community. In other instance, perhaps as a result of fire suppression, Deschampsia exists in almost pure stands. Although today's plant communities are manifestly different from historic communities, they still have value as habitat and as a seed reservoir for native species.

Hydric Soils of West Eugene

Extensive areas of West Eugene are underlain by hydric soils (see Map 2). For the purposes of this discussion, hydric soils may be defined as poorly drained soils which have evolved under a cycle of periodic waterlogging. The hydric soils of West Eugene have a moderate to high montmorillonitic clay content (U.S.D.A. Soil Conservation Service, 1987). The structural properties of montmorillonite allow it to absorb a large amount of water and hold tightly onto water molecules. However, as montmorillonitic clay becomes saturated with water, it swells and becomes increasingly impermeable to water (Brady, 1974). Once saturated, montmorillonitic clay severely retards water drainage and in the presence of excessive moisture creates standing water conditions. These waterlogged conditions result in the development of a pale-colored "gley" soil horizon which is characteristic of West Eugene's hydric soils.

Since gley soils have their pore space saturated with water for part of the year, they have properties which result from oxygen shortages, because oxygen diffuses 10,000 times more slowly in water than in air (Etherington, 1983). The gley horizon occurs in the upper organic rich layers of the soil and appears grey to grey-green in color, frequently with brown, ocher, or black patches of iron or manganese oxide enrichment. The grey-green color is due to the reduction of Fe^{3+} to Fe^{2+} under anoxic conditions. In the absence of oxygen, soil microbes must depend upon electron acceptors other than oxygen for oxidative metabolism, most frequently Fe^{3+}, Mn^{3+}, $Mn4^{+}$, NO_3^-, SO_4^{2-}, and CO_2. Once



MAP 2. West Eugene hydric soils

microbes have converted the available Fe^{3+} to Fe^{2+} under anaerobic conditions, the Fe^{2+} may be washed out of the soil by slowly percolating water, because Fe^{2+} is more water soluble than Fe^{3+}. Therefore, with the loss of iron compounds from the upper soils layers, the soils loses its normal red or brown coloration and becomes "bleached" to gray or gray-green. Under flooded soil conditions, concentrations of dissolved iron and manganese may reach phytotoxic levels, and the ability of wetland plants to tolerate these metals is an important aspect of niche partitioning (Etherington, 1983).

Under anoxic, saturated conditions, gley soils become deficient in nitrate, NO_3^- (Etherington, 1983). Once all the free oxygen is removed from a soil, microbes utilize NO_3^- as an electron acceptor for respiration, during this process NO_3^- is denitrified to N_2O or N_2, which are unavailable forms of nitrogen for plants. Under NO_3^- deficient conditions, vegetation must depend upon free ammonium, NH_4^+, for nitrogen metabolism which is normally very scarce.

During dry periods oxygen reenters gley soils as pore spaces open from dehydration. Also, living roots to some extent leak oxygen to the surrounding soil (Etherington, 1983). As a result, Fe^{2+} oxidizes to Fe^{3+} and precipitates into visible patches (concretions) of iron oxide around roots and in large pore spaces. In a similar manner, reduced Mn^{2+} is oxidized to Mn^{3+} or Mn^{4+} in the presence of oxygen and precipitates into dark-colored concretions of manganese oxide.

The U.S.D.A. Soil Conservation Service (1987) described three hydric

soil series for West Eugene: Awbrig, Dayton, and Natroy. The three are similar in that they are deep, clayey soils occupying low, flat stream terraces. All of them are moderately acidic near their surface (pH 5.4-5.8) but tend toward neutral with depth. In all three, gley horizons are present, mottled with oxide concretions which range from black to red.

West Eugene Wildlife

The relic, prairie wetlands, marshes, open fields, and wooded bottomlands found in West Eugene provide habitat for variety of animals. This section will review some of the birds, mammals, reptiles, and amphibians which have been reported in the immediate vicinity of West Eugene. The sightings presented here are anecdotal in nature and are only intended to give some insight into the possible significance of West Eugene as habitat.

West Eugene's wetlands afford habitat for diverse, water-loving bird species (Gordon, 1988a; Gordon, 1988b; Lev & Zika, 1988). Waterfowl commonly sighted in ponds and marshes include: mallard (Anas platyrhynchos), American wigeon (A. americana), northern pintail (A. acuta), northern shoveler (A. clypeata), blue-winged teal (A. discors), cinnamon teal (A. cyanoptera), green-winged teal (A. crecca), and Canada goose (Branta canadensis). Gordon (1988a; 1988b) has reported sightings of four shorebird species: common snipe (Gallinago gallinago), greater yellowlegs (Tringa melanoleuca), spotted sandpiper (Actitis macularia), and killdeer (Charadrius vociferus). Additionally, the great blue heron (Ardea herodias), green heron

(Butorides striatus), pied-bill grebe (Podilymbos podiceps), and American coot (Fulica americana) have been observed in marsh and stream habitats in West Eugene (Gordon, 1988a; Gordon 1988b; Lev & Zika, 1988).

West Eugene supports predatory bird species, two popular game birds, and multitude of other bird species. Raptors which have been reported include: northern harrier (Circus cyaneus), red-tailed hawk (Buteo jamaicensis), American kestrel (Falco sparverius), long-eared owl (Asio otus), short-eared owl (A. flammeus), and turkey vulture (Cathartes aura) (Gordon, 1988a; Lev & Zika,1988). In contrast to the raptors, the California quail (Callipela californica) and the ring-necked pheasant (Phasianus colchicus) are two species of gallinaceous birds which inhabit the mixed prairie, field, and wooded bottomlands of West Eugene. The species listed in Table 1 have been observed in West Eugene and are indicative of the large number of bird families found there.

The mammals of West Eugene typify those that exhibit an adaptive ability to subsist in a semi-urban environment. The largest mammal occupying West Eugene is the blacktail deer (Odocoileus hemionus columbianus) while the smallest are shrews (Sorex spp.) which may be as little as 10 cm long (Ingles, 1965). Four carnivores are known to be common in West Eugene: red fox (Vulpes fulvus), raccoon (Procyon lotor), striped skunk (Mephitis mephitis), and spotted skunk (Spilogale putorius) (Lev & Zika, 1988). Two noteworthy species in West Eugene are the marsupial oppossum (Didelphis marsupialis) and nutria (Myocastor coypus), a South American aquatic rodent.

TABLE 1. Birds Observed in West Eugene

Northern flicker	(Colaptes auratus)
Pileated woodpecker	(Dryocopus pileatus)
Downy woodpecker	(Picoides pubescens)
Ash-throated flycatcher	(Myiarchus cinerascens)
Western wood-pewee	(Contopus sordidulus)
Cliff swallow	(Hirundo pyrrhonota)
Violet-green swallow	(Tachycineta thalassina)
Steller's jay	(Cyanocitta stelleri)
Black-capped chickadee	(Parus atricapillus)
Bushtit	(Psaltriparus minimus)
Winter wren	(Troglodytes troglodytes)
Bewick's wren	(Thryomanes bewickii)
Marsh wren	(Cistothorus palustris)
American robin	(Turdus migratorius)
Golden-crowned kinglet	(Regulus satrapa)
Cedar waxwing	(Bombycilla cedrorum)
Solitary vireo	(Vireo solitarius)
Northern shrike	(Lanius excubitor)
Orange-crowned warbler	(Vermivora celata)
Audubon's warbler	(Dendroica coronata)
MacGillivray's warbler	(Oporornis tolmiei)
Common yellowthroat	(Geothlypis trichas)
Western meadowlark	(Stunella neglecta)
Yellow-headed blackbird	(Xanthocephalus xanthocephalus)
Red-winged blackbird	(Agelaius phoeniceus)
Western tanager	(Piranga ludoviciana)
Lazuli bunting	(Passerina amoena)
Purple finch	(Cardodacus purpureus)
Pine siskin	(Carduelis pinus)
American goldfinch	(Carduelis tristis)
Lesser goldfinch	(Carduelis psaltria)
Rufous-sided towhee	(Pipilo erythrophtalmus)
Oregon junco	(Junco hyemalis oreganus)
White-crowned sparrow	(Zonotrichia leucophrys)
Golden-crowned sparrow	(Zonotrichia atricapilla)
Fox sparrow	(Passerella iliaca)
Lincoln's sparrow	(Melospiza lincolnii)
Song sparrow	(Melospiza melodia)

Source: Gordon, 1988a; Gordon, 1988b; Lev & Zika, 1988

In 1889, nutrias were imported from Argentina and introduced into California for fur farming, but was subsequently released into the wild when the business became unprofitable (Willner, 1982). Evidence of beaver (Castor canadensis) has been reported in the vicinities of Willow Creek and the Amazon Channel (Gordon, 1988a; Lev & Zika, 1988). Other notable species detected in West Eugene include: camas pocket gopher (Thomomys bulbivorus), western gray squirrel (Sciurus griseus), muskrat (Ondatra zibethica), porcupine (Erethizon dorsatum), deer mouse (Peromyscus maniculatus), vagrant shrew (Sorex vagrans), and Townsend's vole (Microtus townsendii).

Brown (1973) made collections of various amphibians and reptiles species in the Eugene area. Among the amphibians collected by Brown, two species were taken from the West Eugene vicinity: western long-toed salamander (Ambystoma macrodactylum macrodactylum) and northern rough-skinned newt (Taricha granulosa granulosa). In addtion to these amphibians, the Pacific tree frog (Hyla regilla) has been reported at West Eugene sites (Gordon, 1988a). Brown located the following reptiles in West Eugene: northwestern pond turtle (Clemmys marmorata marmorata), Pacific gopher snake (Pituophis melanoleucus catenifer), western yellow-bellied racer (Coluber constrictor mormon), red-spotted garter snake (Thamnophis sirtalis concinnus), and Oregon alligator lizard (Gerrhonotus multicarinatus scincicauda) (Stebbins, 1985).

The animals described in this section were only selected representatives of the West Eugene wildlife community; the true extent of the number of species

involved is unknown, nor is it specifically known which species may be endangered by future development activities. However, the important concept, which must be emphasized here, is that West Eugene currently provides habitat for a large number of animals, and future decisions about how West Eugene is to be managed will have impact, either postively or negatively, upon those animals.

Wetland Management Issues

West Eugene's wetlands raise a host of issues which must be addressed by concerned citizens, landowners, and state and local governments. At the most basic level, federal law requires that wetlands be conserved in some manner; at a minimum, the approach ultimately taken to manage West Eugene's wetlands must comply with federal law. However, in the spectrum of management options now available, there exists opportunities to take some uniquely creative approaches to conserve, enhance, and increase Eugene's wetlands in an economically viable manner.

In order to effectively conserve these wetlands, a number of crucial issues must be resolved in the public forum, addressing the conflicting interests involved. First, to what degree should existing wetlands be conserved? In other words, should all existing wetlands be saved or should only wetlands which are deemed valuable by current evaluation techniques be saved? Second, if privately owned wetlands are saved, then what compensation, if any, should be provided to the landowner? Third, is wetland creation or restoration

a viable option to allow development on wetlands to occur? Fourth, if wetland creation is used as a conservation tool, then what kinds of wetlands should be created and where should they be created? Fifth, will wetlands, both natural and created, require upkeep and maintenance? Who will pay for it? For the present, these questions will be posed, but left unaddressed until the question of wetland creation or restoration has been explored in the next chapter. The feasibility of wetland creation and restoration in West Eugene is a central management question which must be considered before a proposal to help conserve wetlands can be attempted.

West Eugene Wetlands Public Opinion Survey

Public opinion concerning management goals for West Eugene's wetlands has not yet been adequately assessed. However, some preliminary data on public opinion does exist from a local wetlands workshop conducted by L-COG on April 1, 1989. The workshop was designed to provide information to the public about West Eugene's wetlands and to stimulate public response and comment on the related wetland and development issues (Lane Council of Governments, 1989b). The workshop was attended by 99 people from the community (see Table 2). Opportunities were furnished to participants to comment on wetland issues, comment on mapped wetlands, vote on selected management options, and fill out a questionaire. The questionaire was completed by sixty-one of the workshop participants and gives some degree of insight into public perception of wetland issues (Lane Council of

TABLE 2. Types of Groups and Citizens Attending Wetlands Workshop

Attorneys
Chamber of Commerce
City Legal Councilors
Eugene Natural History Society
Landscape Architects
Lane Community College Board Member
Lane County Audubon Society
League of Womens Voters
Lumber Mill Representative
Metro Partnership
Native Plant Society
Oregon Department of Fish and Wildlife
Oregon Natural Resource Council
Planners
Planning Commission Member
Property Owners
Realtors
Sand and Gravel Company Representative
University Professors
University Students

Source: Lane Council of Governments, 1989b

Governments, 1989b). Obviously, the small size of survey response makes any conclusions derived from this poll tentative; however, it can nonetheless serve as a guide to future public reaction.

