ENVIRONMENTAL ASSESSMENT
FOR AN
INTEGRATED PEST MANAGEMENT PROGRAM
FOR LEASED LANDS
AT LOWER KLAMATH AND TULE LAKE NATIONAL WILDLIFE REFUGES
OREGON/CALIFORNIA

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COVER SHEET

Proposed action: Implementation of a phased Integrated Pest Management (IPM) program
Alternative 2 for Leased Lands at Lower Klamath and Tule Lake National Wildlife Refuges in Oregon and California.

Type of statement: Environmental assessment (EA)

Lead agency: U.S. Fish and Wildlife Service

Cooperating agency: U.S. Bureau of Reclamation, Klamath Basin Area Office

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Abstract: The U.S. Fish and Wildlife Service (Service), in cooperation with the U.S. Bureau of Reclamation (Reclamation), propose to implement a phased IPM program for the Lower Klamath and Tule Lake National Wildlife Refuges in Oregon and California. Integrated pest management does not eliminate use of pesticides, but attempts to use them as a last resort to control pests. Growers would be expected to use several pest controls based on knowledge of crops, pests, and pests' natural enemies to avoid crop loss and minimize effects on natural resources.

Major elements of the proposed action include:

- mandatory implementation of crop scouting
- phased, mandatory implementation of pest economic thresholds and additional IPM techniques, once demonstrated/identified in the Klamath Basin
- continued Service and Reclamation review and approval of pesticides proposed for use on the refuges
- administration of the plan by the Refuge IPM Coordinator
- managing buffer zones to exclude weeds and benefit fish and wildlife.

This document also examines three alternatives to the proposed action including: the no-action alternative (Alt. 1), a modified IPM program (Alt. 3), and a transition from synthetic pesticides to organic (Alt. 4).

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CHAPTER 1: THE PURPOSE, NEED, AND PERMITTING PROCESS FOR IMPLEMENTING AN INTEGRATED PEST MANAGEMENT AT LOWER KLAMATH AND TULE LAKE NATIONAL WILDLIFE REFUGES

1.0 INTRODUCTION

This document is the environmental assessment (EA) for implementing a comprehensive integrated pest management (IPM) program on Lower Klamath and Tule Lake National Wildlife Refuges leased lands and adjacent berms, located in the Klamath Basin of southern Oregon and northern California, near the towns of Klamath Falls, Oregon and Tulelake, California (**Figure 1**). This EA documents the analysis of possible environmental consequences of a proposed action and alternatives to that action. The purpose and need for the action; laws, policies, and authorities affecting the EA and the refuges; the EA process; and public participation process for the EA are described in this chapter.

1.1 PURPOSE AND NEED FOR THE PROPOSED ACTION

It is U.S. Department of the Interior policy to reduce the use of pesticides through IPM, and to implement IPM on all National Wildlife Refuges (NWRs) in the United States. The U.S. Fish and Wildlife Service (Service) and U.S. Bureau of Reclamation (Reclamation) are proposing to implement a comprehensive IPM program on lands leased by private farmers within the Tule Lake and Lower Klamath NWRs. An IPM Plan written specifically for the leased lands is the basis for the IPM program. All lands leased for agriculture purposes and associated berms (included canals and levees) on the Tule Lake and Lower Klamath NWRs are potentially affected. About 22,000 acres of leased lands are divided into 210 lease lots (varies slightly by year).

The proposed IPM program is designed to manage pest control practices within the goals of agriculture production and profitability, consistent with waterfowl management as stipulated by the Kuchel Act (Public Law 88-567). **The long-term goal of the proposed IPM program is to minimize the use of pesticides associated with agricultural practices on the leased lands over time.**

An integrated pest management program is defined in the Agencies' 1998 IPM Plan as:[1]

"...treating pests as part of a crop production system that includes not only the crop and its pests, but also the crop's entire physical setting. A good IPM program coordinates pest management activities with each other and with production methods to reach cost-saving,

[1] Based on the U.C. Integrated Pest Management Project definition.

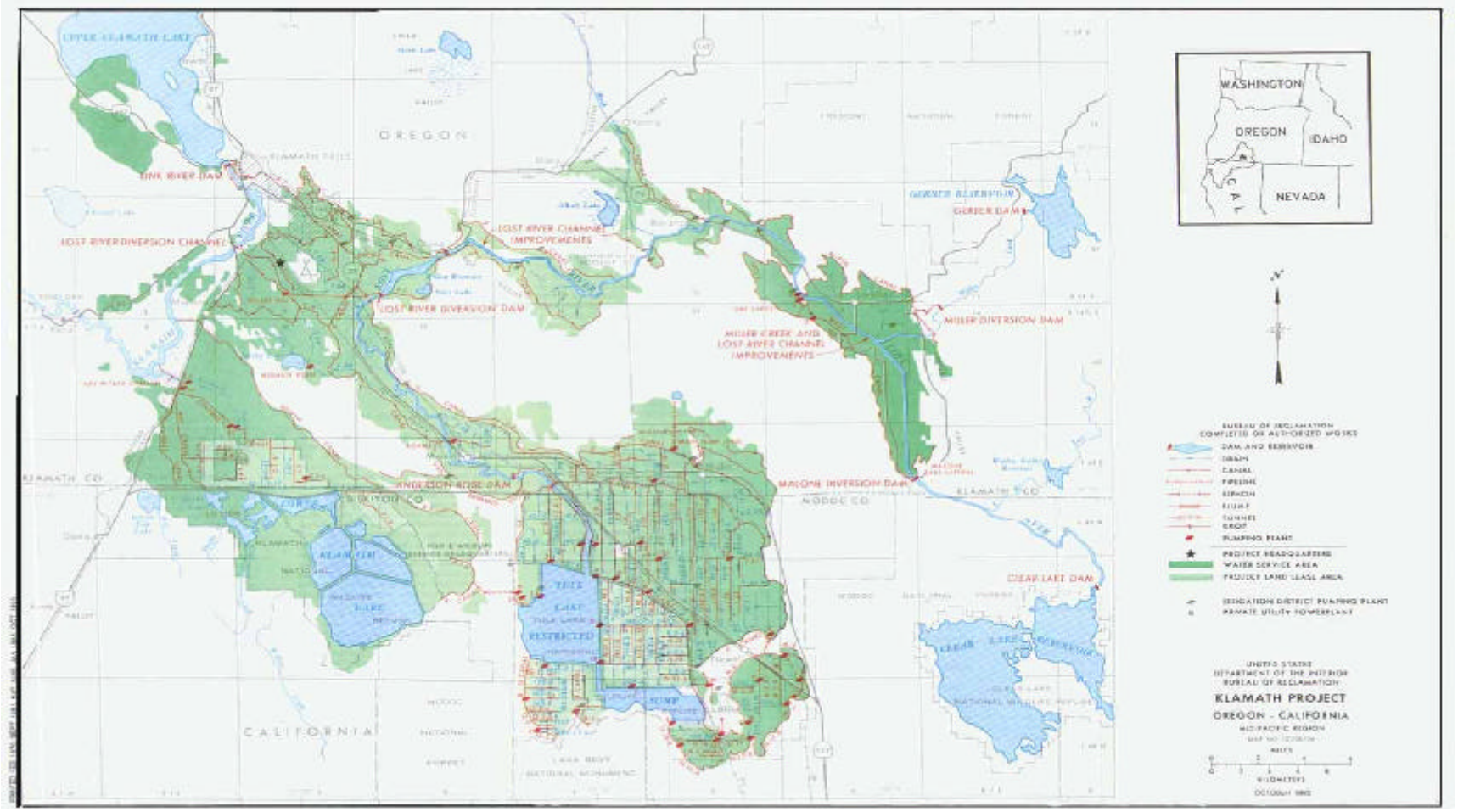

Figure 1. Klamath Project

long-lasting solutions to pest problems. The emphasis is on knowing about and preventing problems before they occur. An IPM program may not eliminate use of pesticides, but attempts to use them as a last line of defense against pests, not as the first option for control. In practice, a farmer will use several pest controls based on knowledge of the crop, pests, and pests' natural resources."

The IPM Plan is for all terrestrial pests that negatively affect agricultural operations and/or wildlife habitats on leased lands and adjacent berms. The pests considered in the IPM Plan include noxious weeds, insects, mites, nematodes, rodents, and diseases.

Major components of the proposed action include:

- < Requiring farmers who lease lands on the NWRs to frequently monitor crops for pests and diseases (crop scouting);
- < Using field trials to test and demonstrate IPM techniques locally;
- < Using locally determined pest-infestation rates (action thresholds) to determine when pesticide spraying would be allowed;
- < Hiring a Refuge IPM Coordinator to assist farmers in implementing comprehensive IPM on Refuge lands and monitoring implementation of the IPM program;
- < Using lease incentives to encourage adoption of IPM techniques;
- < Implementing sump rotation as research results become available;
- < Reviewing the IPM Plan annually and comprehensively reviewing it every 5 years;
- < Forming local citizen groups to help guide the Service and Reclamation with IPM Plan implementation;
- < Addressing weed problems on ditches and berms as the highest priority for the first years of program implementation.

An additional purpose of implementing the plan would be to provide crop- and pest-specific, technical information about IPM to leased-land growers since there is little site-specific IPM information available to them.

1.2 LAWS, POLICIES, AND AUTHORITIES AFFECTING THE ENVIRONMENTAL ASSESSMENT AND THE REFUGES

1.2.1 The Kuchel Act

Lower Klamath NWR was set aside by President Theodore Roosevelt as the "Klamath Lake" on August 8, 1908, by Executive Order No. 924, and amended by two subsequent executive orders (No. 2202 on May 14, 1915, and No. 3422 on March 28, 1921). Tule Lake NWR was created by Executive Order No. 4975 on October 1928, and amended by two subsequent executive orders (No. 5945 on November 3, 1932, and No. 7341 on April 10, 1936).

In the early 1960s, Congress debated the best manner of using the land in the Tule Lake and Lower Klamath NWRs. Congress was faced with the question of whether to dedicate the land to the Klamath Project (a major irrigation-water delivery and drainage system), and needed to overcome the threats of continued homesteading and wetland conversion to waterfowl management, to recognize international treaty responsibilities for the conservation of migratory waterfowl, and obligations to the Klamath Drainage District and Tulelake Irrigation District. In addition, lawmakers wanted to offset some of the costs of services to the refuges provided by affected counties.

Debate was heard from all sides and was settled with the passage of the Kuchel Act (Public Law 88-567) in 1964 (from statement of Stewart L. Udall, Secretary of the Interior, on S.1988 [Kuchel Act] to the Subcommittee on Irrigation and Reclamation, Interior and Insular Affairs, U.S. Senate, February 23, 1962). The Act, which targeted only four national wildlife refuges, states:

"Notwithstanding any other provision of law, all lands owned by the United States lying within the Executive Order boundaries of the Tule Lake National Wildlife Refuge, the Lower Klamath National Wildlife Refuge, the Upper Klamath National Wildlife Refuge, and the Clear Lake National Wildlife Refuge, are hereby dedicated to wildlife conservation. Such lands shall be administered by the Secretary of the Interior for the major purpose of waterfowl management, but with full consideration to optimum agricultural use that is consistent therewith..."

Section 4 states, in part:

"The Secretary shall, consistent with proper waterfowl management, continue present patterns of leasing.... Leases for these lands shall be at a price or prices designed to obtain the maximum leasing revenues. The leases shall provide for the growing of grain, forage, and soil building crops, except that not more than 25 per centum of the total leased lands may be planted to row crops."

Section 3 states, in part:

"...that the priority of use of the total net revenues collected from the leasing of the lands described in this section shall be (1) to credit or pay from such revenues to the Tulelake Irrigation District that amounts already committed to such payment or credit; (2) to pay from such revenues to the Klamath Drainage District the sum of $197,315; and (3) to pay from such revenues to the counties the amounts prescribed by this section."

The Kuchel Act requires that these NWRs be managed for two objectives: for waterfowl management and agriculture production. The administration and management of the agriculture program on the Tule Lake and Lower Klamath NWRs is more complicated than most other national wildlife refuges due to the Kuchel Act. ***Various interest groups interpret the Kuchel Act differently.***

1.2.2 National Wildlife Refuge System Administration Act of 1966

The National Wildlife Refuge System Administration Act of 1966, as amended in 1976 (Public Law 94-233), designated the Service as the agency required to administer units of the Refuge system, including lands covered by the Kuchel Act. A Department of the Interior solicitor's opinion stated that the continued presence of Reclamation on Kuchel Act land was consistent with the Act because of a cooperative agreement (in 1977) between the two agencies, recognizing the Service's ultimate administrative control. The solicitor's opinion made the Service the final decision maker as to whether agricultural leases were consistent with proper waterfowl management under the Kuchel Act.

1.2.3 U.S. Fish and Wildlife Service and Bureau of Reclamation Cooperative Agreement

According to the 1977 cooperative agreement (Reclamation and Service contract No. 7-07-20-W0089) between the two agencies, the Service has ultimate administrative control of the refuges, but Reclamation manages the agricultural leased lands program. Reclamation must consult with and obtain the approval of the Service in developing the agricultural leasing program and lease conditions.

1.2.4 Migratory Bird Treaty Act of 1918

The Migratory Bird Treaty Act is the domestic law that affirms or implements the United States' commitment to four international conventions (with Canada, Japan, Mexico, and Russia) for the protection of a shared migratory bird resource. Each of the conventions protects selected species of birds common to the U.S. and one or more of the above-mentioned countries (i.e., they occur in two or more of the treaty countries at some point during their annual life cycle).

Both the Lower Klamath and Tule Lake NWRs are listed as areas of "special importance" in Appendix I of the 1976 Convention between the USA and the USSR Concerning the Conservation of Migratory Birds and Their Environment. The species of concern in this instance is the entire population of the Wrangel Island snow goose. Under this treaty the United States must "manage such areas so as to preserve and restore the natural ecosystems."

1.2.5 National Wildlife Refuge System Improvement Act of 1997

On October 9, 1997, President Clinton signed a bill to improve the management of the national wildlife refuge system. This new law amends the National Wildlife Refuge System Administration Act of 1966. This act legislated the mission of the refuge system. Section four states:

"The mission of the system is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

The act provided new guidance in determining which activities within the National Wildlife Refuge System would be allowed. All activities occurring within national wildlife refuges must now, in the sound professional judgement of the agency's director, not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge. The act provides that if there is a conflict between the mission of the refuge system and the purpose(s) of a specific refuge, the conflict will be resolved in a manner that protects the purpose(s) of the refuge first and, to the extent possible, achieves the mission of the System. The Kuchel Act, described earlier, further defines the purposes of the Lower Klamath and Tule Lake NWRs. The refuges are dedicated to wildlife conservation and the lands administered for the major purpose of waterfowl management, but with full consideration to optimum agricultural use.

1.2.6 The Endangered Species Act of 1973

The Agencies are required by the Endangered Species Act to ensure that any actions they take will not jeopardize the continued existence of a threatened or endangered species, or result in the destruction or adverse modification of critical habitat. Pursuant to Section 7 of the Act, the Service has prepared a biological assessment that evaluates the potential effect of the proposed project on threatened or endangered species that may be present in the area. The evaluation includes any measures the Service believes are needed to minimize or compensate for effects on the species.

1.2.7 U.S. Department of the Interior Policies

The IPM Plan needs to comply with certain policy requirements of the U.S. Department of the Interior. Specifically, in management of the lands and waters under its jurisdiction, it is Department policy to "...use pesticides only after full consideration of alternatives... including chemical, biological, and physical methods, and no action..." and to "...adopt integrated pest management (IPM) strategies whenever practicable..." (U.S. Department of the Interior 1982).

The use of pesticides on wildlife refuges requires a series of approvals from the Service and Reclamation. Pesticide use on the refuges is governed by U.S. Department of the Interior Pesticide Use Policy (U.S. Department of the Interior 1982), and a Service manual (Service Manual 7RM 14.4G). The Service's policies state that, "The Service will eliminate unnecessary use of pesticides by implementing integrated pest management techniques and by selecting crops that are beneficial to fish and wildlife but do not require pesticides." Department of the Interior policy in the Interior Manual, guiding use of pesticides on NWRs, states:

- *pesticides will be used only after the full range of alternatives is considered, and then the least hazardous material will be chosen;*
- *IPM will be adopted wherever practicable, pesticides used must be registered by the Environmental Protection Agency (EPA) in full accordance with FIFRA*

[Federal Insecticide, Fungicide and Rodenticide Act], as amended, and as provided in regulations, orders, or permits issued by EPA;

- *handling and use of restricted-use pesticides be conducted with caution and only by personnel who are either certified or under the direct supervision of a certified applicator;*
- *all pesticides and pesticide containers are transported, stored, and disposed of in a manner that will safeguard human health, fish, and wildlife, and prevent soil and water contamination, and that safety to humans, fish and wildlife, and other non-target organisms is fully considered; and*
- *pesticides may be used in habitats involving endangered and threatened animal or plant species only after it is determined that such use will not adversely affect the species or its critical habitat.*

Further, a pesticide use proposal (PUP) must be prepared for each chemical used in pest control programs on Refuge lands (Service Manual 7RM 14.4G). PUPs are used to evaluate the specifics of proposed chemicals, treatment sites, application methods, and sensitive aspects of use.

To expedite a review of new pesticides proposed for use within the Refuge leased lands, the Service and Reclamation formed a Regional PUP Committee, composed of Agency staff that have expertise in the leased-land program, Refuge management, IPM, endangered species, and pesticide effects on natural resources. The decision to approve or disapprove a new farm chemical is based on extensive toxicity data, proposed use of the pesticide, environmental conditions, degradation rates, solubility, and numerous other factors. High toxicity ratings for a particular pesticide for fish, wildlife, and plants on the NWRs and threatened and endangered species are factors considered before approval of PUPs are given.

The Regional PUP Committee also considers whether there are IPM alternatives, including less toxic chemicals that are effective. Following the review process, growers are given an opportunity to comment, provide additional information, and to appeal decisions to the Service's Regional Director. After review, the PUP Committee's recommendations for a PUP are provided to the Klamath Basin Refuge Complex Refuge Manager for approval or rejection.

All pesticides recommended in the IPM Workbook (a portion of the IPM Plan) that have not already been evaluated would have to undergo PUP approval and endangered species consultation before their use on leased lands (U.S. Bureau of Reclamation 1994 and 1994a).

Other Department of the Interior policies are also relevant to this project. The Service's administrative manual, pest management policy and responsibilities (part 30 am 12.4.b) states: *"...land management practices, including farming programs, will be examined to ensure that (1) they have a high value for fish and wildlife resources, (2) they do not encourage the exposure to pathogens or*

development of disease vectors that affect fish or wildlife resources, and that (3) they require minimal or no application of hazardous chemicals."

1.2.8. Other Federal Actions

There are no other NEPA actions (environmental impact statements or other environmental assessments) currently pending that would influence the scope of this environmental assessment.

1.3 ENVIRONMENTAL ASSESSMENT PROCESS

This environmental assessment is being prepared to meet the requirements of the National Environmental Policy Act of 1969 (NEPA). NEPA requires that if an action by the federal government is not categorically excluded or listed as requiring an environmental impact statement, then an EA must be prepared. This EA is being prepared to allow the Agencies to determine whether implementing an IPM program, or one of the reasonable alternatives, on the Tule Lake and Lower Klamath NWRs would have significant environmental impacts. If it is determined that implementation of the IPM program would have significant impacts, then an EIS will be prepared.

If, on the other hand, it is determined there would be no significant effects, then a finding of no significant impact (FONSI) will be prepared and issued by the Service.

The Service (Klamath Basin National Wildlife Refuges) and Reclamation (Klamath Basin Area Office) are the federal agencies involved with this proposed action. No other federal, state or local agencies are involved in this EA.

1.4 SCOPING

The Service and Reclamation conducted internal scoping activities to determine issues related to implementing an IPM program. In addition, the contractor preparing this EA conducted external scoping to determine the issues or concerns associated with the proposed action and reasonable alternatives. A written notice, describing the proposed action, reasonable alternatives and requesting public comment was sent to more than 160 individuals, organizations, and local and state government offices. The mailing list included all the farmers who currently hold leases on the NWRs, as well as the people who had submitted written comments on the draft IPM Plan. A number of written comments were received as a result of this mailing.

Two scoping meetings were held January 15, 1998, in the project area because of the continued concerns surrounding IPM on the refuges. The first meeting was with the IPM Advisory Committee, a local group, comprised of farmers, conservationists and agency personnel that provided advice and comments throughout the process of developing the IPM Plan. A second meeting was held with a small group of citizens representing various conservation groups. In addition, some comments received

on the draft IPM Plan were about NEPA issues, so these were also included as part of the scoping effort.

The following issues were identified during scoping:

1. IPM might not control pests, damaging crops both on and off the refuges.
2. Income to individuals, the county, and the local economy might be lost by implementing IPM.
3. Without IPM, endangered or threatened species (Lost River and shortnose suckers, peregrine falcons, bald eagles) and other wildlife and habitat might be further compromised by the use of pesticides as the primary form of pest control.
4. Without IPM, soil, water, and air quality may be degraded both on and off Refuge by the continued use of pesticides on Refuge.
5. Differing interpretations of the Kuchel Act and Agency policies has created ongoing conflicts and controversy.
6. Implementation of IPM will further degrade the relationship between the growers leasing lands from Reclamation. Failure to implement IPM could cause the environmental community to pursue additional legal action against the Agencies.
7. Growing row crops that require pesticides and not used by wildlife is inconsistent with DOI policies.
8. Pesticide use is not in compliance with Department of the Interior, Fish and Wildlife Service policies or compatibility analysis.
9. Simultaneous application of two or more pesticides could have potential negative effects not analyzed in the pesticide use proposal (PUP) process.
10. IPM strategies have not been sufficiently "field tested" to establish local effectiveness.
11. County tax revenues may be reduced if an IPM program is implemented. If IPM proves ineffective, pests may reduce the forage base and cover for wildlife.
12. The sump rotation program should be implemented as part of the IPM Plan (at a faster rate).
13. Organic farming should be an alternative evaluated in this EA.
14. The IPM program will add more bureaucracy, mandatory requirements, and unnecessary expenditures for leased-land growers.
15. There is a potential for significant social and economic impacts (if the IPM Plan is implemented) which should trigger an EIS.
16. If lease requirements are added without adequate warning to leased-land growers, severe economic hardship could result (to growers).
17. Lawsuits could be filed against the Agencies by agriculture groups and local government entities.
18. If row crops are removed as part of an IPM program, rotation of crops, an intrinsic part of IPM, will be severely diminished.
19. There is no documented evidence that pesticides are negatively affecting water quality.
20. Pesticide regulations in California are the most stringent in the nation.
21. IPM implementation could affect the Klamath Tribes trust resources.

22. Continued pesticide use conflicts with recreational uses on the refuges, such as hunting and bird watching.

All of the issues above were examined and discussed by the Agencies (Service and Reclamation). The following were chosen for detailed analysis after being determined by the Agencies that they were significant and/or relevant issues to this EA analysis :

- < Income to individuals, the county, and the local economy might be lost by implementing IPM.
- < Without IPM, the risk to endangered or threatened species (Lost River and shortnose suckers, peregrine falcons, bald eagles) and other wildlife and habitat might be increased by the use of pesticides as the primary form of pest control.
- < Without IPM, soil, water, and air quality may be degraded both on and off Refuge by the continued use of pesticides on Refuge.

1.5 SCOPE OF THIS DOCUMENT

The proposed IPM program, described more fully in Chapter 2, addresses IPM practices to be carried out only on the leased lands and associated berms, canals, and levees on the Tule Lake and Lower Klamath NWRs (the program does not apply to co-op lands). As such, this document addressed practices and actions (primarily voluntary) proposed for the leased lands under the IPM Plan, and is not intended to address overall wildlife management practices on the refuges.

Currently, the Agencies and Universities of California and Washington are conducting a research project to determine the effect of farmland/wetland rotation (sump rotation) on Tule Lake NWR. Sump rotation on the Refuge is expected to be expensive and therefore difficult to perform at a rapid pace.

This EA does not serve as the NEPA compliance document for sump rotation. This EA does not address the overall sump rotation trials, or implementation of a sump rotation program except in a general way. It is intended that as beneficial aspects of sump rotation on wildlife and agriculture are documented, they would be implemented on the Tule Lake NWR, probably over a 10- to 15-year period. Additionally, sump rotation will have to be analyzed in an appropriate NEPA document, and a determination made under NEPA as to its environmental consequences.

1.6 FEDERAL PERMITS AND LICENSES

There are no federal permits or licenses needed to implement the IPM program. Pesticides used by the farmers on Refuge lands are submitted to and reviewed and approved by the Service via the PUP process (discussed earlier).

In California, recommendations for using pesticides can only be made by licensed pest control advisors (PCAs) who work directly for the farmers.

1.7 REMAINING CHAPTERS

Chapter 2 summarizes the proposed action and reasonable alternatives to the proposed action. It also compares the potential impacts of the alternatives with one another. Chapter 3 discusses the existing environment for all resources affected by a significant issue as determined by the Agencies. Chapter 4 addresses the potential environmental consequences of the proposed action and alternatives. Chapter 5 lists the persons who prepared this document. Chapter 6 lists the agencies and persons consulted during the preparation of this EA. Chapter 7 contains the glossary and Chapter 8 the references cited.

CHAPTER 2: DESCRIPTION OF ALTERNATIVES

2.0 INTRODUCTION

This chapter summarizes the U.S. Fish and Wildlife Service's and Bureau of Reclamation's (the Agencies') proposed action: implementation of the *Final Integrated Pest Management Plan for Leased Lands at Lower Klamath and Tule Lake National Wildlife Refuges, Oregon/California* (1998). Reasonable alternatives to the proposed action, including the no-action alternative, implementation of a modified integrated pest management (IPM) program, and a transition from synthetic pesticide use to a long-term organic system also are described.

A summary comparison of alternatives is presented in **Table 2**.

2.1 ISSUES AND DEVELOPMENT OF ALTERNATIVES PROCESS

The Agencies identified significant and relevant issues as discussed in **Chapter 1, Scoping**. Significant issues are defined as those having the potential to be adverse or beneficial, to be severe or long-lasting, to affect a large area, or to occur frequently when a resource's quantity, quality, fragility, or uniqueness are considered. Relevant issues were determined to be within the scope of this EA.

A description of three significant or potentially significant and relevant issues is provided below. In addition, the means for predicting, and where possible, measuring the issues' associated effects under each alternative, are provided below:

Issue 1. Effects on income to individuals and the local economy. If crops are lost as a result of any ineffective IPM techniques, then individual and local income could be lost. In addition, growers are concerned about the effects on adjacent farmlands if IPM proves ineffective on refuge lands. They anticipate additional chemical inputs might be required to control pests, with the secondary economic effect the cost of buying chemicals could have on landowners. Some growers anticipate the counties would receive reduced tax revenues required to be paid from leased-land revenues under the Kuchel Act because IPM will prove ineffective. Some members of the public believe the potential social and economic impacts from implementing an IPM program should warrant an EIS. *Effects will be predicted from studies comparing the experience of IPM growers in settings, and for crops of, a similar nature.*

Issue 2. Effects on threatened and endangered species, other wildlife, and habitats. Environmental groups are very concerned that the continued use of pesticides would further jeopardize threatened and endangered species (Lost River and shortnose suckers, peregrine falcons, and bald eagles). *Effects will be measured by review of studies and literature pertaining to the effects of pesticides on local endangered and threatened animals, and other wildlife and habitats.*

Issue 3. Effects on soils, water, and air quality. Certain pesticides may have short- and long-term residual effects in air, water, or soil. These residuals may affect the resources on and off the refuge and the habitat they provide, well into the future. *Effects will be measured by addressing the Pesticide Use Proposal (PUP) process used to approve chemicals, and by examining how the proposed and alternative IPM programs might affect these resources, based on existing studies.*

2.1.1 Development of Alternatives

The Agencies are required under the National Environmental Policy Act (NEPA) to consider appropriate alternatives to the proposed action. In addition to the proposed action (Alternative 2 Phased IPM Program), the Agencies developed three other alternatives in response to identified environmental issues and issues raised by the public. Alternative 1 is a no-action alternative, maintaining the current management program on the leased lands. Alternatives 3 and 4 were developed with input from the public (meetings with environmental and agricultural interests) during scoping activities. The intent was to provide the public and the decision makers with a full range of reasonable alternatives that addressed significant and relevant issues, and to provide a disclosure of the possible consequences of each alternative.

Alternatives to the proposed action are limited in part by the fact that the action is a proposed *program* for specific federal property. Therefore, locational and physical sub-alternatives common to other projects are not necessarily applicable here.

2.1.1.1 Alternative 1 No Action

Management by the Agencies. Under Alternative 1, the Agencies would continue to manage pests as they have in the recent past. No comprehensive IPM program would be implemented on leased lands at Lower Klamath and Tule Lake NWRs. IPM practices that would continue to be carried out or required by the Agencies on the leased lands would include: lease stipulations for disposal of crop wastes that could spread disease, use of certified seed and seed treated for seed-borne disease in certain crops, providing wash stations and requiring washing of equipment for nematode control, crop rotation, off-refuge disposal of soil from sheds handling potatoes, prohibiting growing of nematode host crops in consecutive years, winter cover crops on row crop yields, and flooding for control of pests. (Different stipulations would apply to different portions of the leased lands.)

The Agencies have converted a portion of Area J into a trial organic lease for the 1998 growing season. Along with IPM, the Agencies would encourage organic farming practices by offering organic farming options within leases under this alternative. Other IPM techniques would continue to be added in the future, if and when the Agencies decided they were applicable to the leased lands.

The Refuge IPM Coordinator would not carry out a formal and comprehensive IPM program, but would continue to work with growers on developing IPM alternatives to pesticides on a less organized basis. Field trials to test the effectiveness of IPM would continue on a voluntary basis by lessees, and under special experimental leases designed by the University of California Intermountain Research and Extension Center, the Oregon State University's Klamath Experiment Station, and the Agencies.

Berm Management would be addressed by the Agencies as money and time permitted. The specific priorities in the IPM Plan to control pests on the berms would not be implemented, nor would incentives likely be offered by the Agencies for IPM initiatives. The Agencies would continue to work on berm management. However, berm management would likely proceed more slowly and on a more limited area without the additional funding anticipated if the IPM program were implemented.

New PUPs (not previously approved) would not be approved for use on Refuge leased lands. The Regional PUP Committee would continue reviewing existing PUPs annually. Modifications of existing PUPs would undergo endangered species consultation prior to their use on leased lands. Currently the PUP process, including the emergency approval process, is under review by Agency officials.

Management goals for the refuges would remain unchanged (see **Chapter 3, 3.1**).

Sump Rotation. Seasonal/periodic rotation of agricultural land/wetlands (sump rotation) would proceed as research was completed and beneficial techniques for wildlife and agriculture, including IPM, could be funded. This would be expected to occur over a 10- to 15-year period. Modifications (such as flooding) of the area now leased on Tule Lake NWR could occur as a result of sump rotation. (See **Chapter 3, 3.1 Lower Klamath and Tule Lake National Wildlife Refuges [NWRs]** for a summary of sump rotation).

Practices of Leased-Land Growers. Crops grown on the refuges would continue to include small grains, alfalfa, grass hay, and row crops including onions, sugarbeets, potatoes, and organic horseradish. As voluntary field trials showed promise for other crops that required less chemical input, comparable profits, and potential for wildlife benefits, these might be incorporated into the range of crops grown on the refuges. Changes in crops grown on leased lands could occur as a result of future trials, economic conditions, or ongoing and/or future compatibility analyses.

Lessees would control agricultural pests using a variety of means. IPM techniques would probably continue to include: noxious weed control via mowing, burning, and chemical treatment; flood fallowing lots for controlling wild oat and quackgrass, nematodes, and rodents; growing winter cover crops on row crop acreage; using wash stations to prevent spread of disease; dewatering canals to control aquatic weeds; biological controls, including raptor perches for rodent control, and beneficial insect releases; increasing seeding rates to out-compete weeds; selecting pest-resistant crop varieties; and

chemical treatment. Crop rotation would continue to be an important aspect of pest control. Growers could continue to use pesticides previously approved under the PUP process. As new IPM techniques became available, as new varieties of pest-resistant crops were developed, and as new technology became available, aspects of each could be incorporated into growing operations on a voluntary basis.

Crop Scouting. *Crop scouting is not mandatory under state or federal law, or current leased land agreements (leases).* Growers would continue to scout their crops or hire Pest Control Advisors (PCAs) to do so. Growers (lessees) and PCAs would typically visit their fields at least once a week during the growing season and sometimes daily, depending on the time of season and the crop involved. Growers and PCAs would check fields for a variety of factors including irrigation needs, pest infestations, crop development, fertility and stand establishment. Frequency of scouting would be determined by crop development stage, potential for pest occurrence, weather conditions, and market considerations.

Though all growers would check their fields for pests, considerable variation would continue regarding *frequency* and *methods* used for scouting and record-keeping. Calendar spraying sometimes would occur instead of crop scouting. Sample replication and statistical analyses aspects of crop scouting are not consistently practiced at present, and no reliable records would be available to document crop scouting results. Little quantitative data would be maintained on pest/disease infestation levels versus levels of economic damage and various treatment options are not systematically gathered and collated to develop action thresholds based on effectiveness and economic damage.

In addition to growers and PCAs, field representatives from sugar-processing companies, seed company representatives, commodity buyers, pesticides company representatives, TID staff, and local Extension personnel could scout fields for growers and advise growers of pest infestations.

Growers usually would work with their PCA to mutually determine the need for pesticide treatments or alternative pest control measures. Under California law, restricted-use pesticides can only be applied by a licensed applicator after obtaining a PCA recommendation. PCAs would routinely scout for and collect quantitative data on pests that have University-established economic threshold levels and sampling techniques.

Site-specific, Klamath Basin or University-determined economic (action) threshold levels have not been established for many pests of refuge-grown crops. When economic threshold levels were not available, PCAs would use best professional judgement based on prior experience with the crop, number and size of pests, crop development stage, and potential economic damage. Growers would make the final decision about when and whether to spray, or to use some other control technique. Most pesticides would be commercially applied by a pest control operator working for a PCA.

IPM Research Projects for 1975 - 1998 Conducted at the UC Intermountain Research Station of the University of California.[2]

- Biological Control of Russian Wheat Aphid
- Rotational Management of Wetlands
- Alternative Cropping Systems Wetlands/Cropland Rotation
- Berm Management for Wildlife Habitat and Weed Suppression
- Development of Prediction Models for Late Blight Development in Potatoes
- Identification and Epidemiological Studies of Potato Tuber
- Control of Barley Stripe Rust
- Development of Onion Resistance to White Rot
- Black Dot and Silver Scurf Evaluation
- Irrigation and Fungicide Evaluation for Control of Pink Flea Beetle Control in Intermountain Sugarbeets
- Control of White Rot with DADS
- Control of White Rot with Garlic powder
- Flooding to Control White Rot
- Evaluation of Water Management in the Development of Onion Basal Disorder
- Planting Date and Weed Control in Sugarbeets
- Weed Biology and Control in Small Cereal Grains
- Chemical and Cultural Management of White Mold in Potatoes
- Crop Fallow to Lower Columbia Root-knot Nematode Populations
- Alternative Methods of Nematicide Control
- Degree-day Model to Predict Columbia Root-knot Nematode Population Levels
- Evaluation of Cereal Grain Varieties as Hosts for Barley Root-knot Nematode
- Crop Rotation to Reduce Columbia Root-knot Nematode
- Biological Control of Bacteria on Potato Roots
- Flooding to Control Columbia Root-knot Nematode
- Alternative Non-host Crops for Columbia Root-knot Nematode
- Evaluation of Cereal Grain Varieties as Hosts for Columbia Root-knot Nematode
- Potato Variety Resistance to Damage by Columbia Root-knot Nematode
- Early Harvest Date to Avid Damage by Columbia Root-knot Nematode
- Chemical and Cultural Control of Pink Rot in Potatoes
- Control of Columbia Root-knot Nematode with Chitin Based Materials
- Vegetative Planting of Berms

[2]Harry Carlson, Superintendent of the Intermountain Research and Extension Center in Tulelake, California.

2.1.1.2 Alternative 2 Phased IPM Program (Preferred Alternative)

Management by the Agencies. Under Alternative 2, the Agencies would implement the *Final Integrated Pest Management Plan for Leased Lands at Lower Klamath and Tule Lake National Wildlife Refuges, Oregon/California* (1998). (For an Executive Summary of the Plan, see **Appendix A.)** The IPM Plan embodies the concept that IPM treats pests as part of a crop production system that includes not only the crop and its pests, but also the crop's entire physical setting. The proposed IPM program coordinates pest management activities with each other and with production methods to reach cost-saving, long-lasting solutions to pest problems.
The emphasis is on knowing about and preventing problems before they occur. The program also provides outreach opportunities to (1) disseminate information on pest infestations within leased lands in a timely manner, (2) convey results of successful new IPM methods to growers, and (3) prioritize field trials to eliminate the most toxic pesticides in use on leased lands.

The IPM Plan does not eliminate use of pesticides, but attempts to use them as a last line of defense against pests, not as the first option for control. It recognizes that, in practice, a grower would use several pest controls based on knowledge of the crop, pests, and pests' natural enemies to avoid crop loss and minimize harmful effects on natural resources.

The IPM Plan for the national wildlife refuge leased lands proposes control of pests by the following:

- *Identifying pests and their natural enemies;*
- *Understanding the physical and biological factors that affect the number and distribution of pests and their natural enemies;*
- *Monitoring pests and their natural enemies for damage and biological control;*
- *Determining if and when a treatment is needed to prevent economic damage;*
- *Follow-up to see how well control measures work and to see if further action is needed; and*
- *Using a combination of cultivation (and other cultural) practices, biological, and chemical pest controls to reduce reliance on pesticides.*

The key ***administrative*** elements of the Plan implemented under Alternative 2 would include:

- Pursuing funding to implement the IPM Plan
- Granting authority to an Refuge IPM Coordinator to carry out the IPM Plan
- Establishing an ongoing IPM Coordination Group
- Forming a berm management subcommittee of the Coordination Group
- Forming a pesticide subcommittee of the Coordination Group
- Offering lease incentives for field testing IPM techniques
- Filing PUP-approved pesticide labels at Agency offices
- Subjecting row crops grown for certified seeds to the same pest control thresholds as commercial crops

- < Maintaining data files on field trials (Refuge IPM Coordinator)
- < Incorporating beneficial aspects of sump rotation into the IPM Plan as results become available
- < Compiling baseline physical, biological, and wildlife data on the leased lands
- < Exploring alternative pesticides by the Agencies/Growers to help prevent pest resistance problems
- < Developing IPM outreach activities
- < Pursuing private/public partnerships to carry out IPM
- < Reviewing the IPM Plan annually
- < Reviewing the IPM Plan comprehensively every 5 years

The key ***field*** elements of the Plan implemented under Alternative 2 would include:

- < Crop scouting (as defined below under ***Crop Scouting)*** would be required as part of new lease agreements
- < Field trials would be used to test and demonstrate IPM techniques
- < Within 5 to 10 years, growers could expect new IPM requirements in lease agreements
- < Alternative crops would be field-tested in the Klamath Basin
- < Cover crops would be encouraged to reduce erosion. The Agencies have incorporated this element into 1998 lease contracts.
- < If vole control was needed, only nonchemical methods would be used
- < Once action thresholds were known for specific crop/pests, they would be the primary determinant when deciding whether ground or aerial pesticide spraying would be allowed

All pesticides proposed for use under the IPM program would continue to be reviewed under the PUP process, and would still require endangered species consultation prior to use on leased lands.

Management objectives for wildlife would remain unchanged unless a new wildlife management plan was written. Berm management would be carried out cooperatively by growers, the Agencies, Tule Lake Irrigation District (TID), and U.C. Intermountain Research and Extension Center.

Sump Rotation. This would be the same as Alternative 1.

Practices of Leased-Land Growers. Crops grown on the refuges would continue to include small grains, alfalfa, grass hay, organic horseradish and row crops including onions, sugarbeets, and potatoes. As field trials showed promise for other crops that required less chemical input and comparable profits, these might be incorporated into the range of crops grown on the refuges. Within the parameters of the Kuchel Act and other laws, a wide variety of alternative crops eventually could be grown depending on economics, crop markets, equipment availability, IPM techniques and practices, IPM research, and wildlife values.

Lessees would control agricultural pests using a wider variety of means than they do now (described under Alternative 1), including new IPM methods suggested in the IPM Plan and field- trialed methods as they became available. Not all required IPM techniques would need to be tested in the Basin if they were proven effective under similar situations (e.g., planting habitat for natural enemies of pests and cover crops). Similarly, not all new pesticides are tested in the Klamath Basin before they are marketed under a general pesticide label. Growers could continue to use pesticides approved under the PUP process. As new, reliable IPM techniques became available via the experiment stations, as new varieties of pest-resistant crops were developed, and as new technology and biocontrols became available, aspects of each could be incorporated into growing operations through stipulations on lease agreements and on a voluntary basis.

The IPM Plan was written to give growers the information needed to practice comprehensive IPM. In addition, the IPM Plan recommends field trials for testing IPM methods that could benefit leased-land growers and wildlife. The trials are for methods that have worked in other U.S. locations for pests on particular crops, but have not yet been sufficiently tested in the Klamath Basin.

Phased implementation of IPM would reduce the economic and operational risks to growers. At the same time it would enable assessing wildlife benefits. Therefore, to reduce the effects of immediate implementation, the Agencies would require only a few essential elements of IPM immediately under Alternative 2; the remainder probably would be phased in over the next decade. IPM program requirements would be:

- crop scouting as defined in the IPM Plan and refined by the Refuge IPM Coordinator
- new lease stipulations over the next 5 to 10 years as field trials demonstrated successful IPM techniques applicable to the Basin
- and the use of action thresholds when deciding whether ground or aerial pesticide spraying would be allowed by the Agencies on the refuges, where available and as they became known for crops/pests in the Basin

Crop Scouting. The proposed action would *require* crop scouting to be carried out in a *frequent, organized, and documented* fashion using more systematic, standardized protocols than is currently undertaken by many lessees. The IPM Plan states that weekly crop scouting (and more often if a pest outbreak has been detected or is suspected) is essential to the success of IPM. It states that crop scouting *"provides the best information possible for making pest management decisions."*

Under Alternative 2, crop scouting would be carried out by a Refuge-certified individual (including PCAs and growers). The Refuge IPM Coordinator would conduct crop scouting classes for anyone interested in becoming a Refuge-certified crop scout. For different pests, different crop scouting methodologies would be required, as suggested in the Plan. Record-keeping would also be an intrinsic component of crop scouting because *it is from these records that action thresholds would be*

developed and validated (over a 3-to-5-year period). Knowing field history, weather conditions, pest cycles, and disease symptoms would be essential elements of IPM crop scouting.

Action Thresholds. Under Alternative 2, as action thresholds were determined from local field trials, additional to those developed by U.C. Davis, the intensity and distribution of pest infestation would be confirmed before pesticides were sprayed. Because it is important to act before a pest reaches the injury level, the IPM program would use the concept of an *economic or action threshold* level. This is the level at which controls would be used to prevent pest populations from exceeding injury levels. There are currently few established action thresholds for pests of crops grown on Refuge leased lands. As these became locally validated (via Basin field trials and crop scouting), economic or action thresholds would be the primary determinant when deciding the IPM practices to be implemented.

The intent of this element of the IPM Plan is to minimize pesticide-associated risk to the environment, and to reduce the costs of pesticide use for growers. This would be accomplished by determining more precisely if and where pesticides needed to be applied. The risks of human exposures to pesticides (a secondary impact) also would be reduced.

2.1.1.3 Alternative 3 Modified IPM Program

Management by the Agencies. Alternative 3 would be the same as Alternative 2 except several key administrative and field elements of the proposed IPM program would be modified. This alternative is based on the premise that all IPM techniques should be proven effective in the Klamath Basin prior to their use on the NWRs, and the funding for the IPM program should be increased to speed development of effective pest management alternatives. The value of crop rotation, including rotating row crops, is recognized as an important IPM technique under this alternative. Support is emphasized for the PUP process, including existing emergency measures for spot treatments with pesticides to protect human health and safety, environmental quality, and/or to quell area-wide spread of serious crop pests.

Under Alternative 3, the Agencies would implement the proposed IPM program (as described under Alternative 2) but the following key ***administrative*** elements of the program would be *modified* to include:

- All required IPM techniques and alternative crops would be field trialed and demonstrated beneficial and cost-effective to growers, in cooperation with the Agencies, Universities of California and Oregon, and the TID Lease Land Advisory Committee
- Growers would actively support funding for research, development, and demonstration projects to test IPM techniques applicable to conditions in the Klamath Basin
- The Agencies would manage or administer management of berms, and growers would administer management of buffer zones (areas adjacent to drains and laterals within the lessee's field) using approved IPM techniques

- < Growers would have the option to manage berms using IPM techniques approved by the Agencies

The key ***field*** elements of the IPM program *modified* under Alternative 3 would include:

- < Existing crop scouting protocols would continue
- < New methods of vole control would receive consideration but would not be required to be pesticide free
- < New IPM requirements in lease agreements would be fewer and occur at a slower pace

Crop scouting. Crop scouting is pest, weather, and crop-growth-stage dependent. Scouting requirements should be designed around these items and not arbitrarily stipulated as weekly. Crop scouting would be conducted in all lease fields by qualified individuals, including PCAs, growers, and independent crop scouts. Growers would have the option of hiring a crop scout if they desired, but could do their own scouting and record-keeping if they preferred, as long as they were certified by the Refuge as crop scouts.

Fields would be scouted using sampling techniques and thresholds determined by the universities of California and Oregon and published in their IPM literature. Records of pest levels would be maintained in PCAs' personal field record books. These field records could be shared with the Refuge IPM Coordinator at a mutually agreeable interval, so together, appropriate thresholds for refuge-grown crop pests could be re-evaluated. The Refuge IPM Coordinator would periodically sample fields to help assist and coordinate scouting data.

2.1.1.4 Alternative 4 Transition from Synthetic Pesticide Use to Long-term Organic

Management by the Agencies. Under Alternative 4, a modified version of the proposed IPM program would be implemented and only crops beneficial to wildlife would be grown. Crops beneficial to wildlife are defined as those crops providing food or cover, as determined by Refuge wildlife biologists. Alternative 4 would be phased in as leases came up for renewal (20 percent of leases each year for 5 years, with one lease extending 8 years). Pests would be managed primarily through non-chemical means. However, organic pesticides would be allowed as long as they were approved under the PUP process and after completion of Section 7 consultations. Synthetic pesticide use would be prohibited except in certain situations, that is when fish, wildlife, or their habitats were threatened by a pest. An example would include the infestation of a noxious weed that threatened wildlife, forage, or habitat. The use of synthetic pesticides could delay or interrupt the transition to long-term organic growing. A public health emergency might also warrant synthetic pesticide use (such as an outbreak of plague associated with rodents on the NWRs). Those crops with clearly demonstrated benefits (forage or cover) to wildlife would be allowed to be grown. Crops grown under this alternative could potentially include currently grown crops and alternative (non-traditional) crops that could meet the above criteria (see **3.2.1.2 Croplands**).

Under Alternative 4 (as under Alternative 2), the Agencies would implement certain elements of the *Final Integrated Pest Management Plan for Leased Lands at Lower Klamath and Tule Lake National Wildlife Refuges, Oregon/California* (1998). The IPM Plan would need to be amended or substantially revised to include elements essential to organic agricultural management, and delete synthetic chemical recommendations. Further IPM techniques would be described for an additional set of crops determined to be beneficial to wildlife.

All PUPs would be re-reviewed annually to determine if problems associated with the chemical or its application had arisen over the previous year. Any organic or synthetic pesticide proposed for emergency use under Alternative 4 would continue to be reviewed under the PUP process, and would still require endangered species consultation prior to use on leased lands. If the Refuge IPM Coordinator determined emergency pesticide (both organic and/or synthetic) use was warranted, emergency use of pesticides would need to be approved by the Service outside the Basin (regional office recommendation to Washington office).

The key ***administrative*** elements of the Plan *modified* under Alternative 4 would include:

- An ongoing IPM Coordination Group would not be established
- An emergency pesticide use subcommittee of the Coordination Group would not be formed
- Lease incentives for field testing IPM techniques would not be offered under this alternative.
- Eliminating the growing of any crop requiring synthetic pesticides, and not beneficial to wildlife.
- Amending the IPM Plan to include new information on alternative crops and organic farming techniques
- Prohibition on the use of synthetic pesticides, except in the event of an emergency

The key ***field*** elements of the Plan *modified* under Alternative 4 would include:

- Field trials to test and demonstrate IPM techniques with an emphasis on determining crops with proven forage and/or cover benefits to wildlife
- New crop requirements in new lease agreements within 2 years, and new stipulations on IPM practices as methods proved effective for the Basin based on the judgement of agricultural experts within or outside of the Basin
- Not requiring alternative crops to be field-tested in the Klamath Basin, but alternative crops would be a field-trial priority
- Agency implementation of cover cropping and irrigation, as appropriate, if leased-land parcels were not leased

Management objectives for wildlife would remain unchanged, until and unless a new wildlife management plan was written. However, the underlying premise of this alternative would be that any

agricultural practice would have, at worst, a neutral effect on wildlife, and preferably an enhancing effect.

Sump Rotation. This would be the same as Alternative 1.

Practices of Leased-Land Growers. Currently, the crops grown that provide benefits to wildlife include small grains, alfalfa, potatoes, and grass hay. As yet, the wildlife benefits for onions, sugarbeets, and horseradish have not been shown. Therefore, these crops might be eliminated from the leased lands in the future. All grain crops on the Tule Lake NWR could be rotated with alfalfa or alternative crops as a pest prevention practice. As growers chose to plant alternative crops, they would contact the Refuge staff or conduct field trials to determine benefits to wildlife and agree to discontinue the use of all but organic pesticides except where a pest threatened fish or wildlife species or their habitat.

Under this alternative, it is assumed that a planned crop rotation -- the sequencing of cash and soil-building crops on a field over time -- would be made. Crop rotations would feature perennial forage legume crops such as alfalfa and/or annual leguminous cover crops to provide all or most of the nitrogen needed by grain, vegetable, and fiber crops that do not fix nitrogen. Varying crops in a sequence also would break up the life cycles of important disease and insect pests. Since organic farming precludes the use of synthetic pesticides and soluble commercial fertilizers, growers would employ the means discussed above to manage pests and soil fertility. (For more information on crop rotations, see **Appendix C**.)

Alternative 4 would feature four rotation sequences -- two on each Refuge. (Other rotations of varying lengths and crops mixes would be possible, but they appeared less feasible.) Sequences would occur simultaneously on different portions of the leased lands. The crops used and the acreage occupied are presented in **Table 1**. Four sequences would be needed to meet the different crop production provisions of the Tule Lake and Lower Klamath leases, including constraints of the Kuchel Act that effectively limit the acreage of row crops, and waterfowl management considerations that limit alfalfa acreage. Another constraint on crop rotation results from the elimination of onions, sugarbeets, and horseradish as crop options since they are not known to provide wildlife benefit.

Each rotation sequence is based on several assumptions:

Rotation Sequence 1: Potatoes are the most valuable crop in this rotation, generating the highest gross income (see **Section 4.6.4.1**). In a 6-year rotation with alfalfa and small grains, most-to-all of the nitrogen fertility could be provided by natural fixation and most serious soil-borne pests suppressed. Winter cover crops (preferably a nematode suppressing crop like rape or oilseed radish) would follow potatoes. Winter cover crops would be desirable, but optional following small grains. Alfalfa would be managed as a two-cut system to protect nesting birds; first irrigation and cutting would be delayed, allowing only two cuttings per year.

Rotation Sequence 2: This 6-year rotation also favors potatoes for economic reasons. The lack of alfalfa in rotation (because of the need to grow enough grain to meet waterfowl food requirements) would require leguminous and nematode-suppressing cover crops to be overseeded into all small grains. The purchase of some expensive organic fertilizers to supply additional nitrogen for potatoes would be likely.

Rotation Sequence 3: Sequence 3 is similar to sequence 2. However, potatoes cannot be grown on the Lower Klamath Refuge due to conflicts with waterfowl objectives and lack of adequate irrigation infrastructure. As a result, sequence 3 lacks a row crop component. As in sequence 2, alternating legume and nematode-suppressing cover crops would be necessary following small grains. It is unlikely that supplementary organic nitrogen fertilizer could be afforded in this rotation.

Rotation Sequence 4: Perennial grass hay would be grown continuously. For purposes of this alternative analysis, this is referred to as a rotation though the term is a misnomer.

Agricultural practices carried out on the refuges would be examined for benefits to wildlife. Irrigation and harvest times would be keyed to waterfowl nesting, cover, and forage needs. Staging, foraging, and nesting requirements of associated upland wildlife would also be examined when an agricultural crop or method was proposed. An example of a beneficial crop and practice at present is post-nesting harvest of grass hay; it provides forage and cover for wildlife during spring and summer, can be harvested in the late summer and pastured in the fall, and provides early green-up for geese and other waterfowl.

Lessees would control agricultural pests using IPM methods suggested in the IPM Plan, organic pesticides or synthetic pesticides only in approved emergency situations, and field-trialed methods as they became available. Pesticides would continue to be approved under the PUP process, although the number of pesticides reviewed would be dramatically reduced. The PUP process would be used only for biocontrols, new organic pesticides, and new pesticides needed for emergency chemical applications. As new, reliable IPM techniques became available via the experiment stations and/or the IPM program, as new varieties of pest-resistant crops were developed, and as new technology and biochemicals became available, aspects of each would be incorporated into growing operations, primarily through stipulations on lease agreements. However, it is also assumed that a wide range of techniques would be available to growers within the leases to allow wide-ranging use and applications, to tailor techniques to a given situation, and to increase experimentation. In the long term it assumed that most leased-land growers would convert to organic practices to profit from this more exclusive marketing niche. Organic practices sustaining soil tilth, and frequent crop rotations also would be used.

Crop Scouting. Under Alternative 4, it is likely that crop scouting would continue to be carried out, similar in method and effect to Alternative 2.

Action Thresholds. If an action threshold was reached under this alternative, it would trigger an evaluation as to the action most beneficial to wildlife (organic treatment, sacrifice of crops, or emergency application of synthetic pesticides). The Refuge IPM Coordinator, Extension, and Agency staff would disseminate available information in addition to the IPM Plan on action thresholds. As these became established via Basin field trials or at other applicable sites in the nation, they would be the primary determinant when deciding to treat a pest.

TABLE 1.
Rotation Sequencing under Organic Scenario

Tule Lake Rotation Sequence 1
(on 4,000 acres; about 667 acres in each crop)

Small Grain	°	Small Grain/ Alfalfa Establishment	°	Alfalfa (1st full season)	°	Alfalfa (2nd full season)	°	Alfalfa (3rd full season)	°	Potatoes/ Cover Crop	**
year 1		*year 2*		*year 3*		*year 4*		*year 5*		*year 6*	

Tule Lake Rotation Sequence 2
(on 11,814 acres; about 1,969 acres in each crop)

Oats/ Cover Crop	°	Barley/ Cover Crop	°	Oats/ Cover Crop	°	Barley/ Cover Crop	°	Oats/ Cover Crop	°	Potatoes/ Cover Crop	**
year 1		*year 2*		*year 3*		*year 4*		*year 5*		*year 6*	

Lower Klamath Rotation Sequence 3
(on 4,000 acres: about 2,000 acres in each crop)

Oats/	°	Barley/	°	**
year 1		*year 2*		

Lower Klamath Rotation Sequence 4
(on 1,800 acres)
Continuous Grass Hay

** At the end of each sequence, the rotation is assumed to repeat.

2.2 ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER STUDY

A number of alternatives suggested during scoping have been determined by the Agencies to be infeasible, unreasonable, or outside the scope of this document. Therefore, the alternatives discussed in this section have been dismissed from further study. The reasons for dismissal have been summarized under each alternative heading.

2.2.1 No Regulation of Pesticides Under the PUP Process

Pesticide use would occur under U.S. Environmental Protection Agency, California Environmental Protection Agency, and Oregon Department of Environmental Quality guidelines without the Agencies' oversight. No specific IPM program would be conducted.

This alternative violates Department of the Interior pesticide policy and Service pest management policy, and Section 7 of the Endangered Species Act.

2.2.2 Eliminate Leased-Land Farming From the NWRs

The Agencies would decide that lands no longer could be managed for optimum agriculture consistent with waterfowl management ("...for major purpose of waterfowl management, but with full consideration to optimum agricultural use that is consistent therewith." - Kuchel Act of 1964)

This would be inconsistent with current management interpretation of the Kuchel Act as the Service believes that via sump rotation, the current level of agriculture will be consistent with waterfowl management. Furthermore, experience on the refuges has shown there are agricultural practices that are clearly beneficial to wildlife -- practices that provide forage and cover.

2.2.3 Remove the Leased Lands from the NWRs

The 22,000 acres where the leased-land farming program currently occurs would be removed from the National Wildlife Refuge System and sold or exchanged for other private lands. If sold, the land would be declared excess to the U.S. Fish and Wildlife Service. It would then be offered to other federal agencies, or, if not needed by other federal agencies, it would be offered and sold to private individuals. If the loss of the 22,000 acres was judged to hinder the mission and objectives of Lower Klamath and Tule Lake NWRs, lands of similar wildlife values would be acquired and added to the NWR system in the Klamath Basin.

Removing lands from the NWR System and acquiring land outside the approved boundaries of Lower Klamath and Tule Lake National Wildlife Refuges is a cumbersome, time-consuming, and expensive

process and requires Congressional and Administration approval. This process would involve changing the Kuchel Act. This alternative would cost considerable taxpayer dollars to analyze, to carry through the NEPA process, and to conduct land transactions. It is not reasonable to pursue this alternative when other more practical alternatives exist to accomplish an IPM program for the refuges.

2.2.4 Grow Existing Crops with Substantially Reduced Pesticides

The Agencies would adopt policy that substantially reduced the use of pesticides on the refuges. No IPM program would be implemented but onions, sugarbeets, and potatoes would continue to be allowed.

This alternative seems impractical because it does not address the potential loss of agricultural crops *or* loss of wildlife habitat due to pests, including noxious weeds. While it addresses reducing pesticide use, it does not offer an integrated approach to pest management as called for under Service and Department of Interior policy.

2.2.5 Retire Entire Leased-Land Program and Pay Farmers to Grow Crops

The leased-land program would be eliminated and contracts would be signed with farmers to grow crops for wildlife forage and habitat. The U.S. Fish and Wildlife Service would pay for all agricultural activities needed to provide wildlife forage and habitat. The IPM program would be implemented under this alternative and contracts would reflect desired pest-control activities.

The effects of this alternative are similar to removing leased-land farming from the refuge. This would be inconsistent with the current management interpretation of the Kuchel Act. This action would be dependent on major budget increases to pay growers into the future. Furthermore, experience on the refuges has shown that there are some agricultural practices that are clearly beneficial to wildlife -- practices that provide forage and cover.

2.2.6 Restore All Wetlands on the NWRs and Eliminate Leased-Land Program

Total wetland restoration would be initiated, the leased-land program would be eliminated, and the NWRs would be restored to and managed strictly for wildlife habitat. This alternative would require a finding by the Service that lands could no longer be managed for optimum agriculture consistent with waterfowl management. The Service is currently of the opinion that optimum agriculture consistent with waterfowl management can be achieved through implementation of a sump rotation program.

Another reason to eliminate this alternative is because the refuges are not assured of a water source to restore wetlands. The Tulelake Irrigation District, via a contract ratified by Congress, receives payment

for all water applied to the croplands on the Tule Lake NWR. Currently the bulk of these payments ($38/acre in 1998) is made by the individual lessees. The Service is charged for water to its 2,500 acres of cooperative farmland. Should croplands not be farmed, but converted to wetlands instead, the possibility exists the government would be liable for the water payments on approximately 15,000 acres of commercial croplands ($570,000 in 1998). Even after payment, whether water would be delivered for non-agricultural purposes to the refuges is unknown. To implement this alternative would take considerable funding, numerous agency permits, determination of water rights, water availability, and NEPA review.

The effects of eliminating the leased-land program are discussed in the alternative above. This would be inconsistent with the current management interpretation of the Kuchel Act.

2.2.7 Sump Rotation Concurrent with the IPM Program

Sump rotation would be implemented along with the IPM program. Research on sump rotation is proceeding to determine its effects. To implement sump rotation will take considerable funding, determination of water rights, agency permits, water availability, and NEPA review. Sump rotation is expected to be implemented over the next decade on the Tule Lake NWR, but is considered to be impractical as an immediate alternative.

2.2.8 Short-term Transition from Existing Leased-Land Program to Organic Farming

Under this alternative, an IPM program would include transitioning out of current pest control practices, and requiring crops to be grown without the use of synthetic pesticides and fertilizers. Under organic certification standards, lands must be synthetic pesticide- and fertilizer-free for a minimum of 3 years and meet strict pesticide-free testing requirements. The organic-farming program would be consistent with the National Organic Foods and Production Act of 1990.

This alternative is not considered reasonable in the short term (within the next 10 years) for a variety of factors. Most of the factors when considered singularly would not eliminate consideration of this alternative in the short term. However, when considered together, they indicate that a short-term alternative is not reasonable. A long-term (more than 10 years from now) organic alternative, however, is evaluated as part of Alternative 4.

Reasons for dismissal of the short-term organic alternative include:

Chemical-free status. To meet current organic standards under the Organic Foods Act for the entire leased land area would take up to 11 years. This includes the time it would take for current leases to come up for renewal and a subsequent 3-year, synthetic chemical-free period needed to meet organic

certification requirements. While individual fields could be phased in over a shorter period of time, the practicalities of this are less than ideal. Leased lots under an organic system would be subject to drift from aerial spraying of synthetic pesticides on as many as four sides until all leases were renewed with chemical prohibitions. (Lease renewal dates are intermingled among the lots; lease renewal dates are not applied in blocks of lots.) While mitigating drift could be partially handled by buffer zones, such zones would reduce the amount of land available for farming.

Market considerations. Investing in organic production is still a relatively risky venture compared to conventional farming. The market is immature, leading to volatile demand and pricing. Distribution and marketing channels are not well developed (Holly Born, National Center for Appropriate Technology, personal communication, May 11, 1998; Stearns and Watt 1993; and Farm Aid News 1995). Production is unlikely to be profitable in the first few years of farming. Whether farmers would have adequate incentive to convert to organic production remains unclear. At present, organic production on the refuges would appear to represent a substantial increase in total West Coast acreage. For instance, California Certified Organic Farmers-certified potato acreage was 858 acres in 1996, while about 2600 acres of potatoes were planted on the refuges in 1996. A large and fairly immediate increase in supply of organic potatoes could depress prices.

The organic food industry, however, is growing at 20 to 30 percent annually in both fresh-produce and manufacturing sectors (Natural Food Merchandiser 1997). As organic farming is practiced over the next decade, more information and comparable statistics will also become available. If current trends continue, organic markets will expand over the next 10 years, and many of the current unknowns associated with organic practices will have been answered, reducing uncertainties.

Organic infrastructure. Processing organic products would require either separate processing facilities, or in the case of potatoes, dedication of an existing facility for organic processing at least on a part-time basis. One of the existing facilities could be steam-cleaned to accommodate organic processing. Storage of organic products would be another consideration.

Separate facilities would have to be built or secured. In the case of potatoes again, organic growers would want the option of storing potatoes to respond to fluctuations in market demand.

Farmer motivation. This is probably the most important factor influencing success of an organic program on the refuges. It is sometimes assumed that organic farmers represent a back-to-the-land movement, where animals are used for tillage, mainly fruits and vegetables and/or specialty crops are raised, and operations are marginal, subsistence enterprises. There is sometimes the conception that organic farmers function contrary to prevailing lifestyles and economic institutions. Wernick and Lockeretz (1977) found a very different picture after surveying 150 organic farmers in the Midwest. Most raised field crops and livestock on a commercial scale using mechanized methods. It was a

combination of motivations, rather than outward appearance of operations, that set organic growers apart from conventional farmers. Motivations were generally centered around three factors: Organic growers had specific problems with conventional farming, such as animal or soil health; they had ideological misgivings, mainly about the use of pesticides; and they had been contacted by an individual or organization that suggested a favorable organic alternative.

More recent research into organic farming reveals that successful organic growers share a strong *philosophical commitment* to their practices, and that without this, organic farming is rarely successful (Rex Dufour, National Center for Appropriate Technology, personal communication, May 7, 1998). During the process of preparing the 1998 IPM Plan, the Agencies witnessed a high level of resistance to converting conventional practices to the degree necessary to include comprehensive IPM methods. (For this reason, phasing in IPM on the refuges was proposed.) Organic practices would require a far greater personal commitment, both of resources and philosophy, than comprehensive IPM. Further, few organic growers have expressed continued interest in growing organic crops on the refuges at present[3]. Given these reasons, the Agencies have concluded that the requisite number of farmers willing to grow organically may not be sufficient at present to lease out 22,000 acres of organic cropland.

2.2.9 Immediate Implementation of the Proposed IPM Program

The proposed IPM program would be implemented immediately, not phased in as proposed. Lease requirements would be changed in the next round of lease negotiations to include stipulations for IPM techniques that showed promise elsewhere, but were not necessarily proven effective in the Klamath Basin.

This alternative did not seem to address the primary issues raised by the public. It is recognized by all parties involved in IPM that locally proven techniques are going to be the most effective, and that immediate changeover to new techniques could cause economic hardship to growers that could be avoided by phasing.

2.2.10 Continue the Existing Situation with Incentives for Growers and Documented Field Trials

The IPM program would be modified; it would include only two elements, giving incentives to growers to try IPM techniques, and conducting and documenting field trials to test IPM techniques in the Basin.

[3] Recently, five growers contacted the Refuge staff about the possibility of organic farming on the leased lands (echinacea, St. John's wort, potatoes, carrots). Also, organic horseradish is now grown on 12 acres of Area J.

This alternative does not go far enough from the existing situation toward implementing IPM on the refuges. The Agencies, therefore, would not be in compliance with Department of the Interior and Service policies.

2.3 COMPARISON OF ALTERNATIVES

This section summarizes the descriptions of the action alternatives and compares them in **Table 2**. A more detailed narrative analysis of the potential effects of the action alternatives is provided in **Chapter 4 Environmental Consequences**. A side-by-side comparison of the consequences of each alternative in **Table 15**.

2.4 THE AGENCIES' PREFERRED ALTERNATIVE

Alternative 2, phased implementation of an IPM program, is the Agencies' preferred alternative (**2.1.1.2 Alternative 2 Phased Implementation of an IPM program**).

TABLE 2. COMPARISON OF ALTERNATIVES

Project Element	Alternative 1 No Action	Alternative 2 Phased IPM Program (Preferred Alternative)	Alternative 3 Modified IPM Program	Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic
Pesticide Use	Pesticide use would continue at generally current rates and trends, using PUP-approved chemicals. New PUPs (not previously approved) would not be approved for use on Refuge leased lands. The Regional PUP Committee would continue reviewing existing PUPs annually. Modifications would undergo ESA Section 7 consultation prior to their use on leased lands. The PUP process, including the emergency approval process, is under review by Agency officials.	Growers could continue to use pesticides approved under the PUP process. As new, less toxic pesticides became available, they could be reviewed by the PUP committee and be approved for use on the lease lands. Modifications would undergo ESA Section 7 consultation prior to their use on leased lands.	Same as Alternative 2. Modification would undergo ESA Section 7 consultation prior to their use on leased lands.	Pests would be managed primarily through non-chemical means. However, organic pesticides would be allowed as long as they were approved under the PUP process and after completion of ESA Section 7 consultations. Synthetic pesticide use would be prohibited except in certain situations, that is when fish, wildlife, or their habitats were threatened by a pest. The PUP process, including the emergency approval process, is under review by Agency officials.

TABLE 2. COMPARISON OF ALTERNATIVES

Project Element	Alternative 1 No Action	Alternative 2 Phased IPM Program (Preferred Alternative)	Alternative 3 Modified IPM Program	Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic
Crops Grown on Refuge	Crops grown would include onions, sugarbeets, potatoes, grains, alfalfa, organic horseradish, and grass hay. As voluntary field trials showed promise for other crops that required less chemical input, comparable profits, and potential for wildlife benefits, these might be incorporated into the mix of crops grown on the refuges.	Same as Alternative 1 plus alternative crops would be field trialed and those requiring less use of pesticides might be incorporated into the mix of crops grown.	Same as Alternative 2.	Crops grown would have to be beneficial to wildlife. Currently, the crops grown that provide benefits to wildlife include small grains, alfalfa, potatoes, and grass hay. As yet, the wildlife benefits for onions, sugarbeets, and horseradish have not been shown. Therefore, these crops might be eliminated from the leased lands in the future. All grain crops on the Tule Lake NWR could be rotated with alfalfa or alternative crops as a pest prevention practice.

TABLE 2. COMPARISON OF ALTERNATIVES

Project Element	Alternative 1 No Action	Alternative 2 Phased IPM Program (Preferred Alternative)	Alternative 3 Modified IPM Program	Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic
Level of IPM Implemented on the Refuges (Administrative)	An IPM program would not be implemented. IPM on the refuges would include current practices carried out by growers and the Agencies, and actions included in current leases by the Agencies. The current Refuge IPM Coordinator would likely research additional techniques and disseminate these to growers over time, but would not carry out a formal program. Seasonal/periodic rotation of agricultural land/wetlands (sump rotation) would proceed as research was completed and beneficial techniques for wildlife and agriculture, including IPM, could be funded. This would be expected to occur over a 10- to 15-year period. Modifications (such as	A comprehensive IPM program would include the following Administrative elements: 1) Funding would be sought to implement a comprehensive IPM program. 2) Refuge IPM Coordinator would implement an IPM Plan. 3) An IPM Coordination Group would be formed. 4) A berm management subcommittee would be established. 5) A pesticide subcommittee would be established. 6) Lease incentives for field trials	An IPM program would be carried out similar to Alternative 2, but would be modified: 1) Funding would be actively supported by the growers. 2) Same as Alternative 2. 3) Same as Alternative 2. 4) Same as Alternative 2. 5) Same as Alternative 2. 6) Same as Alternative 2.	A modified version of the proposed IPM program would be implemented and only crops beneficial to wildlife would be grown. 1) Same as Alternative 2. 2) Same as Alternative 2. 3) An ongoing IPM Coordination Group would not be established. 4) Service carries out berm management beneficial to wildlife, no subcommittee. 5) No subcommittee formed. 6) Lease incentives for field testing IPM techniques would

TABLE 2. COMPARISON OF ALTERNATIVES

Project Element	Alternative 1 No Action	Alternative 2 Phased IPM Program (Preferred Alternative)	Alternative 3 Modified IPM Program	Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic
Level of IPM Implemented on the Refuges (Administrative cont.)		8) Row crops grown for certified seed would be subject to same action thresholds as commercial crops. 9) Refuge IPM Coordinator would maintain data files on field trials. 10) Same as in Alterative 1. 11) Baseline natural resource data would be compiled. 12) Alternatives to pesticides would be explored. 13) IPM outreach would be developed. 14) Private/public partnerships to carry out IPM. 15) Annual and 5-year review of IPM Plan.	8) Same as Alternative 2. 9) Same as Alternative 2. 10)Same as Alternative 1. 11) Same as Alternative 2. 12) Same as Alternative 2. 13) Same as Alternative 2. 14) Same as Alternative 2. 15) Same as Alternative 2.	8) Beneficial row crops, same as Alternative 2. 9) Same as Alternative 2. 10) Same as Alternative 1. 11) Same as Alternative 2. 12) Organic pesticides would be used; fewer synthetic pesticides would be considered, and only for emergency use. 13) Same as Alternative 2. 14) Same as Alternative 2. 15) Same as Alternative 2, but IPM Plan would be amended for an organic program.

TABLE 2. COMPARISON OF ALTERNATIVES

Project Element	Alternative 1 No Action	Alternative 2 Phased IPM Program (Preferred Alternative)	Alternative 3 Modified IPM Program	Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic
Level of IPM Implemented on the Refuges (Field)	1) Field trials to test the effectiveness of IPM would continue on a voluntary basis by lessees, and under special experimental leases designed by the University of California Intermountain Research and Extension Center, and the Agencies.	1) Field trials would be prioritized to test and demonstrate IPM techniques for which local testing was needed. Field trials would be administered by the IPM Coordinator in cooperation with the Agencies and growers.	1) Field trials would be used to test *all* IPM techniques in cooperation with the Agencies and growers, and to demonstrate them beneficial and cost-effective to growers prior to being required in leases.	1) Field trials would be carried out the same as Alternative 2, except for the maximum benefit of wildlife and to demonstrate IPM techniques with an emphasis on determining crops with proven benefits to wildlife.
	2) As new IPM techniques became available, aspects of each could be incorporated into growing operations on a voluntary basis.	2) Within 5 to 10 years, growers could expect new IPM requirements in lease agreements.	2) Same as Alternative 2, but fewer requirements at a slower pace.	2) Growers would have new lease requirements within the next 5 years including requirements for crops grown, and prohibitions on synthetic chemicals.
	3) As new varieties of pest-resistant crops were developed, could be incorporated into growing operations on a voluntary basis.	3) Alternative crops would be field-tested in the Klamath Basin.	3) Same as Alternative 2, but fewer requirements and at a slower pace.	3) Alternative crops would not be required to be field-tested in the Klamath Basin, but alternative crops would be a field-trial priority.
	4) In leases after 1997, cover crops required on harvested row crop ground	4) In leases after 1997, cover crops required on harvested row crop ground, additional cover crops would be encouraged to reduce erosion.	4) Same as Alternative 2.	4) All grain crops on the Tule Lake NWR could be rotated with alfalfa or alternative crops as a pest prevention practice.

TABLE 2. COMPARISON OF ALTERNATIVES

Project Element	Alternative 1 No Action	Alternative 2 Phased IPM Program (Preferred Alternative)	Alternative 3 Modified IPM Program	Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic
	5) If vole control was needed, only nonchemical methods would be used.	5) Same as Alternative 1.	5) Same as Alternative 1.	5) Same as Alternative 1.
	6) Site-specific, Klamath Basin or University-determined economic (action) threshold levels have not been established for many pests of refuge-grown crops. When economic threshold levels were not available, PCAs would use best professional judgement based on prior experience with the crop, number and size of pests, crop development stage, and potential economic damage. Growers would make the final decision about when and whether to spray, or to use some other control technique	6) When action thresholds were known for specific crop/pests, they would be the primary determinant when deciding whether ground or aerial pesticide spraying would be allowed.	6) Same as Alternative 2.	6) If an action threshold was reached, it would trigger an evaluation as to the action most beneficial to wildlife. The Refuge IPM Coordinator, Extension, and Agency staff would disseminate available information in addition to the IPM Plan on action thresholds. As these became established via Basin field trials or at other applicable sites in the nation, they would be the primary determinant when deciding to treat a pest.

TABLE 2. COMPARISON OF ALTERNATIVES

Project Element	Alternative 1 No Action	Alternative 2 Phased IPM Program (Preferred Alternative)	Alternative 3 Modified IPM Program	Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic
	7) Berm Management would be addressed by the Agencies as money and time permitted.	7) Berm management would be carried out cooperatively between growers, the Agencies, and other cooperators.	7) Berm management would be carried out by Service *or* grower, using IPM. Buffer zones (areas adjacent to drains and laterals within field) done by grower using approved IPM techniques.	7) Berm management would be carried out by the Service for the maximum benefit of wildlife.
Crop Scouting	PCAs, growers, and crop field representatives would scout crops on a *voluntary* basis. Records kept by PCA and/or grower.	Crop scouting would be according to protocols in IPM Plan. Refuge-certified individuals would carry out scouting and records on scouting data would be kept by scouts and turned into the Refuge IPM Coordinator on a regular basis.	Crop scouting could be carried out similar to Alternative 1 but would be required and scouts would have to be Refuge-certified. Records would be turned into the Refuge IPM Coordinator at mutually agreeable intervals.	Same as Alternative 2.

TABLE 2. COMPARISON OF ALTERNATIVES

Project Element	Alternative 1 No Action	Alternative 2 Phased IPM Program (Preferred Alternative)	Alternative 3 Modified IPM Program	Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic
Action Thresholds Establishment	Action thresholds now used include the growers' and PCAs' knowledge and experience, and thresholds established by the Universities of California and Oregon.	Where action thresholds were established, they would be used as outlined in IPM Plan. As scouting record information was collected, action thresholds would be developed and validated.	Same as Alternative 1.	If an action threshold was reached it would trigger an evaluation as to the action most beneficial to wildlife. The Refuge IPM Coordinator, Extension, and Agency staff would disseminate available information in addition to the IPM Plan on action thresholds. As these became established via Basin field trials or at other applicable sites in the nation, they would be the primary determinant when deciding to treat a pest.

TABLE 2. COMPARISON OF ALTERNATIVES

Project Element	Alternative 1 No Action	Alternative 2 Phased IPM Program (Preferred Alternative)	Alternative 3 Modified IPM Program	Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic
Practices of Leased-Land Growers	Growers would continue current crop patterns and acreages using a combination of IPM and pesticides.	As field trials showed promise for other crops that required less chemical input and comparable profits, these might be incorporated into the range of crops grown on the refuges. Lessees would control agricultural pests using a wider variety of means than they do now, including methods suggested in the IPM Plan and field-trialed methods as they became available. Growers could continue to use pesticides approved under the PUP process, although to a lesser degree over time as economic thresholds became established for the Basin. Growers would have information from the IPM Plan to implement additional IPM techniques.	Same as Alternative 2, except *all* required IPM methods would be field trialed.	As growers chose to plant alternative crops, they would contact the Refuge IPM Coordinator to determine beneficial effects to wildlife. Synthetic pesticide use would be discontinued except in the case that a pest threatened wildlife species or habitat, or public health. Any agriculture practices carried out on the leased lands would be examined for benefits to wildlife.

CHAPTER 3 EXISTING ENVIRONMENT

3.0 INTRODUCTION

Chapter 3 describes the existing environment, and resources that could effect or be affected by the proposed action or its alternatives. Resources related to significant issues identified in Chapter 2 are described in the most detail. Discussion under each resource heading concentrates on the significant issues identified. Other resources are discussed briefly or not at all, depending on their relevance to IPM on the refuges.

3.1 LOWER KLAMATH AND TULE LAKE NATIONAL WILDLIFE REFUGES (NWRs)

Lower Klamath and Tule Lake NWRs are located in the Klamath Basin (Basin) of southern Oregon and northern California, near the towns of Klamath Falls, Oregon and Tulelake, California (**Figure 1**). The Basin contained over 350,000 acres of wetlands prior to 1900 (Adkins 1970). The region provided rich and abundant habitat for the 6 million waterfowl that gathered here in the spring and fall to restock their reserves for migration along the Pacific Flyway. The Basin provided vital nesting habitat for waterfowl and colonial nesting pelicans, cormorants, egrets, and herons.

The Basin lost 75 percent of its historic wetlands due to diversion and redistribution of water, resulting in a reduced capacity to support waterfowl. Waterfowl numbers now peak between 1 and 4 million. Remnant wetland acreage exists in Clear Lake, Lower Klamath, Tule Lake and Upper Klamath NWRs.

In spite of habitat losses, the Basin supports tremendous bird life including the largest wintering population of bald eagles in the lower 48 states, and migrating waterfowl. The refuges provide visitors with the opportunity to view and study wildlife, and to hunt, fish, and canoe in the area. Historically, the refuges reduced crop depredation in California's Central and Imperial valleys by attracting and delaying migrating birds during harvest of rice and other valley crops.

These wildlife refuges were established on the Klamath Project (Lower Klamath NWR in 1908 and Tule Lake NWR in 1928). The Klamath Project on the Oregon-California border was one of the earliest federal reclamation projects. Project works, authorized in 1905, drained and reclaimed lakebed lands of Lower Klamath and Tule lakes, stored waters of the Klamath and Lost rivers, diverted irrigation supplies, and controlled flooding of the reclaimed lands.

As Tule Lake receded, reclaimed lands were leased for farming before opening to homesteading. The practice of leasing aided in developing the land during the construction of irrigation and drainage facilities to serve farm units and permit homestead entry. To protect developed

homestead lands from flooding, areas at lower elevations were designated as sumps and reserved for flood control and drainage. Some of the marginal sump acreage subject to less frequent flooding was made available for leasing, but retained in federal ownership. In addition to providing flood control, the reserved sump areas also preserved existing marsh habitat now included within the Basin's NWRs.

The refuges receive their water via direct diversion, and from agricultural return flows. Water rights within the Basin currently are being adjudicated; adjudication could affect water supplies both to agricultural users and to the refuges.

Lower Klamath NWR covers 46,912 acres of open water, wetlands, berms, and cropland and was the first waterfowl refuge and first large area of public land to be reserved as a National Wildlife Refuge. Tule Lake NWR covers 39,116 acres of open water, wetlands, berms, and cropland.

Management goals on Lower Klamath and Tule Lake NWRs are:

- to manage for the conservation, enhancement and recovery of threatened, endangered and sensitive species and the natural habitats on which they depend;
- conserve and enhance wildlife habitats with an emphasis on high quality production and migration habitat for migratory birds;
- to protect and restore native habitats and associated populations of wildlife representative of the natural biological diversity of the Klamath Basin;
- integrate the maintenance of productive wetland habitats and sustainable agricultural systems and ensure agriculture practices will conform to the principles of integrated pest management and proper waterfowl management; and
- to provide high quality, wildlife-dependent visitor services with emphasis on environmental education, interpretation, wildlife observation, hunting and photography opportunities which are compatible with refuge purposes.