A reproduction of the complete survey questionaire is located in Appendix A. The questions were intended to gauge public attitude on the following issues: important wetland functions, preservation versus development, future industrial development, wetland creation, and where mitigation should take place. I will present the results of questions two through

six, since these are the most significant to this study.

Question two asked participants to mark the two functions which were most important to them. Figure 1 shows the choices offered and the relative voting percentage each choice received (Lane Council of Governments, 1989b). Although the question asked respondents to limit themselves to two choices, some people expressed dissatisfaction over the question's attempt to simplify a complex issue and marked more than two choices. As a result, sixty-one individuals generated 138 choices--16 more than anticipated. These additional choices have been averaged into the final results. These results

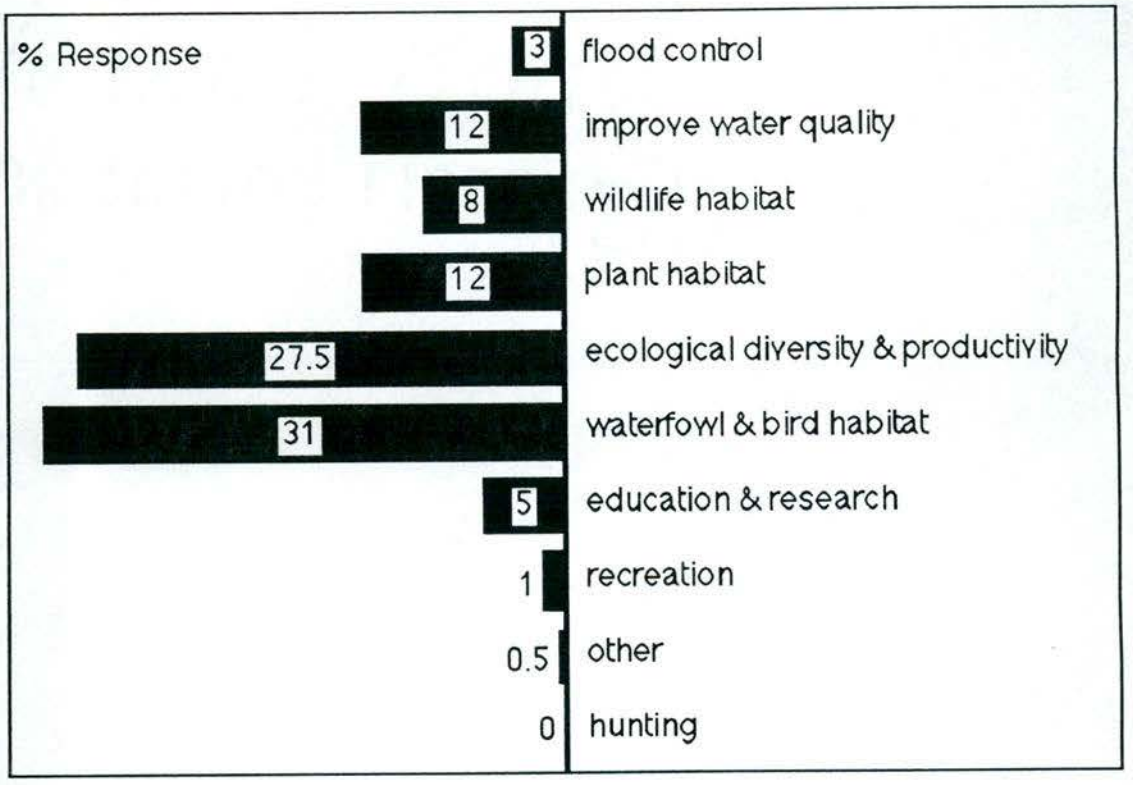


FIGURE 1. West Eugene wetlands public opinion survey. Which two wetland functions are most important to you?

indicate that wetlands were judged to be most important as habitat, particularly waterfowl and bird habitat, and as a source of ecological diversity and productivity.

Question three asked participants to choose between three levels of preservation versus development. Figure 2 reveals that, overwelmingly, the participants favored either complete preservation, or preservation of the highest value wetlands and development only on the lowest value. On the questionaire, mitigation was mentioned as part of any development to create replacement wetlands (Lane Council of Governments, 1989b).

Question four dealt with Eugene's problems concerning industrial development involving wetlands. Participants were asked to select the two development concerns which were most important to them. Figure 3 discloses a split decision concerning development. While 42 percent preferred avoiding development impacts to wetlands altogether, approximately 48 percent of the responses favored some level of development (Lane Council of Governments, 1989b). One quarter felt it was important to identify in advance which wetlands were suitable for development, thereby settling one source of apprehension for landowners in West Eugene. Additionally, the data indicate there is public concern over the adequacy of the industrial land base in Eugene, as well as concern over the substantial investments which have been made in West Eugene to encourage development.

Question five was concerned with the project goals of wetland creation. First of all, Figure 4 shows that there was public support for minimizing the need

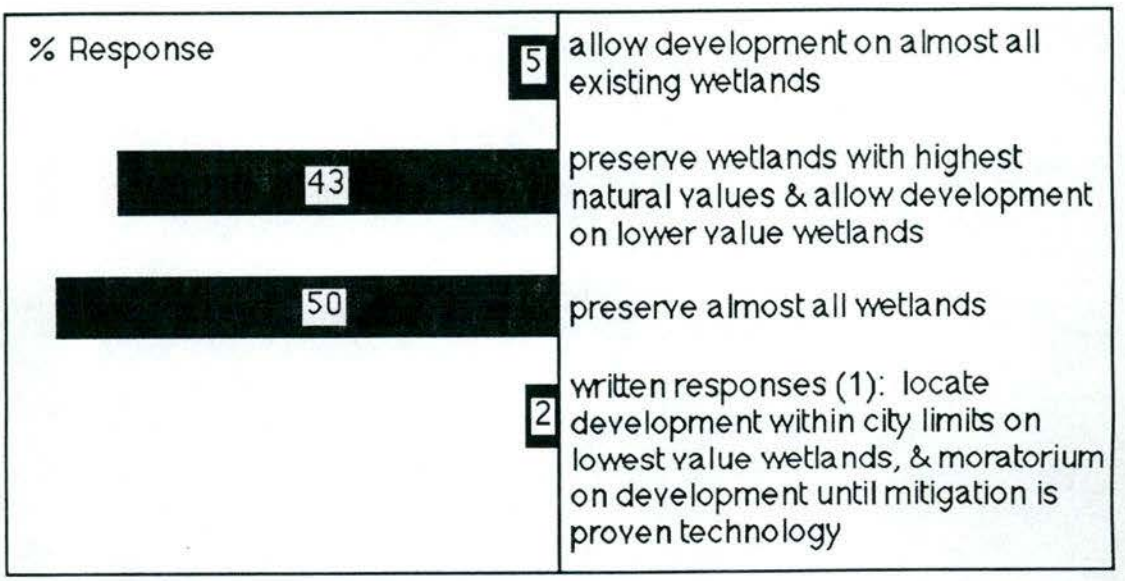


FIGURE 2. West Eugene wetlands public opinion survey. Which options do you prefer for balancing development and environmental concerns?

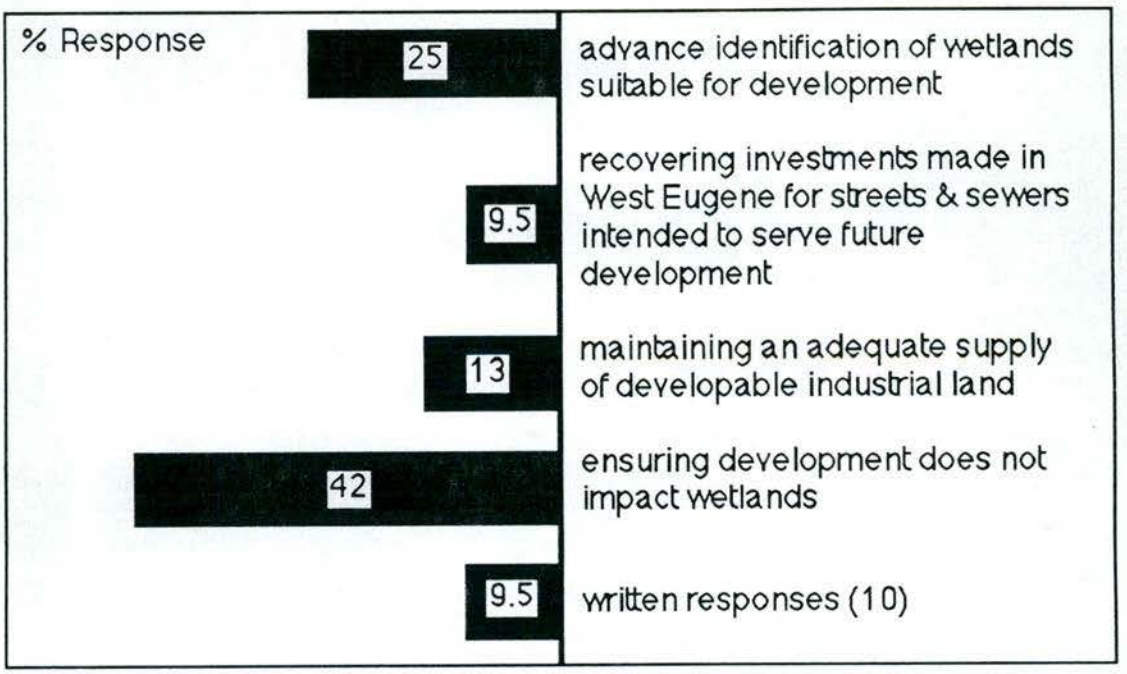


FIGURE 3. West Eugene wetlands public opinion survey. Which two development-related concerns are most important to you?

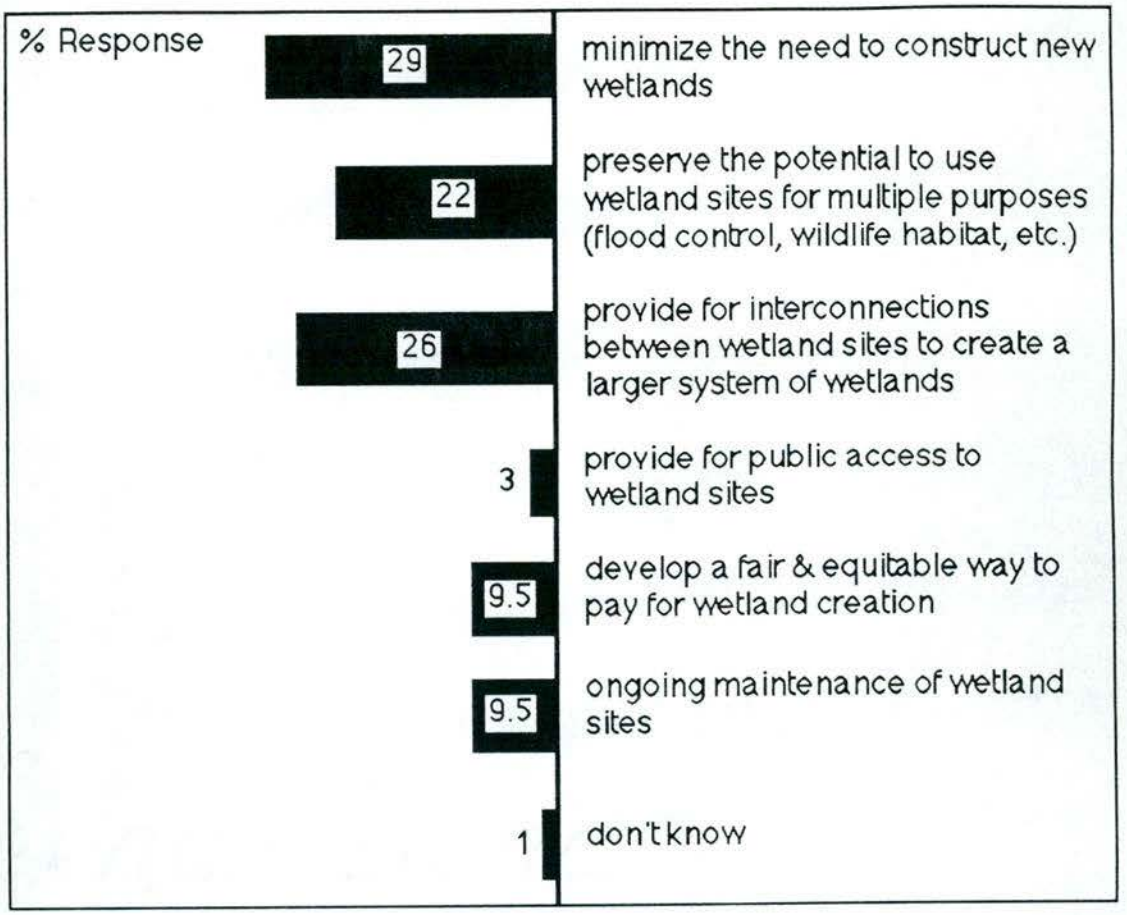


FIGURE 4. West Eugene wetlands public opinion survey. Which two wetland replacement concerns are most important to you?

to create new wetlands. In other words, development impacts on wetlands should be avoided whenever possible to escape the need to create replacement wetlands. If wetland creation is given, then the participants felt that the wetlands should be designed for multiple functions and should be interconnected into a larger system (Lane Council of Governments, 1989b).