3.1.1 Sump Rotation

Sump rotation entails conversion of existing Tule Lake sumps to leased lands for agricultural uses and simultaneous rotation of croplands to new wetland/open water habitats. This is similar to the rotations now occurring in Lower Klamath NWR between cooperative farmlands (not part of leased lands) and seasonal wetlands; this flooding has resulted in increases in waterfowl, shorebird, fish-eating bird, and raptor use on that Refuge. An additional feature of the Tule Lake NWR sump rotation project is expected to restore deep-water habitat and migration corridors for endangered suckers to potential spawning habitat within the Lost River. Sump rotation provides a means of enhancing wetlands by re-establishing a diverse wetland plant species community, restoring waterfowl use and other wildlife values, improving water quality and water depth of endangered sucker habitat, and reducing pests in

Tule Lake NWR. Tule Lake NWR's current program of sump/wetland/crop rotations, directed by Dr. David Mauser, Wildlife Biologist, Klamath Basin refuges, will continue to be expanded under any of the selected alternatives, including the No-Action Alternative. Although sump rotation is expected to result in pest control by non-chemical means and can be regarded as an important IPM method, ongoing aspects of the sump rotation project, or those that will be completed in the future pending funding and permits, are independent of the proposed IPM Plan.

Current achievements under the sump rotation project at Tule Lake NWR include:

- < conversion of 600 acres from agriculture to wetlands or rotational wetlands and agriculture at four sites: Hovey Point, Frey's Island, Lot 5, and Discovery Marsh.
- < establishment of diverse, dense stands of smartweed, barnyard grass, willows, spike rush, bulrush, and other wetland species. The conversion to wetlands was extremely rapid with no seeding required.
- < re-establishment of Columbia cress, a species of concern plant last seen in the Tule lake area in 1928, at two of the wetland conversion sites (Hovey Point and Frey's Island).
- < the apparent eradication of agricultural weeds in converted wetlands.
- < apparent eradication of nematodes in Lot 5 after 1 year as a seasonal wetland and 1 year as a permanent wetland.
- < an increase of 50,000 to 100,000 waterfowl in the 600 acres of wetland created to date, including disproportionately high densities of breeding waterbirds.
- < initial planning of a 300-acre conversion of wetlands to agriculture.
- < completion of planning and acquisition of funding for completion of water control structures for conversion of 3,500 acres of Sump 1B in 1999 to seasonally flooded marsh for the next 5 years. This marsh would be dry from June 15 through September 15 each year. Once emergent wetland vegetation and vegetative nesting islands are established, the site will be returned to wetlands flooded year round.

In 1998, $200,000 in funds were expended on sump rotation; project funding for 1999 is anticipated as $572,000. Recent funding, planning, engineering, and field work for the project have been provided by: Ducks Unlimited; Tule Lake Irrigation District; Upper Basin Working Group; Reclamation; and a number of leased-land growers. Prior to full development of the sump rotation plan, research by principal cooperators is underway to accomplish the following: (1) evaluate the role of new wetlands in improving water quality (Dr. Tim Mayer, Service, Portland); (2) determine pest management and other agricultural benefits of Lot 5 and Frey's Island cell A in 1999 and assess the agricultural yields on portions of these lots comparing the economics of fertilizers to no use of fertilizers (Dr. Carol Sheenan, University of California, Davis and Santa Cruz; and (3) assess waterfowl use, aquatic plant succession, undesirable plant species and invertebrates in seasonally inundated croplands compared to newly converted wetlands (Dr. Christian Grue, University of Washington, Seattle, Dr. David Gilmer,

California Science Center, U.S. Geological Survey; Dr. David Mauser, Service). Additional proposed research includes new studies to evaluate water quality by Dr. Wes Jarrell (Oregon Graduate Institute, Portland) and further assessment of economic costs and benefits of different management strategies under the wetland/cropland rotational management strategy by Michael Gerde, University of California, Davis, and Dr. Carol Sheenan, University of California.

3.2 VEGETATION AND HABITAT

3.2.1 Terrestrial Habitats

3.2.1.1 Lower Klamath NWR

Five habitat types exist on Lower Klamath NWR. They are managed to emulate historic habitats that occupied the Lower Klamath Lake ecosystem prior to the development of Reclamation's Klamath Project.

Seasonally Flooded Uplands. Seasonally flooded uplands were an integral part of the historic system and are differentiated from seasonally flooded marshes by the length of the flooded period and the resulting plant communities. These units are flooded for 3 to 4 weeks during the growing season and usually remain dry until late in the year (December to January). The plant community consists of low grass-forbs and stinging nettles, fireweed, and wild rye. This habitat type is important for nesting shorebirds, owls, ducks, raptors, pheasants, sandhill cranes, and fawning for pronghorn antelope.

Grain Fields. Barley, and to a lesser extent, oats, help meet the fall nutritional requirements of migratory waterfowl. The Refuge grain crop also is intended to attract early migrating waterfowl away from privately grown crops in the Basin. Barley is the predominant crop grown on Lower Klamath NWR, planted by Refuge staff or farmers under Refuge cooperative farming agreement. In the case of Refuge cooperative farming agreements, the farmer provides, seed, cultivation, and weed control in return for 66 percent of the harvest. The remainder of the crops is left standing for wildlife. If the field is farmed by Refuge staff, the entire crop is left standing for wildlife. Under leased land agriculture, Reclamation leases are on a cash basis, thus the entire field is harvested with waste grain left after harvest as a food source for wildlife.[4]

When barley fields are dry in the fall, they are used primarily by dabbling ducks and geese. Beginning in the late fall to early winter, fields are pre-irrigated in preparation for spring planting. At this time they

[4] Refuge cooperative farming agreements and Reclamation leased land agreements are two distinctly separate administrative functions, managed by the U.S. Fish and Wildlife Service, and both the U.S. Fish and Wildlife Service and Bureau of Reclamation, respectively.

receive heavy use by waterfowl, especially dabbling ducks, geese, and swans. Flooding also forces rodents from their burrows making them available to a variety of raptors and wading birds. When water is removed from the fields in the spring, large concentrations of shorebirds use these fields. A partial listing of the many species of wildlife associated with Refuge croplands is contained in **Table 3.**

Irrigated Pasture/Hay. This habitat type provides crucial feeding areas for spring migrant geese. During the spring waterfowl migration, these areas are heavily used by white-fronted, cackling, Canada, and Ross's geese. Long-billed curlews and willets use these areas for nesting in late spring, and white-faced ibis use pasture/hay areas extensively when under summer irrigation. Bald eagles forage for rodents as these fields are flooded in winter.

Uplands. Upland areas are located in Unit 14 (**Figure 2**) and in topographically elevated areas in wetland units. These areas typically do not flood during the winter and, because of the terrestrial nature of the flora and fauna, add substantially to the plant and wildlife diversity of the Refuge. This habitat type is crucial to meeting the needs of several species of federal category and state sensitive species (**Table 4).** Other wildlife species found in the area include rabbits, coyotes, mule deer and small rodents.

Berms. Berms refer collectively to roadsides, ditchbanks, and flat areas between irrigation ditches and drains, and make a substantial contribution to uplands in Lower Klamath NWR, providing habitat for upland birds, small rodents, and ducks. Berm vegetation consists primarily of weeds, predominantly bassia, kochia, perennial pepperweed, and Canada thistle. Grasses, composed primarily of wheatgrass species, exist to a limited extent. Consequently, grasses are used as hiding cover by pheasants, rabbits, and small rodents, and as nesting cover by pheasants, mallards, teal, gadwall, rabbits and small rodents. However, the area would have considerably more wildlife potential if the predominant weed species listed above were controlled and replaced by forbs and grasses.

3.2.1.2 Tule Lake NWR

Three habitat types exist on Tule Lake NWR; croplands, uplands, and berms.

Croplands Two kinds of croplands exist on Tule Lake NWR; agriculture leases where sugarbeets, onions, potatoes, small grains, grass hay, and alfalfa are grown, and cooperative farmlands where grains are grown (for a further discussion on croplands see **3.7.2.3**). Grains and alfalfa provide feed for ducks and geese during spring migrations. Preliminary findings from the first field season of a multi-year study being carried out by the Service on Tule Lake NWR found that potatoes may be a preferred food source over grains of white-fronted geese. This supports earlier finding by Frederick (Frederick et al. 1991; Takekawa, Gonzales, and Orthmeyer 1989). Use of sugarbeet fields by geese was also documented. Some small grains are available to seed-eating birds and mammals as a by-product of commercial harvest.

TABLE 3.
Partial Listing of Wildlife Associated with Refuge Leased Lands

Species	Migrant transients	Breeding wildlife
Mallard	*	*
Gadwall	*	*
Northern Pintail	*	*
Green-wing Teal	*	
Northern Shoveller	*	*
American Widgeon	*	
Redhead	*	*
Canvasback	*	*
Lesser Scaup	*	*
Ruddy Duck	*	*
Eared Grebe	*	*
Western Grebe	*	*
White Pelican		*
Great Blue Heron		*
Great Egret		*
Black-Crowned Nt. Heron		*
Ring-Billed Gull	*	*
California Gull	*	*
California Quail		*
Sandhill Crane	*	*
Ring-Necked Pheasant		*
Golden Eagle		*
Rough-Legged Hawk	*	
Red-Tailed Hawk		*
Northern Harrier		*
Mule Deer		*
Pronghorn Antelope		*
Coyote		*
Western Garter Snake		*
Bullfrog		*
Fathead Minnow		*
Tui Chub		*
Bullhead		*
Savannah Sparrow	*	*
Red-Winged Blackbird	*	*
Tri-colored Blackbird	*	*
Horned Lark	*	*

TABLE 4.
Target List of Sensitive Species on the Refuges

Species	Status
bald eagle	2,5,9
Swainson's hawk	6,10
peregrine falcon	1,5,8
golden eagle	7
ferruginous hawk	4,7
northern harrier	7
merlin	7
prairie falcon	7
short-eared owl (breeding)	7
greater sandhill crane	6,10
bank swallow**	6,10
willow flycatcher**	5
American white pelican	7,10
double-crested cormorant	7
least bittern	7
white-faced ibis	4,7,10
western snowy plover (inland population)**	7,10
long-billed curlew	4,7
California gull (breeding)**	7
tri-colored blackbird	4,7,10
yellow warbler**	7
Lost River sucker*	1,5,8
shortnose sucker*	1,5,8
western pond turtle**	4,7
spotted frog**	3
blue chub	7

1= federally endangered 4= Federal sensitive species 7= California species of special concern
2= federally threatened 5= California endangered 8= Oregon endangered
3= Federal candidate species 6= California threatened 9= Oregon threatened
10= Oregon sensitive sp.
* Suspected to occur in Lower Klamath NWR (Littleton 1993) and observed in Tule Lake NWR.
** Not occurring on Tule Lake NWR (Dr. David Mauser, personal communication, September 24, 1996).

Uplands. The peninsula area (south east corner of the Refuge) is isolated with no public use allowed. It contains upland habitat consisting primarily of cheatgrass, Idaho fescue, basin wildrye, rabbitbrush, and sagebrush. It has vertical cliff faces supporting nesting and roosting sites for barn owls, redtail hawks, American kestrels, prairie falcons and golden eagles. Other wildlife species found in the area include jackrabbits, cottontail rabbits, coyotes, and mule deer.

Berms. Berm vegetation consists primarily of weeds, predominantly bassia, kochia, perennial pepperweed, and Canada thistle. Grasses, composed primarily of wheatgrass species, exist to a limited extent. Consequently, it is used as hiding cover by pheasants, rabbits, and small rodents, and as nesting cover by pheasants, mallards, teal, gadwall, rabbits and small rodents. However, the area would have considerably more wildlife potential if the predominant weed species (bassia and kochia) were controlled and replaced by forbs and grasses.

Aquatic Habitats

The water resources of Lower Klamath and Tule Lake NWRs are directly linked to the agricultural and natural resource activities both on and off of the NWRs within the irrigated lands of the Klamath Basin (**Figure 1**).

3.2.2.1 Lower Klamath Wetlands

Historically, the Lower Klamath wetlands covered about 80,000 acres. In the early and mid-1900s, the Lower Klamath NWR and adjoining lands were cultivated. Using the water from the Tule Lake tunnel, approximately 25 percent of the original Lower Klamath wetlands, or about 20,000 acres, have been restored to wetland habitat. Current practice of the Service at the Lower Klamath NWR is to have both shallow- and deep-water wetlands with interspersed 'islands of vegetation.'

Open Water with Submersed Vegetation. This habitat typifies areas of the original lake, dominated by submersed plants. These deep-flooded units support dense beds of sago pondweed. During fall and spring, large concentrations of swans, widgeon, coots, and diving ducks are commonly seen in these areas. When dewatered in the spring, these units are heavily used by migrating shorebirds.

Seasonally Flooded Wetlands. This habitat type probably dominated much of the original Lower Klamath Lake system, and is critical to meeting the migratory waterfowl management goals of the Refuge. In addition, this habitat provides brood areas for early-nesting waterfowl species, such as mallards (Mauser et al. 1994) and pintails.

Permanently Flooded Wetlands. Permanent wetlands are crucial to meeting the Refuge goals of waterfowl production and habitat for fall and spring migrant waterfowl. These wetland units are characterized by year-round flooding and contain two major plant communities. The emergent community is composed of hardstem bulrush and cattail with minor inclusions of river bulrush. The emergent vegetation provides nesting substrate for many species of waterfowl, wading birds, and passerine birds, and acts as cover for resting waterfowl during periods of inclement weather.

3.2.2.2 Tule Lake Wetlands

Historically, Tule Lake wetlands fluctuated greatly from year to year depending on regional precipitation. At times the Tule Lake wetlands covered more than 100,000 acres (Abney 1964). Today the Tule Lake NWR is 39,116 acres, with 13,240 acres of remaining wetlands called Tule Lake sumps 1-A and 1-B (Mauser 1994). In addition, a network of drainage ditches provides aquatic habitat. Water from these ditches is pumped into the sumps.

Sump habitats are a combination of permanently flooded wetland and open water with submersed vegetation. Vegetative types consist primarily of emergent plants, such as hardstem bullrush and cattail, and submersed plants, such as sago pondweed. The area is used primarily as staging and roosting habitat for geese and ducks. The area also is used extensively by considerable numbers of eared and western grebes.

Plant and animal diversity on Tule Lake sumps is considerably lower than that on Lower Klamath NWR. This is due to degradation from siltation, stabilized water levels, and poor water quality (Mauser 1994). Wildlife and habitat values have declined including a reduction of deep water habitat in the sumps and accelerated aging of the wetlands (U.S. Fish and Wildlife Service 1994a).

A loss of 14 inches of water column was noted from the period 1959-1987, probably resulting from a combination of wind-blown silt from adjacent agricultural fields, both on and off of Tule Lake NWR, and water-borne deposits from the Lost River (U.S. Fish and Wildlife Service 1993).

The Tule Lake NWR wetland sumps receive their water from the Lost River and return flow irrigation. Water levels within the sumps have been stabilized to prevent flooding, contributing from the loss of wetland productivity and diversity. The Tule Lake Tunnel (a concrete-lined 6,000-foot tunnel) was constructed to help in the water level stabilization by conveying drainage from the Tule Lake sump to the Lower Klamath NWR. This transfer of water from Tule Lake to Lower Klamath Refuge has increased water volumes to the Lower Klamath Refuge wetlands.

Sump 1A provides year-round habitat for Lost River and shortnose sucker (**Figure 3**) and Sump 1B only provides habitat in the spring. (Mike Green, U.S. Bureau of Reclamation, Fisheries Biologist, personal communication, April 21, 1998).

3.2.2.3 Open Water

Historically, the Klamath and Lost River basins supported abundant fisheries resources (Cope 1879; Gilbert 1898; and Coots 1965). Suitable fishery habitat is dependent on water quantity of sufficient quality, delivered or available at a specific location(s), for fish species life-cycle requirements. Physical habitat requirements must provide for spawning, nursery, feeding, rearing, and refuge from predation or adverse environmental conditions. In addition, habitat corridors must be available to permit fish to move from one type of habitat to another. Fish movement is severely restricted by the fact that irrigation systems serve as the primary fish corridors and irrigation systems were not designed for fish passage.

Factors responsible for habitat degradation within Refuge boundaries are damming of rivers upstream, dredging and draining of wetlands, flow diversions, over-enrichment of water from fertilizers and other nutrients, high sediment loads, low dissolved oxygen concentrations, high

ammonia concentrations, high summer water temperatures, and invasion of non-native fish. These factors also contribute to a limited diversity within the phytoplanktonic and rooted aquatic plant communities, algal blooms, and reduced water quality.

3.3 WILDLIFE

3.3.1 Lower Klamath

Lower Klamath NWR is the most productive waterfowl refuge in the Klamath Basin NWR Complex and contains the bulk of the 411 species of wildlife occurring on the complex. Most species using the refuges are dependent on wetlands; waterfowl are the most conspicuous. During fall and spring migration, up to 3 million waterfowl rest and feed on these refuges. In 1997, over 140 million waterfowl use days[5] were recorded. Despite a general reduction in the number of waterfowl along the Pacific Flyway, waterfowl use of Lower Klamath has remained stable or increased over the past 15 years, while waterfowl use on Tule Lake NWR has decreased.

The Refuge is host to several species of marsh and water birds, raptors, and colonial nesting waterbirds. American white pelicans nesting in Sheepy Lake Unit 2 - Lower Klamath NWR (**Figure 2**) comprise one of the last two colonies remaining in California. (The other colony is at Clear Lake NWR.) White-faced ibis are also an important nesting species on the refuges. Ibis numbers have grown over the past several years to the present nesting population of approximately 3,800 pairs located in five colonies (U.S. Fish and Wildlife Service 1994).

[5] Any waterfowl using the Refuge for one day = 1 waterfowl use day.

Lower Klamath NWR, as well as Tule Lake NWR, have undergone substantial changes in biodiversity since the drainage of Lower Klamath Lake and associated water bodies in the early 1900s. For example, historically the refuges supported the following amphibians: tiger salamander, Pacific chorus frog, yellow-legged frog, spotted frog and the Western Toad (Bennet, et. Al, 1996). Boyer (1993) reported very low numbers of frogs on both refuges, with only two species now present, the Pacific chorus frog and the introduced bullfrog. Boyer's surveys showed that frog presence was primarily influenced by shoreline diversity, showing that loss of frogs may have been dependent on vegetation removal. The introduction of the bullfrog, a predator and competition of other amphibians, may have also been important.

3.3.2 Tule Lake NWR

Though very little information exists outside waterfowl inventories, Refuge managers believe that on Tule Lake NWR "a lack of habitat diversity has led to reduced wildlife species diversity" (U.S. Fish and Wildlife Service 1994). In 1998, the Refuge created four new wetlands (approximately 600 acres) to provide additional waterfowl habitat. Noxious weeds, lack of nesting cover, and lack of successional marshes have contributed to a decline in the numbers of breeding waterfowl attracted to the Tule Lake NWR. However, very little information exists that indicates present or past population trends or species diversity on NWR lands. A list of species at risk found in **Table 4** refers to threatened, endangered, candidate, and sensitive species as identified in the *Habitat Management Plan Lower Klamath National Wildlife Refuge* (U.S. Fish and Wildlife Service December 1994).

3.3.3 Pesticides on NWRs

The use of pesticides on Tule Lake and Lower Klamath NWRs has had an array of impacts to Refuge wildlife in the past. The most serious impacts have been from use of persistent organochlorine pesticides including DDT, endrin, toxaphene, and dieldrin beginning in 1946 and generally ending in the early 1980s. Use of these pesticides on Tule Lake and Lower Klamath NWRs resulted in high residues in fish and birds; egg-shell thinning and reproductive failure of certain species, particularly raptors and fish-eating birds; and, in many cases, the death of adult birds; and death of fish by toxaphene (Pillmore 1961; Keith 1966a and b; Keith et al. 1967; Godsil and Johnson 1968; Stickel et al. 1979; Frenzel 1984; Boellstorff et al. 1985; Fitzner et al. 1988). For example, Keith (1966a) recorded mortalities of fish-eating birds in Tule and Lower Klamath NWRs from 1960-1964, including over 1100 dead birds of 10 species. Another documented source of large-scale waterfowl mortalities on Refuge leased lands was the use of strychnine and zinc phosphide to control rodents.

However, organochlorine pesticide residues declined to nondetectable or trace levels in birds and fish in the Klamath Basin, including Refuge populations, in the 1980s (Frenzel 1984; Ohlendorf and Miller

1984; Mora et al. 1987) and are currently below detection limits (Maurer, U.S. Fish and Wildlife Service, unpublished; Snyder-Conn, U.S. Fish and Wildlife Service, unpublished). Persistent organochlorine pesticides and/or rodenticides on leased lands are not currently allowed.

The impacts from pesticide use, especially historic uses from the 1940s through the 1970s, as well as other land use on wildlife are less well understood. Studies by Grove (1995) indicate that the primary cause for the decline in ring-necked pheasants on Tule Lake NWR is loss of suitable vegetation cover, in combination with heavy snowfalls in the winter of 1992-93, not pesticides. However, Grove also demonstrated the impacts from two pesticides, methamidophos (Monitor) on potatoes and disulfoton (Disyston), on grains to Refuge fauna. For example, 28 of 41 adult pheasants in/near potato fields sprayed with Monitor (methamidophos) at Tule Lake during 1990-92 showed brain acetylcholinesterase (AChE) inhibition of 19-62 percent, and 33 of 53 juveniles had inhibition of 21-92 percent. AChE inhibition of 50 percent or greater is typically regarded as a definitive cause of death in birds (Linda Glaser, National Wildlife Health Laboratory, U.S. Geological Survey, personal communication,, September 14, 1998). Also, in

1990, two juvenile pheasants found dead in potato fields sprayed two days earlier had 90-92 percent inhibition, with 16 and 3.9 ppm methamidophos in the upper gastrointestinal tract contents. AChE inhibition of 22-57 percent also occurred in birds following disulfoton aerial spraying. Similar to the results with pheasants, Grove also demonstrated high rates of enzyme inhibition in the case of Savannah sparrows in this study, one of the only bird species commonly found in small numbers in all croplands during the spray season.

To date, acetylcholinesterase inhibition has been associated primarily with two classes of pesticides, organophosphates and carbamates, both widely used on leased lands. Organophosphates, such as Monitor and Disyston, appear to cause irreversible or slowly reversible effects, whereas the effects of sublethal carbamate doses are reversible in a matter of hours, if the wildlife do not incur indirect mortality from weather, predators, or as road kills while subchronically affected. The use of Monitor has been banned from the refuges by the Regional PUP Committee, but one application per season of Disyston is currently permitted for the control of brown mites or the Russian wheat aphid in grains. Since the earlier findings of Grove, numerous restrictions have been added, including 300-foot buffer zones from all Refuge waters, and the requirement to haze fields to be treated prior to spraying Disyston. An array of carbamate pesticides such as Sevin (carbaryl) are also currently used on leased lands with similar buffer restrictions. Although two full-time pesticide monitors surveying leased lands documented no bird mortalities that could be related to pesticide applications in 1998, the potential of chronic effects remains. For example, symptoms of acetylcholinesterase inhibition may include lethargy, nest inattentiveness or abandonment, poor motor control, nausea, dizziness, convulsions, and death. Also, although no recent bird deaths have been demonstrated from current pesticide or other agricultural practices on Tule Lake leased lands, detection of dead and dying birds is extremely difficult

and routine monitoring for such bird deaths has only recently been initiated on the NWRs. The potential for chronic effects on Refuge wildlife population numbers and productivity remains unassessed.

No mortalities have been documented from current-generation pesticides in waterfowl, fish-eating birds, or raptors on the refuges. Nor have relationships been demonstrated between population sizes of waterbird or upland birds and pesticide use patterns on leased lands. For example, pheasant population sizes would likely continue to fluctuate over the short and long terms subject to weather conditions and improvements to upland cover habitat rather than as a result of direct pesticide exposure, as demonstrated by Grove (1995). Also, waterfowl numbers have risen dramatically where new wetlands (sump rotation pilot sites) have been created, despite the use of pesticides adjacent to these wetlands (Dave Mauser, U.S. Fish and Wildlife Service, Wildlife Biologist, personal communication, September 28, 1998).

Indirect effects of pesticides probably are occurring. For example, a consequence of herbicide use on berms was loss of cover habitat on the berms, followed by the renesting of pheasants on Tule Lake farm crops and in additional upland habitat in Lower Klamath NWR. Subsequently,

the nest season (first nest incubated to last nest hatched) for pheasants was longer and the number of eggs was smaller at Tule Lake NWR compared to Lower Klamath NWR for similar nest completion dates in 1991 (Grove 1995). In addition, Grove also found a 48.5 percent decline in insects between prespray and 2-days post spray, but a 203.2 percent mean increase in insects at 20 days after spray events, suggesting a possible loss of beneficial insects and pest insects, followed by an increase in certain (unspecified) insect populations.

Laboratory assessments of frog development using Tule Lake water and irrigation drainwater from leased land areas demonstrated a wide range of developmental deformities and toxicity to African frogs (Bennett 1994; Bennett et al. 1996, Boyer 1993). It is unknown whether ammonia, pesticides, or the contaminants entering the drainwaters from on or off Refuge played a role in these findings. Although amphibians are particularly sensitive to pesticides, and pesticides and ammonia have been linked to deformities in research elsewhere, the above-mentioned researchers were unable to establish a link between the deformities and pesticide concentrations in these waters.

Pesticide-related wildlife mortality has occurred in the Klamath Basin (**Table 5)**. With the exception of methamidophos, the pesticides shown in the table are not now or were never believed to be used on the NWRs. It is important to note that no pesticide-related wildlife deaths have been documented on the NWRs since 1990. Both spring and fall waterfowl migrations occur outside of the growing season when most pesticides are applied.

Pesticides used on the NWRs must first go through a formal approval process, called the Pesticide Use Proposal (PUP) process (**Chapter 1, 1.2.7 Department of the Interior Policies**).

Referring to pesticide use nationwide, Benbrook (1996) stated that:

> "Pesticide risks today are at least as serious as they were in the early 1970's. Progress in developing safer pesticide products coupled with adoption of IPM systems and greater attention to the need for safety precautions have lowered the per treatment risk for individual pesticide products in many, but not all circumstances." He went on to say "the capacity to monitor pesticide risk trends is also critical in judging when and where IPM and regulation have done their job and reduced pest management system risks comfortably below levels society is willing to accept. That day remains in the future.
>
> Part of the complexity of risk assessment is the difficulty of establishing cause-effect relationships between pesticide exposure and health effects, even when individual pieces of the causal processes are well documented. Like it or not, our knowledge of the possible adverse effects of current pesticide use patterns on health and the environment is limited and superficial, and it will remain so for a long time."

3.3.4 Threatened and Endangered Species

In accordance with the Endangered Species Act of 1973, there are four Federally listed threatened or endangered wildlife species on Lower Klamath and Tule Lake refuges: the bald eagle (*Haliaeetus leucocephalus*), peregrine falcon *(Falco peregrinus anatum)*, Lost River sucker (*Deltistes luxatus*), and shortnose sucker (*Chamistes brevirostris*).

3.3.4.1 Bald Eagles and Peregrine Falcons

Important foraging habitat for bald eagles is found in both Lower Klamath and Tule Lake NWRs (Keister et al. 1987). Additional information on Klamath Basin population can be found in a recent biological opinion on the use of pesticides and fertilizers on the lease lands (Portland State Office Reference 1-7-95-F-26, U.S. Fish and Wildlife Service, 1995) and is summarized here.

The Klamath Basin bald eagle population consists of breeding adult pairs, nonbreeding immature and subadult birds, and migratory adults breeding in other areas. Important foraging areas include the Upper and Lower Klamath lakes and Tule Lake (Keister et al. 1987). Eagles are far more prevalent in the Lower Klamath NWR than Tule Lake NWR while falcons are extremely rare in both refuges (Dave Mauser, pers. comm., June 2, 1998). Large numbers of nonbreeding individuals and adults from throughout the Pacific Northwest migrate into the basin during the late fall and winter months, with peak

density in January and February. They begin to disperse in late March and April, depending on the weather and food conditions.

Wintering eagles feed primarily on crippled or disease-weakened waterfowl. Flood-irrigation in the Klamath Basin during the late winter months and spring provides opportunities for bald eagles to feed on displaced voles (Opp 1980; Keister 1981).

Breeding bald eagles tend to be nonmigratory as long as sufficient food is available. Adult pairs begin egg-laying in March-April and eggs hatch in about 5 weeks, with eaglets remaining on the nest for 10 to 12 weeks. Waterfowl and rodents serve as the primary sources of food. In addition, bald eagles may forage for fish in adjacent aquatic habitat. Detailed accounts of the general status and life history of the bald eagle can be found in the *Pacific States Bald Eagle Recovery Plan* (U.S. Fish and Wildlife Service 1986.)

The 22,000 acres of leased agricultural lands also serve as occasional foraging habitat for peregrine falcons. (This species is not discussed again because no adverse impacts on peregrines are expected due to its limited occurrence on NWR lands.)

3.3.4.2 Lost River and Shortnose Suckers

Lost River suckers are endemic to Upper Klamath Lake and its tributaries, the Lost River system, Tule Lake, the former Lower Klamath Lake, and Sheepy Lake (Gilbert 1898; Coots 1965; Williams et al. 1985; Stine 1992; Moyle 1976). Their present distribution includes Upper Klamath Lake and its tributaries, Clear Lake Reservoir and its tributaries, Tule Lake, the Lost River, and the Upper Klamath River to the Copco Reservoir (Buettner and Scoppetone 1990).

Shortnose suckers historically occurred in a more limited area, primarily Upper Klamath Lake and its tributaries, the Lost River system, and in Clear Lake (Miller and Smith 1981; Williams et al. 1985). Currently, the shortnose sucker's distribution resembles that of the Lost River sucker, except that shortnose suckers occur at Iron Gate Reservoir in northern California and in the Gerber Reservoir system in southeast Oregon as well (Miller and Smith 1981; Williams et al. 1985).

Both species are lake residents and spawn in gravel-to-cobble substrates of large, cold-water rivers, creeks, or springs associated with lake habitat. After hatching in the spring (March-May), larval suckers drift downstream to lake habitats. Larvae and juveniles of these species are dependent on river and lake shorelines with vegetation for rearing (Klamath Tribe 1991). Larvae and juveniles of the two species also share similar tolerance limits for pH, water temperature, and ammonia (Monda and Saiki 1994). As subadults and adults, Lost River suckers appear to stay closer to the bottom of the water column, while shortnose suckers forage in the mid-water column. Neither species is found near the surface. Their diets overlap widely and include detritus, zooplankton, algae, and aquatic insects

TABLE 5. Pesticide-Related Avian Mortality in the Klamath Basin Region[1]

Date	Source	Wildlife Mortality	Number	Comment
ON REFUGE				
4/15/84	U.S. Fish and Wildlife Service - Klamath National Wildlife Refuge Complex and National Wildlife Health Laboratory, Madison, WI.	White-fronted geese, snow geese	~ 40 geese found dead in field just north of Lower Sump, Tule Lake NWR.	National Wildlife Health Laboratory confirmed zinc phosphide poisoning from the ingestion of poisoned oats. Zinc phosphide is used as an rodenticide.
Summer 1990	Grove, R.A. 1995	Ring-necked pheasants	2 pheasant killed via direct exposure to methamidophos (trade name Monitor) in potato fields, Tule Lake NWR	15% of adult pheasants collected from potato fields had > 55% cholinesterase inhibition.
OFF REFUGE				
1/24/86	U.S. Fish and Wildlife Service, National Wildlife Health Laboratory, Madison, WI.	Bald eagle	1 bald eagle was found sick (Klamath Wildlife Area, Klamath County, Oregon), taken to veterinarian and died same day.	Reported diagnosis as "Suspect lead poisoning. Since lead levels in every tissue analyzed were not extremely elevated, another contributing factor such as organochlorine toxicosis was a consideration."
11/4/86	U.S. Environmental Protection Agency, Washington, D.C. , Ecological Incident System Report, dated 5/11/94 and U.S. Fish and Wildlife Service, National Wildlife Health Laboratory, Madison, WI.	Mallards, pintails, ducks	Approximately 50 ducks-- adjacent to Lower Klamath NWR boundary.	Ingested pesticide phorate and most likely died from phorate poisoning
3/3/87	U.S. Geological Survey, National Wildlife Health Center, Madison, WI	Bald eagle	1 bald eagle, Siskiyou County	Report diagnosis - famphur poisoning
4/1/87	U.S. Geological Survey, National Wildlife Health Center, Madison, WI	Bald eagle	1 bald eagle, Modoc County	Report diagnosis - strychnine poisoning
February/ March 1992	U.S. Geological Survey-Biological Resources Division, National Wildlife Health Center, Madison, WI	Bald eagles	5 bald eagles found dead in vicinity of Bear Valley near Klamath Falls, OR.	Analysis of eagle crop samples identified the pesticide turbofos in 4 of 5 eagles, the Patuxent Wildlife Research Center (Laurel, MD).

Source: Documented pesticide mortality, Klamath Basin Refuges Complex. Prepared by Scott M. Stenquist, Regional Integrated Pest and Weed Management Coordinator, U.S. Fish and Wildlife Service, 9/15/95 and updated 5/7/98

[1] None of the cited pesticides are approved for use on the Lower Klamath or Tule Lake NWRs.

(Buettner and Scoppetone 1990). Both are also long-lived, with lifespans of from 33 to 44 years documented for shortnose and Lost River species, respectively (Scoppettone 1988). Sexual maturity is reached after 6 years or more (Buettner and Scoppetone 1990).

Suckers appear to be strongly influenced by poor water quality induced by high water temperatures, nutrient enrichment, algal blooms and die-offs, low dissolved oxygen, high pH, and possibly high ammonia (Kann and Smith 1993; Perkins 1997).

Adult sucker habitat at Tule Lake NWR consists primarily of sump 1A and the English channel, and to a lesser extent, Sump 1B. During the summer, suckers are concentrated in the central portion of Sump 1A; during other parts of the year, suckers disperse to other portions of the sumps.

On Tule Lake sumps 1A and 1B, the current population of Lost River and shortnose suckers remains at low levels due to a loss of deep water habitat (on Refuge) and spawning habitat (off Refuge). Approximately 105 adult Lost River suckers and 160 adult shortnose suckers were living in Tule Lake in 1993 (Scoppetone et al. 1995).

Recruitment to the population occurs mainly from the Klamath Project irrigation canals and the Lost River, although spawning habitat below Anderson-Rose Dam is limited. The sucker population is not expected to increase in the future, but will probably decrease due to a decline of deep water habitat from sedimentation inputs (Mark Buettner, U.S. Bureau of Reclamation, Fishery Biologist, personal communication, September 22, 1998).

Due to the shallowness of Tule Lake, suckers appear to be at a greater risk from prolonged ice coverage and anoxic (low oxygen) conditions (Mike Green, pers. comm., April 21, 1998). In 1993, after prolonged ice cover, Service personnel found 5 dead suckers and numerous chubs (Jim Hainline, U.S. Fish and Wildlife Service, Wildlife Biologist, personal communication, September 22, 1998). Since that time, no sucker die-offs have been reported in Tule Lake.

Scoppettone et al. (1995) found suckers in Tule Lake to be in better condition than suckers from Clear Lake Reservoir. Suckers from Tule Lake also had no external parasites, as compared to Clear Lake Reservoir suckers. Similar findings have been made regarding blue chubs in 1998 (Snyder-Conn et al., in prep.).

Additional general information is available in the recovery plan for these species (U.S. Fish and Wildlife Service 1993) and in the biological opinion referenced above.

3.4 WATER

3.4.1 Water Quality

During winter and early spring, water quality conditions are generally good in the refuges, because most inflow is from localized runoff. However during periods of protracted ice cover, low or lethal dissolved oxygen conditions sometimes occur (Mike Green, Reclamation, unpublished). In contrast, water quality during the remainder of the year is generally poor, with frequent exceedances of Federal and state water quality criteria for the protection of freshwater aquatic life. Criteria which are frequently exceeded include: water temperature, pH, dissolved oxygen, and un-ionized ammonia (Oregon Department of Environmental Quality data presented during meetings of the Total Daily Maximum Loading Committee, 1996-1998 for the Upper Klamath River and Lost River subbasins). The poor water quality in both Tule Lake and Lower Klamath NWRs originates from the source waters of Upper Klamath Lake and its tributaries, which are naturally enriched in nitrogen and phosphorus. This water has been further degraded by nutrients and other chemicals from nonpoint sources surrounding these waters, including flood irrigation and cattle use of pasture lands and urban, logging, and agricultural land disturbances. Canal and drain maintenance activities are additional sources of sediments and nutrients, as are point sources, including seven sewage treatment plants, one 40-acre log-rafting operation, and at least nine confined feeding operations (dairies) upstream of the refuges. In addition, water quality degradation is associated with irrigation drain waters within and upstream of the NWRs, including the Lost River and Upper Klamath Lake (Sorenson and Schwartzbach 1991; MacCoy 1994; Kaffka et al. 1995; Winchester et al. 1995).

The specific contributions of Refuge practices to poor water quality have not been fully assessed and have been subject to conflicting interpretations. Based on a study of subsurface drainwater quality and estimated crop intake levels, Kaffka et al. (1995) concluded that nitrogen and phosphorous uptake was balanced by crop removal and fertilizer practices on leased lands and did not play a role in the high levels of nitrogen and phosphorous observed in Refuge waters. However, detailed studies of surface water quality by Dileanis et al. (1996) in the Tule Lake area in 1991 and 1992 revealed that dissolved organic nitrogen, total inorganic nitrogen (nitrate + nitrite + ammonia), and phosphorus (mostly as bioavailable orthophosphate) are generally highest in certain leased-land drains and in Tule Lake. The presence of toxic levels of un-ionized ammonia is related to the total ammonia concentration, locally high pH and high water temperature. Dileanis et al. (1996) concluded that several water quality factors, including high pH, low dissolved oxygen, and un-ionized ammonia, were hazards to aquatic life in various Tulelake irrigation return waters and in different Lower Klamath Lake sites. Comparisons to sites at Upper Klamath Lake and upstream of Tule Lake Refuge, indicate a source of additional inorganic nitrogen within the irrigated leased lands. However, sites upstream of the Refuge also contained high concentrations of organic nitrogen, adding to the nitrogen burden.

Bennett (1994) documented the upper limit of temperature tolerance for the fish species found in the refuges. Temperatures exceeding these limits have been observed in the 1994 study by MacCoy (1994) and in 1998 studies by Snyder-Conn and others (unpublished). Relatively high water (above 21° C) temperatures have been documented upstream of the NWRs indicating that factors other than agricultural (shallow lakes, ambient air temperature) are probably primarily responsible for determining water temperature. In fact, data collected from agricultural drains versus canals suggests that the irrigation process may actually result in reducing water temperatures (Mike Green, pers. comm., October 7, 1998). On the other hand, increased sedimentation, associated with wind or water erosion from land disturbance, including certain agricultural practices such as tillage and burning, may result in shallower water depths. Such a pattern in the Tule Lake sumps has undoubtedly contributed to increased sump water temperatures.

Two water quality parameters, conductivity and sulfate concentrations, do tend to be uniquely high in Tule Lake. Conductivity, a measure of salt content, is high because irrigation waters are recycled an estimated five times in the Tule Lake sumps (Godsil and Johnson, 1968). This results in an evaporative concentration of salts with each recycle, with summer conductivities sometimes exceeding 1000 FS/cm (MacCoy 1994). Further evaporation in permanent wetlands in Lower Klamath NWR can result in additional salt concentrations to undesirable levels (Mayer 1997). However, there has been no long-term trend in conductivity based on the available data (Kaffka et al. 1995), and salt and alkali concentrations at Lower Klamath NWR have tended to decrease as soils naturally enriched in salts have been flushed (Bob Davis, U.S. Bureau of Reclamation, Natural Resource Specialist, personal communication, September 10, 1998).

Numerous pesticide monitoring studies have been carried out by the Agencies as well as the North Coast Regional Water Quality Board and University of Washington scientists at Tule Lake sumps, canals and drains, but no comprehensive studies have been performed at Lower Klamath NWR. Therefore, pesticide levels within water on the NWRs can generally be described based on the former studies. However, these studies may not have captured worse-case concentrations. All of the recent studies (since 1990) indicate only ultratrace to nondetectable concentrations of pesticides occurring in the Tule Lake sumps. For example, during intensive monitoring (in 1991 and 1992) conducted cooperatively by the Service and the U.S. Geological Survey, Bennett (1994) noted the drainwater system contained low concentrations of nine herbicides and seven insecticides during the agricultural season. She also observed pesticide drift from aerial applications of methamidophos [a pesticide no longer allowed on the refuges] into Tule Lake drains and canals adjacent to fields in 3 of 12 application spray events monitored, with over-water deposits of up to 23.2 percent of the crop target application rate. However, none of the methamidophos concentrations or other pesticide concentrations detected were at concentrations known to result in either acute or chronic toxicity to fish or other aquatic life.

There is also considerable evidence that pesticide concentrations have generally declined in recent years. For example, earlier studies of pesticide concentrations in water, suspended matter, sediments, plants, invertebrates, fish, and birds of the Tule Lake NWR revealed numerous high concentrations of organochlorine pesticide residues (such as DDD, DDE, DDT) in addition to occasional concentrations of aldrin, BHC, heptachlor, and heptachlor epoxide (Pillmore 1961; Keith 1966a; Keith et al. 1967; Godsil and Johnson 1968; Federal Water Quality Administration 1970). However, more recent studies (Anderson et al. 1984; Boellstorff et al. 1985; Mora et al. 1987; Sorenson and Schwarzbach 1991; Dileanis et al. 1996; Snyder-Conn 1997, 1998; Maurer in prep.) have generally demonstrated declines, showing pesticides concentrations either below known chronic toxicity levels or at nondetectable concentrations. Reduction of pesticide contamination in aquatic areas may be attributable to the nonpersistence of current-generation pesticides, pesticide-free buffer zones, and drift retardants.

3.5 SOIL RESOURCES

Soils on the Tule Lake NWR are some of the most productive agricultural soils in the Basin because they have 5 to 15 percent organic matter, are well drained, and deep. These deep muck soils were formed when the land was covered by water. Much of this irreplaceable soil is currently subject to wind erosion. Lease-land soils on Lower Klamath NWR are also considered productive, but not as good as those on Tule Lake.

Grain stubble and alfalfa reduce wind-blown erosion on two-thirds of the cropland acreage on Tule Lake NWR. The remaining one-third of croplands, row crop acreage allowed under the Kuchel Act, was often left bare during the winter until 1998. A new lease stipulation is now required and states "A cover crop shall be established by the following spring on all harvested row crop acreage by planting a fall/winter sprouting cover crop (grasses, small grains, legumes or other species) known to be adapted to the Klamath Basin ..." Most lessees apply a nitrogen-based fertilizer to the soil each year. Fertilizer practices are dependent on the crop grown and the cropping history of the leased land.

3.6 AIR QUALITY

The Basin enjoys relatively clear air on a year-round basis. Exceptions to this occur during winter/spring months when strong winds create dust storms in the Basin. At times, these dust storms are so intense that visibility is limited to less than one-quarter of a mile. Also, spring and fall burning of stubble fields creates localized air quality problems. During pesticide applications, localized air quality could be degraded with high inhalation toxicities, high volatility, or strong odors.

Particulate matter (PM) occasionally exceeds State/County and Federal ambient air quality criteria in the winter, mostly as a result from soot from wood burning. Agricultural burning would contribute to additional particulates in to the air.

3.7 SOCIOECONOMICS

3.7.1 Socioeconomics of the Region

Siskiyou and Modoc counties in northern California, and Klamath County in Oregon comprise the tri-county area influenced most greatly by activities on the Lower Klamath and Tule Lake NWRs. Klamath Falls, Oregon is the area's economic center, while Klamath County contained over half of the tri-county area's 114,000 residents in 1994 (Laughland and Caudill 1997).

Employment totaled 54,151 in 1994, with 60 percent of the total workforce employed by services, government, and retail trade. Local per capita income averaged $16,375 in 1994, about $5,000 below the national average for the U.S. for the same year (U.S. Bureau of Economic Analysis 1997). Agriculture, a basic industry, is important to the local economy. Aside from agricultural producers, the industry includes crop scouting businesses and agricultural suppliers. Agriculture accounted for 7.5 and 6.4 percent of employment in Klamath and Siskiyou counties, respectively, and 16.2 percent in Modoc County.

There were 2,451 agricultural operators in the tri-county region in 1995, and 57 leaseholders on the refuges in 1996. Assuming the number of agricultural operators remained stable, leased land growers represented 2 percent of the tri-county total in 1996.

While Klamath Falls is the economic hub of the tri-county area, smaller towns are also affected by visitation and farming on the refuges. Total expenditures were estimated at $700,400 for visitor recreation at Tule Lake NWR alone in Fiscal Year (FY) 1995. It is estimated that for every $1.00 spent at the Refuge, $1.50 in revenues is generated by recreational visitation (Laughland and Caudill 1997).

3.7.2 Current Economic Information for Leased Lands

3.7.2.1 Summary of Leased-Land Acreages and Revenues, and County Revenues

In 1996, 57 lessees paid to farm nearly 22,000 acres on the NWR leased lands, and average lease payments were $86 per acre. Lands leased for agricultural purposes on the Lower Klamath and Tule Lake NWRs are divided into 210 lease lots (as of 1996) shown on **figures 2 and 3**. Annual lease revenues have ranged from a low of $1.2 million (in 1980) to a high of $2.4 million (in 1984) (**Table 6**).

In 1996, $1.9 million in lease land fees were collected from the leased lands. This money was returned to the U.S. Treasury and was not used to fund the leased-land program. However, the Kuchel Act directs how the leased-land revenues will influence the Payment-In-Lieu-of-Tax (PILT) the federal

government pays Siskiyou, Modoc, and Klamath counties. The Kuchel Act provides a complicated formula to determine whether the tax limitation imposed by the Act, or the counties' share of the lease land revenue is greater. In 1996, Modoc County received $32,994, while Siskiyou and Klamath counties received $166,773 and $10,381 in leased-land revenues, respectively.

Total county budgets for Modoc, Siskiyou, and Klamath counties were $17.7, $57.2, and $139.8 million, respectively, in 1996. Therefore, leased-land revenue payments represented 0.18, 0.29, and 0.007 percent of affected county budgets, respectively.

Tulelake Irrigation District (TID) also receives payment equal to 10 percent of net leased-land revenues under the Kuchel Act. In 1996, this amounted to a $128,000 payment; or 8 percent of TID's $1.6 million budget for 1996 (Earl Danosky, Tulelake Irrigation District, personal communication, April 13, 1998).

Grower payments are made to the Reclamation office in Klamath Falls. Upon receipt of payments, Reclamation transfers lease revenues to the U.S. Treasury Department in Washington, DC. Thereafter, lease revenues are treated as general revenues of the federal government. The federal budget allocations from the Klamath Basin operations of Reclamation or the Service *are not* statutorily linked to agricultural lease revenues from within the wildlife refuges; none of the Lower Klamath or Tule Lake agricultural lease revenues are directly used to fund Bureau or Service operations in the Basin. The Agencies are funded under congressional and agency budgetary processes.

Lease bid rates are affected by the productivity of individual parcels, the mix of crops permitted to be grown on the land, and anticipated market prices for crops. Lease revenues tend to be greatest from parcels where row cropping is allowed. Growers will bid more for highly productive lands which are free of detrimental insects, crop diseases, and weeds. Market prices for farm commodities fluctuate widely, and also influence grower willingness to pay more or less for leased lands. Favorable market prices prompted the ambitious bidding for leased lands in the early 1980s. Lower commodity prices in the 1990s resulted in less federal revenues generated by the leased lands. Not all lands available for leasing are bid on by area growers, particularly in times of unfavorable market conditions.

The average lease rate for the Refuge lands is generally lower than that for nearby privately leased farmland (Laura Allen, Reclamation, personal communication, December 3, 1996). Conversations with individuals familiar with the Refuge leasing program suggest that this difference in lease rates likely has two primary causes: 1) crop types are restricted on Refuge lands (specifically seed potatoes cannot be grown), and 2) a restricted list of approved pesticides on Refuge lands increases the risk of reduced yields or crop quality (Laura Allen, U.S. Bureau of Reclamation, Environmental Specialist, personal communication, December 3, 1996).

Figure 2. Lower Klamath NWR, Area K Leased Lands

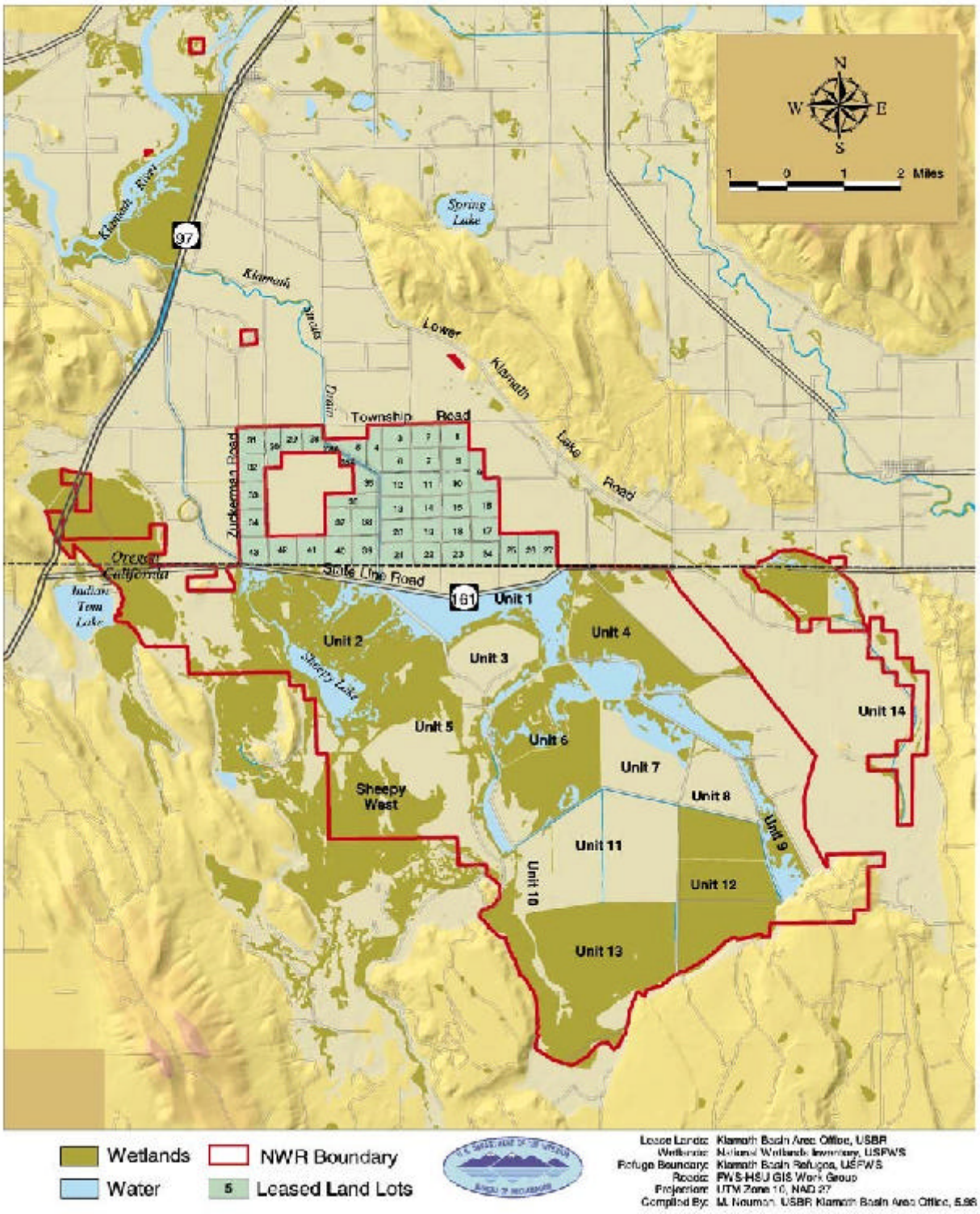

Figure 3. Tule Lake NWR, Leased Lands

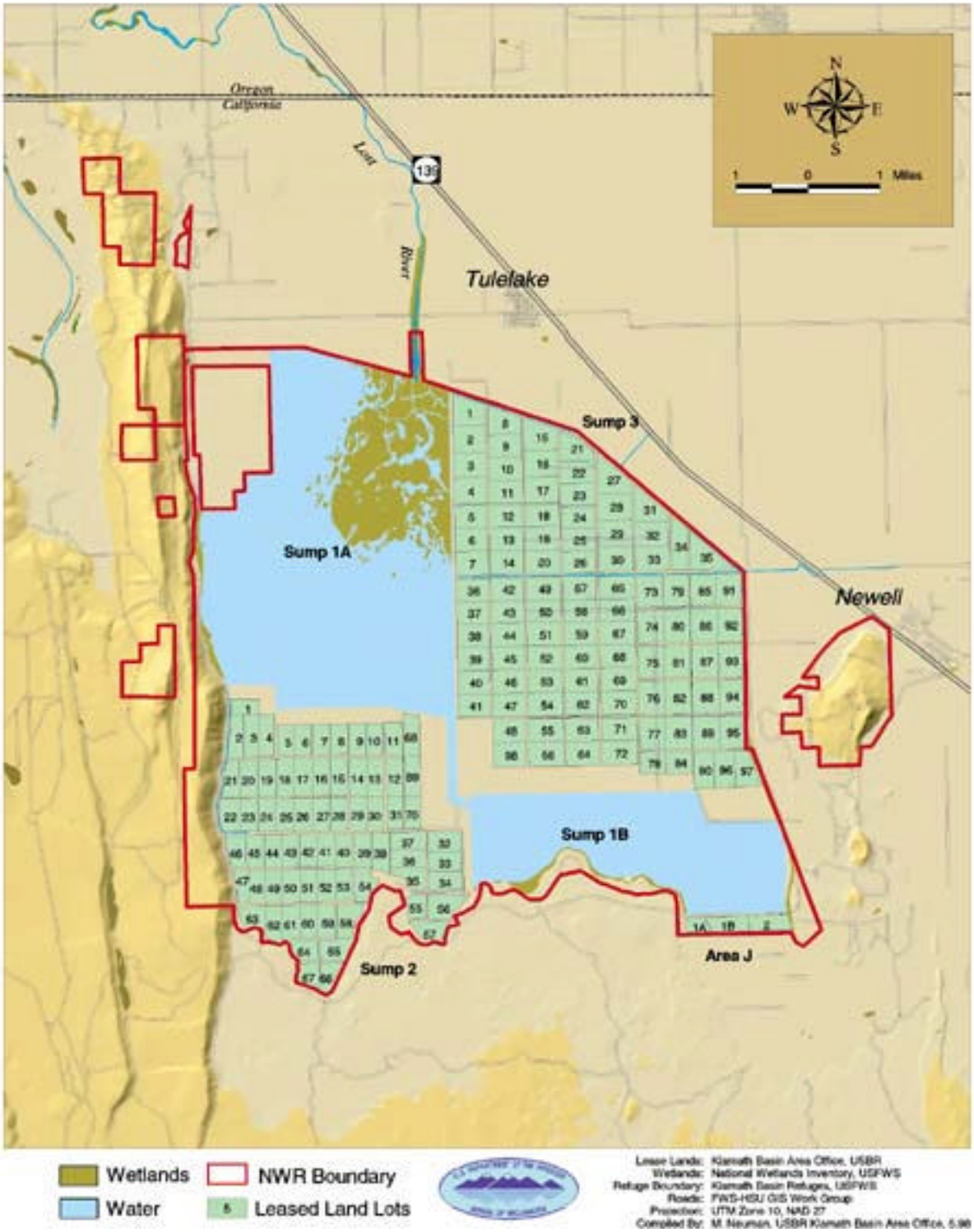

TABLE 6.
Summary of Tule Lake and Lower
Klamath Agricultural Leased Land Acreages and Revenues
1980-1996
(In nominal $/unadjusted for inflation)

Year	Lease Revenues in $	Acres Leased	Average Lease Payment in $ Per Acre
1980	$1,248,704	22,962	$54
1981	2,443,844	21,873	112
1982	2,005,441	22,040	91
1983	2,394,932	21,912	109
1984	2,414,613	21,919	110
1985	2,488,155	22,039	113
1986	2,114,371	21,754	97
1987	1,713,853	21,315	80
1988	1,538,880	21,436	72
1989	1,576,778	21,537	73
1990	1,673,123	21,179	79
1991	1,791,951	21,062	85
1992	1,492,735	21,427	70
1993	1,756,115	21,576	81
1994	1,737,093	21,576	81
1995	1,740,085	21,264	82
1996	1,884,026	21,839	86

As stated in the Kuchel Act, leased lands must provide for growing of grains, forage, and soil building crops on the NWRs. However, no more than 25 percent of the leased land may be planted in row crops. The majority of leased-land acreage is devoted to grain production. In 1996, about 70 percent (15,441 acres) of active farmland was devoted to grains, 17 percent (3,830 acres) to row crops, and 12 percent (2,712 acres) to hay (including alfalfa). About the same amount of land supports grains crops in 1996 as in 1980 (**Table 7**). Over the 1980-1996 period, row crop acreage has increased, whereas land used for hay production has decreased by 1,500 acres.

3.7.2.2 Crop Yields and Values

In 1995, Lower Klamath and Tule Lake leases were estimated to reap $14.5 million in crop value for their leaseholders. This estimate is derived using average yield estimates for the Tulelake Irrigation District (TID) for the California leased lands, and Klamath County for the Oregon

leased lands. Gross sales from all tri-county operators in that year was $229 million (U.S. Bureau of Economic Analysis 1997). In 1995, grain crops accounted for 36 percent, row crops 58 percent, and hay 6 percent of the production value of Refuge farmland.

Row crops typically yield much higher dollar value per acre than grain or hay. In 1995, production values for lands in row crops averaged $2,180 per acre; land in grains generated an average production value of $525 per acre; and lands in hay provided an average value $365 an acre. **Table 8** provides comparisons of average dollar returns per acre for individual crops grown on the two refuges in 1995. Onions were the second most value-intensive crop ($1,625/acre).

Sugarbeets generated an average of $878 per acre in gross income. Production values for grains were $342 per acre for barley, $453 for wheat, and $245 for oats. The market value for alfalfa hay ($570/acre) was considerably higher than the price received for grass hay ($159/acre). By a substantial margin, potatoes generated the highest dollar value per acre ($2,660/acre).

Importantly, row crop production also involves higher expenditures for leases, labor, equipment and machinery, seed, fertilizer, and pest and weed control. In years with high productivity and favorable prices, row crop leases are likely to achieve greater net profits than leases devoted to grains and hay. However, because of the higher costs of farming inputs, the risk of major financial losses also is much greater for row crop growers. The potential for profit and risk of financial loss are major motivations for intensive pest control by row crop farmers. Information on the net profits of individual farming operations on leased lands is proprietary, and unavailable for this analysis.

TABLE 7.
Acres Planted by Crop Type on the Refuge Leased Lands
1980-1996

Year	Barley	Wheat	Oats	Rye	Sugar-Beets	Onions	Potatoes	Pea Seed	Alfalfa	Other Hay
	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres
1980	10,435	646	3,697	3	0	0	2,291	0	371	3,529
1981	11,076	720	4,564	0	0	329	2,453	0	431	3,032
1982	11,236	533	4,972	0	0	441	2,603	0	492	2,503
1983	10,520	962	5,311	0	0	435	2,652	0	574	2,365
1984	10,502	750	5,147	0	0	134	2,945	0	660	2,311
1985	9,963	1,044	5,189	0	0	224	3,262	0	803	2,194
1986	9,238	1,431	3,168	0	0	647	2,788	0	704	2,217
1987	8,800	1,329	3,966	0	0	410	3,071	0	491	2,181
1988	10,704	835	3,956	0	0	573	2,436	0	401	2,075
1989	9,027	1,939	5,768	0	0	613	2,727	0	598	1,948
1990	9,941	1,942	4,429	0	0	614	3,037	53	666	1,940
1991	10,096	1,681	4,156	0	265	947	2,224	0	765	2,340
1992	11,491	1,930	2,948	0	456	160	2,226	0	707	1,940
1993	9,456	1,717	3,155	0	607	318	2,919	0	512	2,010
1994	9,798	1,797	2,927	0	699	134	2,893	102	749	1,819
1995	10,623	1,757	3,691	0	658	318	2,909	0	712	1,802
1996	10,277	2,054	3,110	0	818	387	2,625	0	906	1,806

TABLE 8.
Average Dollar Returns Per Acre by Crop Type
1980-1996

Crop	Average $ Value Per Acre
Barley	$ 342
Wheat	453
Oats	245
Sugarbeets	878
Onions	1,625
Potatoes	2,660
Alfalfa	570
Other Hay	159

3.7.2.3 Current Agricultural Practices

Crops currently grown on the refuges include small grains (barley, oats, and wheat), potatoes, grass hay, alfalfa, sugarbeets, onions, and organic horseradish. In 1998, organic horseradish was added as an experimental crop. If successful, it is hoped that this lease could be certified as organic by the year 2001. Only grain crops are grown in the Lower Klamath NWR; no row crops are produced. Grain crops are grown on the Tule Lake NWR in rotation with row crops. Crop data for 1995 have been used for this analysis.

Small Grains. Small grains are planted on roughly 100,000 acres in Klamath Basin. Barley is the predominant crop, making up roughly 80 percent of small grain acreage, with spring wheat and oats a distant second and third, respectively. A similar situation exists on the leased lands, where 10,200 acres of barley, 3,400 acres of oats, and 1,700 acres of wheat are grown. Much of this grain acreage is on the Lower Klamath Refuge.

Aside from the climate, the main constraints to grain production are the Russian wheat aphid, the wheat stem maggot, common root rot (a fungal disease), and the barley root-knot nematode. For the past 2 years, brown mite has been a pest of concern for some growers (Elaine Snyder-Conn, U.S. Fish and Wildlife Service, personal communication, June 5, 1998). Most other diseases of small grains are

unimportant due to the use of resistant varieties and certified seed. However a new race of barley stripe rust was found in the Basin in 1995. In 1998, the economic impact of this rust has increased.

Small grain growers use a variety of pest control measures. These include preventive practices such as crop rotations, varietal rotation, seed treatment, seed testing, removing pest host plants, and planting resistant varieties. Growers monitor and use pesticides to control damaging pests during the production season. Tillage is used for weed control, along with herbicides.

Potatoes. About 3,200 acres of potatoes, representing a wide variety, are planted on the Tule Lake leased lands annually. Most of the leased-land potatoes, as in the rest of the Klamath Basin, are grown for fresh market; no seed potatoes are grown. Fresh market crops are processed in about 20 locally owned packing sheds and sold primarily in California population centers. Growing practices differ somewhat depending on the market.

The leased lands have two distinct advantages over most other potato production areas in the U.S. First is the exceptional soil quality, and second is the absence of two difficult pests: the Colorado potato beetle and, until 1997, the disease, late blight.

Eight insect pests currently exist on the leased lands. Green peach aphids, loopers, cutworms, potato aphids, grasshoppers, and yellowstriped armyworms are considered priority pests by growers. Root-knot nematode and lesion nematode were also considered priority pests. Twenty diseases are currently associated with potatoes on the Refuge. Priority diseases include early blight, white mold, leaf roll virus, potato virus Y, pink rot, soft rot, Rhizoctonia, silver scurf, blackleg, and Verticillium wilt. Late blight occurred for the first time in August 1997 and is a disease of great concern to growers.

Refuge potato growers use a variety of pest control measures. These include preventive practices such as proper fertility and irrigation, sanitation, starting healthy plants, crop rotations, trials with different varieties, seed treatments, and use of certified seed. Pest control practices used during the season include monitoring and treatments with insecticides, herbicides, and fungicides.

Nematodes are currently managed by crop rotations and fumigants. End-of-season disease prevention practices include care in handling and storage.

Some growers have minimized the need for chemicals by the use of crop rotations, cover crops and green manures. These practices help to maintain soil fertility, tilth, drainage and water-holding capacity, thus promoting a healthy crop better able to withstand pests.

Alfalfa. Roughly 600 acres of alfalfa are currently grown on Tule Lake leased lands. Winter dormant varieties are grown to insure protection of the plants from cold-weather injury. There are three distinct markets for Klamath Basin (including Refuge grown) alfalfa: export or "press" dairy hay, dairy hay for the domestic market (especially for California), and livestock feed. Production practices may differ significantly, depending on the market demand.

Pests that may attack alfalfa on leased lands include seven insects, six diseases and vertebrate pests (primarily voles or mice). Alfalfa weevils, aphids, and variegated cutworms are priority insect pests identified by growers.

Currently a variety of pest controls are used including monitoring, timing of spring cuttings, proper irrigation and fertility management, early cutting, and pesticide applications. Resistant varieties prevent most diseases from being severe. Fungicides are not used. Nematode-resistant varieties (now being developed) are identified by growers as a future method for limiting nematode losses. Currently, no pesticide management is conducted on grass hay crops.

Sugarbeets. Sugarbeet production in the Klamath Basin has expanded from approximately 1,000 acres in 1990 to 11,000 acres in 1995. Production on Tule Lake NWR is roughly 600 acres. Modest beet yields (18 to 23 tons/acre) are offset by the high sugar content of Basin-grown beets. The high quality of these sugarbeets combined with the relative lack of pests that plague other sugarbeet growing areas explain the rapid expansion of this crop in recent years. All beets are grown on contract. Local production costs for sugarbeets have been kept to a minimum because control measures have not been necessary for pests such as curley top virus, yellow viruses, sugarbeet cyst nematodes, and Rhizomania.

On average, 10 to 20 percent of the acreage requires replanting due to frost damage and injury from blowing soils. If the sugarbeets survive the early challenges, then weed and flea beetle control are the second- and third-most important factors determining yield and profitability. Both weeds and flea beetles are controlled with chemical treatments. Sugarbeet growers use a variety of preventive measures against pests including resistant varieties, seed treatments for diseases, crop rotations, and sanitation (by keeping equipment clean) to prevent introduction of Rhizomania and cyst nematodes. Disease control treatments are rarely needed.

Onions. In 1995, onions were grown on 318 acres of the Tule Lake NWR, and are rotated with grains and other row crops. Total production of onions in Klamath Basin is roughly 3,000 acres. Both dehydrating and fresh market onions are grown, while dehydrating onions are grown on contract. Onions are planted on less acreage than other Refuge-grown row crops, but their net return per acre is high.

Onions have three important insect pests, two of which, the onion maggot and thrips are of greatest concern to growers. Most onion fields are treated with insecticides every year to control onion maggots and thrips. Priority diseases include downy mildew, damping-off, white rot, and neck rot. White rot is a limiting factor in onion production, and soils infested with this fungus are avoided for growing onions. White rot is slowly spreading in the leased lands and elsewhere around Klamath Basin.

Current pest controls include high-density planting rates to out-compete weeds, positive displacement (precision application) of insecticide at planting and manipulation of the field environment with solid set irrigation (i.e., wind erosion control ([April-May]), suppression of thrips ([June-July]), and allowing fields to dry to limit disease (August-September). Onions do not compete well with weeds, so tillage and herbicide applications are currently used to control weeds.

Organic Horseradish. Horseradish production in the Upper Klamath Basin is currently grown on 1,160 acres (1998) and is only grown in the Tulelake area. Tulelake-area acreage on the Tule Lake NWR is about 12 acres. Horseradish yields (about 4 tons/acre) are reported on nearby private farms. Most of the locally grown horseradish is placed in cold storage and sold on the fresh market to processors under contract. One local processor resides in Tulelake, CA, while other processors are located in specific areas across the nation. Most horseradish growers belong to the Tulelake Horseradish Growers Association (THGA), for which membership is currently closed.

The Tulelake area is superior for growing horseradish due to the high altitude, cool nights, shorter growing season, and few natural pests. In others areas with warmer climates and faster growing seasons, horseradish is more susceptible to "hollow heart" disease and other natural pests.

Natural pests in the Tulelake area are: cutworms, voles (field mice), and weeds. While crop damage is fairly low, pest control measures include cultural practices such as: cultivation, bedshaping, and hand-weeding. Some chemical control has been used in the past on private lands, but chemical control is rarely needed (Randy DuVal, Tulelake horseradish grower, personal communication, September 21, 1998). No chemicals are currently approved for horseradish on the leased lands. Horseradish fields appear to have lower levels of wild oat invasions as compared to other crops (Gaylord DuVal, Tulelake horseradish grower, personal communication, September 22, 1998). Also, horseradish can be eliminated from a field by a combination of fallowing and cultivation.

Little information is available regarding wildlife use and horseradish within the Tulelake area, but growers have observed pheasants, gulls, deer, and waterfowl in private horseradish fields at various times of the year.

Currently, horseradish is grown organically in an attempt to convert a portion of Area J (**Figure 3**) into certified organic status, while producing an economically viable crop during the 3-year transition period. During this time period, landowner/Agency monitoring of horseradish for wildlife values and economic feasibility will occur.

Weeds. Numerous weed species have been documented on the refuges. Growers indicate there are 12 priority weeds on Refuge lands: five-hook bassia, netseed lambsquarter, pigweed, redroot pigweed, wild mustard, kochia, common purslane, hairy nightshade, wild oats, Canada thistle, perennial pepperweed, and black nightshade. These weeds were listed as affecting all crops grown on leased land to a greater or lesser degree, and five-hook bassia is the greatest pest species of greatest concern. Pesticide use proposals (PUPs) indicate that several additional weeds may reach economically damaging levels, depending on the field history and crop grown. These include poison hemlock, quackgrass, field bindweed, and Russian thistle.

Treatments to control weeds include aerial and ground applications of herbicides, cultivation, crop rotation, and biological controls. Banded herbicide applications combined with between-row cultivation are the primary methods of weed control for onions, sugarbeets, and potatoes. Spring tillage prior to seed-bed preparation controls some weeds. Post-plant applications of herbicides are typically used for broad-leaved and grass weed control. Hand-hoeing occurs in row crops.

Vertebrate Pests. Vertebrate pests are more or less of a problem, depending on the animal, the crop involved, and climatic conditions. For instance, voles (known as mice locally) are of particular concern on alfalfa, potatoes, and sugarbeets, but less so for onions and grains. Blackbirds, on the other hand, are sometimes considered by grain growers to be an economic pest, but are of little concern on other crops. Voles, gophers, blackbirds, coyotes, squirrels, and marmots were listed as vertebrate pest species by some growers.

The montane vole is known by leased-land farmers to be a pest of economic significance. It has done considerable damage to potato crops, and lesser damage to alfalfa and grains. The economic damage to potatoes is of concern as all potatoes with bite marks are considered "culls." Damage to number 1 potatoes varies annually from field to field and from year to year but has reached 30 percent (Brian O'Conner, leased-land grower, personal communication, September 26, 1996). In 1995, 30 percent damage amounted to $630 per acre. Physical barriers and bare buffer strips are currently used to control voles. No rodenticides are currently allowed on the refuges and are prohibited for use on food crops by the State of California.

Crop scouting. *Crop scouting is not mandatory under state or federal law.* Growers scout their crops or hire Pest Control Advisors (PCAs). Oregon's pesticide application laws are less stringent than California's. Chapter 6 of the California Food and Agriculture Code regulates PCAs; only persons having secured a (PCA) license are allowed to make pesticide application recommendations in California.[6] Chapter 6 specifies that PCAs must put all recommendations in writing, and must furnish a copy of each written recommendation to the dealer, the applicator, and

[6] Officials of federal, state, and county agricultural departments, and University of California personnel engaged in official duties relating to agricultural use are exempt from licensing requirements (Article 12001). Crop scouting may be done by any trained individual, but only PCAs can write a recommendation.

property operator prior to pesticide application (Article 12003), and to the agricultural commissioner upon his/her request. Recommendations must provide a variety of details including specifics on acreage, volume, and worker re-entry requirements. Pest population information is recorded in the PCAs' field record books, but is not written on the pest control recommendation. By law, PCAs must describe criteria used to determine the need for treatment with pesticides, and to certify that alternatives and mitigating measures have been considered, and adopted if feasible (Section 6556).

The university and nation-wide agricultural specialists interviewed expressed concern over current chemical use for pest control. Agricultural authorities referred to some nonessential pesticide applications, failure to apply chemicals when needed, and field wide rather than sub-area chemical use as contributing to unnecessary grower expenditures, and/or reductions in crop values. Agriculture professionals are concerned by continued use of "calendar spraying" and applications of ineffective chemicals.

Each crop and agricultural region contends with a different mix of growing conditions and pest problems. Even within sub-areas of the Lower Klamath and Tule Lake refuges, growing conditions and pest problems vary from lease to lease, as do the farming practices of individual growers.

Though all growers check their fields for pests, considerable variation exists regarding frequency and methods used for scouting. Growers are typically in their fields at least once a week during the growing season and sometimes daily, depending on the time of season and the crop involved. PCAs also make weekly visits to growers' fields, or more frequent visits if a pest problem exists or is anticipated. Growers and PCAs check fields for a variety of factors including irrigation needs, pest infestations, crop development, fertility and stand establishment. Frequency of scouting is determined by crop development stage, potential for pest occurrence, weather conditions, and market considerations.

In addition to growers and PCAs, field representatives from sugar-processing companies, seed company representatives, commodity buyers, pesticides company representatives, TID staff, and local Extension personnel scout fields for growers and advise growers of pest infestations.

If growers see a problem in one of their fields, they usually ask their PCA to monitor the field to determine pest population levels. Conversely, PCAs typically contact growers when they spot a potential pest problem in a field. Growers make the final decision about whether or not to make a pesticide application.

PCAs routinely scout for and collect quantitative data on pests that have University-established economic threshold levels and sampling techniques. University-determined economic (action) threshold levels have not been established for many pests of Refuge-grown crops. When economic threshold levels are not available, PCAs use best professional judgement based on their prior experience with the crop, number and size of pests, crop development stage, and potential economic damage.

Most pesticides are commercially applied by a pest control operator working for a PCA. Aerial application is most common, due to factors including wet conditions, in-place irrigation equipment,

potential crop damage associated with ground applications, and cost. A smaller percentage of pesticides are ground applied.

Pesticide Use. Through 1998, approximately 50 pesticide products were renewed. These include herbicides, insecticides, growth regulators, and fungicides. Some of the more recent pesticides approvals replaced more toxic or harmful chemicals, or provided an alternative in case of pest resistance. Not all pesticides are used each year. New methods of application also were approved for many of these chemicals, often improving application techniques.

Additional wildlife surveys were conducted in 1998 to evaluate pesticide effects on wildlife. No mortalities of fish, mammal and birds were found related to pesticides. If wildlife mortality events occur and are determined to be caused by a pesticide application, then measures will be implemented to prevent a re-occurrence. This program should continue through the summer of 2000, and provide additional information to assess pesticide mortalities and sublethal effects.

3.7.2.4 Public Controversy

Currently, there is little trust between the conservation and agricultural communities, and between these groups and the Agencies. For example, the Agencies were sued by Oregon Natural Resources Council (ONRC) and Northwest Coalition for Alternatives to Pesticides (NCAP) for noncompliance with Interior pesticide policies and the Endangered Species Act. The litigants believe that Agency policies addressing the use of pesticides on the refuges are not correctly interpreted at present; that crops grown should be beneficial to wildlife, and that no pesticides should be used. Another lawsuit has recently been filed by Klamath Forest Alliance, along with eleven other groups, asserting that commercial agriculture is inconsistent/ incompatible with primary wildlife purposes of the refuges.

The agricultural community fears the above groups want to put them out of business and remove leasing from the refuges. The lessees do not trust the Agencies to defend the leasing program or their interests.

3.8 RECREATION

Lower Klamath and Tule Lake NWRs are two of six refuges in the Klamath Basin Complex of NWRs. Tule Lake NWR has the highest number of visitors for the six refuges. Most recreational use is associated with wildlife observation. The Refuge has a 14-mile auto tour, a 2-mile canoe tour, and attracts birders, waterfowl hunters, and photographers.

The Tule Lake NWR logged 196,544 visitors in 1995 (Laughland and Caudill 1997). The vast majority of these visitors engaged in various types of wildlife observation. Most visited in the spring and fall, although visitation is spread out throughout the year. Refuge managers estimate that 80 percent of non-consumptive users (those other than hunters) come from outside the local area (more than 30 miles

distant). Lower Klamath NWR recreational visitation totaled 164,000 for the same year. The vast majority of these visitors engaged in wildlife observation, while about 10,200 visitors hunted.

Recreational lands that would be directly affected by an IPM program are parts of Sump 2, Sump 3, and Area J on Tule Lake NWR, and Area K on Lower Klamath NWR (**figures 2 and 3**). Although the predominant recreational uses within the leased lands are waterfowl and pheasant hunting, the auto tour route is adjacent to the leased lands in some locations; large numbers of tourists enjoy bird watching and photography in those locations.

Hunter use during 1997 for the Tule Lake NWR leased lands was estimated at 2,085 waterfowl and 190 pheasant hunter visits. Hunter use during 1997 for the Area K portion of the Lower Klamath NWR, also leased lands, was estimated at 2,000 waterfowl hunter visits with negligible pheasant hunting activity.

During 1997, an estimated 18,780 visits were made by wildlife viewers along the Tule Lake auto tour route (Dave Menke, Refuge Outdoor Recreation Planner, personal communication, October 6, 1998).

3.9 CULTURAL

Under the National Historic Preservation Act, an undertaking is defined as "Any project, activity, or program that can result in changes in the character or use of historic properties (36CFR800.2[o])." The alternatives considered do not have the potential to affect the characteristics of historic or prehistoric archaeological sites eligible to the National Register of Historic Places (36CFR800.1; 36CFR60.4). Use of pesticides, mowing, and crop rotations do not cause significant ground disturbance that may affect a site's integrity of setting, association, or materials, or its ability to provide important information.

The Klamath Tribes were contacted to determine if significant trust resources might be affected by implementation of the alternatives considered. To date, no response has been received from the Tribes. The Agencies have determined that implementation of an IPM Program would not adversely affect trust resources. Analysis of proposed pest management procedures would occur during the PUP review and the endangered species consultation processes to assure protection of trust resources. Therefore, potential effects on cultural and trust resources are not discussed further in this document.

CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

4.0 INTRODUCTION

Chapter 4 contains the Agencies' analysis of probable impacts to the environment that would result from implementation of the proposed action or one of its alternatives. Resources related to significant or potentially significant issues identified in Chapter 2 are described in the most detail, including:

- habitats, wildlife, and threatened and endangered species;
- water, soil, and air quality;
- income to individuals and the local economy.

The public was particularly concerned about the effects of pesticide use related to the above resources. Other resources are discussed briefly or not at all, depending on their relevance to IPM on the refuges.

Certain assumptions about the action alternatives were made to carry out this analysis. These include:

- One of these alternatives would be initiated within the next 2 years.
- Funding of one of the alternatives would occur within 1 year. Impacts associated with a lack of funding for any of the alternatives is not evaluated in this chapter.
- Short-term impacts are those that would occur over the next 10 years. Long term impacts would last beyond a 10-year period.
- Impacts are considered to be *irreversible* if a chemical, biological, or physical process began that could not be stopped. As a result, the resource or its productivity or utility would be lost forever. An impact is considered *irretrievable* when it would eliminate a resource, its productivity and/or utility for the duration of the IPM program.
- Magnitude of impacts is described using terms such as negligible, moderate, and major. Importance of impacts is described using terms such as potentially significant and significant. Impacts are considered to be insignificant unless otherwise identified.
- Cumulative impacts are defined as the combined past, present, and reasonably foreseeable future effects of the project in conjunction with other activities in the surrounding area (see **Glossary**). Cumulative effects are discussed under each resource only if cumulative effects were predicted to occur in the analysis.
- As pesticide inputs increase or decrease under any of the alternatives, the risk of impacts will increase or decrease proportionately. All lands would be leased under alternatives 1, 2, or 3.

Uncertainty is recognized in the analysis of Alternative 4 because of unknown factors associated with the organic farming system/methodologies that might be used. One assumption of this alternative is that 50 percent more of the leased lands may not be leased in the short term.

Pesticide-related impacts are analyzed in terms of relative risks (the probability of adverse impacts) including direct acute toxicity, chronic toxicity (e.g., estrogenic or immune effects), and other indirect or cumulative negative effects that would result from pesticide exposure on the Refuge leased lands and

berms when combined with other reasonably foreseeable activities in the Basin. Historic or current pesticide effects on Refuge wildlife from pesticides applied outside the Klamath Basin are not considered.

Acute toxicity is defined as that which results in death or immobilization, likely leading to death within 96 hours of exposure. Chronic toxicity is generally slower acting and can lead to sublethal effects, such as effects on behavior, growth, development or reproductive success. Pesticide risks depend on the exposure of organisms present; the number, frequency, and rates of various pesticide applications; the acute and chronic toxicity of each particular pesticide used; the persistence of each allowed pesticide in the various environmental media; pesticide availability factors (such as adsorption or absorption of the pesticide to soil or organic carbon rendering the pesticide unavailable for release or biological uptake); and the biological uptake and metabolism of each pesticide. Pesticide risks to Refuge visitors and employees, volunteers, local residents, farm workers, and applicators are limited by federal and state laws and regulations regarding the use of agricultural chemicals and are not considered in depth in this analysis.