In question six (Figure 5), respondents were queried where they would like to see wetlands created. The absolute majority, again, preferred existing wetland preservation over attempts to construct replacement wetlands.

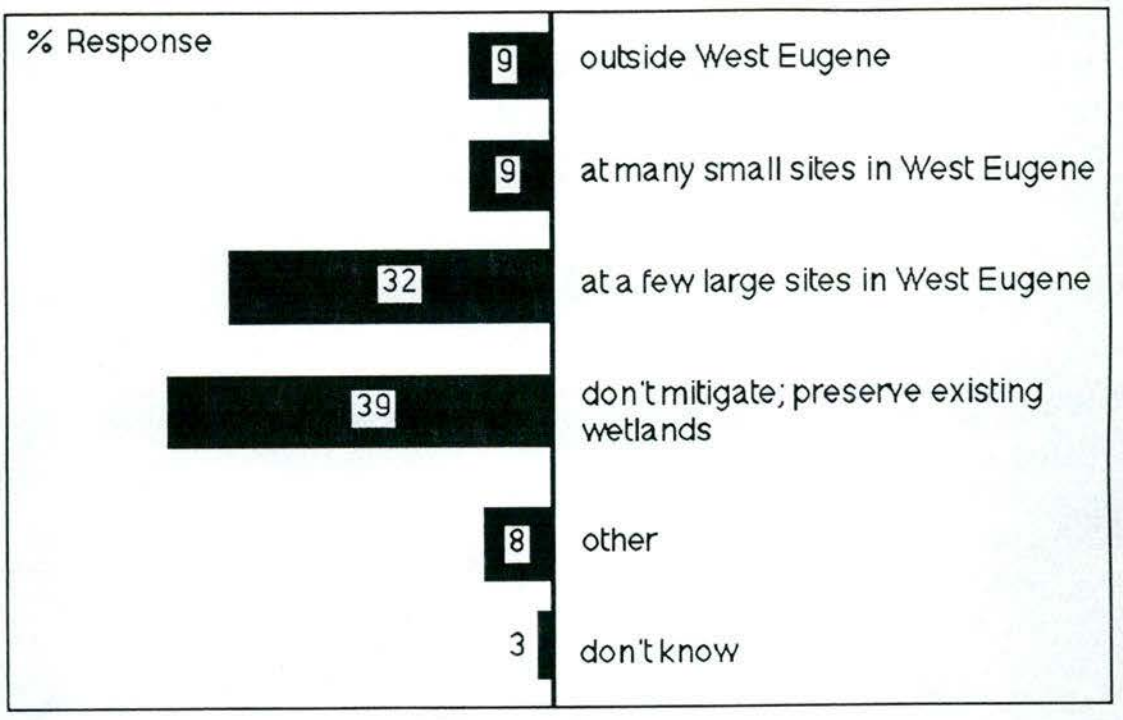


FIGURE 5. West Eugene wetlands public opinion survey. If new wetlands need to be created, where would you like to see them located?

However, among those who acknowledged a need for some development, there was a strong consensus that replacement wetlands should be clustered at a few sites, creating a larger system (Lane Council of Governments, 1989b).

In conclusion, the survey demonstrated public interest in the preservation of existing wetlands. There also is a large group who recognized that development in West Eugene may be necessary, but even this group believed valuable wetlands should be preserved and impacted wetland replaced with created ones. According to results, if wetlands are created, then they should be clustered into an interconnecting system and should be designed to provide multiple functions.

Summary

This chapter described the ecological attributes of West Eugene's wetlands, portrayed the historical and social context, and defined the scope of management issues surrounding these wetlands. West Eugene contains scattered remnants of relic, wet prairie, marshes, wooded bottomlands, and extensive, altered wetlands on hydric soils. Given the present legal climate to protect wetlands, a unique opportunity exists in West Eugene to preserve existing wetlands, and create new wetlands to replace those altered in the past and those that will be altered in the future. West Eugene naturally possesses the ingredients conducive to experimental wetland creation--climate, hydric soils, water, and wetland flora and fauna. However, the usefulness of wetland creation or restoration as a management tool for West Eugene is presently unknown, and cannot be known unless it is tried. An appraisal of wetland creation and restoration technology can only be inferred from the record of past experiences elsewhere, and these experiences used as a guide to develop an effective management program for West Eugene's wetlands

CHAPTER IV

WETLAND CREATION AND RESTORATION

> . . . we can logically argue that the successful restoration of a disturbed ecosystem is an acid test of our understanding of that system.
>
> A. D. Bradshaw, 1987

Introduction

The practice of restoring degraded ecosystems or creating new ones to replace those lost has come to be known as "restoration ecology." In an attempt to stem wetland losses, federal and state officials frequently condition dredge-fill permits with requirements to create, restore, or enhance wetlands to "mitigate" the harm caused to existing wetlands. For example, during a ten year period in Oregon (1977-1987), 58 Section 404 permits issued for 82 existing wetlands stipulated the creation of 80 new ones (Kentula, Sifneos, Good, Rylko, & Kunz, 1989). Although mitigation has become a routine permit requirement, scientific knowledge and experience in wetland creation and restoration is presently limited (Kusler & Kentula, 1989). Since mitigation is being used as an important means to preserve the wetland base when permitting development, it is important to scrutinize the effectiveness of restoration know-how to date and the scope of current knowledge.

First, I will explore the role wetland creation or restoration may play in West Eugene, both the problems and potentials. Then, I will survey a number of wetland mitigation projects nationwide and consider their relative success or failure. In the same vein, I will consider documented Oregon mitigation projects which have undergone qualitative assessment. Finally, lessons from the wetland creation experience documented in this chapter will be summarized as a guide for improving mitigation performance.

Wetland Creation and Restoration in West Eugene

West Eugene is presently faced with a number of development projects which will affect existing wetlands. Local government is concerned with balancing the needs of economic development while preserving the most valuable wetlands. In order to conform with EPA's "no net loss" policy, permitted development on West Eugene wetlands will require wetland creation or restoration for the mitigation of development consequences. At its best, wetland mitigation could increase Eugene's wetland base, provide expanded habitat for rare plants, birds and animals, improve urban recreational opportunities, provide open space, improve water quality from urban run-off, and assist in regional drainage and flood control. At its worst, mitigation could accelerate losses by replacing natural wetlands with artificial ones that function poorly or not at all.

The United States Council on Environmental Quality (CEQ) defines mitigation as:

(a) . Avoiding the impact altogether by not taking a certain action or parts of an action;

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation;

(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

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

(e) Compensation for the impact by replacing or providing substitute resources or environments. (CEQ Definition of Mitigation, 1988)

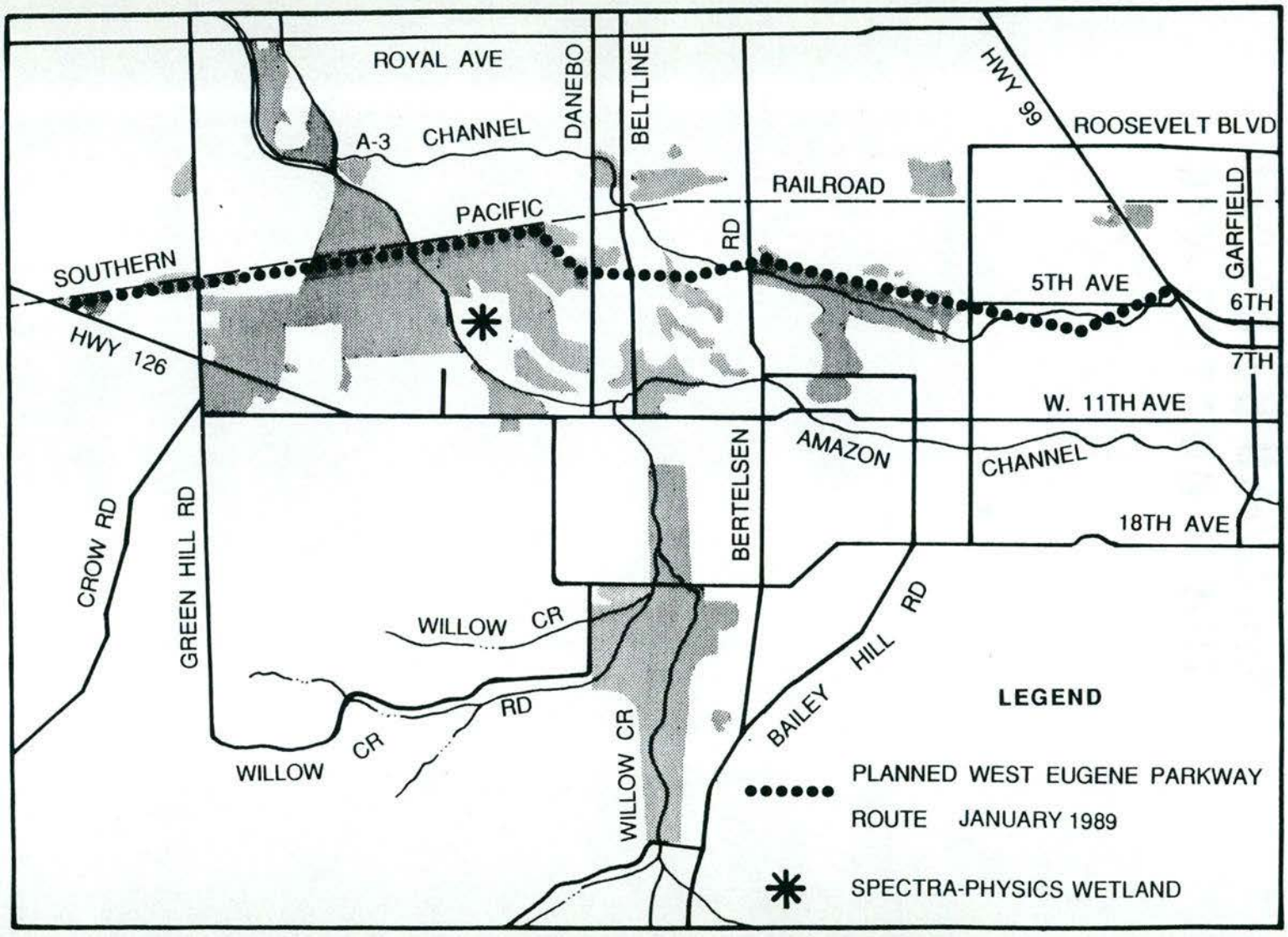
The above definition of mitigation has also been adopted by the Environmental Protection Agency for their review of Army Corps of Engineers' Section 404 permits.

Section 4 of Oregon's Senate Bill 3 (1989) adopts the CEQ's definition of mitigation with minor revisions; (d) adds the words: ". . .by monitoring and taking appropriate corrective measures," and (e) is changed to read: ". . . providing comparable substitute wetland or water resource." Section 3 of Oregon's new law makes it policy to: "Maintain a stable resource base of wetlands through the mitigation of losses of wetland resources. . . ." Additionally, the law now restricts local governments from designating wetlands areas for development unless planned losses are fully offset by creation, restoration, or enhancement of wetland functions and values. In short, locally planned development on wetlands must include mitigation provisions to maintain regional wetland resources. While, at one extreme, mitigation means the total avoidance of impact to wetlands, it alternately means the substitution of

natural wetlands with created, restored, or enhanced ones. In West Eugene, two projects (see Map 3) are currently proposed which are examples of mitigation by substitution--both would create or enhance wetlands as mitigation for development consequences. The two projects will be described in detail below.

The first is a plan to expand the Spectra-Physics manufacturing plant by filling and building upon surrounding wetlands. The second is an Oregon State Department of Transportation project to construct a street through a section of West Eugene which contains a large concentration of wetlands, hereafter referred to as the West Eugene Parkway. The Parkway would extend West 6th and West 7th Avenues to serve as an alternate to West 11th Avenue and become State Highway 126.

Spectra-Physics manufactures fixed laser scanners. In 1979, Spectra-Physics purchased 32 acres in West Eugene and began construction of their manufacturing facility (Lane Council of Governments, 1988). The City of Eugene had actively encouraged Spectra-Physics to locate in West Eugene, an area zoned for industrial development since 1964. In 1980, Spectra-Physics presented a Master Plan to the city which envisioned development of the entire site for manufacturing. Presently, Spectra-Physics has developed about 15 acres on the site for a plant that employs approximately 500 people. Due to explosive growth in the fixed laser scanner industry, the manufacturing facilities have become inadequate to keep up with product demand and the company wants to expand. However in 1988, the remaining 12 acres of the Spectra-



MAP 3. West Eugene Parkway route and Spectra-Physics wetland

Physics site were identified by DSL and L-COG as wetland--future expansion would require permits from both DSL and the Army Corps of Engineers (Lane Council of Governments, 1988). Moreover, EPA's Ralph Rogers has indicated that the original 15 acres of development were an unauthorized fill made without a 404 permit, and EPA will require mitigation for these before any new development can be considered (T. Bingham, personal communication, May 22, 1989).