Other potential impacts, such as effects to air and water quality, are analyzed qualitatively based on the predicted increases or decreases in pesticide inputs. The impacts of IPM-associated agricultural practices, such as flood irrigation, tillage, burning, and cover crops are also analyzed qualitatively.

Impacts are listed by alternative under each resource heading. For all the action alternatives, only those impacts that would differ from the previous action alternative (s) are listed. The reader may assume that all impacts listed under Alternative 1 would occur under subsequent alternatives unless otherwise stated.

4.1 VEGETATION AND HABITAT

In this section, vegetation and vegetation as habitat (food and cover) for fish and wildlife in croplands, uplands (primarily adjacent buffers and berms), and in aquatic habitats, including seasonal and permanent wetlands and open water habitat, are considered. The primary weeds of concern are: Canada thistle, kochia, perennial pepperweed, poison hemlock, and bassia because these species provide little or no habitat values, are extremely invasive, and dominate the berms.

4.1.1 Alternative 1 No Action

4.1.1.1 Terrestrial Habitats

Pesticide inputs and risk of impacts to terrestrial vegetation are primarily limited to the effects of herbicide use and exposure. In croplands, pesticide use would continue to result in economic reductions of agricultural weeds, insects, diseases, and other pests (such as nematodes). Herbicide use would continue to allow high yielding, weed-free grain fields providing abundant waste grain on approximately 15,000 acres for both spring and fall migrating waterfowl. In buffer zones, established to protect waterways, aerial and ground spraying would not be allowed, but spot spraying, wicking and

wiping of certain herbicides would continue to eliminate noxious and other weeds. Certain nontarget vegetation might be killed or subjected to sublethal effects, such as reduced growth. The effects of current herbicide use practices on terrestrial habitats on leased lands would continue over the short term. The magnitude of these effects would vary from year to year depending on weed abundance and corresponding herbicide inputs.

The Service would continue to allow certain herbicides to be used on berms under conversion to perennial grasses. Herbicide treatments would be used to suppress noxious (mostly exotic) weed species, allowing new grass plantings to become established, thus increasing upland habitat values. Additional potential impacts of herbicide inputs in berms would be temporary reductions in vegetative cover. Efforts to improve upland habitat values for ground-nesting birds through a berm (weed) management program would occur in a limited fashion, and only as time and funding became available. These efforts involve the establishment of perennial grasses along berms to exclude noxious weed species, conserve soil, and provide high quality wildlife habitat. The berms and buffer zones in terrestrial habitats would continue to support high populations of noxious weed species resulting in reduced native plant diversity, a continued decline of upland habitats important for nesting, escape, cover, and forage, and an increased threat to agricultural crops, both on and off the refuges. Short-term efforts and funding to manage noxious weeds on the berms are increasing and should continue to increase over the long term. As berms were converted to perennial grasses, and weeds in those areas reduced, herbicide use would potentially decline in the long term, reducing risk to non-target organisms and the potential for weed invasion of adjacent croplands on and off the NWRs.

Based on the assumption that no IPM Plan would be implemented under this alternative, no new pesticides would be approved per an existing Agency directive. The consequences would be that the opportunity to select new, less toxic pesticides than those currently approved would be foregone. In addition, chemical resistance problems would continue under this alternative. The potential to reduce risk to non-target organisms also would be foregone. IPM-associated agricultural practices in croplands that would potentially impact terrestrial habitats include: irrigation management, flooding, burning, tillage, mowing and cover crops. Flooding is used to control quackgrass, but also reduces terrestrial plants, soil-borne plant pathogens and certain soil fauna. This practice reduces terrestrial habitats temporarily in croplands for the duration of the flooding. However, burning at Tule Lake and burning and flooding stubble fields in Area K would continue to enhance grain availability to waterfowl. Mowing of quackgrass hayfields, followed by livestock grazing in Area K would continue to provide an excellent spring browse for northward migrating arctic geese. Lease stipulations for cover crops in harvested row- crop acreage would continue to increase terrestrial habitats substantially.

Burning, mowing and tillage on berms would continue to reduce vegetation temporarily, allowing management of noxious weeds without chemicals and improving habitat over the long term. These activities would continue to enhance the vigor of established grass stands, but may kill or suppress other plant species. These practices and their effects would be expected to continue in both the short and long terms.

4.1.1.2 Aquatic Habitats

With the exception of copper and sulfur compounds used to treat some crop diseases and invertebrate pests, pesticide impacts to aquatic vegetation would be limited primarily to herbicide use in croplands and berms. Indirect effects would potentially include the introduction of increased biomass of decaying vegetation into aquatic habitats, reducing available dissolved oxygen (DO) for aquatic life. These impacts would be negligible, but would continue over the short term.

Buffer zones and drift retardants established to reduce the risk of pesticide entry into waterways, and restrictions on applications of pesticides, would continue to mitigate pesticide-associated risk to aquatic habitats. Special restrictions in applications of herbicides on the berms, such as more intensive drift monitoring and regulation of water flow adjacent to the canal or drain being treated, would be implemented to limit this risk, and have already been required for herbicide applications by Refuge personnel to control weeds in first year grass plantings on the A Dike. Because these restrictions would mitigate impacts to aquatic habitats, effects associated with pesticides would be negligible in the short and long terms.

IPM-associated agricultural practices in croplands that would potentially impact aquatic habitats include irrigation management, flooding, burning, tillage, mowing and cover crops. Flooding would continue to temporarily increase aquatic habitats and aquatic plant species, particularly algae. In Area K, annual quackgrass flooding would still allow for the temporary establishment of sago pondweed, a desirable food for diving ducks and wintering tundra swans. In the long term, if cover crops also served as green manures, replacing some use of commercial fertilizer, reduced nutrient inputs to aquatic habitats could occur. Burning, mowing and tillage on berms could negatively affect aquatic habitats by potentially increasing nutrient and sediment loading resulting in increased ammonia and algae (see **4.3 Water Quality**) and reduced deep-water aquatic habitats. These practices and their effects would be expected to continue in both the short and long terms, and would be cumulative with sump rotation and other potential effects on aquatic habitats affecting upstream and Refuge waters.

4.1.2 Alternative 2 Phased IPM Program-Proposed Action

4.1.2.1 Terrestrial Habitats

Pesticide inputs and risk of impacts to terrestrial habitats would be limited to effects of herbicide use and exposure, similar to Alternative 1, because action thresholds for weeds are not available and would likely take up to 10 years to develop. Herbicide inputs in croplands are not projected to change under this alternative, and short-term impacts from herbicide use would be similar to Alternative 1, although new, more selective herbicides could be approved with the implementa-tion of the IPM Plan. If new products were available and approved, herbicide inputs and associated risks could potentially be reduced in the short and long terms. Furthermore, in the long term, as action thresholds for weeds were developed and implemented, herbicide inputs and associated risk to terrestrial habitats would be expected to decrease more rapidly than Alternative 1.

Implementation of the IPM Plan, including the berm management plan, would reduce noxious weed proliferation and potentially improve terrestrial habitats. Because of the projected additional cooperation and funding by the Agencies, Tulelake Irrigation District, the Intermountain Research Extension Center, and lessees, berm management would potentially be accelerated, relative to Alternative 1, resulting in more desirable nesting cover for birds and greater reduction in noxious weeds in a shorter period of time. However, existing cover and nesting habitat on the berms would potentially be reduced temporarily in some areas of the berms. The increased rate of berm management could potentially increase herbicide inputs and associated risks in the short term, relative to Alternative 1. However, the increased rate of berm conversion to perennial grasses and subsequent reduction of weeds in those areas would potentially result in a more rapid decline of herbicide use in the long term, while improving cover and nesting habitat. This would also reduce risk to non-target organisms and the potential for weed invasion of adjacent croplands on and off the NWRs.

IPM-associated agricultural practices in croplands and their potential impacts to terrestrial habitats would be similar to Alternative 1, over the short and long terms, with some possible exceptions. The initiation of on-site field trials designed with the objective of integrating pest control practices and wildlife goals would increase the opportunity to improve wildlife habitat values on the leased lands. Offering lease incentives to expedite field testing of IPM techniques benefiting crops and wildlife could accelerate adoption of these techniques, resulting in improvements to terrestrial habitats on Refuge lands in the short and long terms. The projected acceleration of the berm management program would potentially increase agricultural activities on the berms including burning, tillage and mowing, with a consequent temporary reduction in terrestrial habitats. However, there would be more rapid improvements to terrestrial habitats in the short and long terms.

4.1.2.2 Aquatic Habitats

Pesticide inputs in croplands and risk of impacts to aquatic habitats would be similar to Alternative 1 in the short term, although by implementation of the IPM Plan, the potential to approve new products with more selectivity could reduce risk in the short and long terms relative to Alternative 1. In the long term, as action thresholds for weeds were developed and implemented, herbicide use and associated risk to aquatic habitats would likely decrease relative to Alternative 1. However, with the projected increase of herbicide inputs on berms, the risk of impacts to aquatic habitats would be greater than Alternative 1 in the short term. In the long term, as grasses were established on the berms**,** herbicide use and associated risk to aquatic habitats would likely decrease relative to Alternative 1.

IPM-associated agricultural practices in croplands and their potential impacts to aquatic habitats would be similar to Alternative 1. The potential for increased tillage and burning activities in the berms resulting from an accelerated berm management program may increase nutrient inputs and sediment loading into aquatic habitats temporarily in the short term. As previously mentioned, nutrient inputs increase algae growth, and sediment loading reduces deep-water habitat. In the long term, these impacts would be similar to Alternative 1.

4.1.3. Alternative 3 Modified IPM Program

4.1.3.1 Terrestrial Habitats

Pesticide (herbicide) inputs in croplands and risk of impacts to terrestrial habitats would be similar to Alternative 2 in the short and long terms. The IPM Plan would be implemented allowing approval of new products with the potential to reduce risk, but leased land growers could assume more responsibility for managing berms; herbicide inputs on berms would potentially increase over the short term, relative to Alternative 2, resulting in a greater reduction of terrestrial habitats. However, control of noxious weeds in berms would be accelerated relative to Alternative 2, because growers could assume more responsibility and have more resources at their disposal. Long-term potential impacts to terrestrial habitats from herbicide inputs to berms would be similar to Alternative 2, and less than Alternative 1.

IPM-associated agricultural practices in croplands and their potential impacts to terrestrial habitats would be similar to Alternative 1 over the short and long terms. The projected acceleration of the berm management program would potentially increase agricultural activities in the berms including burning, tillage and mowing, resulting in a greater reduction of terrestrial habitats over the short term, but similar impacts over the long term to Alternative 2.

However, if weed control on the berms were approached in an uncoordinated fashion by the growers, if some operators managed weeds while others didn't, or if grasses were not established, the berms would revert to linear weed infestations as they have in the past without coordinated management, similar to Alternative 1.

4.1.3.2 Aquatic Habitats

Pesticide (herbicide) inputs in croplands and risk of impacts to aquatic habitats would be similar to Alternative 2 in the short and long terms. However, with the projected increase of herbicide inputs in berms because of more aggressive berm management by growers, the risk of impacts to aquatic habitats would be greater in the short term, but similar in the long term, to Alternative 2.

IPM-associated agricultural practices in croplands and their potential impacts to aquatic habitats would be similar to Alternative 1 over the short and long terms. The projected increase in agricultural activities in the berms would result in potentially greater nutrient inputs and sediment loading into aquatic habitats than Alternative 2 in the short term. Over the long term, impacts would be similar to Alternative 2.

4.1.4 Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic

4.1.4.1 Terrestrial Habitats

Synthetic herbicide inputs in croplands and berms, and risk of impacts to terrestrial habitats would be virtually eliminated over the short and long terms because these materials would no longer be used except in the case of an emergency situation where wildlife and/or habitat were threatened by a pest

that could not be controlled otherwise. It is unlikely that organic herbicides for the proposed crops (small grains, alfalfa, and potatoes) would be commercially available in the short term, resulting in the potential for increase weed populations. This would be true especially for small grains serving as feeding habitat for migratory waterfowl. Increased weed populations would potentially result in reduced grain production. These impacts would be greater than alternatives 1, 2, and 3 over the short and long terms.

No organic herbicides would be available for use on the berms, in the short term, making the establishment of perennial grasses extremely difficult and increasing the proliferation of noxious weeds and the subsequent need for mowing. Although biocontrols are available for certain weeds, they are generally slow to work and not available for most weeds of concern on the berms. If a weed explosion occurred and was not deemed a threat to wildlife habitat, weeds could spread to adjacent private and public habitats and farmlands with negative environmental and economic results. Habitat values would potentially be reduced in croplands and berms. These impacts would be greater than alternatives 1, 2, and 3 over the short and long terms.

IPM-associated agricultural practices in croplands and berms and their impacts would differ from alternatives 1, 2, and 3 over the short and long terms. This alternative would transform cropland terrestrial habitats from one dominated by small grain stubble to one dominated by alfalfa and cover crops. The largest single impact to terrestrial habitats of this alternative would be the reduction of grain stubble available for spring and fall waterfowl feeding habitat: from 11,000 acres to 660 acres on Tule Lake NWR in the long term. This would be a major and irretrievable impact on waterfowl. Agricultural burning in the croplands would be virtually eliminated while cover crops would be increased by 10,000 acres relative to alternatives 1, 2, and 3. Field trials would be initiated to identify profitable organic crops with benefits to wildlife.

The cropping pattern required to make this alternative sustainable in the long term from an economic and agronomic standpoint would conflict with waterfowl habitat management goals for the refuges because grain stubble would be converted to green browse constituting a large-scale loss of waterfowl food. Furthermore, cropping patterns required for long-term sustainability in Area K would not be compatible with existing irrigation infrastructure and would not be possible in the short term without substantial amounts of organic fertilizers (manure). Manures would be a possible source of weed seeds that could contribute to a potential decline in terrestrial habitats values over the short and long terms. Weed control similar to that in other alternatives could be achieved by mechanical cultivation and hand-weeding for potatoes only. Weed control in berms and noncrop buffers would be more dependent on tillage, burning, and mowing resulting in temporary reductions of vegetative cover for nesting to a greater extent than alternatives 1, 2, and 3.

If leases in Area K were unleased under this alternative (see **4.6.4.1 The Agencies**) it is likely Area K would revert to quackgrass cover, with lesser amounts on the Tule Lake NWR. In the long term, these may become organic hay leases. Another possibility would be to have some lease lots consist of mowed weed stands in an attempt to control weed seed production.

4.1.4.2 Aquatic Habitats

Synthetic pesticide (herbicide) inputs in croplands and berms and risk of impacts to aquatic habitats would be virtually eliminated over the short and long terms because these materials would no longer be used except in the case of an emergency situation where wildlife and/or habitat were threatened by a pest that could not be controlled otherwise. However, the potential for increased inputs of copper and sulfur compounds, frequently used under organic systems, in croplands would pose greater risk to aquatic habitats than alternatives 1, 2 and 3 over the short and long terms. However, organic pesticide inputs and risk of impacts would be mitigated by PUP restrictions similar to alternatives 1, 2, and 3.

IPM-associated agricultural practices in croplands with potential impacts on aquatic habitats that would differ markedly from the previous alternatives include burning and cover crops. Agricultural burning in croplands would be virtually eliminated and cover crops increased thereby reducing potential impacts from nutrient inputs and sediment loading into aquatic habitats relative to alternatives 1, 2 and 3 in the short and long terms. However, tillage, burning and mowing in the berms would be greater, thereby increasing potential impacts from nutrient inputs, sediment loading and biomass into aquatic habitats relative to alternatives 1, 2, and 3 in the short and long terms.

If any lands were unleased under this alternative (see **4.6.4.1 The Agencies**), conversion of such lands to wintertime seasonal wetlands using water available from winter runoff could occur. This scenario could only occur during the winter runoff period (normally from December through April), and only if the unleased acreage was consolidated so as to allow for flooding without impacting adjacent leased fields by undiked water flows or sub-irrigation. Water would be drained from the land in June to promote the optimum growth of seasonal wetland plants such as smartweed, red goosefoot, spike rush, bulrush and other wetland species.

4.2 WILDLIFE

The primary wildlife species of concern are waterfowl, other migratory birds, and upland game birds. The threatened and endangered species of concern are bald eagles and shortnose and Lost River suckers.

4.2.1 Alternative 1 No Action

4.2.1.1 Wildlife

Pesticide inputs and risk of impacts to wildlife on the refuges are dependent on direct or indirect (through a food source) exposure to insecticides, fumigants, fungicides, and, in the case of fish and other aquatic organisms, herbicides. Studies described in **Section 3.3.3** indicate there is no evidence that pesticides currently approved for use on leased lands have caused bird, fish, or other wildlife mortalities in the NWRs. If mortalities attributable to a specific pesticide were found, the use of that pesticide would be more severely restricted or prohibited on the NWRs.

No relationships would be expected between population sizes of waterfowl or upland birds and pesticide use patterns on leased lands. Indirect effects would continue to occur for species using berms and buffer habitat. Sublethal exposures to pesticides could occur resulting in acetylcholinesterase depression and related effects, particularly to passerine birds such as Savannah sparrows in croplands. Lethal effects could also result in a small number of deaths of these birds.

Insecticide applications on crops would continue to result in appreciable fluctuations in insect abundance, including beneficial insects, other non-target species, and pests. Although numbers would initially decline precipitously in and immediately adjacent to treated fields, certain species may reoccur and proliferate, leading to additional infestations and crop damage.

Short-term risks to fish and wildlife would continue. Based on the assumption that no IPM Plan would be implemented under this alternative, no new pesticides could be approved per an existing Agency directive. The consequences would be that the opportunity to select new, less toxic pesticides than those currently approved would be foregone. The potential to reduce risk to non-target organisms would also be foregone in the long term.

IPM-associated agricultural practices that would affect wildlife include: irrigation management, flooding, burning, tillage, mowing, and cover crops. Irrigation and first cutting of alfalfa during the spring nesting season would be potentially harmful to nest success, particularly to the first clutch of eggs. Flooding of grain stubble in Area K as pre-irrigation and to control quackgrass would benefit waterfowl by providing excellent feeding habitat, including the provision of aquatic invertebrates high in nutritional value needed by brood-rearing female mallards and young ducklings. Stubble burning is currently limited by lease contracts to the period between January 1 - April 15 to minimize impacts to ground nesting-birds although this practice would potentially increase food availability for waterfowl. Fall tillage would be restricted to retain waste grain on the soil surface making it available to waterfowl. Burning, mowing, and tilling in berms would have potential negative impacts to birds in that they all remove cover. In addition, these activities would continue to adversely affect fish habitat because of increased sediment and nutrient loads into aquatic habitats. Increased sediment loads would reduce deep water habitat while increased nutrient inputs would stimulate algae, resulting in reduced dissolved oxygen levels. Cover crops would reduce wind erosion and subsequent siltation and provide additional green browse for geese in the fall and spring. These practices and their effects would likely continue in both the short and long terms.

4.2.1.2 Threatened and Endangered Species

Pesticide inputs and the risk of impacts to threatened and endangered species (bald eagles and Lost River and shortnose suckers) on the refuges are also dependent upon exposure to insecticides, fumigants, fungicides and, in the case of suckers and their food organisms, herbicides. Potential impacts include direct acute or chronic toxicity, or indirect effects such as those related to food quantity or quality.

Pesticide-use restrictions listed in approved PUPs and additional mitigation measures outlined in biological assessments and required in biological opinions have resulted in a determination by the Service that existing pesticide use would not jeopardize threatened and endangered species or proposed critical habitat on the refuges. Based on these earlier consultations and analyses, and on protective measures required in the biological opinions to reduce potential adverse effects, few negative consequences would be predicted for these species as a result of using currently approved pesticides under Alternative 1.

IPM-associated agricultural practices that would potentially affect threatened and endangered species include irrigation/flooding, tillage, burning and cover crops. Flooding of grain stubble in Area K as pre-irrigation and to control quackgrass would potentially benefit bald eagles by providing additional feeding opportunities on displaced voles (Opp 1980). No effects would be likely to occur on endangered suckers because they are not known to be present in Lower Klamath NWR where pre-irrigation flooding occurs. Burning, mowing, and tilling in croplands and berms would have potential negative impacts on endangered fish species in Tule Lake NWR because of increased sediment and nutrient loads in aquatic habitats with resulting effects as discussed under **4.2.2.1 Wildlife**. However, cover crops would continue to reduce wind erosion and subsequent siltation into aquatic habitats in both the short and long terms.

4.2.2 Alternative 2 Phased IPM Program - Proposed Action

4.2.2.1 Wildlife

Pesticide inputs in croplands and risk of impacts to wildlife (including insects) would be less than Alternative 1 because of reduced pesticide inputs projected under this alternative. According to IPM studies summarized in **tables 9, 10, and 11** in the **4.6 Socioeconomics**, pesticide inputs were reduced by an average of 20 percent in a variety of crops and pests in different locations around the U.S. except in corn where pesticide inputs were increased by 20 percent. (Corn is an unlikely candidate for the Klamath Basin Refuges because of climatic limitations.) For example, IPM programs for potatoes in New York and Massachusetts indicated pesticide reductions of nearly 30 percent resulting from the use of action thresholds to determine the need for pesticide applications. Although herbicide inputs in croplands would not likely change with this alternative relative to Alternative 1, insecticide, fungicide, and fumigant inputs would likely decrease over the short and long terms by full implementation of the proposed IPM Plan. Additional benefits as insecticide usage declined in croplands over time would be increased numbers and kinds of beneficial insects that could also provide more food for wildlife species that feed on these insects. Furthermore, the opportunity to approve new pesticides with less toxicity and greater selectivity with the full implementation of the IPM Plan would potentially reduce risk relative to Alternative 1.

Possible increased herbicide use on berms from the accelerated berm management program would result in a greater loss of cover during the short term relative to Alternative 1, potentially affecting

nesting. In the long term, however, improved grass cover on the berms would potentially enhance nesting for waterfowl and pheasants. Short-term risks to fish would be greater than Alternative 1 with increased herbicide inputs to berms, but these risks would likely be reduced in the long term as herbicide use declined, similar to Alternative 1.

IPM-associated agricultural practices in croplands and their potential impacts to wildlife would be similar to Alternative 1. Increased tillage, burning and mowing from the accelerated berm management program could temporarily reduce cover to a greater extent over the short term than to Alternative 1, potentially affecting nesting cover on the berms. Improved grass cover on the berms in the long term would also potentially enhance nesting success for waterfowl, pheasants, and quail. Increased tillage, burning and mowing would possibly increase nutrient inputs and sediment loading into aquatic habitats to a greater extent over the short term than Alternative 1, potentially affecting fish species by minimally reducing deep-water habitat and dissolved oxygen. Any effects from sump rotation would be cumulative, either adversely or beneficially, with the effects discussed above.

4.2.2.2 Threatened and Endangered Species

Pesticide inputs in croplands and risk of impacts to threatened and endangered species would be less than Alternative 1 because of reduced pesticide inputs projected under this alternative, as discussed above under wildlife. Short-term risks to suckers would be greater than Alternative 1 with increased herbicide inputs to berms but these risks would likely be reduced in the long term as herbicide use declined, to a level similar to Alternative 1.

IPM-associated agricultural practices in croplands and berms and their potential impacts to threatened and endangered species would be similar to those discussed above under wildlife with the possible exception of the effects of flooding grain fields in Area K. Flooding of grain fields in Area K would enhance feeding opportunities for bald eagles similar to Alternative 1.

4.2.3 Alternative 3 Modified IPM Program

4.2.3.1 Wildlife

Pesticide inputs in croplands and the risk of impacts to wildlife would be greater than Alternative 2, but less than Alternative 1, in the short term, because the potential to approve new pesticides with greater selectivity and less toxicity would exist, although the full implementation of the IPM Plan would be delayed by the need to field trial all IPM techniques. Action thresholds would be more difficult to establish because of the lack of standardized crop scouting protocols. Long-term pesticide inputs and risk of impacts would be less than Alternative 1 and similar to Alternative 2, but slowed because the proposed IPM Plan would be fully implemented at a much later date.

Possible increased herbicide use on berms would result in a greater loss of cover during the short term relative to alternatives 1 and 2, potentially affecting nesting, but in the long term, improved grass cover

on the berms would potentially enhance nesting for waterfowl, pheasants, and quail. Short-term risk to fish would be greater than alternatives 1 and 2 with increased herbicide inputs to berms, but these risks would likely be reduced in the long term as herbicide use declined, similar to Alternative 2.

IPM-associated agricultural practices in croplands and their impacts to wildlife would be similar to Alternative 1 in the short and long terms. Increased tillage, burning and mowing from the modified berm management program would reduce cover to a greater extent over the short term than alternatives 1 and 2, potentially affecting nesting. In the long term, improved grass cover on the berms would potentially enhance nesting for waterfowl, pheasants, and quail, similar to Alternative 2. Increased tillage, burning and mowing would possibly increase nutrient inputs and sediment loading into aquatic habitats to a greater extent over the short term than alternatives 1 and 2, potentially affecting fish species by reducing deep-water habitat and dissolved oxygen.

4.2.3.2 Threatened and Endangered Species

Pesticide inputs in croplands and risk of impacts to threatened and endangered species would be similar to those discussed under the wildlife section for this alternative. IPM-associated agricultural practices in croplands and berms and their potential impacts to threatened and endangered species would be similar to those discussed under wildlife for this alternative, with the possible exception of the effects of flooding grain fields in Area K. Flooding of grain fields in Area K would enhance feeding opportunities for bald eagles similar to alternatives 1 and 2.

4.2.4 Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic

4.2.4.1 Wildlife

Synthetic pesticide inputs in croplands and berms and risk of impacts to wildlife would be virtually eliminated in the short and long terms because these materials would no longer be used except in the case of an emergency situation where wildlife and/or habitat were threatened by a pest. There could, however, be increased inputs and risk of impacts to wildlife from certain metal salts, soaps, oils, pyrethrum (a natural botanical pesticide similar to the synthetic pyrethroid permethrin, in its mode of action) and sulfur inputs to treat pests. Sulfur is an organic pesticide of particular concern. Sulfur, as sulfate, is already elevated in Tule Lake waters (Sorenson and Schwartzbach 1991; Kaffka et al. 1995) and hydrogen sulfide, a compound highly toxic to most aquatic life, including invertebrates and fish, is abundant in Tule Lake sediments (Snyder-Conn, personal observation). However, organic pesticide inputs and risk of impacts would be mitigated by PUP restrictions similar to alternatives 1, 2, and 3.

The potential for increased weed populations from the absence of herbicide use, especially in small grains would likely result in lower grain production and a reduced food supply for migratory waterfowl. No organic herbicides are commercially available for use on the berms, making the establishment of perennial grasses extremely difficult and increasing the need for mowing. Increased mowing and the proliferation of noxious weeds would potentially reduce waterfowl nesting in these areas relative to alternatives 1, 2, and 3 and over the short and long terms. The effects would be irretrievable.

IPM-associated agricultural practices in croplands and berms and their impacts would differ from alternatives 1, 2, and 3 over the short and long terms. The virtual elimination of undisturbed grain stubble in the fall in the leased lands of the Tule Lake NWR would likely lead to a precipitous decline in use by migrating ducks and arctic geese. Peak populations of 93,000 white-fronted geese and 78,000 snow geese would either overfly the Klamath Basin or move their feeding to private lands. This would be a major and irretrievable impact on waterfowl.

If the diversity of crop mix were increased, wildlife species diversity would also be expected to increase. Agricultural burning in the croplands would be virtually eliminated while cover crops would be increased resulting in reduced nutrient inputs and sediment loading into aquatic habitats relative to alternatives 1, 2, and 3 potentially benefitting fish. However, Area K would require large amounts of organic fertilizer (manures) to sustain organic agriculture, potentially increasing nutrient inputs into aquatic habitats relative to alternatives 1, 2, and 3. This could be detrimental to fish off Refuge because drainage from Area K flows into the Klamath River.

If grain leases in Area K were unleased because of this alternative (see **4.6.4.1, The Agencies**), it is likely that much of Area K would convert to increased quackgrass fields or mowed fields where quackgrass is not abundant. Conversion would provide a green browse source to local Canada geese and spring migrating geese. Tule Lake NWR would also provide nesting cover for ducks and resident species such as pheasant and quail. Alternately, if mowed weed fields occurred instead, they would provide little habitat for any major wildlife species. If water was available, the mowed weed fields would be flooded. These seasonal wetlands would be valuable to spring migrating and breeding waterfowl (especially mallards, pintail, widgeon, gadwall, shoveler, and teal), but there is little likelihood of there being excess water for flooding during the September through November period due to other system demands. The impacts to Arctic geese are not known. They may abandon the area due to the disappearance of grain fields or they may revert to their natural foraging behavior of grubbing for cattail and bulrush tubers in the newly flooded fields.

4.2.4.2 Threatened and Endangered Species

Synthetic and organic pesticides inputs in croplands and berms and the risk of impacts to endangered species would be similar to those discussed in the wildlife section for this alternative.
IPM-associated agricultural practices in croplands and berms and their impacts to suckers would be similar to those discussed in the wildlife section for this alternative, but would have little impact on bald eagles.

Conversion of unleased parcels (see **4.6.4.1 The Agencies**) to either quackgrass fields, mowed weed fields, or winter seasonal wetlands would probably have negligible effects on either suckers or bald eagles. Conversion of unleased parcels to winter seasonal wetlands would potentially benefit bald eagles by providing additional feeding opportunities on displaced voles during the first year of flooding.

4.3 WATER QUALITY

Tule Lake and Lower Klamath NWR water quality has been described (see **Section 3.4**). Modern pesticides break down in the environment. Their residues do not accumulate in sediment, therefore, cumulative effects, including persistence are unlikely. Because it is assumed existing upstream degraded water sources would not change regardless of the alternative chosen, most effects from agricultural practices under the various alternatives would result in only minor differences in water quality on the refuges.

4.3.1 Alternative 1 No Action

Pesticide inputs to croplands would not adversely affect water quality directly, and any indirect effects related to increases of decaying plant biomass, either blown or falling into waters after herbicide treatment, would likely to be difficult be detect because buffer zones adjacent to aquatic habitats would reduce such impacts. Herbicide use in berms would present the greatest risk of water contamination although such risk is mitigated by PUP restrictions. Indirect effects related to increased decaying plant biomass mentioned above would not be likely because weeds are most often treated in the seedling stage and remain in place.

Based on the assumption that no IPM Plan would be implemented under this alternative, no new pesticides could be approved per an existing Agency directive. The consequence would be that the opportunity to select new, less toxic, less persistent and more selective pesticides than those currently approved would be foregone. The potential to reduce risk to non-target organisms would also be foregone in the long term.

IPM-associated agricultural practices, including flooding, irrigation management, tillage, mowing, burning and cover crops would affect water quality. Flooding of grain stubble in Area K and adjacent private lands, both for pre-irrigation and to control quackgrass, would continue to contribute nutrients and suspended sediments, causing high turbidities in the Klamath Straits Drain and downstream. This activity would continue to adversely affect water quality during late winter and early spring (Dugan, unpublished; Snyder-Conn, unpublished). Tilled soils may also leach minor amounts of salts and other chemicals, temporarily increasing salt concentrations in Tule Lake. Transfer of these waters from Tule Lake to Lower Klamath NWR would continue to be an effective means of managing salt concentrations and avoiding salt toxicity effects on aquatic biota and agricultural crops.

Tillage would continue to affect water quality due to soil erosion and nutrient loading from wind and runoff. Since no sedimentation or nutrient inputs are likely, mowing should have no effect on water quality unless clippings enter the water. Burning and flame weeding management could increase nutrient and sediment inputs. As a result of lease stipulations regarding cover crops in row-crop acreage, adverse effects on water quality from fall harvests and tillage would continue to be reduced under both the short and long terms. Tillage and burning on berms would have the same impacts as those in

croplands. Mowing on berms would potentially introduce biomass into Refuge waters. These impacts would continue over the short and long terms.

Summer ammonia concentrations, sulfur as sulfates and sulfides, and salts would continue to remain high in Refuge waters compared to upstream canal waters (Dileanis et al. 1995), as a likely result of fertilizer inputs on and off Refuge. Existing poor water quality in Tule Lake and Lower Klamath NWRs during the summer would continue, but would not necessarily worsen over the short or long terms.

4.3.2 Alternative 2 Phased IPM Program - Proposed Action

Pesticide inputs to croplands would not adversely affect water quality directly although pesticide inputs and the risk of contamination would potentially decrease relative to Alternative 1 in the short and long terms. However, herbicide use in the berms and risk of contamination would potentially increase in the short term and decrease in the long term relative to Alternative 1. Implementation of the IPM Plan would allow for the selection of new, less persistent pesticides, potentially reducing risk in the short and long terms relative to Alternative 1.

IPM-associated agricultural practices in the croplands potentially affecting water quality and their impacts are similar to Alternative 1. A possible increase in tillage, burning and mowing in berms would result from the accelerated berm management program potentially, increasing sediment loading, nutrient inputs and biomass into water resources over the short term. These impacts would potentially decrease more rapidly over the long term relative to Alternative 1, as berms were converted to perennial grasses.

4.3.3 Alternative 3 Modified IPM Program

Pesticide inputs to croplands would not adversely affect water quality directly, although secondary risks from pesticide inputs would be similar to Alternative 1 in the short term, and to Alternative 2 in the long term. However, herbicide use in the berms and risk of contamination would potentially increase in the short term relative to alternatives 1 and 2 but decrease in the long term similar to Alternative 2. Implementation of the IPM Plan would allow for the selection of new less persistent pesticides potentially reducing risk in the short and long terms relative to Alternative 1.

IPM-associated agricultural practices in the cropland potentially affecting water quality and their impacts would be similar to Alternative 1 in the short term and to Alternative 2 in the long term. A possible increase in tillage, burning and mowing in berms would result from the modified berm management program potentially increasing sediment loading, nutrient inputs and biomass into Refuge waters over the short term. These impacts would potentially decrease more rapidly over the long term relative to Alternative 1, similar to Alternative 2, as berms were converted to perennial grasses.

4.3.4 Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic

Synthetic pesticide inputs in croplands and berms and risk of impacts to water quality would be virtually eliminated in the short and long terms because these materials would no longer be used except in the

case of an emergency situation where wildlife and/or habitat were threatened by a pest. There could, however, be increased inputs and risk of impacts to water resources from certain metal salts, soaps, oils, pyrethrum (a natural botanical pesticide similar to the synthetic pyrethroid permethrin, in its mode of action) and sulfur inputs to treat pests. However, organic pesticide inputs and risk of impacts would be mitigated by PUP restrictions similar to alternatives 1, 2, and 3.

IPM-associated agricultural practices in croplands and berms and their impacts would differ from alternatives 1, 2, and 3 over the short and long terms. Agricultural burning in the croplands would be virtually eliminated, while cover crops would be increased resulting in reduced nutrient inputs and sediment loading into Refuge waters. However, Area K would require large amounts of organic fertilizer (manures) to remain sustainable under an organic cropping system, potentially increasing (relative to alternatives 1, 2, and 3) nutrient inputs into Klamath Straits Drain.

If leased lands were unleased, the impacts on water quality would likely be negligible to beneficial because there would be adequate cover provided by either quackgrass fields, mowed weed fields, or seasonal wetlands to hold soil in place and prevent siltation via wind erosion into the Refuge water and wetlands.

4.4 SOIL RESOURCES

Tule Lake and Lower Klamath NWR soil characters have been described (see **Chapter 3, 3.5**). In the following discussion, impacts of pesticide inputs and agricultural practices on soil organisms, soil organic matter, soil fertility, and soil conservation are discussed. Pesticide residues in soil are dependent upon pesticide inputs and the duration is dependent upon the persistence.

4.4.1 Alternative 1 No Action

Pesticide inputs, especially soil fumigants, would directly affect soil organisms and indirectly affect soil organic matter. Soil fumigants used in croplands would eliminate beneficial soil microorganisms in addition to plant pathogens and plant parasitic nematodes. Elimination of microorganisms responsible for organic matter decomposition would potentially reduce the rate of decomposition. The risk of pesticide contamination of soil resources in croplands and berms would continue over the short and long terms, but residues would not likely accumulate because of the natural breakdown of the product. Based on the assumption that no IPM Plan would be implemented under this alternative, no new pesticides would be approved per an existing Agency directive. The consequences would be that the opportunity to select new, less toxic, less persistent and more selective pesticides than those currently approved would be foregone. The potential to reduce risk to non-target organisms would also be foregone in the long term.

IPM-associated agricultural practices in croplands that would impact soil resources include: flooding/irrigation, tillage, burning and cover crops. Soil flushing by irrigation practices would continue to maintain stable soil salinities. Wind and water erosion and oxidation processes related to tillage

would continue to reduce soil organic content and nutrients over time and changes would be measurable over the long term. The potential for steady declines in yields would be compensated by the increased use of commercial nitrogen fertilizers, green manures, and retained crop residues (e.g., grain straws) (Rodney Todd, Oregon State University Extension Service, personal communication, September 23, 1998). Agricultural burning would continue to expose soil to wind erosion. Cover crops would continue to reduce erosion and soil loss over the short and long terms. Tillage and burning on the berms would have the same effects as those in the croplands over the short and long terms although they would be negligible in comparison. Soil loss from these practices would be irreversible.

4.4.2 Alternative 2 Phased IPM Program - Proposed Action

Pesticide inputs to croplands would potentially decrease and the risk of contamination would also decrease relative to Alternative 1 in the short and long terms. However, herbicide use in the berms and risk of contamination would potentially increase in the short term and decrease in the long term relative to Alternative 1. Implementation of the IPM Plan would allow for the selection of new less persistent pesticides, potentially reducing risk in the short and long terms relative to Alternative 1.

IPM-associated agricultural practices in the croplands potentially affecting soil resources and their impacts would be similar to Alternative 1. A possible increase in tillage, burning and mowing in berms would result from the accelerated berm management program, potentially increasing wind and water erosion over the short term. These impacts would potentially decrease more rapidly over the long term relative to Alternative 1 as berms were converted to perennial grasses.

4.4.3 Alternative 3 Modified IPM Program

Pesticide inputs to croplands would be similar to Alternative 1 in the short term, but inputs and the risk of contamination would potentially decrease, similar to Alternative 2, in the long term. Herbicide use on the berms and risk of contamination would be greater than Alternative 2 in the short term and potentially decrease in the long term similar to Alternative 2.

IPM-associated agricultural practices in croplands would be similar to Alternative 1 in the short term and similar to Alternative 2 in the long term. A possible increase in tillage, burning and mowing in berms would result from the modified berm management program, potentially increasing wind and water erosion over the short term relative to Alternative 2. However, these impacts would potentially decrease more rapidly over the long term as berms were converted to perennial grasses, similar to Alternative 2.

4.4.4 Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic

Synthetic pesticide inputs in croplands and berms would be virtually eliminated in the short and long-terms because these materials would no longer be used except in the case of an emergency situation where wildlife and/or habitat were threatened by a pest. Adverse effects to beneficial organisms from

pesticides would be less than alternatives 1, 2 and 3. Beneficial soil microorganisms (fungi, bacteria and nematodes) would likely increase and the rate of organic matter decomposition could increase as well. There could be increased inputs and risk of impacts to soil resources from certain metal salts, soaps, oils, pyrethrum (a natural botanical pesticide similar to the synthetic pyrethroid permethrin, in its mode of action) and sulfur inputs to treat pests. However, organic pesticide inputs and risk of impacts would be mitigated by PUP restrictions similar to alternatives 1, 2, and 3.

IPM-associated agricultural practices in croplands and berms would differ from alternatives 1, 2, and 3 over the short and long-terms. Agricultural burning in the croplands would be virtually eliminated while cover crops would be increased resulting in greater numbers of beneficial soil microorgansims, improved soil fertility, more soil organic matter and improved soil conservation in the short and long terms relative to alternatives 1, 2, and 3. Area K would require large amounts of organic fertilizer (manures) to become sustainable resulting in increased microorganisms and organic matter. Manures can add undesirable salts to the soil, increasing soil salinities and causing crop toxicities.

Impacts to soil resources from unleased lands (see **4.6.4.1 The Agencies)** would likely be negligible to beneficial because there would be adequate cover provided by either quackgrass fields, mowed weed fields, or seasonal wetland plants to hold soil in place and prevent wind or water erosion.

4.5 AIR QUALITY

Air quality changes are discussed relative to pesticide inputs and dust (particulate matter). Pesticide-associated risks to air resources come from pesticide exposure and secondarily inhalation toxicities. Effects related to carbon monoxide, ozone, and volatile hydrocarbons associated with agricultural practices are believed to be similar for all alternatives.

4.5.1 Alternative 1 No Action

Pesticide inputs in croplands and berms and risk of impacts to air quality would continue as a result of aerial and ground spraying, potentially causing pesticide drift and odor. Pesticide drift would continue to be minimized through PUP restrictions. Based on the assumption that no IPM Plan would be implemented under this alternative, no new pesticides could be approved per an existing Agency directive. As a consequence, the opportunity to select new, less toxic, less persistent, and more selective pesticides than those currently approved would be foregone, as would the potential to reduce risk over time.

Impacts on air quality from IPM-associated agricultural practices in croplands and berms would occur from tillage, burning, and cover crops. Particulates in croplands as a result of tillage would generally be larger (greater than 10 Fm), thus not affecting compliance with state and federal standards for PM-10. Agricultural burning would contribute additional particulates to the air.

There would likely be some net reductions in particulates under this alternative in both the short and long-terms because of lease requirements for cover crops, which would help reduce soil erosion and localized dust storms.

4.5.2 Alternative 2 Phased IPM Program - Proposed Action

Pesticide inputs to croplands and risk of impacts to air quality would be reduced relative to Alternative 1 because pesticide inputs would likely be reduced over the short and long-terms. However, pesticide inputs in berms and risk of impacts to air quality would be increased relative to Alternative 1 because inputs would likely increase over the short term as a result of the accelerated berm management plan. These inputs would likely decline over the long term to a lower level than Alternative 1 as grass plantings became established. Implementation of the IPM Plan would allow for the selection of new, less persistent pesticides, potentially reducing risk in the short and long terms relative to Alternative 1.

IPM-associated agricultural practices in croplands and their impacts to air quality would be similar to Alternative 1 in the short term but would likely be reduced in the long term. Increased tillage and burning in the accelerated berm management program would likely increase particulates over the short term, compared to Alternative 1, but would likely reduce them over the long-term to a lower level than Alternative 1 as grass plantings became established.

4.5.3 Alternative 3 Modified IPM Program

Pesticide inputs in croplands and the risk of impacts to air quality would be similar to Alternative 1. Pesticide inputs to berms and the risk of impacts to air resources would be greater than Alternative 2 in the short term, but similar to Alternative 2 in the long term.

IPM-associated agricultural practices in croplands and their impacts to air quality would be similar to Alternative 1. Increased tillage and burning in the modified berm management program would likely increase particulates over the short term relative to Alternative 2, but would likely reduce them over the long term similar to Alternative 2 as grass plantings became established.

4.5.4 Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic

Synthetic pesticide inputs to croplands and berms and risk of impacts to air quality would be virtually eliminated in the short and long terms because these materials would no longer be used except in the case of an emergency situation where wildlife and/or habitat were threatened by a pest. However, there could be increased inputs and risk of impacts to air quality from certain metal salts, soaps, oils, pyrethrum (a natural botanical pesticide similar to the synthetic pyrethroid permethrin, in its mode of action) and sulfur inputs to treat pests relative to the previous alternatives, although organic pesticide inputs and risk of impacts would be mitigated by PUP restrictions similar to alternatives 1, 2, and 3.

IPM-associated agricultural practices to croplands and berms and their impacts to air quality would differ from alternatives 1, 2, and 3 over the short and long terms. Agricultural burning in the croplands

would be virtually eliminated while cover crops would be increased resulting in reduced particulates relative to alternatives 1, 2, and 3.

Impacts on air quality from unleased lands (see **4.6.4.1 The Agencies**) would likely be negligible to beneficial because there would be adequate cover provided by either quackgrass fields, mowed weed fields, or seasonal wetland plants to hold soil in place and prevent wind erosion.

4.6 SOCIOECONOMICS

Economic effects related to agriculture on the NWRs are extremely difficult to predict because markets are generally volatile, production costs on the leased lands are proprietary, and unpredictable factors such as weather and pests can greatly influence crop production. Further, demand for agricultural products varies substantially with dietary trends and other factors that influence consumer demand. In the case of organic growing, even less quantitative data are available because this market is relatively new.

4.6.1 Alternative 1

4.6.1.1 Effects on the Local Economy

There would be little change from the current situation for leased-land growers and the local economy under the No-Action Alternative. However, since no new chemicals could be approved without an IPM Plan, growers might find an inability to cope with new pests without the availability of new chemicals or tested IPM techniques over the short and long terms (see ***Pesticide Use***, below under **3.6.1.3**) This could indirectly affect growers' ability to achieve the maximum profits from their crops.

The Agricultural Community. The inability to use new pesticides coupled with a lack of tested IPM practices could negatively affect crop production and hence farm profits in the long term. If a serious pest outbreak occurred for which no pesticide was approved or IPM technique tested and available and a crop failure occurred, the economic effects on individual growers and agricultural support industries could be minor to substantial. Effects of such an occurrence also would be irreversible and irretrievable under this alternative.

Future Lease Bids and the Counties. Lease bids would not be directly affected under this alternative. However, since no new pesticides would be approved, and IPM would not necessarily be practiced on a consistent or widespread basis, growers might be unable to respond to infestations of new pests. This indirect effect could, in turn, negatively affect lease bids in the short and long terms and would be irreversible, at least in the short term. Counties receiving lease revenue and Tulelake Irrigation District (TID) could be negatively affected to a minor to negligible degree under this circumstance.

The Agencies. The Agencies would not spend an estimated $250,000 annual budget to carry out a comprehensive IPM Plan on the refuges. The one additional full-time employee and seven

seasonal employees would not be hired, expenditures for supplies and equipment would not be made, and the $40,000 earmarked for research through the Agricultural Experiment Stations would not be allocated. This would indirectly affect the local economy via foregone employment and expenditures.

4.6.1.2 Effects on Crop Yields and Values

Crop yields and values could be negatively affected in the short and long terms if no new chemicals, and few new IPM techniques were available/used. (See discussion under **4.6.1.1 Effects on the Local Economy**, above.) Crop losses would be irretrievable.

4.6.1.3 Effects on Agricultural Practices

Current agricultural practices by leased-land growers would not be affected under Alternative 1, except to the extent discussed below.

Growers would have fewer alternative methods in their pest control 'arsenal,' tailored to the region, than they would have if a formal IPM program was initiated. Although IPM would be implemented on an individual and voluntary basis, the period during which IPM methods were tested and absorbed into farming practices could take considerable time, and might not be documented and shared among other growers or the Agencies. Therefore, the ability to educate and conduct outreach about IPM would be foregone.

The level of Agency-sponsored field and other research to test new farming practices suggested under the IPM Plan to reduce pest levels would be foregone. Conversely, there would be no economic or crop risk from trying new IPM techniques.

Long-term negative aspects of continued chemical use under Alternative 1 would include chemical resistance by pests, killing off natural enemies along with the pests, increases in pests due to killing off natural enemies with pesticides, and potential for certain residual chemicals in the environment. Chemical resistance would be cumulative with other growers' practices in the Basin, and would be irreversible.

Crop Scouting. Crop scouting would not be affected under this alternative.

Pesticide Use. The use of currently approved pesticides would continue, however no new pesticides could be approved. Less effective pesticides could be used in an attempt to control pests where new pesticides could not be approved. This could have negative secondary effects on beneficial insects and might increase pest resistance to certain chemicals. Emergency PUP procedures are being reviewed by the Agencies.

4.6.1.4 Public Controversy

While those opposed to the implementation of an IPM program on the refuges might be satisfied by this alternative, portions of the public believe the Agencies would be in violation of Interior policy directing use of IPM on NWRs, (see **Chapter 1, 1.1 Purpose and Need for the Proposed Action**).

Further, environmental groups and certain individuals would be dissatisfied. They wish to see a reduction in the use of chemicals by alternative methods of pest control, and/or by eliminating row crops they believe are not beneficial to wildlife.

4.6.2 Alternative 2 Phased IPM Program - Proposed Action

4.6.2.1 Effects on the Local Economy

The local economy would likely sustain negligible negative impacts under Alternative 2 in the short term. These effects might occur as farmers converted to IPM from more conventional practices, and therefore made capital expenditures for different supplies or equipment. Regional economic effects are judged to be negligible because only 75 lessees plus and their employees are currently involved in the leased-land program (about 2 percent of regional agricultural operators). For these growers, economic effects are expected to be negligible to minor, depending on the level of IPM currently practiced by individuals. Furthermore, the IPM Program would be phased, allowing growers to incorporate new practices over time; frequent, more intensive and documented crop scouting might actually protect a greater percentage of crops (see **tables 9, 10, and 11**); and lease bidding plus lease incentives would decrease economic risk for growers. Local support businesses might be affected by a change in demand for certain products (e.g., fewer chemicals, but more biocontrols). Demand for crop scouts would be likely to rise, creating more local seasonal jobs.

One full-time and eight seasonal employees would be added to the local workforce contributing approximately $210,000 in annual wages to the local economy. An additional $40,000 would go to fund Agricultural Experiment Station research annually.

***The Agricultural Community*.** The implementation of the IPM Plan on leased lands represents a tradeoff of the known risks of current pest management practices (including some IPM practices) for the perceived risks of new IPM practices (field trials would minimize risk).

Perceived uncertainty associated with IPM methods is compounded by the fact that pest problems and solutions are very crop- and location-specific. Examples of farmers using IPM while raising identical crops under comparable conditions are lacking, except for potatoes and alfalfa. There is, however, a wealth of examples of production of both comparable and non-comparable crops grown under a wide range of conditions where IPM has been successfully implemented. These examples provide a consistent picture of IPM methods lowering costs and increasing crop yields.

In 1994, researchers at Virginia Polytechnic Institute and State University completed a literature review of economic evaluations of pest management programs (Norton and Mullen 1994). These researchers examined 61 studies conducted on crops grown in over 25 states. While the majority of the crops studied are not grown on the Refuge leased lands, a review of the economic evaluations of IPM practices included in the Norton and Mullen report provides evidence that IPM reduces risk and offers greater returns on average when compared to conventional pest management practices.

Table 9 presents the summary results of all 61 IPM studies examined by Norton and Mullen (1994). The results of these economic evaluations are grouped by commodity type. It must be noted that acreages were not considered in the average percent changes presented in **Table 9** for each commodity type. As such, **Table 9** should be viewed as an indicator of the direction of changes in costs and yields rather than as a predictor of specific percentage changes resulting from adoption of IPM practices. **Table 9** shows consistent increases in crop yields and net returns per acre, and consistent decreases in the level of economic risk associated with the adoption of IPM practices.

Tables 10 and **11** present the studies examined by Norton and Mullen for crop varieties grown on the leased lands. The two IPM studies on potato production show a consistent reduction in pesticide costs with the same or better crop quality. The savings associated with the reduction in pesticide use more than offset the cost of IPM in these studies.

Table 11 presents the results of three IPM studies conducted on alfalfa and alfalfa seed production. Again, these studies present a consistent picture of decreased risk and increased net returns per acre resulting from IPM.

Rodale Institute's Farming Systems Trials (Shirley 1993) demonstrated that by using IPM techniques input costs were lowered while maintaining or improving yields and financial risk was reduced after a transition period.

Future Lease Bids and the Counties. Although adoption of comprehensive IPM on Refuge lands would be likely to introduce a degree of perceived economic uncertainty to leaseholders, economic evaluations of IPM and applications of IPM on Refuge lands presents considerable evidence that financial risk from IPM is unlikely to increase, and often decreases. Because many of the studies and experiences cited in discussion that follows have not involved crops and climates identical to those found on the Lower Klamath and Tule Lake refuges, leaseholders on these lands are likely to perceive a degree of risk associated with IPM. The Agencies anticipated the potential risk associated with conversion to a formal IPM Program and mitigated potential risk by phasing lease requirements and field trialing less proven techniques. In addition, the Agencies would offer lease incentives to conduct field trials under this alternative.

TABLE 9. Summary of Results of Farm-level Economic Evaluations of IPM Programs

Commodity	States	Number of Studies	Average Percent Change in Pesticide Use[a]	Percent Change in Production Cost with IPM[a]	Percent Yield Change with IPM[a]	Percent Change in Net Returns Per Acre[a]	Level of Risk with IPM
Cotton	TX, GA, MS, NC, SC, LA, MO, TN, AZ, NM, CA, AR	18	-15	-7	+29	+79	decreased
Soybeans	NC, VA, MD, GA, IN	7	-35	-5	+6	+45	decreased
Corn	IN, IL, and ten other states	3	+20	+3	+7	+54	n/a
Vegetables and flowers	CT, CA, MA, TX, FL, OH, NY, HI	15	-43	Quality increased in 4 studies and remained the same in others.			
Fruits	NY, MA, WA, NJ, CA, CT	8	-20	0	+12	+19	n/a
Peanuts	GA, TX, OK, NC	5	-5	-5	+13	+100	n/a
Tobacco	NC	2	-19	n/a	0	+1	n/a
Alfalfa	OK, WI, Northwest	3	-2	n/a	+13	+37	decreased

[a] For those producers that adopted the specified IPM practices compared to those that did not.
Source: Norton and Mullen 1994.

TABLE 10. Results of Economic Evaluation of Potato IPM Programs

Author	State	Commodity	IPM Technique	Comparison Method	Number of Sprays		Reduction in IPM Users' Pesticide Cost	IPM Costs (Dollars per Acre)	Quality or yield change
					IPM Group	Control pre-IPM			
Coli (1985-1987)	MA	Potatoes	Economic thresholds for 2 insects	IPM growers/ control group	4.4 5.7 4.9	7.5 7.5 7.5	$96,536 for all 3 years	$4.00 $4.00 $4.00	Increase Increase Same
Wright and others (1984-1985)	NY	Fresh Potatoes	Economic thresholds for several insects	IPM growers/ control group	6.2 6.9 4.8 7.8	9.3 8.8 7.0 6.9	$58/acre $31/acre $38/acre $31/acre	$8.00 $8.00 $8.00 $8.00	Same Same Same Same

Source: Norton and Mullen 1994.

TABLE 11. Results of Economic Evaluation of Alfalfa IPM Programs

Author(s)	State	Commodity	Type of IPM practice	Percent Change in Pesticide Cost	Percent Change in Production Cost with IPM	Percent Yield Change with IPM	Percent Change in Net Returns Per Acre	Level of Risk with IPM
McGuckin	WI	Alfalfa	Cultural	decreased	decreased	n/a	increased	decreased
Napit (1986) and Rajotte et al. (1987)	Northwest US	Alfalfa seed	Scouting	-1 to -4	0 to +1	+9 to +17	+35 to +39	n/a
Ward et al. (1990)	OK	Alfalfa	Varietal Resistance Cultural	n/a	decreased	n/a	increased	n/a

Source: Norton and Mullen 1994.

The perceived increases in risk and production costs would likely cause some farmers to place lower bids on leased lands in the short term. The degree to which the bids would be lower would depend on the costs and benefits associated with IPM practices. Initially, it is likely that the out-of-pocket costs of increased crop scouting and the perceived risks associated with IPM would dominate the cost-benefit considerations of farmers when deciding on bid levels. While lease bids may decrease initially (other production and market factors being equal), the long-term effect of IPM on lease bids would depend on the effect IPM practices have on total production costs, total yield, and crop quality.

After a few years of production, much of the uncertainty about per acre net returns using IPM would be eliminated. At that point, lease bids would reflect the actual positive or negative economic effects of IPM. Where IPM has been adopted, it commonly has been found that the additional associated costs, such as for intensive crop scouting, are more than compensated for by increased returns. This is especially true for high value crops with a complex production process. For lower value crops, such as many small grains, the costs of crop scouting may exceed the economic benefits of IPM (Dr. Larry Olson, Director of Michigan State University IPM program, personal communication, January 1, 1997).

Experience suggests, therefore, a long-term minor decrease in lease bids for grain acreage, all other things being equal. On the other hand, lease bids for row crop land could remain stable or increase in the long term, all other things remaining equal.

Reduced lease revenues would be collected from offering lease incentives to conduct field trials. The degree to which this would occur is difficult to quantify, but it is assumed that growers would participate readily in an incentive program. Therefore, lease revenues would decrease as long as incentives were offered.

Given these reasons, the counties receiving leased-land revenues and TID would likely experience minor variances in receipts from lease revenues as a result of implementing an IPM Program. Leased-land revenues represent such a minor amount of the counties' total revenues that any associated increase or decrease is judged to be negligible in the short and long terms.

The Agencies. Under Alternative 2, the Agencies would need to secure funding of approximately $250,000 annually to implement an IPM Program. The commitment of funding for this purpose would be irretrievable, and unavailable for other government purposes. The most likely scenario is for the Agencies to increase their respective budget requests from the Department of the Interior and to receive incrementally increased amounts of revenue earmarked for IPM over time. The direct allocation of lease-fee revenue for this purpose would require changes in federal legislation, necessitating Congressional authorization. (For further discussion of funding, see the 1998 IPM Plan.)

Under Alternative 2, one full-time and seven part-time employees would be added to implement comprehensive IPM on the refuges. This would add to the administrative duties of the Agencies.

4.6.2.2 Effects on Crop Yields and Values

Minor beneficial effects on crop yields and values are anticipated as a result of implementing Alternative 2. In addition to new IPM techniques, pesticides approved under the PUP process would be available for use. Other crops grown in the future might include canola, lentils, and sudangrass, or wetland crops such as wild rice, although these are speculative until trialed in the Basin. As field trials showed promise for other crops that required less chemical input and comparable profits, these might be incorporated into the range of crops grown on the refuges. Thus, cropping patterns might change over the long term.

4.6.2.3 Effects on Agricultural Practices

The number of *current* leased-land growers might decrease slightly in the short term with the implementation of Alternative 2 because some growers could view it as unnecessary government regulation, or might resist the level of initial commitment of time and money that an IPM program requires. However, excellent soils on the leased lands and lack of private ground for lease continue to provide incentive for growers to enter into lease agreements. If the implementation of comprehensive IPM reduced profits from crops in the short or long terms, it is assumed that the market would adjust; bids for leases would decrease commensurate with profitability.

The *rate* at which IPM methods were tested and absorbed into farming practices likely would be substantially increased, both in scope and volume; methods would be *systematically implemented* and *documented* faster than Alternative 1.

The *variety* of pests now associated with the berms (including canals and levees) and the crops grown on the refuges would probably remain the same or increase slightly, but the *volume* of pests would likely diminish with the increase in preventative measures, and a wider array of pest control tools. This would constitute a secondary beneficial impact on adjacent private lands as well. Late blight, a pest of major concern for potato growers, would likely occur on a wider basis regardless of the alternative chosen. Other pests currently unknown on the refuges might also appear, based on historic patterns associated with the spread of crop pests.

Long-term aspects of continued chemical use (including chemical resistance by pests, secondary pest outbreaks, and loss of beneficial insects, and pest resurgence) would be decreased under this alternative over the long term as chemical dependence diminished.

Perhaps the single most dramatic effect for growers as they incorporated IPM practices into daily farming operations would be change. The increase in the level of labor-intensive activities, and the need to learn more about the intrinsic components of IPM, including crop scouting, biology of pests, crop growth cycles, soils, effects of weather, and possible need for new machinery over time would affect the daily lives of growers not currently using a variety of IPM methods. The 1998 IPM Plan states: *"A successful IPM program takes time, money, patience, short- and long-term planning, flexibility, and commitment. Certain IPM strategies, such as increasing beneficial*

insect habitat, may take more than a year — enough time to support an adequate number of predators and parasites to lower the need for pesticides and thus save money. A good system may require a larger initial outlay of time and money than a conventional chemical spray program..." Under Alternative 2, IPM outreach and education would increase local awareness of IPM methodology, thereby enhancing comprehensive IPM implementation.

Crop Scouting.[7] Detailed scouting would be mandatory under this alternative. In other locations, crop scouting is proving to be cost-effective for several of the crops grown on the Lower Klamath and Tule Lake refuges. California, Oregon, Idaho, and Washington growers employing scouting for IPM are increasing their profits. Detailed scouting can result in reduced overall expenditures for chemical pest control. More importantly, because crop scouting is helping growers to make optimal pest control and related cultural practice decisions, yields and crop quality are enhanced.

In most instances, higher quality scouting information reduces grower chemical applications. However, chemical reduction is not guaranteed. Interviews with agricultural faculty, service agencies, and consultants revealed instances where improved scouting actually contributed to increases in the use of agricultural chemicals. An example of this is occurring in the State of Washington, where timely recognition of late blight problems is resulting in a doubling of fungicide application. Detailed scouting also allows for more precise selection and application of pest control chemicals or other IPM techniques, which can lessen the amount of chemical use while improving the effectiveness of pest control. Overall, a net reduction in pesticide applications is anticipated under Alternative 2 as compared to Alternative 1 because of the use of action thresholds, mandatory crop scouting, and coordinated management of the berms.

Spot treatments would be facilitated and unnecessary grower expenditures would be reduced. Chemical use resulting in adverse effects to beneficial insect populations would also be reduced, as would grower expenditure for chemical controls. This could result in increased crop yields.

Crop scouting is likely to be cost-effective for lesser-value crops such as grain only if crop-scouting costs are kept low, possibly by growers becoming Refuge-certified crop scouts. Furthermore, it is most economical for crop consultants to scout multiple fields during a single visit to a farming area. The fact that scouting would be required on all leased lands except the grass hay leases, would create economies of scale for scouting services.

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[7]Information on the cost-effectiveness of intensive crop scouting is based on 20 interviews conducted with university staff across the country, Agricultural Extension Service personnel, county agents, commodity buyers, and professional crop consultants (crop scouts) from California, Oregon, Idaho and Washington. For more detailed analysis and citations, please refer to the Agency file entitled, "*Analysis of Cost-Effectiveness of Crop Scouting,*"available at the Klamath Basin National Wildlife Refuge Complex Office.

It is assumed that University and agricultural agencies, and the Agencies would help to make scouting more efficient and affordable to growers by providing technical assistance (e.g., offering crop scouting training to growers), and access to information, and contributing their expertise in monitoring and analyzing regional and localized environmental factors (e.g., weather, soil moisture, and other considerations) favorable/unfavorable to pests and beneficials. The Agencies would be compiling crop scouting data under this alternative that should assist growers in pest control decisions.

Pesticide Use. The opportunity to approve new products with less toxicity and greater selectivity by implementation of the comprehensive IPM Plan would reduce chemical resistance by pests and decrease killing off beneficial insects, optimizing economic crop production. The number of approved chemicals, both synthetic and organic, might increase over the short and long terms, but at a slower rate than in the past because additional methods of prevention and pest control would be added to growers' options. Overall, a net reduction in pesticide applications is anticipated under Alternative 2 as compared to Alternative 1 because of the use of action thresholds, mandatory crop scouting, and coordinated management of the berms. Additional biocontrols might be added to the list of PUP-approved pesticides as they became available and/or were field tested in the Basin.

4.6.2.4 Public Controversy

Some growers might be dissatisfied with this alternative because they would view it as regulatory intrusion into their farming operations, or would resist the changes that the comprehensive IPM program requires. Other growers may be willing to try the comprehensive IPM program because they see its benefits in the long term. Various individuals would embrace the IPM program because it satisfies the Settlement Agreement, while others may suggest that it does not go far enough in reducing pesticides and protecting endangered species. Those who believe row crops and pesticides should be eliminated from the refuges would not support this alternative.

The Agencies would be in conformance with Department of the Interior policy directing use of IPM and growing of crops on the two NWRs (according to the Agencies' interpretation of laws and policies), and of that portion of the Settlement Agreement addressing IPM.

4.6.3 Alternative 3 Modified IPM Program

4.6.3.1 Effects on the Local Economy

Effects on the local economy would be similar to Alternative 2, except slower in occurring; field trials for new practices would slow any secondary impacts to the local economy.

The Agricultural Community. As discussed under Alternative 2, there appears to be negligible economic risk to growers or agricultural support businesses from implementing IPM on the refuges, particularly since the Agencies have the ability to offer lease incentives (not cash) to offset potentially higher production costs and to conduct field trials. The reason the economic effects of

Alternative 3 are judged to be similar to Alternative 2 is that the Agencies investigated IPM techniques in other regions of the country prior to finalizing the IPM Plan. Those techniques believed to have an unacceptable level of economic risk were recommended for field trial. Only those techniques having proven beneficial effects in similar climates for similar crops were recommended for implementation under the plan. These included such techniques as cover crops, crop rotations and certain biocontrols. Most other techniques were recommended for field trial.

In the long term, economic risks to growers could increase as pest resistance to chemicals increased. Growers could be left without adequate established methods to combat new pests.

Future Lease Bids and the Counties. Under Alternative 3, all IPM techniques would be field trialed and proven effective and beneficial to growers on the refuges prior to becoming possible lease-required practices. This would decrease the perceived risk of IPM techniques and therefore might serve to decrease the short term effects on lease bids discussed under Alternative 2. However, long-term effects on lease bids are assumed to be the same as discussed under Alternative 2; at the point when the uncertainty about per acre net returns using IPM was eliminated, lease bids would reflect the actual positive or negative economic effects of IPM.

Therefore, changes in leased-land revenue contributions to TID and counties receiving leased-land revenues would not likely occur in the short term; in the long term, they would be similar to Alternative 2.

The Agencies. Under Alternative 3, the Agencies would still need to secure funding of approximately $250,000 annually to implement an IPM Program from one of the sources discussed under Alternative 2. All other effects would be similar to Alternative 2, except that fewer seasonal employees would be needed by the Agencies if a number of the growers opted to conduct their own berm management.

4.6.3.2 Effects on Crop Yields and Values

Effects would be the same as Alternative 2, except more field trials would need to be conducted, slowing the process of determining alternative crops suitable to the Basin. Thus, any change in cropping would likely be delayed as compared to Alternative 2.

4.6.3.3 Effects on Agricultural Practices

Agricultural practices would be largely the same as under Alternative 2, except for crop scouting and berm management. The likelihood that IPM methods would be systematically implemented and documented under this Alternative would be decreased as compared to Alternative 2 because crop scouting would not be recorded and reported as consistently. Since all techniques would be field trialed, and because the funding for field trials would limit the amount of trials per year, the rate of IPM implementation would be slowed.

Under this alternative, growers would have the option of controlling pests on the berms using IPM techniques. This could serve to speed the beneficial effects of berm management because the growers have a vested interest in protecting their crops. However, growers would need to coordinate their efforts with the Agencies or other growers. Uncoordinated management of the berms has failed in the past, and this would be a potential outcome under this alternative if growers were inconsistent in weed control practices. (For secondary effects on habitat and wildlife, see appropriate sections.)

Crop Scouting. There would be little change in crop scouting methods from the current situation (Alternative 1) under this alternative. By allowing Refuge-certified growers to scout, the costs of paying an independent crop scout would be alleviated for the growers. By allowing growers *or* PCAs to scout, and by allowing records to be kept by a variety of people using a variety of standards, methods, and data from crop scouting would be less consistent and documentable. The greatest risk involved in this approach to crop scouting is that local action thresholds would be more difficult to establish. This would in turn, delay the ability of the Agencies and growers to establish at what point pesticides or other forms of pest control would be used.

Pesticide Use. Because all IPM techniques would be field tested in the short term, pesticide use would be similar to Alternative 1, except for accelerated use of herbicides on the berms. However, new less toxic pesticides could be approved, similar to Alternative 2. In the long-term, effects of this alternative would be similar to Alternative 2.

4.6.3.4 Public Controversy

The agricultural community might be most satisfied with this alternative because it ensures new measures would be feasible in the Basin. Some growers do not believe Alternative 2 achieves this. While some might believe this alternative satisfies the Settlement Agreement, some would suggest it does not go far enough in reducing pesticides and protecting endangered species. Those who believe row crops and pesticides should be eliminated from the refuges would not support this alternative.

4.6.4 Alternative 4 Transition from Synthetic Pesticide Use to Long-term Organic

Numerous unknown variables affect this alternative, such as: how many current lessees would continue farming under this alternative; willingness of organic farmers to move into the area; the crop mix that would be allowed by the Service within their wildlife goals for the refuges; and the degree to which pests would be controlled using organic/IPM methods. Therefore, the following analysis was formulated with the best information available under the constraints listed above.

4.6.4.1 Effects on the Local Economy

Alternative 4 would have the greatest potential to affect the local economy in the short term. In the long term, under an organic growing system, gross crop values from leased lands could be comparable to or higher than current gross crop values, if prices for organic produce remained high. Change in net values or profits is unknown for both organic and conventional growing systems.

Elimination of all but the emergency use of synthetic pesticides (see **Appendix B** for information on pesticides allowed in organic systems), coupled with the potential change in crop mix because crops would have to be beneficial to wildlife, would noticeably alter agricultural practices on the NWRs, especially during the short term-transition period. These changes could have a ***significant*** negative economic effect on individual lessees, with an attendant effect (that could be major and ***potentially significant***) on the small local towns of Malin, Merrill, and Tulelake, and a minor effect on the tri-county economy in the short term. The short-term economic impacts of this alternative would be irretrievable.

An agronomically/economically viable scenario under Alternative 4 would feature a 6-year rotation of grain, alfalfa, and potatoes (see **tables 12 and 13** below, **Chapter 2, 2.1.1.4 Transitions from Synthetic Pesticide Use to Long-term Organic,** and **Appendix C** for further rationale on rotations selected).

The prohibition on the use of synthetic pesticides would have the effect of providing farm ground for organic growing after 3 synthetic chemical-free years. The total 22,000 acres of leased lands would qualify for organic[8] certification after 11 years (8 years final lease lapse + 3 years of organic growing). It is difficult to predict trends in organic vs conventional markets a decade from now. Research into the most current data reveals that the organic food industry is growing at 20 to 30 percent annually in both fresh produce and process food sectors (Natural Foods Merchandiser 1997a). Market demand for organic potatoes appears fairly strong, and likely to continue for the next few years. The rapidly growing organic dairy market implies that demand for organic feed, including alfalfa hay, may also be growing (Natural Food Merchandiser 1997a). Organic small grain demand appears to be growing at a slower rate. Since organic production accounts for only about 1 percent of total food production (Smillie and Kalogridis 1997), either demand is not particularly strong, or there may be potential for new markets for small grains[9].

Projected increase in demand for organic potatoes is favorable, and the organic market could absorb a fairly large increase in potato supply without price detriment if high quality potatoes could be released into the market during periods of short supply (Karen Salinger, Veritable Vegetable, San Francisco, CA, personal communication, May 1, 1998; Jasch Hamilton, Diamond Organics, Freedom, CA, personal communication, May 1, 1998). Potatoes currently make up 30 percent of vegetable consumption and organic potatoes constitute a promising niche crop with room to grow (Rosselle

[8] The many definitions of organic can be confusing. For purposes of this study, it is assumed that organic means soils have been free from synthetic fertilizer and pesticide use for at least 3 years, crops are grown without the use of synthetic fertilizers or pesticides, frequent crop rotations are used to aid in controlling pests, and methods are used that improve soil tilth.

[9] Carol Savonen, Oregon State University, stated in 1996 that markets for organic cereal grains (wheat, oats, corn, barley, rye, sorghum, and millet) existed at 120 to 170 percent over conventionally grown grains (Savonen 1996).

1998). Storage and processing facilities, both critical to meeting several different market demands and timing of supply, are available in the Basin and could be converted or modified to meet organic processing and storage standards. For instance, potatoes could be processed at Basin facilities used for conventionally grown potatoes as long as the plant and equipment were cleaned properly prior to processing.

To distributors, timing, variety, quality, and packaging are key. Salinger of Veritable Vegetable (pers. comm. May 1, 1998) indicated that the company currently buys potatoes as far away as the Dakotas. A source of organic potatoes closer to the San Francisco area, and available in times of current market shortage, would be highly desirable.

Market prices are extremely difficult to predict into the future. However, current prices for organic potatoes are favorable. Average farmgate prices (price grower receives) for red and russet organic potatoes from January 1997 to April 1998 (Organic Food Business News Fax Bulletin 1998) were $41.20 and $43 per cwt, respectively, as compared to organic break-even prices calculated by a University of Wisconsin study of $7.16 and $4.09, respectively (University of Wisconsin 1992). It is likely that costs of organic production and yields would be substantially lower in actual production conditions since these results occurred under experimental conditions with intensive and expert management.

The effect of growing organically on farmers' net income is unknown given the limited amount of available data on organic costs and yields, especially for this location. Some evidence suggests organic potato costs are 50 percent higher per unit produced due to high losses, lowering yield by 30 to 50 percent (Pimentel 1993), partially because pest and disease control methods are not well developed. Costs of production are also higher because of increased labor requirements.

However, Woody Deryckz, crop consultant in Concrete, Washington (personal communication, May 4, 1998) indicates some of the farmers he consults with have been able to lower their costs to conventional levels, though lowering production costs may mean a larger proportion of small, less valuable potatoes that may not garner organic premiums.

Assuming Tule Lake potato acreage were to remain stable at roughly 2,688 acres, and that the California Certified Organic Farming (CCOF)- acreage were to grow by 3 percent per year for 11 years, CCOF acreage would total 1,141 acres in 2009, when all leased lands would be certified. At that time, the leased lands would represent a substantial increase in regional potato acreage. (Note that acreage certified by other agencies could also be a factor, however, no information is currently available.) Given current estimates of 30 percent annual growth rate in the organic produce industry, it is possible the market would be able to absorb this increase in supply.

Maintenance of potato acreage at about 2,688 is possible given the 6-year rotations shown in **Table 12**. Rough estimates of value of production on Tule Lake NWR are shown in **Table 14**. Whether prices shown would still be available when organic production became established is uncertain.

TABLE 12.
Acreage by Crop under Organic Rotations

Tule Lake Rotation Sequence 1	
alfalfa	2,000
potatoes	680
small grains (any)	1,320
total	4,000
Tule Lake Rotation Sequence 2	
small grains (oats)	5,907
small grains (barley)	3,899
potatoes	2,008
total	11,814
Lower Klamath Rotation Sequence 1	
small grains (oats)	2,000
small grains (barley)	2,000
total	4,000
Lower Klamath Rotation Sequence 2	
continuous grass hay	1,800

Assumptions/justifications:
1. Potatoes can be produced on any lease units throughout the 15,814 acres on Tule Lake NWR.
2. The alfalfa-potato rotation, while agronomically optimal, is confined to 4000 acres, to provide for current level of grain fields as a food source for waterfowl.
3. It is assumed that production costs for potatoes would be higher under Rotation 2 because supplementary nitrogen fertilizer would probably be purchased since alfalfa is not used as a nitrogen fixer.
4. All alfalfa production would be managed as a two-cut-per-year system so that irrigation and harvest could be delayed for nesting waterfowl. As a result, a 20 percent yield reduction to 4T/acre/year is assumed. An approximate price reduction, to $70/T, is also assumed due to lowered quality.
5. All small grain fields in Tule Lake Rotation Sequence 2 would require over-seeding or no-till drilling of cover crops after all grain crops to provide for minimal levels of both nitrogen and pest management.
6. Lack of sufficient livestock manures for the Tule Lake NWR means legumes in rotation are critical to cost-effective organic crop production. Legumes considered are either alfalfa or winter annual, cover crops in other rotations. Livestock manure for Area K on Lower Klamath NWR would be available.
7. Where barley and potatoes appear in the same rotation, nematode suppressing cover crops (e.g., oilseed, radish, rape) may need to be alternated with leguminous cover crops.
8. Organically produced barley would be feed-, not food-grade.
9. A 6-yr. alfalfa-potato rotation is the most sustainable presented; potato rotations of less than 5 years entertain risks of soil-borne disease problems for this crop.
10. Weed problems would be expected to increase under organic farming, but, for the purposes of this analysis, are not expected to decrease crop acreage.

TABLE 13.
Rotation Sequencing under Organic Scenario

Tule Lake Rotation Sequence 1
(on 4,000 acres; about 667 acres in each crop)

Small Grain	°	Small Grain/ Alfalfa Establishment	°	Alfalfa (1st full season)	°	Alfalfa (2nd full season)	°	Alfalfa (3rd full season)	°	Potatoes/ Cover Crop	**
year 1		*year 2*		*year 3*		*year 4*		*year 5*		*year 6*	

Tule Lake Rotation Sequence 2
(on 11,814 acres; about 1,969 acres in each crop)

Oats/ Cover Crop	°	Barley/ Cover Crop	°	Oats/ Cover Crop	°	Barley/ Cover Crop	°	Oats/ Cover Crop	°	Potatoes/ Cover Crop	**
year 1		*year 2*		*year 3*		*year 4*		*year 5*		*year 6*	

Lower Klamath Rotation Sequence 3
(on 4,000 acres: about 2,000 acres in each crop)

Oats/	°	Barley/	°	**
year 1		*year 2*		

Lower Klamath Rotation Sequence 4
(on 1,800 acres)
Continuous Grass Hay

** At the end of each sequence, the rotation is assumed to repeat.

Figures shown in **Table 14** are in gross income per acre. Gross income does not include production costs; production costs are assumed to be higher for alternative 4 than under alternatives 1, 2 or 3 for crops shown.

Whether organically grown barley could meet brewers standards is unclear, but appears unlikely. Until an organic market for malting barley developed, either another small grain could be grown (assuming wildlife benefits), or feed barley would be grown. Alfalfa exported to Japan often requires heavier uses of herbicides. This market could also be lost.

If premiums held and markets for these crops could be found, this very preliminary analysis appears promising, although net values or profits could not be calculated for reasons discussed above.

The Agricultural Community. The number of *current* leased-land growers would probably decrease more than alternatives 1, 2, or 3 in the short term because some growers would view it as unnecessarily restrictive, particularly regarding the use of pesticides. Others might resist the level of

initial commitment of time and money that an organic IPM program required, or would want only to grow the row crops currently allowed. Therefore, the transition phase may prove especially difficult for some; a few may opt for non-renewal of leases under alternative 4. It is conceivable that some growers who have little land of their own might go out of business. It is also possible that, if a few growers did not rebid leased lands, other—perhaps some with organic experience—organic growers might take up those leases.

During the initial years of transition to an organic program, some loss of grower revenue is likely. This is typical and results from the complications of phasing in a new production system, along with the time and experience required to learn new skills. After an organic system becomes established, the degree to which income declined or rose would depend on the crop rotation used, and other market, climatic, and pest factors. The cost to farmers in terms of foregone income, and need to invest in new facilities and machinery, might be substantial. Farmers would have to be well capitalized and in the position to wait up to several years for positive returns.

Madden (1990) found that: *"Severe managerial difficulties are often (not universally) encountered by a farmer switching from chemical-intensive to low-input/sustainable practices. If a farmer chose (or was forced by regulatory or other pressure) to abruptly stop using all synthetic chemical pesticides and fertilizers, then yields and profits could decline sharply in the first few years of the transition... [If a more gradual transition occurred, and with adequate investment in research and education to improve the profitability of the low-input alternatives, these adverse side-effects could be largely or totally avoided.]"*

In a 1994 survey of organic farmers, the University of California found that organic farms are generally run as sole proprietorships or family partnerships. Nearly half made 25 percent or less of their 1992 net family income from farming but, conversely, nearly 25 percent made 70 to 100 percent of their 1992 net family income from farming. The median gross income from the farm in 1992 was $15,000 to $30,000, but about 20 percent of farms grossed $100,000 or more (University of California 1994).

The effects on the social fabric of communities of Tulelake, Malin, and Merrill would be ***significant and adverse*** in the short term, especially if a proportion of leases were unleased. These effects could include lowered economic status, employee layoffs, and families moving to other locations. Economic effects for the leased-land growers could be ***significant and adverse*** in the short term, and moderately adverse to beneficial in the long term.

Future Lease Bids and the Counties. It is assumed that since leases are now on a 5-year renewal basis, the phase-in for this alternative could take 5 years (except for one 8-year lease). Those whose leases came up for renewal first would be the most directly affected both by loss of revenues and changes in agriculture practices. Some leased-land bidders would have up to 5 years to adjust

TABLE 14[(1)]. A Comparison of Production Values between Conventional Farming and Conceptual Organic Crop Rotations on the Leased Lands (in gross dollars)

Estimated current total value of conventional production on NWR leased lands [(2)]					
Crop	**Acreage**	**Unit**	**Production/acre**	**Price/unit $**	**Total $ value**
Potatoes	2,625	cwt	400	4.61	4,840,500
Sugarbeets	818	ton	22	45.00	809,820
Onions	387	cwt	440	4.21	716,879
Alfalfa	906	ton	5	86.57	392,162
Small grains	15, 072	bu	111	5.62	9,402,215
Grass hay	1,806	ton	4.5	75.29	611,882
Total	**21,614[(3)]**				**$16,773,458**
Estimated total value of organic production on NWR leased lands					
Tule Lake Refuge, Rotation Sequence 1					
Crop	**Acreage**	**Unit**	**Production/acre**	**Price/unit $**	**Total $ value**
Potatoes [1]	680	cwt	200	30	4,080,000
Small grains [1, 2]	1,320	bu	90	4.23	502,524
Alfalfa [1]	2,000	ton	4	70	560,000
Subtotal	4,000				5,142,524
Tule Lake Refuge, Rotation Sequence 2					
Potatoes	2,008	cwt	200	30	12,048,000
Small grains (oats)	5,907	bu	90	2.2	1,169,586
Small grains (barley)	3,899	bu	90	3.5	1,228,185
Subtotal	11,614				14,445,771
Lower Klamath, Rotation Sequence 3					
Small grains (oats)	2,000	bu	90	2.2	396,000
Small grains (barley)	2,000	bu	90	3.5	630,000
Subtotal	4,000				1,026,000

Lower Klamath, Rotation Sequence 4					
Continuous grass hay	1,800	ton	4.5	75.29	609,849
Total	**21,614**				**$21,224,144**

(1) Assumptions for organic crops:

• Potato yield slightly less than organic potato yield from University of Wisconsin (1992) study. Potato price assumed 75 percent of current farmgate average from Organic Foods Business News Fax Bulletin, April 20, 1998. Organic prices could go as low as $19/bu and still maintain current total value.