A 1988 wetland delineaton at the Spectra-Physics site, performed by Scientific Resources, Inc., identified the remaining undeveloped land as a combination of Fraxinus latifolia and emergent wetland (Lane Council of Governments, 1988). In addition, DSL identified virtually all of the vacant land surrounding Spectra-Physics' property to be regulated wetland (Lane Council of Governments, 1988). Therefore, any permitted future development at Spectra-Physics will unavoidably alter existing wetlands and require mitigation.

A 1988 L-COG report which evaluated mitigation options for Spectra-Physics, concluded that future plant expansion could be managed in such a way as to affect only 5.5 acres of emergent wetland (Lane Council of Governments, 1988). This affected emergent wetland would require off-site mitigation. Under L-COG's scheme, Spectra-Physics would create replacement wetlands somewhere along the Amazon Channel, depending upon the availability of suitable land. Lands along Amazon Channel possess appropriate hydric soils and the channel provides a stable source of water for manipulation. However, since the issue of Spectra-Physics' original wetland fill

is unresolved, it is uncertain whether EPA will issue a permit for new construction on the Spectra-Physics site.

The Oregon State Department of Transportation's project to construct the West Eugene Parkway will affect a number of wetlands. While the exact alignment of this road has not been finalized, the road will originate at 5th Avenue near where West 6th and West 7th Avenues merge, follow the north side of Bertelsen Slough, skirt the Bethel-Danebo landfill to the south, then run south of the Southern Pacific Railroad tracks, cross Green Hill Road, and finally merge with the existing Highway 126 (Oregon State Department of Transportation, 1989). This project is intended to improve traffic flow through town, and also improve access to areas currently zoned Special Light Industrial, Light-Medium Industrial, and Heavy Industrial by the Metro Plan (1987).

Many of these industrially zoned lands are located upon areas that have been recognized as potentially regulated wetlands (Lev & Lane Council of Governments, 1988) Specifically, according to a Oregon State Department of Transportation (1989) assessment, the street project's alignment will directly involve 28 acres of wetland. In order to offset the project's consequences, various mitigation options have been explored.

On January 10, 1989, the Oregon State Department of Transportation issued a mitigation plan which outlined a proposal to purchase 14.86 aces of existing wetland, enhance 1.63 acres of wetland, and create another 30.32 acres. This 30 acres of wetland creation will take place in three different locations: along Bertelsen Slough, on A-3 Channel east of Bertelsen Slough,

and west of Green Hill Road (Oregon State Department of Transportation, 1989).

The January 1989 mitigation plan summarized a functional analysis of the three wetland locations affected by the proposed construction route (Oregon State Department of Transportation, 1989). The wetlands were evaluated for groundwater recharge, groundwater discharge, flood storage, and wildlife habitat. The areas were not rated for shoreline anchoring, sediment trapping, nutrient retention, food chain support, fishery, or recreation. The reasons cited for excluding certain functions were as follows: a lack of permanent water means that there are no shorelines and no sediment production or trapping; nutrients remain in place since there is largely no flowing water; the food chain is not well developed because these wetland communities possess low structural diversity; and finally, a lack of permanent water prohibits both fish and recreation in these wetlands. The functional analysis rated the three locations as moderate to high for groundwater recharge, moderate to low for groundwater discharge, high for flood storage, and low for wildlife habitat (Oregon State Department of Transportation, 1989).

Under this proposal, approximately 8 acres of wetland will be created along Bertelsen Slough on the east side of Bertelsen Road. The concept for this 8 acres site is to create two sloping basins linked by channels to the slough. Check dams will be provided to control seasonal water levels in the basins. The upper edges of the basins will be planted with Fraxinus latifolia, Salix spp., and Populus spp., while the inundated lower areas are expected to become

naturally established with Typha spp., Carex spp., Juncus spp., Scirpus spp., and Phalaris arundinacea.

An additional 4 acres of wetlands will be constructed along the A-3 Channel east of Bertelsen Slough where 5th Avenue will intersect with the project road. These created wetlands will be sandwiched between the 5th Avenue and the new road. Although the existing wetland in this area was assigned a low wildlife habitat rating, the mitigation plan actually notes: "Incidental improvement in waterfowl habitat, . . ., may be largely offset by the proximity of the mitigation sites to the project and to 5th Avenue, which is a busy local collector" (Oregon State Department of Transportation, 1989, p. 17). According to the mitigation plan, the objectives at this site are to increase storm runoff and improve drainage, flood storage, and aquifer recharge functions of the A-3 Channel. Like the Bertelsen Slough mitigation, vegetation would be re-established through a combination of planting and natural invasion.

The final 18 acres of created wetland will occur on a 33 acre land parcel presently owned by the Department of Transportation west of Green Hill Road and north of the Southern Pacific Railroad tracks. The parcel is currently cropped for annual ryegrass (Lolium spp.) and has been delineated as an agricultural wetland--it is unknown at this time how much mitigation credit, if any, will be allowed by the EPA (T. Bingham, personal communication, October 26, 1989). The mitigation would attempt to re-establish Deschampsia cespitosa wet prairie (Oregon State Department of Transportation, 1989). Underlying the site is Dayton silt loam, a gley soil, making it a suitable candidate for restoration.

The plan is to clear the site by first harvesting the Lolium and then burning the residues. Deschampsia seed will be collected by mowing areas of wet prairie impacted by the road project and then spreading the hay over the prepared ground. Timing is critical using this method for seed collection, because the hay must be mown when the seeds are mature but have not yet fallen (Cottam, 1987). Nitrogen fertilizer will be applied to the site and a contact herbicide will be used to combat weeds.

All of the mitigation sites will be monitored annually for five years to evaluate plant survival, hydrology, wildlife activity, water quality, and natural revegetation (Oregon State Department of Transportation, 1989). However, the mitigation plan does not identify any specific remedial actions which will be undertaken if functional values have not been achieved.

The Spectra-Physics and West Eugene Parkway projects raise five important issues concerning wetland creation in West Eugene. I will now consider each of the issues in turn, before examining wetland creation and restoration projects in other parts of the nation and Oregon.

First, many of the wetlands in West Eugene are located on land currently zoned for industrial development--such zoning is inappropriate. At the time West Eugene zoning was established, these wetlands were either not recognized or their significance was poorly understood. New and rapid changes to law have expanded the scope of wetlands regulated by Section 404. Even as recently as 1980, when the Spectra-Physics plant was first begun, seasonally wet areas in West Eugene were not properly understood to

be regulated wetlands. Spectra-Physics current problems could have been avoided with better environmental planning. Once these wetlands have been surveyed and mapped, the West Eugene Wetlands Management Plan being prepared by L-COG will specify which wetlands should be protected and recommend appropriate adjustments to zoning.

Second, the West Eugene Parkway project is proceeding with construction plans which will alter wetlands before the relative overall significance of these wetlands has been appraised by L-COG. The road project will have far-reaching consequences on the future management of these wetlands, because, at a minimum, the road will result in fragmentation of these areas and cause further development pressure on surrounding wetlands. Therefore, a final decision concerning the road should not be made until the West Eugene Wetlands Management Plan has been completed and adequately reviewed by the public. The highest level of mitigation is to avoid the impact altogether. If significant wetlands are found along the planned route, then the route should be modified or completely abandoned.

Third, the West Eugene Parkway project takes a strictly monotypic approach to wetland creation, rather than one that attempts to replace plant communities or create habitat. This approach is the lowest level of creation. Since it deals with planting only one or two species, the created wetland at best is an incomplete substitute for the natural one; and since it depends upon nature to re-establish the community, a time lag inevitably results before the created wetland can function like a natural one. At a minimum, created

wetlands should be significantly larger in size than the affected area to offset any temporary or permanent functional losses.

Fourth, the West Eugene Parkway project fails to show that the planned mitigations will be functionally equal to the wetlands filled by this project. The January 1989 mitigation plan sets objectives to replace or improve the functional values of the altered wetlands. However, the functional analysis used to evaluate of the involved existing wetlands did not adequately quantify values to determine the proper size and scope of replacement wetlands (Oregon State Department of Transportation, 1989).

Fifth, monitoring and maintenance should be an integral part of any mitigation project in West Eugene. While the January 1989 mitigation plan for the West Eugene Parkway project envisioned a limited monitoring program, its objectives are too vague and its annual frequency inadequate for substantive data on restoration. Wetland creation and restoration is highly experimental in general, and very little is known about the West Eugene ecosystem specifically. Therefore, every mitigation project needs to incorporate a diligent monitoring program together with trial and error experimentation to develop a scientific information base for wetland creation.

In summary, the Spectra-Physics and West Eugene Parkway projects illustrate well the conflicts which arise nationwide between development and wetlands. Persuasively, development projects put capital into the local economy, while the benefits of wetlands do not easily translate into financial gain. As a result, economic forces favor development interests above wetland

conservation. Wetland creation may be viewed as the less costly alternative to a prohibition on development, because the cost of mitigation is likely to be a fraction of the financial benefit of development to the local economy. However, the overall effectiveness of creation projects in preserving natural wetland functions is controversial, because many failures have been documented across the nation.

Kusler and Kentula (1989) have brought to light several general conclusions concerning creation and restoration projects, based upon a review of thousand of nationwide projects. First, practical experience and knowledge in wetland creation and restoration are limited for most types of wetlands and varies regionally. Second, most wetland creation projects do not have clear goals, making meaningful assessments difficult. Third, short- or long-term monitoring of wetland projects has been uncommon. Fourth, total duplication of a natural wetland is impossible; however, some systems can be approximated and specific functions restored or created. Fifth, partial project failures are common. Last, certain wetland types and functions are more difficult to create than others. These general findings are relevant both to West Eugene and the projects presented elsewhere in this discussion.

Nationwide Wetland Mitigation Projects

Information assessing mitigation projects is difficult to come by. The information that is available generally evaluates created wetlands based upon how well vegetation has become re-established, but functional comparisons

with similar natural wetland ecosystems are seldom attempted. As mentioned in Chapter II, preliminary research on a standardized method for functional analysis will not be conducted by EPA until 1990, after work on the Wetland Characterization Method has been completed (R. Sumner, personal communication, July 11, 1989). Mitigation assessments are sometimes inconclusive, because the project's objectives were never clearly stated. Others are anecdotal in nature based largely upon the authors impressions. Yet, for still others, it is simply too soon to judge whether they will be successful or not. Under these circumstances, any declaration concerning the general success or failure of mitigation is, at best, tentative. Therefore, with these aforementioned limitations in mind, this section will survey a number of documented estuarine and freshwater mitigation projects that have occurred nationwide and examine the reported results of these studies.

Although estuarine wetlands have important differences from inland freshwater systems, they are analogous in the kinds of engineering problems they present. In both types of wetlands the following factors are critical: depth of water level and range of fluctuation, frequency and period of inundation, water flow, grading of banks and contours, substrate characteristics, nutrient cycling, and vegetation. Therefore, some degree of competence in wetland creation can be gauged from the results of estuarine mitigation projects.

Nationwide Estuarine Mitigation

California has lost over 90% of its original, historic wetlands since

pioneers first settled the land (Tiner, 1984). Today, California's remaining wetlands, approximately 450,000 acres, consist mainly of San Francisco Bay and a series of lagoons and estuaries stretching from Humboldt Bay to San Diego (Josselyn, 1986; Ray & Woodroof, 1986). Reacting to public concern over coastal access and wetland losses, the California legislature created the San Francisco Bay Conservation and Development Commission and the California Coastal Commission to regulate development involving coastal wetlands. Since 1973, these two commissions have approved numerous projects involving wetland creation or restoration to mitigate for development. However, from the beginning, California's mitigation projects have been controversial and their effectiveness questioned (Harvey & Josselyn, 1986; Race, 1985).

Race (1985) assessed past mitigation projects in San Francisco Bay for the years 1977 to 1982 which involved restoration, enhancement, or creation. According to Race, 11 projects were undertaken in San Francisco Bay: 6 projects involved experimental planting of vegetation and 5 projects involved substrate alterations to create habitat. All 6 of the experimental planting projects were concerned with attempting to establish cordgrass (Spartina foliosa) on dredge spoil or denuded areas. Plantings were made utilizing a combination of seedlings, cuttings, and seeds. The results of the 6 planting projects were disappointing; they ranged from complete failure to 48% survival of seedlings--on 3 projects all the seedlings died within 8 months. The results for the 5 substrate alteration projects were mixed. Vegetation was established

to some degree on all the sites; however, this has been due more to natural colonization than successful planting. As of 1985, none of these substrate alteration projects could be characterized as achieving the goal of restoration. Race concluded that these projects did not demonstrate an ability to predictably restore estuaries. In Race's opinion based upon the San Francisco Bay experience, wetland restoration is unproven technology and has been adopted prematurely into the 404 permit process.

In New Jersey, Shisler and Charette (1984) evaluated 8 artificial salt marsh projects for their productivity by comparison to adjacent natural ones. The artificial salt marshes were created as mitigation for development projects and illegal wetland fills. The projects varied from 0.06-5.0 acres in size, but were typically less than one acre. Saltmarsh cordgrass (Spartina alterniflora) and saltmeadow cordgrass (Spartina patens) were the two predominate species used in artificial marsh construction. Shisler and Charette observed four primary problems with the marshes investigated:

(1) destruction of the artificial marsh fringe due to high wave energy exposure;

(2) sediment flow onto the artificial marsh from upland sources;

(3) human disturbance of the artificial and natural marshes; and

(4) several artificial marsh projects have not been initiated. (p. 83)

In its evaluation of vegetation, the study found that the total biomass of the artificial marshes was significantly lower than in natural marshes, indicating lower productivity; additionally, plant densities and reproductive heads were

significantly lower in artificial marshes, but the number of species was actually found to be higher. The sediment characteristics of created marshes were very different from adjacent natural ones: artificial marshes exhibited lower nutrient levels (phosphorous, potassium, calcium, nitrogen, and magnesium), lower percentages of organic matter, and reduced electrical conductivity. Microinvertebrate densities were lower in some of the created marshes as compared to natural marshes, but macroinvertebrates were commonly found in both natural and artificial marshes. Overall, this study found compelling evidence that young, artificial salt marshes were less productive than adjacent natural salt marshes.

In a study of created salt and freshwater marshes near Norfolk, Virginia, the Army Corps of Engineers evaluated 26 sites for wetland replacement and compliance with 404 permit conditions (Quammen, 1986). Relative success was judged in terms of ability to locate the created wetland, presence of hydrophytes, and permit specifications. The study concluded that 13 sites were successful or would eventually become successful, 6 sites were unsuccessful or only partial successful, and 7 sites had not been initiated. Although this study shows promising successes in creation, a significant rate of failure suggests that deficiencies remain in technical proficiency.

A 404 permit for a marina project in Bourne, Massachusetts specified the creation of 1.8 acres of emergent estuarine wetland (Reimold & Thompson, 1986). In 1982, sprigs of emergent hydrophytes were planted in the intertidal zone, but establishment success was low. Sprigs failed because they either

were planted too low in the intertidal zone or were consumed by migratory waterfowl.

The above studies represent only a tiny fraction of the thousands of estuarine mitigation projects which have taken place nationwide; and while these examples cannot be portrayed as truly representative of the majority of projects, they do reveal problems with wetland creation. Since all of these studies reported incomplete successes, they illustrate mitigation's greatest potential shortcoming: a net loss of wetland through failure of replacement.

Nationwide Freshwater Mitigation

A great deal of work has taken place around the country to enhance freshwater wetlands to make more waterfowl habitat. The Prairie Pothole wetlands of North and South Dakota, Minnesota, and Iowa represent one of the best examples of this type of wetland habitat enhancement. Tiner (1984) regarded prairie potholes as the most valuable inland marshes for waterfowl production in North America. Twelve species of ducks are commonly found in the region; seven species are dabbling ducks: mallard (Anas platyrhynchos), northern pintail (A. acuta), gadwall (A. strepera), blue-winged teal (A. discors), northern shoveler (A. clypeata), green-winged teal (A. crecca carolinensis), and American widgeon (A. americana); and five species are diving ducks: canvasback (Aythya valisineria), redhead (A. americana), lesser scaup (A. affinis), ring-necked duck (A. collaris), and ruddy duck (Oxyura jamaicensis) (Batt, Anderson, Anderson, & Caswell, 1989).

Prairie potholes are lakes and lacustrine wetlands, most less than 2 meters deep, located in glacial drift left behind by the Wisconsin glacial advance (Winter, 1989). The region occupies an area of about 300,000 square miles, including North Dakota, South Dakota, northern Iowa, western Minnesota, and the prairies of southcentral Canada. Pothole wetlands have been seriously reduced by agriculture and flood control projects. North and South Dakota have lost over half of their original wetlands, Iowa more than 99 percent, and approximately 53 percent have been drained in Minnesota (Tiner, 1984).

In an attempt to reverse this trend, the U.S. Fish and Wildlife Service, the Soil Conservation Service, Ducks Unlimited, and other conservation groups have allied to initiate pilot projects to restore drained wetlands. Madsen (1988) reported that a Minnesota pilot project begun in 1984 restored 1,460 acres of wetlands by demolishing water control structures. Pothole wetlands exhibited an ability to naturally revegetate with hydrophytes which presumably germinate from relic seedbanks (Kantrud, Milnar, & van der Valk, 1989; Madsen, 1988).

A study by Batt, Anderson, Anderson, and Caswell (1989) found a positive relationship between the number of May (spring) ponds and the number of ducks--duck numbers decline in dry years and increase in wet years. However, Batt et al. detected an overall decline in waterfowl numbers in the pothole region due to habitat deterioration from farming activities. Kaminski and Prince (1981) reported an increase in species diversity and density for dabbling ducks where wetland habitat was managed to achieve a 50:50 interspersion of

water and emergent hydrophytic vegetation. Together, these studies indicate an ability to achieve restoration success from the standpoint of waterfowl recruitment. However, they do not reveal the relative degree of success for other wetland values.

In Keene, New Hampshire, a mitigation project to create 13 acres of marsh with emergent vegetation was only partially successful. The resulting wetland consisted of 5 acres of littoral habitat with steep banks and channels. Emergent vegetation was unable to become established on the steep slopes, and upland species invaded the banks (Reimold & Thompson, 1986). In another mitigation project in Nashua, New Hampshire, emergent vegetation also failed to become established due to the construction of extremely steep channel banks (Reimold & Thompson, 1986). These two projects demonstrate an underlying failure to consider hydrophytic vegetation requirements: soil type, degree of soil saturation, frequency of saturation, nutrient levels, and possibly seed sources.

In Arcata, California an innovative experiment is taking place which integrates wastewater management with wetland creation. A series of artificial freshwater marshes are being used to treat wastewater with aquatic plants (Allen, Gearheart, & Williams, 1982). Interestingly, the system was originally proposed by two Humboldt State University professors, George Allen and Robert Gearheart, as an alternative to the enormously expensive state-of-the-art facility recommended by experts. Although the system must be characterized as experimental, it has produced a dramatic improvement in the purity of water

released from the facility.

The Arcata wastewater systems serves a population of approximately 14,000. Wastewater receives secondary treatment in an aerated lagoon, and then is passed into an oxidation pond for retention. From the oxidation pond effluent is pumped through a stilling tower to an artificial marsh, consisting of twelve cells (Allen et al., 1982). Aquatic macrophytes in the artificial marsh cells act to lower the concentration of ammonia, nitrate, and phosphate through metabolic processes. To achieve further cleansing by macrophytes, the wastewater is passed from the artificial marsh cells to the adjacent Arcata Marsh and Wildlife Sanctuary, where it flows through three created freshwater marshes and a recreation lake.

The Arcata Marsh and Wildlife Sanctuary was completed in 1981 with funds provided by the California Coastal Conservancy. The freshwater marshes and lake, totalling 63 acres, were constructed aside Humboldt Bay on a site which was formerly used for cattle grazing and as a dump. Leachates from the old dump are presently detectable in the marshes and pose an uncertain degree of health risk (Allen et al., 1982). However, the nutrient-rich wastewater flowing into the three marshes have resulted in the establishment of luxuriant emergent vegetation. The sanctuary is used by as many as 250 species of birds and has become extremely popular among birdwatchers. The sanctuary has developed trails, picnic sites, boat launches, and viewing blinds.

As part of the integrated approach, Arcata wastewater is being used in a pilot project to rear salmon in the oxidation ponds. A major salmon ranching

project is being planned within the Arcata Marsh and Wildlife Sanctuary. Additionally, it has been proposed that the macrophytes be periodically harvested and processed for alcohol. The alcohol would then used by the city as a fuel.

Attempts to restore or create wet prairie are particularly relevant to West Eugene. Extensive research on prairie restoration has been conducted at the University of Wisconsin. While differences exist between Wisconsin's and West Eugene's prairie communities, Wisconsin's wet prairie is analogous in many respects to the one found in West Eugene. A look at Wisconsin's restoration experience should provide clues to what could be expected in West Eugene.

In 1935, a project was begun to restore tallgrass prairie on an exhausted piece of farmland near Madison, Wisconsin (Jordan, Gilpin, & Aber, 1987). The planting was carried out by a small group of Civilian Conservation Corps workers under the direction of Aldo Leopold, and represented one of the earliest attempts at restoration ecology. Leopold's restoration efforts grew into a program in prairie research at the University of Wisconsin's Arboretum which remains active today. Presently, the Arboretum has two prairies, the Curtis and the Greene Prairies, which are restored to reasonable facsimiles of native prairie. The success of these restorations was predicated upon detailed knowledge of all of the physical factors and life histories of the species involved, although guesswork and accident certainly played a role (Cottam, 1987).

Both the Curtis and Greene Prairies possess drainage conditions which range from wet to dry. These moisture conditions provide opportunities to study

plant community changes based upon moisture gradients (Cottam, 1987). Interestingly, data indicate that community types, based upon indicator species, undergo boundary shifts through time as introduced species move to optimum sites and communities respond to short-term climatic events (Cottam, 1987). Therefore, a community survey made in a particular year is only valid for a certain point in time.

Despite serious attempts to eliminate them, exotic species have managed to persist in the restored Curtis and Greene Prairies, although individual species differed in their ability to survive fires (Kline & Howell, 1987). Curtis Prairie was once dominated by the non-native bluegrasses Poa pratensis and P. compressa (Cottam, 1987). Experimental burning has helped to reduce the frequencies of these bluegrasses, but has not eliminated them (Kline & Howell, 1987). Furthermore, in the absence of fire, the Curtis and Greene Prairies are rapidly invaded by trees and woody shrubs. However, prescribed burns have not always succeeded in controlling woody species. Kline and Howell (1987) attribute unsuccessful fire control efforts to the following causes: burns are typically conducted under conditions which make burning safe, only small areas are burned at one time, fires are not allowed to burn into woodlands, and the intervals between fires may be too long--fuels are suppressed by the invasion of brush.

In sum, the Curtis and Greene Prairies demonstrate that wetland prairie restoration is possible, although exotic species, in all probability, will never be eliminated. Importantly, fire was found to be an essential ingredient to establish

and maintain native prairie species. Additionally, in order to achieve a duplication of natural prairie, an extensive knowledge base and diligent effort was required for success. Work was conducted over a period of fifty years employing a large labor force, intensive planting, and management techniques (Cottam, 1987). The level of exertion required for a successful project emphasizes the obstacles which may be encountered if the goal is complete restoration.

Oregon Wetland Mitigation Projects

Kentula, Sifneos, Good, Rylko, and Kunz (1989) have investigated the effect of 404 permit decisions in Washington and Oregon on the wetland resource base. They compiled information from permits which required wetland creation and restoration and identified patterns and trends. In Oregon, from January 1977 to January 1987, 58 permits were issued for 80 wetland creation projects. The 58 permits affected 73.9 ha (182.6 ac) of wetlands, but resulted in the creation of only 41.81 ha (103.3 ac) in replacement. These findings reveal a net loss of 32.09 ha (79.3 ac) in natural wetlands. Of all the wetland types involved, freshwater systems were the most seriously impacted, recording a loss of 15.42 ha (38.1 ac). These results raise serious questions about the effectiveness of mitigation to date as a regulatory tool to protect the wetland resource base. However, these trends do not reveal anything about the value of individual projects. The following studies may shed more light on mitigation as it is currently practiced in Oregon.

The information on mitigation used in this section was gathered from three studies performed for the Oregon Division of State Lands. These reports were prepared by independent environmental consultants to evaluate the success of various mitigation projects around the state. Two of the reports evaluated projects carried out in estuarine areas, and the third was concerned exclusively with freshwater projects in the Beaverton area.

Oregon Estuarine Mitigation

Fishman Environmental Services (1987a) evaluated 19 Oregon projects which involved wetland creation, restoration, or enhancement in estuarine areas. Project sites ranged in size from 0.01-35.50 acres, and in at least five instances the mitigation area was substantially less than the area lost to development. The majority of evaluated projects were begun after 1983; therefore, relatively little time has passed since they were initiated. Projects were spread over a broad coastal zone: 5 along the Columbia River; 3 along the Necanicum River; 1 on the Nehalem River; 1 at Nestucca Bay; 1 at Yaquina Bay; 3 along the Umpqua River; 4 at Coos Bay; and 1 along the Coquille River.