• Some evidence suggests organic potato costs are 50 percent higher per unit produced due to high losses, lowering yield by 30 to 50 percent (Pimentel 1993), partially because pest and disease control methods are not well developed. Costs of production are also higher because of increased labor requirements.

• Small grain price average of wheat, oat, and barley prices from Organic Food Business News Fax Bulletin, April 20, 1998. Organic oat and barley prices are from the Organic Food Business News Fax Bulletin, September 7, 1998.

• Under the assumption of two cuttings for alfalfa, yields and prices decrease to 4 T/acre @$70 (Tule Lake leased land grower, personal communication, September 21, 1998).

• Mixed hay yield and price are average of alfalfa and grass from **tables 7, 8, and 9**.

(2) Source: Plan average prices and acreages. Average of wheat, oats, and barley prices and yields 1980-95. Assumed acreage in crops same as 1996 acreage from **tables 7, 8, and 9**.

(3) Elsewhere in this document, this acreage has been rounded up to 22,000 acres for purposes of analysis. Acreage varies slightly by year.

to the new requirements, or to decide they were too restrictive. In the latter case, new lease bidders would need to participate in the bidding process, or lands would go unleased. Once implemented, the lease period would likely increase to 6 years to accommodate the rotation schemes shown in **Table 13**.

If the implementation of this alternative reduced profits from crops in the short or long terms, it is assumed the market would adjust; bids for leases would decrease commensurate with profitability. Therefore, the short-term effects on future lease bids could be expected to be similar to Alternative 2, except that there would be a potential for 50 percent or more of the acreage to go unleased. Profitability of new crops would probably come at the expense of lowering lease bids on the refuges in the short term. Combined short-term effects on lease bids could be moderate to major. The potential for increased weed infestations under organic management may reduce the bid price on many leases. This would reduce total lease bid revenues, potentially by as much as half, or nearly $1 million, in the short term. This money would not go into the federal treasury, and therefore would be an irretrievable loss of federal funds. The loss would be partially offset because incentives to growers for field trials would not be offered under this alternative.

Leased-land revenue contributions to TID and counties receiving leased-land revenues would be most affected by this alternative, primarily because leased-land revenues could be reduced by half in the short term. This could reduce TID's annual revenues by as much as 4 percent. County revenues might

also be reduced, but this would be a small impact on the counties, given the low percentage of the total county budget these revenues represent.

The Agencies. Because of the intensive wildlife management aspect of this alternative, the Service would likely take over the leasing program and its attendant administrative costs from Reclamation. Considerable record-keeping would be required to track the field-rotation history, adding to administrative costs. For example, if the leased-land units were assumed to be an average size of 100 acres under this Alternative, and each unit was under a 6-year rotation, the number of units and rotations to be tracked and monitored each year would be quite large, and the process complex and time-consuming.

Money would be sought for an IPM program including field trials, and these would emphasize field testing new, potentially wildlife-beneficial crops. Another cost under Alternative 4 would be the revision of the IPM Plan to accommodate an organic approach. Another cost for the Service could be incurred if much of the leased land was not leased. If not properly managed, or neglected, the potential for the area be completely covered by weeds would be likely. The Service would have to address this problem, either by planting cover crops, tilling or mowing the acreage to control weeds, or allowing conversion to quackgrass or seasonal wetlands. Due to minimal inputs, mowing, conversion to quackgrass and/or seasonal wetlands would be the likely scenario. The Service would have to pay the water bill of $38 per acre for any unleased lots (see discussion under **Chapter 2, 2.2.6 Restore All Wetlands on the NWRs and Eliminate the Leased Land Program**). If 50 percent of leases (7,807 acres) on Tule Lake NWR were not leased, this could increase Service administration cost for water by up to $295,645. Conversion of any unleased lands to wintertime seasonal wetlands would inundate and damage field drains and access roads. Though most irrigation canals and laterals generally would be unaffected due to their higher elevations.

Since the Wrangle Island snow goose population could be displaced from using the leased lands under this alternative the Service would be obligated to coordinate with Russia under the 1976 Convention of Migratory Birds and Their Environment of the Migratory Bird Treaty Act.
It is assumed under this alternative that the Agencies would begin to hold field days and conduct other outreach to growers as changes were transitioning to organic status on the refuges. Outreach could include demonstrations or publications of field trials that showed successes and failures of particular crops or techniques. This would serve to implement this alternative in a comprehensive manner.

Other impacts of this alternative would be similar to Alternative 2.

4.6.4.2 Effects on Crop Yields and Values

See **Table 14** for details. For a discussion of short-term production losses see ***Effects on the Local Economy,*** above.

4.6.4.3 Effects on Agricultural Practices

Alternative 4 would generate the greatest degree of uncertainty and change for leased-land growers. Controlling agricultural pests using organic methodologies is currently not widespread in the Basin's agricultural community. By changing crop rotations on the leased lands, and prohibiting all but emergency use of pesticides, lessees would have to substantially change practices on the leased lands. Growers would probably begin to experiment with relatively higher value crops over time.

The *rate* at which organic methods were tested and absorbed into farming practices, likely would be substantially increased both in scope and volume for hay and grains and any allowable row crops in the short term. In the long term this would also apply to alternative crops. The likelihood that IPM methods would be *systematically implemented* and *documented* also would be increased compared to alternative, 1 and 3, and would be comparable to Alternative 2.

The *variety* of pests associated with the berms (including canals and levees) and the crops grown on the refuges would probably diminish in the short term if onions and sugarbeets were removed from the leased lands. However, the pest populations associated with remaining crops could explode in the short term (depending on climatic conditions and other factors) until organic and additional IPM techniques were used and established. This impact could have secondary effects on adjacent private lands with attendant costs for controlling weeds.

Long-term impacts of continued synthetic pesticide use (including chemical resistance by pests, killing off natural enemies along with the pests, increases in minor pests due to killing off natural enemies with pesticides, potential for residual chemicals in the environment) would be decreased to the greatest degree locally by this alternative. However, some organic pesticides may have similar problems.

Learning organic farming techniques and evaluating and assessing the performance of various rotations would require time, effort, and money, especially for new organic growers. The intensive management required to successfully farm organically requires substantial agronomic expertise and familiarity with the ecological roles of many different types of crops. Access to labor may also be limited.

Spray drift and dust or water movement from non-organic fields could pose problems for growers on the refuges, especially those adjacent to non-organic fields off the NWRs. Also, buffer zones may be necessary in organic fields, especially if organic pesticides used posed threats to water quality.

Growers would also need to keep records of their practices and would likely become certified organic under one of the many certification programs now available. Certification requires obtaining and completing applications materials, and passing inspections including soil lab tests for most conventional pesticide residues.

Compelling pest problems under an organic program would include weeds, late blight, rhizoctonia, and nematodes for potatoes; nematodes, mites, Russian wheat aphids, grasshoppers, and various aphids for small grain; alfalfa weevil for alfalfa and some noxious weeds. Of all these pests, weeds and late blight could be the most difficult pests to control under an organic system (as they currently are under conventional systems).

Weeds. The leased lands are host to several noxious weeds that have increased over time. The use of weed control methods under an organic/IPM growing system may not adequately control weeds; they may worsen over time, completely taking over some lease lots. Noxious weed problems could be lessened with cultural and biological methods. Currently, biological controls are available for Canada thistle, hemlock, and purple loosestrife. Chemical treatments for exploding weed infestations would be permitted if wildlife habitats were threatened.

Potatoes - Late Blight. This disease has recently been found on Tule Lake NWR. Sanitation is the first line of defense against late blight in organic systems, but could be difficult with a large number of participant growers, especially if some were not fully committed to making the program work.

Currently, no potato varieties are resistant to late blight but genetic engineering (GE) may produce resistant cultivars as early as 2000. However, USDA recently announced that GE crops will not be allowed to be labeled organic (Shapiro 1998). Copper formulations are currently the only widely recognized organic fungicides recommended for control of late blight and their efficacy is often less than optimal.

Compost tea is also reported to suppress late blight (Weltzein 1990). The use of compost tea as a fungicide, however, is still experimental. While farmers could make their own compost tea, they would first have to make compost, a proposition involving much time and learning. There is also some question as to whether compost tea's effectiveness extends to the new race of late blight, causing current difficulties. Pre-harvest destruction of vines also limits late blight infection. Both mechanical flailing and flaming show promise in destroying vines.

Rhizoctonia. This disease is controlled partially by not allowing potato crops to follow sugarbeet plantings. The recent release of T-22 [10] provides another tool for controlling Rhizoctonia, but this would have to be PUP approved and proven beneficial to wildlife.

[10] T-22 Planter Box is a biological fungicide. It has an EPA "exemption from tolerance" rating in food crops and is developed from the *Trichoderma fungus* found naturally in soil. BioWorks, the manufacturer, sells it as protection against Pythium, Rhizoctonia, and Fusarium as it colonizes on root surfaces where it feeds on nutrients released by the plant roots. The fungus then forms a protective barrier and continues to multiply on root surfaces and prevent invasion of pathogens.

Nematodes. Two species of nematodes are particularly problematic: root-knot and stubby-root nematodes. These pests could probably be controlled with crop rotations to grains and grasses, flooding, fallow periods with occasional discing, and plowdown with nematicidal cover crops.

Small Grains - Nematodes. Similar controls would be used for grains. Attention to rotations and cover crops, along with backup use of biological controls would likely make nematode control manageable.

Mites. Water management, biological control, and crop rotations all would likely play a role in mite control on the NWRs. Among backup controls are insecticidal soaps.

Russian wheat aphid. Aphids are seldom a great problem when natural biological control agents prosper (George Kuepper, National Center for Appropriate Technology, personal communication, May 14, 1998). Biological control is enhanced by good crop rotation, use of cover crops, reduced pesticide use, and some additional attention to the management of buffer strips and other bordering vegetation. Excessive nitrogen in other crops has been associated with aphid problems; excess nitrogen is rarely a problem in organic farming. Good water management and early planting also helps. Release of aphid-resistant barley strains in the near future is also anticipated, though any GE strains would not be allowed under an organic system.

Grasshoppers. The IPM Plan suggests methods for grasshopper control that would be the same for both conventional and organic systems, except the use of synthetic pesticide baits would not be allowed under an organic system. One additional tool for grasshopper control is *Nosema locustae* (a predacious protozoa), although its use would need PUP approval). The risk associated with the control of grasshoppers would probably be about the same between alternatives.

Alfalfa - Alfalfa weevil. It appears that a number of acceptable organic alternatives for weevil control exist, though farmers would need to adopt IPM techniques, including nurturing large populations of beneficial parasitic wasps. Records from eastern U.S. alfalfa production regions indicate where nine out of ten alfalfa fields were sprayed for weevils 10 years ago before release of parasitic wasps, only one in ten is sprayed now (Sullivan 1998).

It is conceivable that an uncontrolled pest outbreak could spread to agricultural operators both on and off Refuge lands, having a negative effect on localized crop production. The risk of crop loss due to an inability to control pests would be comparable to the experiences of organic farmers in the short and long terms, although synthetic pesticides could be used if they threatened wildlife habitat, or public health and safety. This could have a secondary beneficial effect of protecting adjacent fields both on and off the NWRs.

Crop Scouting. Scouting efforts would be comparable to Alternative 2 for the crops grown.

Pesticide Use. Synthetic pesticide use trends would be expected to decrease drastically after the phase-in period. Secondary benefits from this trend would include lower human health and safety risk for field workers and farm operators, and the recreating public on the refuges from reduced aerial spraying. However, several organic pesticides can also pose health and safety risks.

Under a long-term organic program, if emergency pesticide use related to wildlife habitat occurred on croplands, organic status of the land would be jeopardized and growers would lose the ability to market organically for a subsequent 3-year period. Elimination of pesticides would involve greater risk of crop loss and noxious weed infestation, especially until beneficial insect habitat and familiarity with new IPM and organic techniques were established. The degree to which risk of crop loss would occur in any given year would depend on the kind of infestation, weather, and operator practices, as well as the rate at which biocontrols were developed. Introduction of organic and IPM techniques would help minimize crop losses even though synthetic pesticides could not be used.

4.6.4.4 Public Controversy

Most growers probably would reject this alternative because it might limit short-term potential profitability and flexibility of options. They would view it as regulatory intrusion into their farming operations, and/or would resist the changes that organic growing requires. Others may be willing to support it, especially organic growers, because they see its benefits in the long term. Various individuals will suggest that Alternative 4 goes too far in restricting agricultural practices. Those who believe crops beneficial to wildlife should be grown and synthetic pesticides should be eliminated from the refuges will support this alternative.

4.7 RECREATION

4.7.1 Alternative 1 No Action

Under Alternative 1, little change would result from the current situation. Most conflicts between recreationists and leased-land growers have resulted where row crop harvesting and field hunting for waterfowl have been attempted in the same or adjacent lease lot (Fran Maiss, U.S. Fish and Wildlife Service, personal communication, April 21, 1998). Visitors would probably continue to register the occasional complaint that the Refuge experience was diminished by aerial pesticide applications, and the smell of chemicals. Possible human health and safety concerns associated with pesticide drift would continue.

4.7.2 Alternative 2 Phased IPM Program - Proposed Action

Implementing a phased comprehensive IPM Program would have little direct effect on recreation on the NWRs. Indirect aspects of implementing IPM would include some annoyance of recreationists from cultural and mechanical pest control practices. Conversely, beneficial effects would include the enhanced opportunity for passerine bird and upland game bird viewing, and pheasant hunting with improved upland cover provided by the berm management program, and cover and windbreak planting on leased lands. In addition, as pesticide use diminished over time with the use of IPM techniques, aerial applications would diminish as would the use and odor of pesticides. This could serve to enhance recreationists' experience of the NWRs as well as decreasing human health and safely risks.

4.7.3 Alternative 3 Modified IPM Program

Effects on recreation would be generally similar to Alternative 2, but would take longer to achieve.

4.7.4 Alternative 4 Transition from Synthetic Pesticide Use to Long-Term Organic

The combination of the prohibition on all but emergency pesticide use, the emphasis on compatible crops, the emphasis on habitat and cover, and the decrease in the perceived nuisances of noxious smells and public safety hazards from pesticides could serve to beneficially affect wildlife, with a secondary benefit to recreation and human health and safety. When wildlife habitats were threatened with exploding weed populations, chemical treatments could be applied,
resulting in short-term effects in limited areas, similar to Alternative 1.

The implementation of this alternative would effectively eliminate field-hunting opportunities for ducks and arctic geese in the Tule Lake leased lands. It could greatly reduce wildlife viewing opportunities along the Tule Lake auto tour route since waterfowl staging could be greatly reduced under this alternative. It may increase opportunities for pheasant hunting should pheasant populations increase due to enhance habitat.

TABLE 15. COMPARISON OF IMPACTS BY ALTERNATIVE

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM Program	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
TERRESTRIAL HABITATS	Pesticide inputs and risk of impacts to terrestrial vegetation are primarily limited to the effects of herbicide use and exposure. In croplands, pesticide use would continue to result in economic reductions of agricultural weeds, insects, diseases, and other pests (such as nematodes). Herbicide use would continue to allow high yielding, weed-free grain fields	Same as Alternative 1.	Same as Alternative 1.	Synthetic pesticide inputs would be virtually eliminated over the short and long terms because these materials would no longer be used except in the case of an emergency situation where wildlife and/or habitat were threatened by a pest that could not be controlled otherwise.
	The opportunity to select new, less toxic pesticides than those currently approved would be foregone. In addition, chemical resistance problems would continue under this alternative. The potential to reduce risk to non-target organisms also would be foregone.	Approval of new products could potentially reduce risk in the short and long terms. As action thresholds for weeds were developed and implemented, herbicide inputs and associated risk to terrestrial habitats would be expected to decrease more rapidly than Alternative 1.	Same as Alternative 2.	Organic herbicides for the proposed crops (small grains, alfalfa, and potatoes) would not be commercially available in the short term, resulting in the potential for increased weed populations in croplands with reduced habitat values.
	Efforts to improve upland habitat values for ground-nesting birds through a berm (weed) management program would occur in a limited fashion, and only as time and funding became available.	The berm management would potentially be accelerated, relative to Alternative 1, resulting in more desirable nesting cover for birds and greater reduction in noxious weeds in a shorter period of time.	The berm management would potentially be accelerated more than Alternative 2, unless grower participation was uncoordinated similar to Alternative 1.	Uncontrolled weeds on berms could spread to adjacent private and public habitats and farmlands with negative environmental and economic results. Grain stubble available for spring and fall waterfowl feeding habitat would be reduced from 11,000 acres to 660 acres on Tule Lake NWR in the long term. Agricultural burning in the croplands would be virtually eliminated while cover crops would be increased by 10,000 acres relative to alts. 1, 2, and 3.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM Program	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
AQUATIC HABITATS	Pesticide impacts to aquatic vegetation would be limited primarily to herbicide use in croplands and berms. Indirect effects would potentially include the introduction of increased biomass of decaying vegetation into aquatic habitats, reducing available dissolved oxygen for aquatic life. These impacts would be negligible, but would continue over the short term.	Same as Alternative 1 except the potential to approve new products with more selectivity could reduce risk in the short and long terms. Herbicide use in berms and associated risk to aquatic habitats would be greater than Alternative 1 in the short term. As grasses were established on the berms, herbicide use and associated risk to aquatic habitats would decrease.	Same as Alternative 2. Herbicide use in berms would be greater than Alternative 2 unless grower participation were uncoordinated.	Synthetic pesticide inputs would be virtually eliminated over the short and long terms. Herbicide use in berms would be virtually eliminated.
	Buffer zones and drift retardants established to reduce the risk of pesticide entry into waterways, and restrictions on applications of pesticides, would continue to mitigate pesticide-associated risk to aquatic habitats.	Impacts from increased activity on the berms would be greater in the short term but similar in the long term to Alternative 1.	Impacts from increased activity on the berms would be greater than Alternative 2 unless grower participation were uncoordinated.	Impacts from increased activity on the berms would be greater than alternative 1, 2 and 3. If any lands were unleased under this alternative (see 4.6.4.1 The Agencies), conversion of such lands to wintertime seasonal wetlands using water available from winter runoff could occur.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM Program	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
WILDLIFE	Pesticide inputs and risk of impacts to wildlife on the refuges are dependent on direct or indirect (through a food source) exposure to insecticides, fumigants, fungicides, and, in the case of fish and other aquatic organisms, herbicides. If mortalities attributable to a specific pesticide were found, the use of that pesticide would be more severely restricted or prohibited on the NWRs.	Pesticide inputs in croplands and risk of impacts to wildlife (including insects) would be less than Alternative 1.	Pesticide inputs in croplands and risk of impacts to wildlife (including insects) would be less than Alternative 1 but greater than Alternative 2.	Synthetic pesticide inputs in croplands and berms and risk of impacts to wildlife would be virtually eliminated. Organic pesticide inputs and risk of impacts would be mitigated by PUP restrictions similar to alternatives 1, 2, and 3.
	The opportunity to select new, less toxic pesticides than those currently approved would be foregone. The potential to reduce risk to non-target organisms would also be foregone in the long term.	The opportunity to approve new products with less toxicity and greater selectivity with the full implementation of the IPM Plan would potentially reduce risk relative to Alternative 1.	Same as Alternative 2.	Same as Alternative 2. The virtual elimination of undisturbed grain stubble in the fall in the leased lands of the Tule Lake NWR would likely lead to a precipitous decline in use by migrating ducks and arctic geese.
		Improved grass cover on the berms in the long term would also potentially enhance nesting success for waterfowl, pheasants, and quail.	Improved grass cover on the berms in the long term would also potentially enhance nesting success for waterfowl, pheasants, and quail unless grower participation was uncoordinated.	If grain leases were unleased they would likely be converted to quackgrass fields or mowed. Quackgrass provides green browse for local Canada geese and spring migrating geese. Mowing would create little habitat for any major wildlife species. If water was available, seasonal wetlands would be valuable to spring migrating and breeding waterfowl, but there is little chance of excess water for flooding during September through November.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM Program	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
Threatened & Endangered Species	Pesticide-use restrictions listed in approved PUPs and additional mitigation measures outlined in biological assessments and required in biological opinions have resulted in a determination by the Service that existing pesticide use would not jeopardize threatened and endangered species or proposed critical habitat on the refuges. Based on these earlier consultations and analyses, and on protective measures required in the biological opinions to reduce potential adverse effects, few negative consequences would be predicted for these species.	Pesticide inputs in croplands and risk of impacts to threatened and endangered species would be less than Alternative 1. Short-term risks to suckers would be greater than Alternative 1 with increased herbicide inputs to berms but these risks would likely be reduced in the long term as herbicide use declined, to a level similar to Alternative 1.	Pesticide inputs in croplands and the risk of impacts to wildlife would be greater than Alternative 2, but less than Alternative 1, in the short term, but similar to Alternative 2 in long term. Short-term risks to suckers would be greater than Alternative 2 with increased herbicide inputs to berms but these risks would likely be reduced in the long term as herbicide use declined, to a level similar to Alternative 1.	Synthetic pesticide inputs in croplands and berms and risk of impacts to wildlife would be virtually eliminated. Organic pesticide inputs and risk of impacts would be mitigated by PUP restrictions similar to alternatives 1, 2, and 3. Conversion of unleased parcels (see 4.6.4.1 The Agencies) to either quackgrass fields, mowed weed fields, or winter seasonal wetlands would probably have negligible effects on either suckers or bald eagles. Conversion of unleased parcels to winter seasonal wetlands would potentially benefit bald eagles by providing additional feeding opportunities on displaced voles during the first year of flooding.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM Program	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
WATER	Pesticide inputs to croplands would not adversely affect water quality directly.	Pesticide inputs and the risk of contamination would potentially decrease relative to Alternative 1 in the short and long terms.	Pesticide inputs and risk of contamination would be similar to Alternative 1 in the short term, and to Alternative 2 in the long term.	Synthetic pesticide inputs in croplands and berms and risk of impacts to wildlife would be virtually eliminated. Organic pesticide inputs and risk of impacts would be mitigated by PUP restrictions similar to alternatives 1, 2, and 3.
	Herbicide use in berms would present the greatest risk of water contamination although such risk is mitigated by PUP restrictions.	Herbicide use in the berms and risk would potentially increase in the short term and decrease in the long term relative to Alternative 1.	Herbicide use in the berms and risk would potentially increase in the short term relative to alternatives 1 and 2 but decrease in the long term similar to Alternative 2.	Agricultural burning in the croplands would be virtually eliminated, while cover crops would be increased resulting in reduced nutrient inputs and sediment loading into Refuge waters.
	The opportunity to select new, less toxic, less persistent and more selective pesticides than those currently approved would be foregone. The potential to reduce risk to non-target organisms would also be foregone in the long term.	Implementation of the IPM Plan would allow for the selection of new, less persistent pesticides, potentially reducing risk in the short and long terms relative to Alternative 1.	Same as Alternative 2.	However, Area K would require large amounts of organic fertilizer (manures) to remain sustainable under an organic cropping system, potentially increasing (relative to alternatives 1, 2, and 3) nutrient inputs into Klamath Straits Drain.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM Program	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
SOILS	Pesticide inputs to croplands and berms and risk of contamination would continue over the short and long terms, but residues would not likely accumulate. The opportunity to select new, less toxic, less persistent and more selective pesticides than those currently approved would be foregone.	Pesticide inputs to croplands would potentially decrease and the risk of contamination would also decrease relative to Alternative 1 in the short and long terms. Herbicide use in the berms and risk of contamination would potentially increase in the short term and decrease in the long term relative to Alternative 1. Implementation of the IPM Plan would allow for the selection of new less persistent pesticides, potentially reducing risk in the short and long terms relative to Alternative 1.	Pesticide inputs to croplands would be similar to Alternative 1 in the short term, but inputs and the risk of contamination would potentially decrease, similar to Alternative 2, in the long term. Herbicide use on the berms and risk of contamination would be greater than Alternative 2 in the short term and potentially decrease in the long term similar to Alternative 2. Same as Alternative 2.	Synthetic pesticide inputs in croplands and berms and risk of impacts to soil resources would be virtually eliminated. Organic pesticide inputs and risk of impacts would be mitigated by PUP restrictions similar to alternatives 1, 2, and 3. Agricultural burning in the croplands would be virtually eliminated while cover crops would be increased resulting in greater numbers of beneficial soil microorgansims, improved soil fertility, more soil organic matter and improved soil conservation in the short and long terms relative to alternatives 1, 2, and 3. Area K would require large amounts of organic fertilizer (manures) to become sustainable resulting in increased microorganisms and organic matter. Manures can add undesirable salts to the soil, increasing soil salinities and causing crop toxicities.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM Program	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
AIR QUALITY	Pesticide inputs to croplands and berms and risk of impacts to air quality would continue as a result of aerial and ground spraying, potentially causing pesticide drift and odor. Pesticide drift would continue to be minimized through PUP restrictions. The opportunity to select new, less toxic, less persistent, and more selective pesticides than those currently approved would be foregone.	Pesticide inputs to croplands and risk of impacts to air quality would be reduced relative to Alternative 1. Pesticide inputs in berms and risk would be increased relative to Alternative 1 in the short term but would likely decline over the long term. Implementation of the IPM Plan would allow for the selection of new, less persistent pesticides, potentially reducing risk in the short and long terms relative to Alternative 1.	Pesticide inputs in croplands and risk of impacts to air quality would be similar to Alternative 1. Pesticide inputs to berms and the risk would be greater than Alternative 2 in the short term, but similar to Alternative 2 in the long term. Same as Alternative 2.	Synthetic pesticide inputs in croplands and berms and risk of impacts to air quality would be virtually eliminated. Organic pesticide inputs and risk of impacts would be mitigated by PUP restrictions similar to alternatives 1, 2, and 3. Agricultural burning in the croplands would be virtually eliminated while cover crops would be increased resulting in reduced particulates relative to alternatives 1, 2, and 3.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM Program	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
SOCIOECONOMICS				
Effects on the Local Economy	Would be little change from the current situation for leased-land growers and the local economy. However, since no new chemicals could be approved, growers might find an inability to cope with new pests over the short and long terms. This could indirectly affect growers' ability to achieve the maximum profits.	The local economy would likely sustain negligible negative impacts under Alternative 2 in the short term. Demand for crop scouts would create more local, seasonal jobs. One full-time and seven seasonal workers would be added to the federal workforce, contributing $210,000 in wages. An additional $40,000 would go to Agricultural Experiment Research Station annually.	Effects on the local economy would be similar to Alternative 2, except slower in occurring; field trials for new practices would slow any secondary impacts to the local economy.	This alternative would have the greatest potential to affect the local economy in the short term. In the long term, under an organic growing system, gross crop values from leased lands could be comparable to or higher than current gross crop values, if prices for organic produce remained high. Net crop values are unknown. Would noticeably alter agricultural practices on the NWRs, especially during the short term-transition period. These changes could have a significant negative economic effect on individual lessees, with an attendant effect (that could be major and potentially significant) on the small local towns of Malin, Merrill, and Tulelake, and a minor effect on the tri-county economy in the short term. Short-term economic impacts would be irretrievable.

The Agricultural Community	The inability to use new pesticides coupled with a lack of tested IPM practices could negatively affect crop production and hence farm profits in the long term. Economic effects on individual growers and agricultural support industries could be minor to substantial. Effects of a major pest outbreak could be irreversible and irretrievable under this alternative.	A tradeoff of the known risks of current pest management practices (including some IPM practices) for the unknown risks of new IPM practices would result. Consistent increases in crop yields and net returns per acre, and decreases in the level of economic risk associated with the adoption of IPM practices would be expected in the short and long terms.	Economic effects are judged to be similar to Alternative 2. Levels of perceived risk would be reduced over alternatives 2 and 4. In the long term, economic risks to growers could increase as pest resistance to chemicals increased.	The number of current leased-land growers would probably decrease more than alternatives 1, 2, or 3 in the short term The effects on the social fabric of communities of Tulelake, Malin, and Merrill would be significant and adverse in the short term, especially if a proportion of leases were unleased. Economic effects for the leased-land growers could be significant and adverse in the short term, and moderately adverse to beneficial in the long term.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
Future Lease Bids and the Counties	Lease bids would not be directly affected under this alternative. Growers might be unable to respond to infestations of new pests. This indirect effect could, in turn, negatively affect lease bids in the short and long terms and would be irreversible, at least in the short term. Counties receiving lease revenue and Tulelake Irrigation District (TID) could be negatively affected to a minor to negligible degree under this circumstance.	The perceived increases in risk and production costs would likely cause some farmers to place lower bids on leased lands in the short term. While lease bids may decrease initially, the long-term effect of IPM on lease bids would reflect the actual positive or negative economic effects of IPM. Affected counties and TID would likely experience minor variances in receipts from current lease revenues, judged to be negligible in the short and long terms.	Similar to Alternative 1 in the short term. Long-term effects on lease bids would be the same as Alternative 2. Changes in leased-land revenue contributions to affected counties and TID would not likely occur in the short term; in the long term, they would be similar to Alternative 2.	If reduced profits from crops in the short or long terms, market would adjust; bids for leases would decrease commensurate with profitability. Short-term effects on future lease bids could be expected to be similar to Alternative 2, except that there would be a potential for 50 percent or more of the acreage to go unleased. Combined short-term effects on lease bids could be moderate to major if alternative reduced total lease bid revenues, potentially by as much as half, or nearly $1 million. This would be an irretrievable loss of federal funds. The leased-land revenue contributions to TID and counties receiving leased-land revenues would be most affected by this alternative. This could reduce TID's annual revenues by as much as 4 percent. County revenues might also be reduced negligibly.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
The Agencies	The Agencies would not spend an estimated $250,000 annual budget. One additional full-time employee and seven seasonal employees would not be hired, expenditures for supplies and equipment would not be made, and the $40,000 for research through the Agricultural Experiment Stations would not be allocated, indirectly affecting the local economy via foregone employment and expenditures.	The Agencies would need to secure $250,000 annually to implement a comprehensive IPM program. The commitment of funding for this purpose would be irretrievable, and unavailable for other government purposes. One full-time and seven part-time employees would be added to implement comprehensive IPM on the refuges. This would add to the administrative duties of the Agencies.	Similar to Alternative 2, except that fewer seasonal employees would be needed by the Agencies if a number of the growers opted to conduct their own berm management.	The Service would likely take over the leasing program and its attendant administrative costs from Reclamation. Considerable record-keeping would be required to track the field-rotation history, adding to administrative costs. Other costs would be the revision of the IPM Plan to accommodate an organic approach and additional administrative costs if much of the leased land was not leased. The Service would be obligated to coordinate with Russia under the 1976 Convention of Migratory Birds and Their Environment of the Migratory Bird Treaty Act.
Crop Yields and Values	Crop yields and values could be negatively affected in the short and long terms if no new chemicals, and few new IPM techniques were available/used. Crop losses would be irretrievable.	Minor beneficial effects on crop values and yields would be anticipated. As field trials showed promise for other crops that required less chemical input and comparable profits, these might be added to the mix of crops grown on the refuges. Thus, cropping patterns might change over the long term.	Same as Alternative 2, except more field trials would need to be conducted, slowing the process of determining alternative crops suitable to the Basin. Thus, any change in cropping would likely be delayed as compared to Alternative 2.	Yields for small grains, potatoes, and alfalfa will be reduced. Values for small grains and alfalfa will be reduced, while values for potatoes will be increased.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
Agricultural Practices	Current agricultural practices by leased-land growers would not be affected under Alternative 1, except growers would have fewer alternative pest control methods. IPM would be implemented on an individual and voluntary basis but could take considerable time, and might not be documented and shared among other growers or the Agencies. Therefore, the ability to educate and conduct outreach about IPM would be foregone. Most Agency-sponsored field trials to reduce pest levels would be foregone. Conversely, there would be no economic or crop risk from trying new IPM techniques. Long-term negative aspects of continued chemical use under Alternative 1 would include chemical resistance and pest resurgence. Chemical resistance would be cumulative with other growers' practices in the Basin, and would be irreversible.	Growers would have more pest control options than Alternative 1. The number of current leased-land growers might decrease slightly in the short term. The rate at which IPM methods were tested and absorbed into farming practices likely would be substantially increased, both in scope and volume; methods would be systematically implemented and documented faster than Alternative 1. Variety of pests would probably remain the same or increase slightly, but volume of pests would likely diminish. Would have a secondary beneficial impact on adjacent private lands. Long-term aspects of continued chemical use would be decreased over the long term. Cooperative management of the berms between the Agencies, growers, and cooperators would accelerate pest control on berms. Implementing comprehensive IPM would mean changes for some growers. Perhaps the single most dramatic effect for growers as they incorporated IPM practices into daily farming	Agricultural practices would be largely the same as under Alternative 2, except for crop scouting and berm management. The likelihood that IPM methods would be systematically implemented and documented under this Alternative would be decreased as compared to Alternative 2. Since all techniques would be field trialed, and because the funding for field trials would limit the amount of trials per year, the rate of IPM implementation would be slowed. Under this alternative, growers would have the option of controlling pests on the berms using IPM techniques. This could serve to speed the beneficial effects of berm management. However, growers would need to coordinate their efforts, or outcome would be similar to Alternative 1.	Would generate the greatest degree of uncertainty and change for leased-land growers. The rate at which organic methods were tested and absorbed into farming practices, likely would be substantially increased both in scope and volume. The likelihood that IPM methods would be systematically implemented and documented also would be increased compared to alternatives 1 and 3, and would be comparable to Alternative 2. Pest populations associated with remaining crops could explode in the short term (depending on climatic conditions and other factors) until organic and additional IPM techniques were used and established. This impact could have secondary effects on adjacent private lands with attendant costs for controlling weeds. Long-term impacts of continued synthetic pesticide use would be decreased to the greatest degree locally by this alternative. However, some organic pesticides may have similar problems. Weeds and late blight could be the most difficult pests to control under an organic system (as they currently are).

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
Crop Scouting	Crop scouting would not be affected under this alternative.	Detailed scouting would be mandatory under this alternative, and would need to be carried out by a Refuge-certified individual. Crop scouting likely would be cost-effective for most crops; lesser-value crops such as grain would be cost-effective only if crop-scouting costs were kept low, possibly by grower becoming crop scouts.	Little change in crop scouting methods from Alternative 1. By allowing Refuge-certified growers to scout, the costs of paying an independent crop scout would be alleviated for the growers. Crop scouting would be less consistent and documentable. Local action thresholds would be more difficult to establish, and would be delayed compared to Alternative 2.	Scouting efforts would be comparable to Alternative 2 for the crops grown.
Pesticide Use	The use of currently approved pesticides would continue, however no new pesticides could be approved. Less effective pesticides could be used having negative secondary effects on beneficial insects and might increase pest resistance to certain chemicals. Emergency PUP procedures are being reviewed by the Agencies.	Would reduce chemical resistance, optimizing economic crop production. The number of approved chemicals, both synthetic and organic, might increase over the short and long terms. Overall, a net reduction in pesticide applications is anticipated under Alternative 2 as compared to Alternative 1 because of the use of action thresholds, mandatory crop scouting, and coordinated management of the berms. Additional biocontrols might be added to the list of PUP-approved pesticides.	In the short term, pesticide use would be similar to Alternative 1, except for accelerated use of herbicides on the berms. However, new less toxic pesticides could be approved, similar to Alternative 2. In the long-term, effects of this alternative would be similar to Alternative 2.	Synthetic pesticide use trends would be expected to decrease drastically after the phase-in period. Secondary benefits from this trend would include lower human health and safety risk. However, several organic pesticides also pose risks. Elimination of synthetic pesticides would involve greater risk of crop loss and noxious weed infestation. Introduction of organic and IPM techniques would help reduce crop losses.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
Public Controversy	While those opposed to the implementation of an IPM program on the refuges might be satisfied by this alternative, portions of the public believe the Agencies would be in violation of Interior policy directing use of IPM on NWRs. Environmental groups and certain individuals would be dissatisfied. They wish to see a reduction in the use of chemicals by alternative methods of pest control, and/or by eliminating row crops they believe are not beneficial to wildlife.	Some growers might be dissatisfied with this alternative, because they would view it as regulatory intrusion into their farming operations, or would resist the changes that the comprehensive IPM program requires. Other growers may be willing to try the comprehensive IPM program because they see its benefits in the long term. Various individuals would embrace the IPM program because it satisfies the Settlement Agreement, while others may suggest that it does not go far enough in reducing pesticides and protecting endangered species. Those who believe row crops and pesticides should be eliminated from the refuges would not support this alternative.	The agricultural community might be most satisfied with this alternative. While some might believe this alternative satisfies the Settlement Agreement, some would suggest it does not go far enough in reducing pesticides and protecting endangered species. Those who believe row crops and pesticides should be eliminated from the refuges would not support this alternative.	Most growers probably would reject this alternative. Others may be willing to support it because they see its benefits in the long term. Various individuals will suggest that Alternative 4 goes too far in restricting agricultural practices. Those who believe crops beneficial to wildlife should be grown and synthetic pesticides should be eliminated from the refuges will support this alternative.

Project Element	Alternative 1 - No Action	Alternative 2 - Phased IPM Program - Preferred Alternative	Alternative 3 - Modified IPM	Alternative 4 - Transition from Synthetic Use to Long- Term Organic
RECREATION	Under Alternative 1, little change would result from the current situation. Possible human health and safety concerns associated with pesticide drift would continue.	Would have little direct effect on recreation on the NWRs. Indirect aspects of implementing IPM would include some annoyance of recreationists from cultural and mechanical pest control practices. Conversely, beneficial effects would include the enhanced opportunity for passerine bird and upland game bird viewing, and pheasant hunting.	Effects on recreation would be generally similar to Alternative 2, but would take longer to achieve.	Could serve to beneficially affect wildlife, with a secondary benefit to recreation and human health and safety. When wildlife habitats were threatened, chemical treatments could be applied, resulting in short-term effects in limited areas, similar to Alternative 1. Would effectively eliminate field hunting opportunities for ducks and arctic geese in the Tule Lake leased lands. It could greatly reduce wildlife viewing opportunities along the Tule Lake auto tour route but increase opportunities for pheasant hunting.

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CHAPTER 7 GLOSSARY

action threshold The population level at which control measures are needed to prevent pest populations from reaching the economic injury level. The action threshold is lower than the economic injury level to allow for control measures to take effect before the population reaches economic damage.

(the) Agencies U.S. Fish and Wildlife Service (Service) and U.S. Bureau of Reclamation (Reclamation)

berms Dikes, canals, and roadways on the leased lands, collectively referred to as berms.

biological control Use of predators, parasites, natural or genetically engineered diseases, attractants, hormones, trap crops.

buffer zone Variable-width pesticide no-spray zones adjacent to waterways, established to protect aquatic habitats.

compatible (use) A wildlife-dependent recreational use or any other use of a refuge that, in the sound professional judgement of the Director [of the Service], will not materially interfere with or detract from the fulfillment of the mission of the [NWR] system, or the purposes of the refuge.

crop scouting Systematically sampling a crop to determine pest identification, development, abundance, and population, as well as status of the crop.

cultural control Physical means of reducing pest populations (e.g., fertilization, mowing, cultivation, crop rotation, timing of planting or harvesting).

cumulative impact Cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

economic injury level The lowest number of insects or mites that will cause economic damage--expressed as a number of insects per leaf or plant part.

Finding of No Significant Impact (FONSI) After a determination by the lead agency (Service) that a proposed action will not significantly affect the human environment, a FONSI is prepared. A summary of the environmental assessment is incorporated into the FONSI.

integrated pest management (IPM) IPM treats pests as part of a crop production system that includes not only the crop and its pests, but also the crop's entire physical setting. A good IPM program coordinates pest management activities with each other and with production methods to reach cost-saving, long-lasting solutions to pest problems. The emphasis is on knowing about and preventing problems before they occur. An IPM program does not eliminate the use of pesticides, but attempts to use them as a last line of defense against pests, not as the first control option. In practice, a grower will use several pest controls based on knowledge of the crop, and pests' natural enemies to avoid crop loss and minimize harmful effects on natural resources.