The Fishman Environmental Services study did not characterize any completed projects as entirely successful--with the sole exception of a DSL mitigation project in Astoria (1987b). In six projects revegetation problems were described: Swash Lake Channel Mitigation (Columbia River), Astoria Airport North Dike Breaching Mitigation (Columbia River), City of Seaside Bike Path Mitigation (Necanicum River), Reddekopp Residential Development Fill

Mitigation (Nestucca Bay), International Paper Company Unauthorized Fill Mitigation (Umpqua River), and City of Coos Bay Pony Slough Mitigation (Coos Bay). In three projects, bank erosion problems were found: City of Seaside Bike Path Mitigation (Necanicum Bay), Highway 38 Widening Mitigation (Umpqua River), and International Paper Company Unauthorized Fill Mitigation (Umpqua River). In six projects, existing wetlands were damaged or altered by the mitigation projects: Swash Lake Channel (Columbia River), Warrenton Church of Christ Parking Lot Mitigation (Columbia River), Gnat Creek Bridge Mitigation (Columbia River), City of Seaside Waterfront Park Mitigation (Necanicum River), Reddekopp Residential Development Fill Mitigation (Nestucca River), and International Paper Company Unauthorized Fill Mitigation (Umpqua River).

After evaluation of the mitigation data, Fishman Environmental Services (1987a) identified a series of deficiencies in the removal-fill permit process which had contributed to mitigation failure. First, specific replacement objectives were often not indicated on the permit: types of vegetation, types of habitat, wildlife values, or hydrological functions. Second, habitat and wetland values were not being assessed for the original wetlands prior to development. Therefore, it was impossible to make a meaningful value comparison between the developed wetland and the created one. Third, habitat and wetland evaluations were not prepared for the mitigation site prior to development. In some instances wetlands existed on the sites selected for mitigation and were destroyed to create other wetlands. Fourth, if monitoring is required, then an

evaluation schedule should have been included in the permit together with specific criteria and methodology. Fifth, mitigation plans were often not submitted with the original permit application. In this way, the adequacy of the mitigation plan could not be considered prior to permit approval. Sixth, DSL and Oregon Fish and Wildlife should have provided more assistance to applicants. Mitigation goals and legal requirements must be better communicated to the prospective applicant, and more technical support offered to develop adequate mitigation plans. Taken together and aside from the engineering challenges of wetland creation, if these deficiencies were corrected, the Oregon permit process should become more effective and mitigation efforts more effective.

During April 1987 to September 1987, Hodder and Posey (1987) studied the City of North Bend's Pony Slough mitigation site. A 0.55 acre upland site on Pony Slough had been excavated to create an intertidal flat as mitigation for a boat ramp construction (Fishman Environmental Services, 1987a). Hodder and Posey sampled for invertebrates, vegetation colonization, and sediment composition at the mitigation site and a nearby control site (1987). The study found that in six of the eight most common invertebrate taxa present there were no significant differences in abundance between the mitigation and control site, indicating rapid colonization of the mitigation site by invertebrates from adjacent wetlands. However, significant seasonal differences were found in the invertebrate communities of the mitigation and control areas. In contrast to invertebrates, vegetation was only slowly colonizing the mitigation site. The

most common plants were woody glasswort (Salcornia virginica), Lyngby's sedge (Carex lyngbyei), and common sandspurry (Spergularia marina). Finally, sediments were sampled for mean grain size and compared with results from the prior year, but only minor differences existed in the samples obtained.

In summary, the evidence presented in the above studies reveal that problems exist in attempts to create estuarine wetlands in Oregon--at least in the short period of a few years. Vegetation is often difficult to establish, improperly graded banks erode and will not support hydrophytes, and mitigation sites themselves sometimes destroy important existing wetland or habitat values. In some cases, the created site conditions may allow wetlands to eventually become naturally established, but the number of years for this to occur is unknown.

Oregon Freshwater Mitigation

Harenda (1988) has evaluated ten mitigation projects in Oregon's Washington County for relative success. Eight were intended to be emergent wetlands with areas of open water and two were riverine. With the exception of one, each project was less than one acre in size. All of the projects must be characterized as enhancements since they were constructed upon existing wetlands bordering streams. Of the ten sites investigated, four could be characterized as successful, although one of these four was apparently plagued by visible pollution reaching the pond from several storm drains. The remaining six sites can only be labeled partially successful to unsuccessful; all of them

experienced problems establishing emergent vegetation. In one instance, the constructed ponds were landscaped with ornamental plants and bark chips. In another, no planting of any kind had been initiated and there was no water reaching the site through its channel. Harenda theorized that the poor success in establishing emergent vegetation was the result of improper water depth and sediment anoxia. Evidence of sediment anoxia was found at five of the six sites experiencing vegetation problems. Others problems noted were high water turbidity (two sites) and trash accumulation (two sites).

The Harenda results show a forty percent success rate for freshwater wetland enhancement projects. Harenda's evaluations suggest that this success rate could have been improved with better project design and more clearly defined goals. However, it must be emphasized that these mitigation projects were undertaken on existing wetlands. First, the successful projects benefited by their proximity to surrounding wetlands. Second, the question must be asked: Do enhancements of existing wetland adequately compensate for fills made elsewhere? If the answer is no, then all of these mitigations, even the successful ones, resulted in a net loss of wetland.

Conclusion

Based upon the assessments presented, the science of wetland creation and restoration must be characterized as largely experimental. Until technical proficiency is improved, every mitigation involving creation needs to be regarded as a pilot project designed to generate better information

concerning wetland ecology. A number of factors were responsible for partial or complete project failures. Before creation can be an effective tool to preserve and enhance the wetland resource base, the problems summarized below must be addressed in any wetland management program.

First, wetlands are often inadequately assessed before alteration. As a result, baseline data was unavailable to establish mitigation objectives. Mitigation objectives can only be properly addressed when the relative functions and values of involved wetlands are known. Additionally, better pre-project assessments would identify and protect inappropriate sites from being used for mitigation, such as other wetlands or good wildlife habitat.

Second, mitigation projects suffer from improper design. Better planning can reduce the frequency of failures which result from factors such as unsatisfactory grading, unsuitable substrate conditons, improper water depth, inappropriate vegetation, or an incorrect planting timetable. Plans need to be reviewed and approved by expert consultants before wetland alterations are allowed to occur. Improved pre-project planning will also serve to make permit holders aware of the potential cost and commitment associated with a successful project.

Third, mitigation projects are commonly only partially successful in achieving objectives. Even successful projects involve a significant time lag before the created wetlands are fully functioning. Therefore, mitigation sites should as a rule be larger in size than the wetlands originally affected to compensate for functional shortcomings in space and time. The difference in

size between the mitigation site and the affected wetland must be based upon the general difficulty in re-creating a particular type of wetland or duplicating a particular function, and the anticipated period of time it will take to accomplish objectives. A good data base will be essential to establish appropriate ratios to judge the size requirements of mitigation sites. However, until such data are available, wetland managers will have to rely on considered judgement in specifying the size of a mitigation site.

Fourth, many projects failures are due to improper construction and a lack of qualified supervision. Mitigation plans should clearly set out specifications, materials, equipment, and deadlines. Field work should be supervised and inspected by certified consultants to ensure compliance with plan requirements. Any plan changes must be approved beforehand with appropriate officials and certified consultants. Mitigation plans should be used to develop practical construction methods which will yield predictable results.

Fifth, monitoring and testing is generally inadequate and of insufficient duration. Mitigation projects are not being managed to provide needed baseline data. Increased proficiency in creation and restoration will only result from long-term data collection assessing projects for functional objectives.

Sixth, many projects failures can be traced to a lack of follow-up modification and correction. Permits should require that a reasonable level of success be achieved before a permit holder is absolved from responsibility. If monitoring reveals that a project is not meeting objectives, then the permit holder must undertake modifications until the objectives are met. Additionally,

the studies revealed that evaluations of success or failure are based primarily on the presence of vegetation, invertebrates, or wildlife, but they seldom evaluate other wetland functional abilities or persistence over time (Kusler & Kentula, 1989). In the absence of a complete functional assessment, the value of creations or restorations cannot be accurately appraised. Wetland evaluations should also include assessments of flood control and conveyance, groundwater recharge and discharge, water quality, food chain complexity, quality of habitat, and aesthetics. Furthermore, evaluations are generally based upon percent cover of vegetation over an area for a specific period of time--typically two or three years. This evaluation period is too short to make accurate judgements about the long-term success of a created wetland. Monitoring and modification responsibilities should be required for a period of up to twenty years or more, depending on the type of wetland involved.

Finally, wetland creation and restoration has the potential to play an important role in West Eugene, but that role must be circumscribed by the above conclusions. Restoration ecology is experimental, and used without caution can result in greater harm than good. Wetland functions in West Eugene must be better understood before ambitious creation or restoration projects are attempted. Therefore, mitigation projects in West Eugene should be considered an opportunity for research and designed with that end in mind. Furthermore, wetlands must be regarded as whole ecosystems, and creation concerned with multiple values; replacing natural wetlands with simplified ones only impoverishes the environment.

CHAPTER V

CONCLUSION

The purpose of this chapter is to propose a management scheme for West Eugene wetlands based upon the current legal milieu, what is known about the involved wetlands, and the state of wetland creation and restoration technology. I address the following questions: (a) What are the values of West Eugene wetlands?; (b) Which wetlands should be preserved?; (c) What are the prospects for successful creation/restoration of West Eugene wetlands?; (d) Who will manage them and how will they be acquired and maintained?; and (e) What kinds of wetlands should be created, and where? Finally, I conclude with reflections on the implications of my management proposal.

What Are the Values of West Eugene Wetlands?

The present state of knowledge about the values of West Eugene wetlands is far from conclusive. The conclusions presented in this chapter are largely derived from the Eugene/Springfield habitat study commissioned by Lane Council of Governments (Lev & Lane Council of Governments, 1988), and from experiments conducted on historic prairie by The Nature Conservancy and Oregon State University scientists (J. Kagan, personal communication, May 5, 1989; Kauffman, 1988). Wetland values, such as flood storage, aquifer

recharge, recreation opportunities, etc., have not yet been quantified, but are of obvious significance to West Eugene and the metropolitan area. Otherwise, certain wetland values, like recreation or open space, can be legitimately appraised in the absence of hard data, because these values are social; they are derived from the culture and subject to changing human beliefs and circumstances.

Ongoing field surveys in West Eugene are mapping wetland boundaries and gathering hydrological data (Lane Council of Governments, 1989a). This new information, anticipated by December 1989, will shed more light on the relative wetland values involved.

Lev and Zika (1988) evaluated thirty-three wetland and riparian sites in West Eugene for wildlife habitat value (Lev & Lane Council of Governments, 1988). The Lev and Zika study used an evaluation technique which assigned a numerical rating to sites based upon the relative quantity, diversity, seasonality, and quality of food, water, and cover (Lev & Lane Council of Governments, 1989). Out of a possible total of 96 points, results for West Eugene wetlands ranged from a low of 17 to a high of 78 (Lev & Lane Council of Governments, 1988). Table 3 shows a number of significant wetland locations in West Eugene which received moderate to high ratings.

Within West Eugene, The Nature Conservancy's Willow Creek wetland received the highest rating, and the Spectra-Physics and Amazon Channel wetland were given good ratings. Outside L-COG's West Eugene Wetlands Special Study Area, two wetlands in Eugene were given relatively good habitat

TABLE 3. Habitat Ratings for Selected West Eugene Wetland Sites

#	Site	Score
1	Green Hill Road & Southern Pacific Railroad tracks	43-45
2	Danebo Pond	45
3	Stewart Pond	47
4	Amazon Channel	50-60
5	A-3 Channel	52
6	Spectra-Physics	64-71
7	Willow Creek	78

Source: Lev & Lane Council of Governments, 1988

ratings: Amazon Park (located at 24th Avenue and Amazon Parkway) received a rating of 51, and the Delta Ponds (located on the east side of the Willamette River and along the Delta Highway) received ratings ranging from 51 to 69. The Willamette River and its riparian corridor were rated from 64 to 74. These findings indicate that many wetland and riparian sites in West Eugene and Eugene metropolitan area have good habitat value in their existing state. Arguably, managed enhancement of these areas could result in a substantial improvement in habitat value.

The precise value of West Eugene wetlands to control or temporarily store flood waters has not been determined. Dams and flood control structures now in place on tributaries to the Willamette and McKenzie Rivers have diminished the importance Eugene wetlands may have once had in flood water storage. However, high water levels and inundated conditions still occur seasonally in areas of West Eugene, resulting from incidents of high

precipitation, and controlled releases from dams to make water level adjustments during peak water flow. Therefore, these wetlands as a whole still play an significant role in the temporary storage of excess waters until the combined action of evaporation, percolation through soils, and runoff removes this excess.

The Amazon and A-3 Channels now function to transport excess storm waters, and would play even more crucial roles in an unusual flood event. Obviously, certain sites may be more valuable than others with regard to flood control, but their collective value for this function cannot be discounted.

The functional value of West Eugene wetlands for aquifer recharge is also uncertain. The question of aquifer recharge value may be of negligible significance to incorporated areas of the city, because their water supplies are drawn from the McKenzie River. However, some agricultural water users depend upon groundwater supplies for cropping. Furthermore, as discussed in Chapter III, these wetlands area are associated with hydric soils which impede the percolation of water at their upper layers, resulting in seasonally perched water tables. Perched water tables create conditions where water is lost to the atmosphere through evaporation and transpiration.

West Eugene definitely has good potential to develop for certain kinds of recreation. At present, the Audubon Society and the Native Plant Society make use of specific wetland sites which are favorable for observing birds or studying rare plants. Since virtually all of the sites are privately owned, recreation is not a well developed value. If public access were possible, and trails and

observation facilities developed, then the ponds, marshes, and wet swales could afford good opportunities for bird watching, photography, and hiking. However, care must be taken to protect the wetland habitat and, particularly, sensitive plants or animals.

Since West Eugene wetlands are largely undeveloped or used for farming, they possess a high open space value, a statewide planning goal. Wetland conservation would assure this value be maintained regardless of future development in West Eugene.

Although education and research did not score highly in L-COG's public opinion survey (Chapter III), professors and students alike at the University of Oregon and Oregon State University have recognized the educational and research opportunities the relic, prairie wetlands offer for studying rare plants, soils, and prairie restoration. While The Nature Conservancy's Willow Creek wetland and the Fern Ridge prairie wetland are protected for future research, other more disturbed wetlands offer research possibilities for restoration or creation experiments. In sum, West Eugene wetlands have a very high research and education value which is presently underutilized, but may be better appreciated at some future time.

Finally, many of West Eugene's wetlands have historic value, particularly the wet prairie, ash swales, and riparian landscapes. Since these areas are mere pieces of their former extent, they have value for posterity. These wetlands are heirloom landscapes that challenged and sustained our ancestors, and they deserve to be saved for no other reason.

Which Wetlands Should Be Preserved?

Possibly the greatest threat to the functional integrity of West Eugene wetlands is increasing fragmentation from development. In order to conserve wetland values, it should be a management goal to preserve the existing wetlands in continuous, intact blocks, and attempt to maintain unbroken linkages between wetlands with riparian corridors. Discouraging new development intrusions will serve to preserve wildlife values, hydrological conditions, and future enhancement or restoration potential. However, the goal of conserving larger wetland units does not mean that small wetlands already isolated by development should be sacrificed. For example, Stewart Pond is a 14 acre wetland surrounded by paved streets, but has relatively high value as wildlife habitat (Lev & Lane Council of Governments, 1988). The fate of smaller, fragmented wetlands will have to be considered on a case-by-case basis once their individual values are better understood. Wetlands of low functional value would make up the group of regulated wetlands subject to permitted development requiring mitigation.

Specific identification of which wetlands should be preserved and which can be developed is an urgent question for local government to settle. Many economic interests will be affected by the outcome--industries, farmers, landowners, and local taxpayers. In order to promote the development of West Eugene as an industrial area, the State of Oregon and the City of Eugene have made substantial investments in infrastructure including: a 2.3 million dollar

extension of the sewer trunk line; construction of the Chambers Street railroad overpass linking River Road with 6th and 7th Avenues; extension of electric, water, gas, and telephone services into the area; street improvements to West 11th Avenue; relocation of the Amazon Flood Channel for Spectra-Physics development; and the planned West Eugene Parkway project (Lane Council of Governments, 1988). If development is severely restricted by wetlands in West Eugene, then these investments will be difficult to recover. Therefore, putting aside the question of the soundness of these past investments, the importance of identifying the land where development can occur is critical for everyone concerned.

The largest, continuous block of wetlands in West Eugene is found south of the Southern Pacific Railroad tracks, north of 11th Avenue, and west of Danebo Road. If wetlands areas along the Amazon Channel north of the railroad tracks are added, then this wetland is at least 370 acres in extent, and more wetlands exist outside the study area boundary (Lev & Lane Council of Governments, 1988). Lev and Zika (1988) gave the majority of this wetland a habitat rating of 44; however, in the area surrounding the Spectra-Physics firm, the ratings ranged from 64 to 71 (Lev & Lane Council of Governments, 1988).

The area south of the railroad tracks and west of Danebo Road to Green Hill Road is dominated by Deschampsia cespitosa, which has been invaded along drainage channels by Salix spp., Populus trichocarpa, and Fraxinus latifolia. Two candidates for federally protected endangered species status have been found growing in this wetland--Aster curtus and Erigeron

decumbens var. decumbens (Lev & Lane Council of Governments, 1988).

The wetland areas north of the railroad tracks along the Amazon Channel to Royal Avenue received habitat ratings varying from 30 to 52. Major portions of the Amazon Channel wetlands north of the tracks are dominated by Phalaris arundinacea; in some instances, Phalaris is found in almost pure monocultural stands.

Outside of the Willow Creek and Fern Ridge prairie wetlands, these wetlands along the railroad in West Eugene may have the best potential for prairie restoration experiments. The entire area is underlain by hydric soils: Natroy silty clay loam on the east side (near Danebo road) and Dayton silt loam (clay substratum) on the west (U.S.D.A. Soil Conservation Service, 1987). A Deschampsia community is already established in this area, but lacks the structural diversity of the Willow Creek community (Lev & Zika, 1988). Additionally, a special value of this wetland is its natural connection with the Amazon Channels; this connection creates a continuous corridor stretching all the way from Danebo Road to Fern Ridge Reservoir.

On the west side of Green Hill Road, just north of the tracks, lies the 33 acre tract of land owned by the State of Oregon (Oregon State Department of Transportation, 1989). This 33 acre tract also has Dayton silt loam soil, but is currently cropped for annual ryegrass. The presence of hydric soils and the property's proximity to Deschampsia cespitosa wet prairie also make it a good candidate for restoration experiments. The Oregon State Department of Transportation has proposed using this property as a mitigation site for the West

Eugene Parkway.

The Amazon Channel and Diversion Channel north of the Southern Pacific tracks have good prospects for enhancement as marsh or emergent wetland favored by waterfowl. The Amazon Channel's existing hydrological connection with the Fern Ridge reservoir make this an extensive wetland corridor. Therefore, riparian areas and their attendant watersheds within the metropolitan area should be preserved and enhanced to safeguard water quality and provide wildlife habitat.

Unfortunately, the Oregon State Department of Transportation's West Eugene Parkway project would significantly diminish the existing values of this wetland block. I think these railroad/Amazon Channel wetlands should be preserved without any intrusive road development. Since the West Eugene Parkway would serve as a busy transportation artery for Eugene, it would disrupt the continuity these wetlands now possess, and harm their potential enhancement value to wildlife.

Evidence has shown that the success and value of enhancement or restoration efforts is improved by the interspersion of project sites with naturally occurring wetlands (Fishman Environmental Services, 1987b; Harenda, 1988; Hodder & Posey, 1987; Lev & Lane Council of Governments, 1988; Shisler & Charette, 1984). Interspersion provides opportunities for flora and fauna to become naturally established and creates habitat diversity which is critical for many animals. The Parkway will act as a isolating barrier, permanently shattering their cohesiveness. The impact of the West Eugene Parkway must

be understood to extend beyond the actual acreage upon which it will be built to the surrounding area.

In addition to the railroad, the Parkway will introduce yet another direct source of oil and chemical pollution into these wetlands--which cannot be entirely prevented from occurring. If environmental considerations are the criteria for evaluation, then these railroad/Amazon Channel wetlands should be preserved from all forms of development, except wetland enhancement or restoration. The West Eugene Parkway should be routed to avoid existing wetlands.

In contrast to the West Eugene Parkway, Spectra-Physics' planned development is peripheral to the main body of this wetland. Lane Council of Governments (1988) has outlined a proposal for new construction at Spectra-Physics which minimizes additional wetland impacts to 5.5 acres, and leaves largely untouched the area with the highest habitat value. The Spectra-Physics project could be used to create enhanced or replacement wetlands elsewhere. One goal of the mitigation should be to create more wetland than was filled by construction. However, once Spectra-Physics has completed its project, the wetlands west of Danebo Road should be conserved.

Conservation of large tracts of wetlands in West Eugene will be controversial because substantial investments in infrastructure have been made in West Eugene by local and state governments to promote industrial development. Since Eugene suffers from a shortage of vacant land suitable for industrial development, future investments will be required to access alternative

sites to compensate for the loss of developable land in West Eugene. However, the situation in West Eugene with respect to investment is symptomatic of the general blindness of market forces to environmental values.

West Eugene wetlands have value for flood storage and conveyance, water quality, wildlife habitat, habitat for rare plants, recreation, and open space. Additionally, these wetlands have cultural value as a historic landscape which has almost disappeared.

Financial investments were made in West Eugene by local government to promote development in the public's interest. These investments were made at a time before West Eugene's wetlands were identified as subject to regulation under Section 404 of the Clean Water Act of 1977, and before the values of these wetlands were better understood. The loss of this investment to protect wetlands can be justified because it is in the long-term public interest to conserve and enhance wetland values. These wetlands should be regarded as an important public amenity, like the Willamette or McKenzie Rivers, which must be protected to maintain their crucial physical, biological, and cultural functions.

In summary, planning efforts should be directed at preserving wetlands in cohesive units, throughout Eugene. Likewise, small wetlands sites possessing significant functional values should be preserved. In an effort to counteract historic losses, an overall goal must be established to increase the number and diversity of wetlands in the Eugene/Springfield metropolitan area. A wetland emphasis should placed on West Eugene, because of its hydric soils, availability of water, existing wetlands, and undeveloped land base. West

Eugene's industrial zoning should be revised by the City of Eugene, and a large wetland conservation zone established west of Danebo Road, extending along the Southern Pacific Railroad tracks and along the Amazon Channel to Fern Ridge Reservoir.

What Are the Prospects for Successful Restoration Ecology Experiments in West Eugene?

Does restoration technology really help to conserve wetlands? Or, is restoration technology just a vehicle to get around government regulation? Unfortunately, the answers to both questions are no, . . . and yes. As the literature reviewed in Chapter IV has shown, attempts at wetland creation and restoration have been disappointing, meeting with many partial or complete failures (Fishman Environmental Services, 1987; Harenda, 1988; Hodder & Posey, 1987; Kentula, 1989; Race, 1985; Shisler & Charette, 1984). However, a veritable litany of management deficiencies has undoubtedly contributed to creation/restoration failures: poor public information and education, unclear mitigation project objectives, lack of expert advise and supervision, poor or nonexistent pre-project wetland assessments, mitigation plans allowed to be filed after wetland impacts have been permitted, creation of less wetland area than impacted, and lack of post-project monitoring and compliance enforcement. Even if management deficiencies were corrected, the technology is still experimental and expensive; therefore, its outcome is not predictable and land developers have an understandable aversion to the potential costs. Why

use it at all?. Well, there are several good reasons.

In an age of alarming wetland losses and escalating environmental crises, science must learn how to restore or re-create ecosystems. Restoration ecology holds the potential of revitalizing environments back to health, and creating reserves for ecological and genetic diversity. In essence, nature's resources have not kept pace with human rates of consumption; nor can the environment any longer effectively cope with our human by-products. Reducing our impact on the environment is part of the solution, but repairing the environmental damage which has already occurred is also imperative. Once more research on wetland creation and restoration has been completed, the practical limits and potentialities of the technology will be better defined. The potential benefits make experimentation with restoration ecology worth a serious investment effort.

In West Eugene, the serious investment effort means establishing a mitigation bank, committed to research and experimentation in wetland creation and restoration. The bank could be set up as one of the state's pilot banking projects to serve as a model for future programs elsewhere. The bank would begin by attempting to acquire land or conservation rights to land in the wetlands west of Danebo Road and along the Amazon Channel from seed money provided by both the State of Oregon and the federal government. The bank would grow by the stockpiling of mitigation credits. Developers would obtain mitigation credits in the bank by cash purchase, funding enhancement or restoration of existing sites within the bank, donating suitable land to the bank,

or funding administrative, research, or monitoring activities associated with the bank's operation. The bank would be administered by a regional authority with technical staff responsible for granting regional fill permits, overseeing mitigation activities, ensuring contract compliance, long-term monitoring, and data collection. Of critical importance, the operation of the regional authority should be structured to correct the institutional shortcomings of the fill-removal program identified in Chapter IV.

Who Will Administer the Mitigation Bank and How Will It Be Funded?

The basis for local adminstration of a West Eugene mitigation bank comes from the recently adopted Senate Bill 3 (1989). Under this legislation, the West Eugene Wetlands Management Plan currently being developed by L-COG could be accepted by the Oregon Division of State Lands as a regional Wetland Conservation Plan. The new law requires that a Wetland Conservation Plan contain a mitigation plan which includes a program for the replacement of planned wetland losses and restoration of lost functions and values. This replacement would be achieved through the creation of new wetlands or the enhancement of existing wetland areas. The Wetland Conservation Plan must designate specific mitigation sites within the plan area and actions for restoration and enhancement.

Under the provisions of Senate Bill 3, DSL may not approve a Wetland Conservation Plan until the City of Eugene and Lane County have adopted

comprehensive policies and land use regulations to implement the provisions of the conservation plan. However, if DSL accepts a city or county Wetland Conservation Plan, then DSL may authorize a site-specific removal-fill permit, exempt from individual review by the state. In effect, this site-specific permit would become a regional wetland permit administered by local government under the approved Wetland Conservation Plan. Therefore, Senate Bill 3 provides the legal framework for the locally administered wetland mitigation bank proposed in this paper. However, in the event DSL approves the Wetland Conservation Plan but requires individual review, the bank could still be managed under a regional administration, but the regional authority would then only play an advisory role to the state with regard to permitting. As provided in the new law, DSL would review every five years, the effectiveness of the bank in meeting the goals set forth in the Wetland Conservation Plan.

The authority administering the mitigation bank needs to be regional, because the bank should not be confined to the jurisdictional limits of the City of Eugene. Potentially suitable property for the bank lies both inside and outside Eugene's city limits, along the Amazon Channel, Green Hill Road, and Fern Ridge Reservoir. By operating at a regional level, the amount of potential bank land is increased; thereby, enhancing the range of competitive choices and helping to control the price of land acquisition. Furthermore, if banks were to be set up elsewhere in Lane County, then the regional organization would already be in place to assume administration over them.

In order for the bank to succeed, a stable source of funding must be

provided. Initially, the State of Oregon, Lane County, and the City of Eugene could jointly provide money to establish the regional authority and make land acquisitions for the bank to get started. The federal government is another potential source of funding. Since the bank really represents a public resource, its funding should be regarded as in the same light we regard funding for parks, forests, refuges, and clean water supplies. Indeed, the bank's goals are to enhance wildlife habitat, water quality, open space, protection for rare species, and recreation. As time passes, the bank's land base and funding will grow through the addition of mitigation credits. Although the bank will always require some level of public funding, private donation could be tapped as another source of funding.

A local, nonprofit wetlands conservation foundation should be created as an integral part of the mitigation bank. The foundation would have an advisory role with respect to mitigation planning, operations, and acquisitions. Membership in the foundation would be open to the public, and representatives to the mitigation bank freely elected by foundation members. The foundation would actively seek funding or land grants in support of the mitigation bank, and launch programs to educate and interest the public in wetland conservation. However, the foundation should function as an independent entity, with its own budget derived from membership and donations, and discretion over how its money is spent in support of wetland conservation. Additionally, the foundation may possess title to lands which are part of the bank and managed by the regional authority. In principle, the foundation is necessary to provide a vehicle

for local citizen involvement in management decisions supervising the bank--of particular concern is the adequacy of projects to create or restore wetlands. Under this scheme, the foundation has the role of regulatory critic to ensure experimental restoration efforts are being properly implemented. The foundation itself could join as an active member in a mitigation project, participating in planning, funding, development, and monitoring.

A variety of strategies are necessary to establish a land base for the mitigation bank. First of all, lands approved by the EPA for mitigation use must be delineated and negotiations undertaken with landowners to acquire them. Second, attempts must be made to purchase suitable wetlands from owners who are willing to sell for a reasonable price. Third, whenever possible, attempts should be made to purchase or otherwise obtain conservation easement to the land rather than outright purchase. This easement would permit public use of the land for mitigation projects and access, but ownership is retained by the seller. Theoretically, an easement would be less costly than an outright land purchase. For agricultural lands, the easement might come into effect after a specified number of years. Fourth, state and local governments need to pass legislation giving tax breaks to landowners who donate or sell land or conservation easements to mitigation banks. Additionally, tax incentives should be made available to wetland owners who conserve property rather than develop it. Finally, efforts should be made to obtain land donations. Donor could receive special recognition for their civic concern for the environment, and at the same time receive tax advantages. Perhaps certain wetland projects

could be tailored to the special interests of the donor--waterfowl enhancement or restoration experiments with native prairie.

One of the most daunting aspects of creating the mitigation bank will be its high initial start-up costs to acquire land. Whether a mitigation bank is funded in West Eugene, or elsewhere, will be a reflection of the strength of political commitment to wetland conservation. However, if initially funded, the bank has good potential to thrive and become a model for urban wetland management.

What Kinds of Wetlands Should Be Created, and Where?

The question of the kinds of wetlands that should be created depends upon many extrinsic elements: the kind of wetland being mitigated for, the physical conditions at the chosen mitigation site, the proximity and type of natural wetlands, and public opinion. The objectives of many wetland creation/restoration projects may not be in-kind replacement, but instead general improvements to water quality, wildlife habitat, wetland integration, or storm water conveyance. Until the mitigation bank concept is more thoroughly discussed in a public forum, it is premature to exclude certain kinds of wetlands from consideration. However, it is appropriate to submit some specific suggestions on what could be tried.

First, it is critical that experimental efforts be undertaken to restore islands of native prairie. On the one hand prairie research is of interest to science, and on the other, the prairie has an interesting historical side. These two features

could be combined in special research and interpretive park for historic prairie wetland. Four locations in the vicinity of West Eugene recommend themselves for this purpose: (1) The Nature Conservancy's Willow Creek wetland; (2) the Army Corps of Engineers' Fern Ridge prairie wetland; (3) the Bureau of Land Management's Danebo office site; and (4) with considerable manipulation the Oregon Department of Transportation's Green Hill Road property. The Fern Ridge site has the advantage of a high visibility location on a well travelled road.

The Amazon Channel wetlands west Of Danebo Road has good potential for marsh enhancement and creation. According to L-COG's Steve Gordon, nearby Danebo Pond which supports many waterfowl is an example of a artificially created marsh (Personal communication, July 7, 1989). The existing riparian habitat around the Amazon Channel lends itself for natural sources of invading emergent vegetation (Lev & Zika, 1988).

Finally, the Eugene/Springfield metropolitan area's wastewater treatment system lacks a tertiary treatment facility. Tertiary treatment removes ammonia, nitrate, and orthophosphate which remain in water that has been treated solely for microorganisms. These nutrients pollute water bodies through eutrophication, particularly closed systems like lakes. Presently, once Eugene's wastewater receives secondary treatment, it is discharged directly into the Willamette River, where it flows downstream to cities that use it as a water supply. Eventually, in order to meet water quality standards, every city will need to install tertiary treatment facilities to remove these excess nutrients. Tertiary

treatment of wastewater can take place in natural wetlands.

In Eugene/Springfield, an opportunity exists to create a wastewater wetland similar to the experimental one developed in Arcata, California (discussed in Chapter IV). It could be created, either in the vicinity of the Delta Ponds near the present sewage treatment facility or, with pumping, in a location in West Eugene. Wastewater wetlands embody the best kind of ecological thinking, since wastewater is viewed as a resource rather than simply an economic problem. In much the same way as sludge is used for agricultural fertilizer, wastewater stimulates the growth of aquatic plants, midge larvae, invertebrates, and snails which support fish and waterfowl. Potentially, wastewater wetlands could improve water quality and wildlife habitat, yet be used for fish farming and fuel production. A wastewater wetland deserves serious consideration as an alternative in Eugene/Springfield's mitigation program.

In summary, the emphasis on wetland creation/restoration projects in West Eugene should be integration and enlargement of existing wetlands, improvement of water quality, storm water management, habitat enhancement, and restoration of native prairie areas. Creation or restoration projects could be undertaken on the perimeter of existing wetlands to integrate fragmented areas and provide a continuous corridor for wildlife. Projects could be initiated along the A-3 and Amazon Channels to improve storm water movement, water quality, and habitat values. Emergent marshes could be constructed along the Amazon Channel to provide enhanced waterfowl habitat. Finally, efforts should

be initiated to establish bioreserves of restored prairie wetland plant communities. Relic, prairie communities located at Willow Creek and Fern Ridge Reservoir could be used as nuclei for the growth of prairie reserves, providing natural seed sources for restoration.

Summary Comments

Wetland creation and restoration involves certain risks, but there are arguably more serious risks in relying solely upon preservation to save wetlands ecosystems. Although creation/restoration technology is experimental, and therefore unpredictable, it holds genuine promise to help retrieve lost wetland values. However, a great danger exists that the institution administering this technology will not be effective. The institution may fail to require from developers the costly obligation wetland creation demands. In order for creation technology to succeed, at a minimum it needs careful planning, clear objectives, vigorous compliance enforcement, a good data base developed, and long-term monitoring. Any commitment less faithful than this will only repeat past failures.

Historically, human economics has operated almost independently of nature's economy. Of course, the relative abundance of economically valuable natural resources has an effect upon price, but the effect of human enterprise upon the environment is only recently being factored into price. The cost of ameliorating environmental impact is a liability in the marketplace, because it is currently more profitable to avoid environmental costs if at all possible. Since

enforced environmental standards vary greatly from place to place, marketplace economics penalizes costly environmental protection measures. As long as the environment is treated as business liability, rather than an asset, environmental degradation will continue.

Historically, wetlands have been treated as wastelands. One palpable manifestation of this attitude is the evidence of human garbage which has been dumped in Eugene's wetlands (Lev & Zika, 1988). However, growing recognition of the value of wetlands has enabled some important changes to law. Wetland alterations are now regulated, and the EPA has recently declared a goal of "no net loss." Courts have upheld EPA's authority to deny wetland alteration permits--in effect, placing wetland values above private property rights. The law stands on the threshold of recognizing wetlands as a common good which belongs to everyone, like air and water. If the law does not shrink from this stand, then wetlands may actually begin to increase in extent.

Eugene has an opportunity to be a model of the new ecology--where nature's economy is integrated into the human economy. Despite the perils of wetland creation technology, it has the beneficial effect of establishing a linkage between nature's economy and human economy; wetland alteration will now come with a tangible and unavoidable cost--development on wetlands must pay the price of creation or restoration. When the costs associated with creation are realized, the economic value of existing, natural wetlands should rise. If the mitigation bank institution functions as it should, then West Eugene wetlands will increase both in number and diversity in the years to come. And, wetlands

will no longer be wastelands, but instead an important asset to the community.

APPENDIX

WEST EUGENE WETLANDS PUBLIC OPINION SURVEY

WEST EUGENE WETLANDS SURVEY
April 1989

1) How familiar are you with wetland issues? (Circle one)

1 2 3 4 5

not very

2) Wetlands are productive natural areas which serve all of the purposes listed below. Please mark the two functions which are most important to you.

___ flood control
___ improve water quality
___ ecological diversity and productivity
___ plant habitat
___ waterfowl and bird habitat
___ other wildlife habitat
___ education and research
___ recreation
___ hunting
___ other _____

3) The planned industrial development of West Eugene will be modified to account for federal and state wetlands regulation, and the environmental value of wetlands. Below are three options for balancing development and environmental concerns. Please circle the option you prefer.

a) allow development on almost all existing wetlands
   * Developed wetlands would be replaced with newly constructed wetlands (mitigation sites).

b) preserve wetlands with relatively highest natural values, and allow development on lower value wetlands
   * Replace developed wetlands with mitigation sites; would require fewer sites than Option A.

c) preserve almost all wetlands
   * Relocate planned industrial land elsewhere and/or reduce the amount of land planned for future development.

d) your option

_____
_____
_____
_____

e) don't know

4) Eugene's future industrial development will be affected by the wetlands in West Eugene. Please circle the <u>two</u> development-related concerns which are most important to you.

a) identifying in advance wetlands that are suitable for development
b) recovering the investment made in streets and sewers intended to serve future development in the area
c) maintaining an adequate supply of developable industrial land
d) insuring that development does not impact wetlands
e) other _____
f) don't know

5) New wetlands can be created to replace those lost due to fill and dredging. Please circle the <u>two</u> wetland replacement concerns which are most important to you.

a) minimizing the need to construct new wetlands
b) preserving the potential to use wetland sites for multiple purposes, such as for flood control, recreation, and wildlife habitat
c) providing for connections between wetland sites to create a larger wetland system
d) providing for public access to wetland sites
e) developing a fair and equitable way to pay for wetland creation
f) ongoing maintenance of wetland sites
g) other _____
h) don't know

6) If new wetlands need to be created, where would you like to see them located? (Circle one)

a) at many small sites in West Eugene
b) at a few large sites in West Eugene
c) outside of West Eugene
d) don't mitigate; preserve existing wetlands
e) other
f) don't know

7) The issue of wetland functions, preservation, development and creation have been mentioned in this survey. Do you have any additional West Eugene wetland issues that you would like the study to address? If so, please describe them.

_____
_____
_____
_____

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