IPM Citizens Advisory Group A group of persons having interest in IPM on the refuges including leased-land growers, conservation groups, recreationists, and Agency personnel. The group was formed to advise the Contractor preparing the IPM Plan.

irreversible Impacts are considered to be *irreversible* if a chemical, biological, or physical process began that could not be stopped. As a result, the resource or its productivity or utility would be lost forever.

irretrievable An impact is considered *irretrievable* when it would eliminate a resource, its productivity and/or utility for the duration of the IPM program.

leased lands The nearly 22,000 acres within the Lower Klamath and Tule Lake NWRs leased to growers for agricultural purposes by Bureau of Reclamation.

long term Would last beyond a 10-year period.

mechanical control Control of pests by physical means such as tillage.

pests All organisms that negatively impact agriculture operations and/or wildlife habitats, including plants, noxious weeds, insects, diseases, and rodents.

pesticides Substances or mixtures of substances intended to prevent, destroy, repel, or reduce populations of pests (either plant or animal) to an acceptable level.

pesticide use proposal (PUP) A proposal that must be prepared for each chemical used in pest control programs on Refuge lands. It is used to evaluate the specifics of proposed chemicals, treatment sites, application methods, and sensitive aspects of use, including effects on endangered species.

row crops For purposes of this document, row crops are defined as sugarbeets, onions, and potatoes.

short term Would occur over the next 10 years.

U.S. Bureau of Reclamation An agency of the U.S. Department of the Interior whose mission is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

U.S. Fish and Wildlife Service An agency of the U.S. Department of the Interior whose mission, working with others, is to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people.

wildlife-compatible crops Crops used directly by wildlife for food, cover, and nesting.

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APPENDIX A

Executive Summary
for the
Integrated Pest Management Plan
for Leased Lands at Lower Klamath
and Tule Lake National Wildlife Refuges
Oregon/California

EXECUTIVE SUMMARY

This document explains the concept of integrated pest management (IPM) and how it can be applied to the Tule Lake and Lower Klamath national wildlife refuges (NWRs). It is Department of the Interior policy to implement IPM plans on all wildlife refuges in the United States, and this IPM Plan was, in part, prepared to satisfy that requirement. Another purpose of this Plan is to balance pest control practices with the goals of agriculture production and profitability, consistent with wildlife management as called for in the Kuchel Act.

SCOPE

The IPM Plan describes current agricultural practices, pest management and pesticide use on the Tule Lake and Lower Klamath NWRs, and provides an on-the-ground, how-to IPM manual for growers and refuge managers specific to the refuges. *This is not an enforcement document.* However, guidance provided by this Plan may influence the content of leases and pesticide use proposals written for leased lands on Tule Lake and Lower Klamath NWRs. This IPM Plan covers all federal lands (22,600 acres) that are leased for agriculture purposes in 1996 on the Tule Lake and Lower Klamath NWRs.

The Plan addresses terrestrial pests found on Refuge lands that are leased for agriculture purposes and also addresses pests found on bank-tops associated with the refuges' extensive water delivery system, roadsides, and grasslands. Pests are identified as all organisms that negatively impact agriculture operations and/or wildlife habitats, including plants, noxious weeds, insects, fungi, bacteria, and rodents.

IPM PLAN

The Plan is organized in three sections. The first describes the scope of the Plan, background and history of the refuges, principal authorities and policies that guide the Agencies (U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation), public involvement activities of the project, the IPM Plan goals and current terrestrial and aquatic habitat conditions, and agriculture conditions on the refuges.

The second section is an IPM Workbook. It begins by presenting information on the role of IPM on the refuges, provides a working definition of IPM, discusses general IPM techniques (such as crop scouting and field trials) and explains general approaches to cultural, biological, and chemical control methods. The next part of the IPM workbook contains sections on weeds and refuge grown crops (potatoes, small grains, sugar beets, onions and alfalfa, and their pests). Each crop section is organized in the following way: crop overview, monitoring, invertebrate pests, diseases, field trial recommendations, useful contacts and resources and literature cited. This section is the heart of the IPM Plan because it offers crop and pest-specific IPM options for use by growers on Refuge lands. The last part of the IPM Workbook provides information on IPM methods to combat vertebrate pests (voles).

The third section of the Plan presents final recommendations that would result in some immediate changes in lease agreement conditions, as well as longer-term changes as IPM methods are phased in on Refuge lands. The section also provides an implementation plan and a process for reviewing and updating the Plan.

FINAL RECOMMENDATIONS

A brief listing of the *final recommendations* follows:

Administrative Recommendations:

- Funding to implement the IPM Plan must be obtained
- An IPM coordinator will be hired and given authority to carry out the IPM Plan
- An ongoing IPM Coordination Group will be established
- A berm management subcommittee of the Coordination Group will be formed
- A pesticide subcommittee of the Coordination Group will be formed
- Lease incentives will be offered for field testing IPM techniques
- PUP-approved pesticide labels will be filed at Agency offices
- Row crops grown for certified seeds will be subject to the same pest control thresholds as commercial crops
- The IPM coordinator will maintain data files on field trials
- Beneficial aspects of sump rotation will be incorporated into the IPM Plan as results become available
- Baseline physical, biological, and wildlife data should be compiled
- Alternative pesticides should be explored by the Agencies/Growers to help prevent pest resistance problems
- IPM outreach activities should be developed
- Private/public partnerships will be pursued to carry out IPM
- The IPM Plan will be reviewed annually
- A comprehensive IPM Plan review will occur every 5 years

Field Recommendations:

- Crop scouting will be required as part of new lease agreements
- Field trials will be used to test and demonstrate IPM techniques
- Within 5 to 10 years, growers can expect new IPM requirements in lease agreements
- Alternative crops need to be field-tested in the Klamath basin
- Cover crops will be encouraged to reduce erosion
- If vole control is needed, only nonchemical methods will be used
- When action thresholds are known for specific crop/pests, they must be the primary determinant when deciding whether ground or aerial pesticide spraying will be allowed

TABLE 1. Recommended Implementation Schedule (Note: Bolded text in the 'Who's Responsible' column denotes primary responsibility).

ADMINISTRATIVE RECOMMENDATIONS

Task	Who's Responsible	Estimated Amount of Funding	Start Date*	Remarks
1. Fund the IPM Plan	**Service, Reclamation,** Congressional delegation, with support from ag. service agencies, growers, and interested public	$250,000 total annually; individual cost breakdowns listed separately below	As soon as IPM Plan is adopted	Funding options need to be explored by the agencies as soon as possible due to the time it takes to resolve these kinds of issues. **Essential**
2. IPM Coordinator will be given Authority to Carry- out IPM Plan	**Klamath Refuge Manager**	Cost: $110,000/year/total: Coordinator $58-$65,000; technician $28,000; overhead $18,000. Equipment $38,000.	October 1997	Critical to IPM Plan implementation **Essential** $38,000 for equipment is a one-time capital cost
3. Establish IPM Coordination Group	**IPM Coordinator**	Staff time	Year 1	IPM Coordinator will consult with growers, Agency staff, conservation groups in establishing this group.
4. Berm Management Subcommittee	**IPM Coordinator**, IPM Coordination Group, TID, Reclamation	$80,000/year/total: four, 6-month seasonal employees $60,000, equipment & supplies $20,000	Year 1	IPM Coordinator will work closely with growers, ag researchers and others interested in solving the berm problems.
5. Pesticide Subcommittee	**IPM Coordinator** IPM Coordination Group, PUP Review Team	Staff time	On an as-needed basis but no less than twice a year	
6. Offer Lease Incentives for IPM Implementation	**Reclamation** with cooperation from growers	Variable, lease-fee incentives	Year 1	This will help pass techniques on to growers
7. File PUP-Approved Pesticide Labels	**IPM Coordinator**	staff time	Year 1	**Essential**

Task	Who's Responsible	Estimated Amount of Funding	Start Date*	Remarks
8. Allow Certified Seed Crops on Refuges if Subject to Same Thresholds as Commercial Crops	**Reclamation**	Minimal	Year 1	**Essential**
9. Maintain field trial data files	**IPM Coordinator**	Staff time	Year 1	
10. Implement Sump Rotation Elements as Research Results Becomes Available	**Service and Reclamation**	Multi-million dollar project	Annual review of sump rotation studies to determine whether research has proven beneficial to IPM and wildlife.	**Essential**
11. Baseline data Program	**Special research teams**, refuge biologists, UC Davis	$20,000/year/total: for soil, water quality, wildlife, fisheries monitoring. Two seasonal biological technicians.	Year 1	This will provide baseline data for long-term management and evaluation; data will be filed at Service headquarters at Tule Lake. Data should be scientific quality and publishable.
12. Provide Alternative Pesticides for Rotations	**PUP Review Committee**, growers	Staff time	Annually	Field trials will be used to assess effectiveness of alternative pesticides and biologicals.
13. IPM Outreach Activities	**Reclamation, Service**, agriculture service agencies, volunteers	Staff time	Year 2	
14. Private/Public Partnerships	**Refuge and Reclamation Managers,** organization volunteers	Staff time	Year 2	
15. Review IPM Plan	**Service,** Reclamation, IPM Coordination Group	Staff and volunteer time	Annually	

Task	Who's Responsible	Estimated Amount of Funding	Start Date*	Remarks
16. Comprehensive IPM Plan Review	**Service,** Reclamation, IPM Coordination Group	Staff and volunteer time	Every five years	

FIELD RECOMMENDATIONS

Task	Who's Responsible	Estimated Amount of Funding	Start Date*	Remarks
17. Require Crop Scouting	**Service and Reclamation** in leases	Staff time to set up new lease clauses	Year 1	**Essential**
18. Conduct Field Trials to Test IPM	**Agriculture researchers, growers,** IPM Coordinator, IPM Coordination Group	$40,000year/total: Agriculture Experiment Station salaries and equipment	Year 1	Prioritize trials within 6 months of IPM start date. Establish scientific protocols and requirements for different levels of field trials. **Essential**
19. IPM Requirements in Lease Agreements	**Reclamation,** in leases	Staff time	No later than 5 to 10 years	Field tested locally and found appropriate for lease lands **Essential**
20. Testing of alternative crops	**Agriculture researchers, growers, ag. extension, IPM Coordinator**	growers' labor and equipment, lease fees if incentives provided, grants	Year 2	
21. Encourage Cover Crops	**Reclamation** in leases**,** in cooperation with growers	Leased-land fees, Natural Resource Conservation Service shelter belt program, growers	Year 2	Soil cover requirements could be included in leases. Incentives could be given for windbreaks.
22. Nonchemical control methods for voles	**Reclamation**/ Growers	Staff time	Year 1	**Essential**
23. Action Thresholds must be the primary determinate before spraying decision is made.	**Reclamation**/ Growers/ IPM Coordinator	Staff time	Year 1	For known interim thresholds, add to lease requirements as they come up for bid. As new, local thresholds are established, these will also be added to lease requirements. **Essential**

* Start Date -- date when Agencies complete required administrative process (including NEPA Process) and begin the Plan implementation. Some elements of the Plan will be implemented sooner than others.

APPENDIX B

From *IPM Practitioner* xx(4) April 1998

Bio-Integral Resource Center (BIRC)
P.O. Box 7417
Berkeley, CA 94707
(501) 524-2567

Box A. Natural (Non-Synthetic) Substances Allowed in Crop Production

Since no natural (non-synthetic) items is forbidden, then all natural substances are allowed. A partial list historically permitted for use in organic production is published in the Proposed Rule and is reprinted below (p. 65888).

Animal Substances or By-Products

Blood meal, bone meal and bones, feather meal, fish emulsions, fish hydrolysate, fish products (fish meal, fish bones, and fish powder), fish solubles, guano, bat or bird, hoof and horn meal, insect extracts, manures, animal, manure tea, oyster shells and other sea shells, oyster shell lime, sea animal wastes, tankage, whey, worm castings.

Beneficial Organisms

Algae, bacteria, including *Bacillus thurigiensis* (BT), fungi, higher animals, higher plants, insects, microbial soil, compost, plant and seed inoculants, mites, nematodes, protozoa, viruses.

Fermented and Other

Alcohol from natural sources only (ethyl) biodynamic preparations, compost, compost tea, gibberelic acid, leaf mold, mushroom compost, vinegar.

Mined Minerals and Other Mined Substances

Basalt, borate and boron products, calcium sulfate (gypsum), Chilean nitrate (sodium nitrate_, clays, colloidal phosphate, cryolite (sodium fluoaluminate), diatomaceous earth, dolomite, feldspar, granite dust, greensand, humates from mined sources, humic acid derivatives, kieserite, lignite, limestone, marl, muriate of potash, niter (potassium nitrate), peat perlite, raw phosphate rock potassium sulfate, pumice, rock dust, sand, sulfur, sulphate of potash magnesia (langbeinite), sodium bicarbonate, vermiculite.

Plant Substances or By-Products

Alfalfa pellets or meal, aquatic plant extracts, citrus products, citrus oil, cocoa bean hulls, cotton gin trash, cottonseed meal, food processing wastes, garlic, grape and other pomaces, herbal preparations, hay; unprocessed, meal, extracts or other derivatives of kelp or seaweed; leaves, molasses, neem and neem extracts, peanut meal, peanut hulls, plant extracts, propolis, pyrethrums, rice hulls and other residues, rotenone, ryania, sabadilla, saw dust, bark, wood chips and other wood wastes, soybean meal, straw, tobacco and tobacco by-products, wood ash, vegetable waste, cannery waste.

Box B. Active Synthetics (Pesticides) Allowed in Crop Production

Horticultural oils may be used as insect pest smothering or suffocation agents. Horticultural oils include dormant oils, suffocating oils, and summer oils. Soaps may be used as insecticides, algicides, de-mossers, large animal repellents, and herbicides (p. 65944).

Production aids may be used as follows: acetic acid as a pesticide; pheromones as insect mating disruptors; vitamins as growth promoters and rooting facilitators; vitamin D3 as a rodenticide; amino acids as growth promoters; antibiotics as pesticides; magnesium sulfate as a cation balancing agent; newspaper and other re-cycled paper products as mulch and compost feed-stocks; piperonyl butoxide as a synergist; potassium sulfate as a cation balancing agent; and boric acid as a pesticide.

Toxins derived from genetically engineered bacteria (or other microorganisms that are not released live into the agroecosystem) may be used as pesticides.

Cooper and sulfur compounds as follows may be used as pesticides: Bordeaux mixes; copper, including fixed coppers exempt from tolerance by EPA, copper hydroxides, basic sulfates, oxychlorides and oxides; Lime sulfur, including calcium polysulphide, and sulfur dioxide.

Micronutrient minerals as follows may be used: chelated micronutrients; soluble boron products; and sulfates, carbonates, oxides, or silicates of zinc, iron, manganese, molybdenum, selenium, cobalt or copper.

Minerals as follows may be used as defoliants in organic fiber production: Calcium chloride; magnesium chloride; sodium chlorate; and sodium chloride (p. 65891; 65944).

Active Synthetic Substances Allowed in Organic Livestock Production

Trace minerals nutrients and dietary supplements: feed additives; animal drugs and other animal health care substances; vaccines and biologics; and pest control substances (p. 65893; 65944).

Box C. Non-Organic Substances Allowed in Organic Processing

Agar-agar, alginates, alginic acid, aluminum-free baking powder, ammonium bicarbonate, ammonium carbonate, ascorbic acid, beeswax, calcium carbonate, calcium chloride, calcium citrate, calcium sulfate, calcium hydroxide, calcium phosphates (mono, di and tribasic), candelilla wax, carbon dioxide, carnauba wax, carregeenan, chymosin, citric acid.

Non-synthetic colors, non-synthetic dairy cultures, dipotassium phosphate, enzymes, non-synthetic glycerin , gums, lactic acid, unbleached or bleached lecithin, magnesium chloride, magnesium carbonate, magnesium stearate, magnesium sulfate, mono and diglycerides, natural flavoring agents, non-synthetic nutrient supplements, low-methoxy and native (high-methoxy) pectin.

Potassium acid tartrate, potassium carbonate, potassium chloride, potassium citrate, potassium phosphate, silicon dioxide, sodium bicarbonate, sodium carbonate, sodium citrate, mono, di and tribasic sodium phosphates; sulfur dioxide (not to exceed 100 ppm when used in wine).

Tartaric acid, tocopherols, whey and its fractions, wood rosin, xanthan, gum, non-synthetic yeast autolysate, non-synthetic baker's yeast, non-synthetic brewer's yeast, non-synthetic nutritional yeast, non-synthetic smoked yeast (p. 65894; 65944).

APPENDIX C

Clarification of and Rationale for Rotation Sequencing in Alternative 4 (Transition from Synthetic Pesticide Use to Long-term Organic)

The following discussion is provided to assist in explaining the organic growing system presented under Alternative 4 in this EA. The sections that follow discuss crop rotations and cover crops from the perspective of sound organic and agronomic (crop production) practice; they do not address the constraints on crop selection and management imposed by law, the priorities of wildlife management, or Refuge infrastructure and lease considerations. Those considerations are thoroughly discussed in the body of the EA.

Organics Defined

Organic crop production is most simply understood as the growing of crops without the use of synthetic pesticides or commercial (salt-based, synthetic) fertilizers. Organic growers manage fertility and pest control through with a host of alternative means including crop rotation, green manuring, cover crops, tillage, addition of livestock manures, composting, ground-rock mineral fertilizers, enhancing biological controls, and the use of natural pesticides – mostly mineral, botanical, or biological in origin. Because of the relatively higher values of row crops and relatively lower values of small grains and forages, organic growers would rely under this scenario on low-input strategies, such as crop rotation and cover crop/green manures to create production systems that were both agronomically and economically viable.

Rotations Explained

Crop rotation refers to the sequence of crops that may appear on a specific field over time.

Alternately planting oats and barley on the same field without change is an example of a 2-year crop rotation:

oats	°	barley	°	oats	°	barley	°	*cycle repeats*
year 1		year 2		year 3		year 4		year 5 plus

• A specific sequence of crops may be as long as 8 years and feature a diversity of crops. A 6-year rotation featuring 3 years of perennial alfalfa and potatoes with a winter annual cover crop is presented:

potatoes/ winter cover crop	°	oats	°	barley/ alfalfa establishment	°	alfalfa	°	alfalfa	°	alfalfa	°	*cycle repeats*
year 1		year 2		year 3		year 4		year 5		year 6		year 7 plus

• Continuous cropping, in which the crop grown on a field does not change (e.g., continuous corn or continuous hay) is also referred to as a rotation though the term is largely a misnomer.

The Benefits of Planned Rotations

Rotations benefit crop production in two ways that are especially important to organic culture:

1. Rotations that include full-season forage legume crops (e.g., alfalfa) and/or winter annual legume cover crops provide nitrogen (N) to the soil that will be available to subsequent crops of grains and vegetables that lack the ability to fix N from the atmosphere.

2. Rotations disrupt the life cycles of various weeds, insects, and disease organisms, completely eliminating the need for pesticides and other controls in many instances.

Agronomic Assumptions and Rationale Supporting Rotation Sequences Presented in Alternative 4

• Rotation Sequence 1. (see below)

potatoes/ winter cover crop	°	oats	°	barley/ alfalfa establishment	°	alfalfa	°	alfalfa	°	alfalfa	°	*cycle repeats*
year 1		year 2		year 3		year 4		year 5		year 6		year 7 plus

Rotation sequence 1 can be considered a sound organic rotation based on agronomic principles. The main crop of economic value in this rotation is potatoes. As this 6-year cycle repeats itself, potatoes immediately follow alfalfa, where the maximum benefit of nitrogen is achieved. Potatoes appear only once in 6 years because a minimum of 5 years is required to suppress most of the soil-borne diseases common to potatoes. It is also separated from barley, which also hosts a common nematode pest, by 3 years of alfalfa (a non-host). A nematode-suppressing cover crop (e.g., rape, oilseed radish) would be advisable following potatoes to reduce erosion and nutrient leaching while further reducing the pest population.

Alfalfa is established by interseeding into small grains. The small grain then serves as a "nurse crop" to the alfalfa, eliminating the need for herbicidal weed control. Alfalfa is maintained for 3 years to help assure that the costs of establishment are recovered. By the end of 3 years, it is also reasonable to assume that grasses and other weeds may be invading the stand, reducing its quality and marketability.

Small grains follow potatoes to benefit from the nematode suppression provided by the winter cover crop (barley specifically). Small grains also benefit from the carry-over weed suppression obtained under potatoes. Weed management in potatoes is relatively easy using timely mechanical tillage and irrigation. Two different small grains would be planted in this rotation for economic diversity and to reduce nematode problems.

- Rotation Sequence 2. (see below)

potatoes/ winter cover crop year 1	oats/ winter cover crop year 2	barley/ winter cover crop year 3	oats/ winter cover crop year 4	barley/ winter cover crop year 5	oats/ winter cover crop year 6	*cycle repeats* year 7 plus

The principal crop of economic value in this rotation is potatoes, as it is in sequence 1. Since there is no perennial legume in rotation, however, it must rely on sufficient nitrogen fixation from winter annual cover crops, interseeded into the oat crops. Nematode-suppressing cover crops would probably need to be employed following potatoes and all barley crops to assure suppression of that pest. It is possible that supplementary organic nitrogen fertilizer would be necessary to produce an acceptable yield of potatoes as enough N might not be fixed under this rotation.

Weed problems in small grains could also be expected to be worse in this rotation when compared to sequence 1 since there is less crop diversity, and therefore, less diversity in crop competition and control practices such as mowing. Sequence 2 is a less sound rotation from an agronomic perspective than sequence 1, but should still be workable.

- Rotation Sequence 3. (see below)

oats/ year 1	barley/ year 2	*cycle repeats* year 3 plus

The N required for this rotation would have to be supplied by large amounts of locally obtainable organic fetlizer (manures). Ostensibly, the greatest agronomic threat appears to derive from weeds, which can easily flourish under a rotation with so little diversity. It is least desirable of the organic rotation sequences from an agronomic perspective.

- Rotation Sequence 4. Continuous grass hay.

When native species or aggressive weedy species (e.g., quackgrass) are grown, maintenance can be minimal. The overseeding of some legume species to serve as a companion and source of N can often be of great benefit if native species do not volunteer

Graphic Presentations

Crop rotation is most easily understood when it is presented graphically.

Example #1: A Single Farm Model 6-year rotation on six fields.

Field 1		Field 2		Field 3	
year 1	potatoes/cc	year 1	oats	year 1	barley/ae
year 2	oats	year 2	barley/ae	year 2	alfalfa
year 3	barley/ae	year 3	alfalfa	year 3	alfalfa
year 4	alfalfa	year 4	alfalfa	year 4	alfalfa
year 5	alfalfa	year 5	alfalfa	year 5	potatoes/cc
year 6	alfalfa	year 6	potatoes/cc	year 6	oats

Field 4		Field 5		Field 6	
year 1	alfalfa	year 1	alfalfa	year 1	alfalfa
year 2	alfalfa	year 2	alfalfa	year 2	potatoes/cc
year 3	alfalfa	year 3	potatoes/cc	year 3	oats
year 4	potatoes/cc	year 4	oats	year 4	barley/ae
year 5	oats	year 5	barley/ae	year 5	alfalfa
year 6	barley/ae	year 6	alfalfa	year 6	alfalfa

cc = winter cover crops; ae = alfalfa establishment

The graphic presentation above is an idealized model. In the real world, the farmer faces varying land capabilities, different field sizes, evolution of market demands, weather and pest problems a host of factors that require adjustments in rotation planning and execution of a plan. The second example, provided on the next page, illustrates how a more complex farm with more fields and field sizes could still adapt three of the rotation sequences described. The resulting acreages of each crop will vary year to year under these circumstances because field size would vary, however, that is a practical result of trying to implement a planned rotation scheme.

It is also helpful to understand that the models shown represent these rotation schemes at a "matured" stage. In other words, they have been in place for a few years. Because no one can start a new field in its third year of alfalfa, for example, a synchronization period of 3 to 4 years would likely be necessary to bring all field units into their desired spot in the crop sequence.

Example #2: A Single Farm Model: 6-year, 2-year, and 1-year rotations on nine fields.
(a real-world conceptualization)

year 1	potatoes/cc
year 2	oats
year 3	barley/ae
year 4	alfalfa
year 5	alfalfa
year 6	alfalfa

year 1	oats
year 2	barley/ae
year 3	alfalfa
year 4	alfalfa
year 5	alfalfa
year 6	potatoes/cc

year 1	barley/ae
year 2	alfalfa
year 3	alfalfa
year 4	alfalfa
year 5	potatoes/cc
year 6	oats

year 1	alfalfa
year 2	alfalfa
year 3	alfalfa
year 4	potatoes/cc
year 5	oats
year 6	barley/ae

year 1	alfalfa
year 2	alfalfa
year 3	potatoes/cc
year 4	oats
year 5	barley/ae
year 6	alfalfa

year 1	alfalfa
year 2	potatoes/cc
year 3	oats
year 4	barley/ae
year 5	alfalfa
year 6	alfalfa

year 1	oats/cc
year 2	barley/cc
year 3	oats/cc
year 4	barley/cc
year 5	oats/cc
year 6	barley/cc

year 1	grass hay
year 2	grass hay
year 3	grass hay
year 4	grass hay
year 5	grass hay
year 6	grass hay

year 1	barley/cc
year 2	oats/cc
year 3	barley/cc
year 4	oats/cc
year 5	barley/cc
year 6	oats/cc

cc = winter cover crops; ae = alfalfa establishment

APPENDIX D

Comments and Responses Concerning the Draft Environmentmental Assessment for an Integrated Pest Management Program for Leased Lands at Lower Klamath and Tule Lake National Wildlife Refuges Oregon/California

A draft environmental assessment (EA) was sent to all parties on a mailing list compiled during the preparation and review of the IPM Plan. In addition, the EA was posted on the Internet. Public comments were received on this EA during a review period from July 9, 1998 through September 10, 1998. E-mail comments received or letters postmarked after September 10, 1998 were not considered or responded to.

Four hundred and thirty-two letters (including e-mail letters) of comment were received in response to the draft EA. Comments from these letters along with comments from two public meetings, were paraphrased and sometimes grouped for ease of response and review. Responses were drafted by the appropriate technical specialist or Agency personnel, and then reviewed by the interdisciplinary team that reviewed the EA.

Some of the responses were answered by amending the EA in the appropriate section; this occurred where the comment appeared to have substantive merit. In addition, the Agencies revised the EA because new information came to light since the release of the draft EA and/or for purposes of clarification; and/or to improve the relevancy or accuracy of the document. While comments expressing opinions and endorsements were appreciated, only substantive comments were addressed here.

A list of people and organizations who provided comments (within the public comment period) is provided at the end of this appendix.

These comments and responses are now a part of the public record on the IPM Plan EA and will be forwarded to decision-makers: the Area Manager for U.S. Bureau of Reclamation, Klamath Basin Area Office; and the Regional Director, U.S. Fish and Wildlife Service, Pacific Region.

Comment 1. Numerous commentors supported additional or total removal of agriculture from the refuges. In general, their comments reflected the opinion that agricultural chemicals are incompatible with wildlife production on the National Wildlife Refuges (NWRs.**)**

Response: See page 1-1, **Purpose and Need for the Proposed Action**. Within this section it is stated that: *It is U.S. Department of Interior policy to reduce the use of pesticides through IPM, and to implement IPM on all National Wildlife Refuges (NWRs) in the United States.* It is further stated that: *The long-term goal of the proposed IPM Program is to minimize the use of pesticides associated with agriculture on the leased lands over time.*

The Agencies interpret the Kuchel Act (see **Section 1.2.1 The Kuchel Act** in the EA) to include both agricultural and wildlife uses at the NWRs. The purpose of the IPM Plan was to reduce pesticide use associated with agriculture on the NWRs, not to eliminate agriculture.

Comment 2. Numerous commentors opposed to chemical use on the National Wildlife Refuges (NWRs) supported organic farming as the preferred alternative.
Response: The EA evaluated an organic alternative. See chapters 2 and 4. The Agency decision-makers will determine which alternative is implemented.

Comment 3. Develop a blueprint (concrete plans and completion dates) that creates agricultural borders and designate those areas that will remain off limits to agricultural users.

Response: See second paragraph in response to Comment 1.

Comment 4. Wetlands are a very important part of our environment and should be protected from pesticides now.

Response: A pesticide use proposal (PUP) must be prepared for each chemical used in pest control on the NWRs. PUPs evaluate the specifics of proposed chemicals, treatment sites, application methods, and sensitive aspects of use. Through this process, wetlands on the NWRs are protected.

Comment 5. The preferred alternative may actually allow increased use of toxic chemicals; this would be unacceptable.

Response: The preferred alternative does allow the use of pesticides when other methods have failed, and after action thresholds have been met. Refer to EA, **Chapter 4, Section 4.2.2.1 Wildlife**.

Comment 6. I care about the Klamath Basin refuges and am deeply concerned by their mismanagement.

Response: The IPM Plan evaluated by this EA addressed only integrated pest management on the Lower Klamath and Tule Lake NWRs. The Plan took an in-depth look at agricultural pesticide use with the aim of improving environmental practices where possible. It was not intended for this plan to be an area-wide evaluation of NWR management.

Comment 7. These places are critical for native fish and wildlife – protect them for all of us and for the future.

Response: See responses to comments 1 and 5.

Comment 8. Several commentors stated that the EA does not set goals for reducing pesticide use.

Response: True, the EA does not. The IPM Plan, however, does propose specific methodologies that could substantially reduce pesticide use over time. Refer to EA, **Chapter 4, Section 4.2.2.1 Wildlife**.

Comment 9. With regard to the Klamath Basin refuges, banning of pesticides in surrounding areas would contribute to a healthier environment in the refuges. Klamath Basin refuges are currently being negatively affected by poor environmental practices in the area.

Response: The area to be addressed by the IPM Plan included only the leased lands on the NWRs. Actions proposed to address current land use practices off the refuges are outside the scope of this EA.

Comment 10. Agriculture is causing unnecessary pollution and destruction of wildlife.

Response: See responses to comments 1 and 5.

Comment 11. If this is a wildlife refuge, what are all the farmers doing on the property, and why are they allowed to poison the waters with pesticides?

Response: See **Section 1.2.1 The Kuchel Act**, of the EA. This section explains why agricultural practices were included as acceptable uses on the subject NWRs. Effects on water quality under all alternatives are addressed under Chapter 4.

Comment 12. There seems to be little or no consultation with Indian tribes or state wildlife agencies. If such consultation was done, it is not presented to the public in the draft EA.

Response: Comments were solicited from the Klamath Tribes, California Dept. of Food and Agriculture, Oregon Dept. of Agriculture, California Dept. of Fish and Game, and Oregon Dept. of Fish and Wildlife.

Comment 13. The Klamath Basin once harbored ten million birds. This number has been dramatically reduced over the years because of agricultural runoff and mismanagement.

Response: It is recognized in the EA that the Klamath Basin lost 75 percent of its historic wetlands due to diversion and redistribution of water, resulting in a reduced capacity to support waterfowl. See **Section 3.1 Lower Klamath and Tule Lake National Wildlife Refuges (NWRs)**. In spite of habitat losses however, the Basin supports peak populations of between 1 and 4 million birds annually as well as the largest wintering population of bald eagles in the lower 48 states.

Comment 14. Any improvements to the NWRs should be directed towards increasing the number of birds.

Response: The IPM Plan was directed at reducing pesticide use associated with the NWR leased lands; it was not intended as a wildlife management plan.

Comment 15. The proposed EA doesn't adequately address the problems of pesticides, water diversion, and agricultural runoff/waste management.

Response: Without more specific information about 'adequacy' it is difficult to respond to this comment. Water diversion, runoff, and waste management are outside the scope of the IPM Plan and this EA. See response to Comment 5.

Comment 16. I am appalled that the action in the EA continues to allow pesticides known to be toxic to wildlife. These refuges belong to all Americans, not only a few farmers, and you should try to protect them for future generations.

Response: The decision to approve or disapprove a new farm chemical is based on extensive toxicity data, proposed use of the pesticide, environmental conditions, degradation rates, solubility, and numerous other factors. High toxicity ratings for a particular pesticide for fish, wildlife, and plants on the NWRs and threatened and endangered species are factors considered before approval of pesticides use proposals (PUPs) is given. The Regional PUP Committee also considers whether there are IPM alternatives, including less toxic chemicals that are effective. See **Section 1.2.7 U.S. Department of the Interior Policies** in the EA.

Comment 17. A critical point missed by the EA is that organic farming on the scale of the lease program is not possible. There are not sufficient markets for the crops that can be grown on the refuges, and if there was, overproduction of organic commodities would lower prices, removing any financial incentive to produce crops organically.

Response: In **Section 4.6.4 Alternative 4 Transition from Synthetic Pesticide Use to Long-term Organic** in the EA. It is recognized in this section that any predictions about the future profitability of organic farming are speculative at this time. The EA now reflects production values in gross dollars and does not predict net profits. As per analysis of Chapter 4 of the EA, Section **4.1.4.1 Terrestrial Habitat**, large-scale organic farming would conflict with waterfowl management objectives.

Comment 18. If the organic markets currently existed, growers would be doing it now – they would not be waiting for the government to change policy to force them.

Response: See response to Comment 17. If Alternative 4 were chosen, growers would have the choice of participating in the leased-land program; the government would not be forcing participation.

Comment 19. The EA presentation of the no-action alternative is biased against the status quo. The tone and phraseology paints a picture of dire consequences if things are left unchanged.

Response: The description of the no-action alternative in chapters 2 and 4 of the EA has been revised.

Comment 20. Under the no-action alternative, it is implied that water quality problems are linked to the no-action alternative and that correcting the problem is linked to the adoption of other alternatives- this is not true. Poor water quality would continue to exist under all alternatives.

Response: See response to Comment 19.

Comment 21. The section on water quality should be dropped or it should be revised to say "implementation of the IPM plan does not promise to affect water quality in any measurable way."

Response: This section has been revised in **Chapter 4 Section 4.3 Water Quality**. See response to Comment 19.

Comment 22. You should state that "there are no known problems with pesticide contamination of refuge waterways under current operation procedures."

Response: Refer to EA **Chapter 3 Section 3.3.3 Pesticides** on the NWRs and **Chapter 4 Section 4.2.1 Alternative 1 No Action**.

Comment 23. Under the no-action alternative, the EA states "no comprehensive IPM Plan would be implemented on the leases." This is either a grand statement, or patently untrue.

Response: The key word is *comprehensive*. The Agencies and lessees are practicing some IPM methodologies as recognized in the EA and the IPM Plan. However, until and unless an IPM Plan was implemented, comprehensive IPM would be extremely difficult to achieve.

Comment 24. The succession [sic] of the PUP process (no-action) is a ludicrous situation. The PUP process should in no way be held hostage to the time delays and red tape of the IPM Plan development process. If this is a condition of the Settlement Agreement, the agreement needs to be revisited.

Response: The PUP process and emergency approval are currently under Agency review.

Comment 25. There is an offending sentence in the IPM definition that should be removed ("IPM attempts to use pesticides as a last line of defense against pests, not as the first option for control") and should be replaced by a more generally accepted definition of IPM. Many pest and disease problems exist where pesticide applications may be the first line of defense, and critical to the effectiveness of other integrated control measures.

Response: The IPM Advisory Committee, made up of lessees, other agricultural representatives, conservationists, and environmental groups examined the many definitions of IPM and agreed upon the definition that is now in the IPM Plan.

Comment 26. The EA states repeatedly that imposing more restrictive regulations on pesticide use will reduce the impact of pesticides on wildlife, yet the EA fails to identify adverse effects of current practices on wildlife. Therefore, there is no justification for repetitive references that more restrictive regulations in alternatives 2, 3, or 4 will reduce "risk of short-term negative effects on wildlife from pesticides."

Response: While few wildlife mortalities have been documented in the vicinity of the refuges (see **Table 5., Pesticide Related Avian Mortality in the Klamath Basin Region**), documenting causes of death in every dead animal is difficult at best. Further, very little monitoring of pesticide-related maladies in animals has been conducted to date on the refuges. The Agencies believe it is both truthful and important to say that the *risk* of negative effects on wildlife from pesticides would be reduced by having fewer pesticides used on the refuges.

Comment 27. The EA references the practice of "calendar spraying." This is an accepted and preventative recommended approach for potato late blight with protectant fungicides.

Response: Potato late blight occurs when certain climatic conditions (day and night temperature, humidity, and moisture) occur for 4-5 consecutive days. While these conditions closely correspond to calendar dates, monitoring field conditions will identify the exact time when IPM treatments should occur.

Comment 28. Does the EA imply the Ag Commissioner is approving unnecessary pesticide applications? Do the authors believe that producers are incurring unnecessary production costs by applying unneeded materials?

Response: No. crop scouting data confirms the presence, abundance, and density of pest organisms leading to precise timing of IPM techniques, including pesticides. The Agricultural Commissioners and others recognize that this specific crop scouting data is critical to the IPM process. Crop scouting data may indicate that additional IPM techniques, including pesticides, may be needed more often to manage new pests or resurgence of existing pest populations.

Comment 29. In Chapter 2**,** University of Oregon should be changed to Oregon State University.

Response: This will be corrected in the text.

Comment 30. What evidence suggests current practices are a risk for human health and safety on the refuges?

Response: Certain IPM practices, including the use of pesticides, pose risks for human health and safety on the refuges. For example, the use of heavy equipment and agricultural equipment pose risk to the operator or by-stander. Protective devices on the equipment and the operator's knowledge of the equipment reduce these risks. Pesticides are designed to be toxic to the target, and they pose a risk to human health and safety and other non-targets.. Through the requirements of California, Oregon, and federal regulatory agencies, human health and safety conditions are contained in the pesticide label and the material safety data sheet. These protection requirements combined with conditions in the pesticide use proposals (PUPs) reduce the risk to human health and safety and non-target organisms.

Comment 31. I strongly object to the belief by the Service that growers are using unnecessary pesticides.

Response: It is not the intent of the Service to point fingers and imply that certain operators are using unnecessary pesticides. It *is* the intent of the Agencies to implement IPM on the refuges and to minimize the use of pesticides over time. See response to Comment 1.

Comment 32. Given the recent purchase of wetlands, habitat, or storage, this option may not be an unreasonable proposal. The exercise of drafting and implementing an IPM Plan seems no less cumbersome, time-consuming, and expensive, and may require equal time for legal interpretations of the Plan, to congressional time for approval of sales.

Response: While drafting and adopting the IPM Plan has been a lengthy and, at times, contentious process, we disagree that it is equally time-consuming to selling and buying replacement wildlife refuge land for the reasons given on **Section 2.2.3 Remove the Leased Lands from the NWRs**. Furthermore, it is Department of the Interior policy to implement IPM on its lands, including NWRs.

Comment 33. Under Alternative 1, there is no reason that items 1,3, 4, 10, 12, 13, and 14 would not occur. At the least, university work will be carried on regardless of IPM Plan adoption.

Response: The EA does not state that these practices/programs would not occur under Alternative 1. However, the likelihood that they would be carried out on a comprehensive basis without a plan and attendant funding are far less likely.

Comment 34. Why must the IPM Plan be adopted to move forward with berm management? This is a major problem in the leased lands that should be addressed whether a Plan is adopted or not.

Response: See **Section A. Current Berm Management** in the IPM Plan. Berm management is a major problem and concern for both the Agencies and the lessees. However, uncoordinated management of pests on the berms has been unsuccessful in the past. A plan offers the opportunity to recognize all the IPM needs on the NWRs and to present them to agency administrators for funding. This effort further coordinates IPM techniques on the berms including the involvement of local and

regional researchers to solve weed problems and to establish competitive native vegetation for wildlife habitat.

Comment 35. No evidence exists that current pesticide use poses any risk to suckers or water quality.

Response: Refer to **Chapter 4, Section 4.2.1.2 Threatened and Endangered Species** and **Chapter 4, Section 4.3 Water Quality**.

Comment 36. Alternative 2 poses much greater risks as unproven IPM practices from other regions would be implemented with little assurance of success locally.

Response: Alternative 2 was designed to reduce risk to growers. It would be phased in over time, would provide lease incentives for growers trying new techniques, would implement field trials for testing IPM methods that could benefit leased-land growers, and for trials that have worked elsewhere in the US, but have not been sufficiently tested in the Klamath Basin. However, commonly accepted IPM methods, such as use of cover crops and implementation of crop scouting, would not have to be field trialed prior to use on the NWRs.

Comment 37. Alternative 4 presents a very large risk that pests and diseases will spread from organic production systems to private property.

Response: The EA recognizes that pest populations could explode in the short term until organic and IPM techniques were used and established. These pests could spread to adjacent private lands (see **Section 4.6.4.3 Effects on Agricultural Practices** and **Section 4.1.4.1 Terrestrial Habitat**), with the secondary effect that private growers might have to control pests on their property.

Comment 38. The consistent increases in yields and net returns claimed for Alternative 2 are wishful thinking.

Response: The conclusions drawn about yields and net returns were based on 61 studies of growers involved in IPM, the best information available to date. However, gains in net yields and returns might be less for growers already practicing IPM on the refuge.

Comment 39. Much discussion is included in the EA on pesticide-related incidents which document deaths of nine bald eagles, two pheasants, 40 geese, and 50 ducks. There was no discussion of tens of thousands of waterfowl deaths due to botulism and other avian diseases, predation, hunter harvest, and road kills. These other causes overwhelm any effects pesticides or agricultural practices have on waterfowl and other avian species.

Response: It is agreed that other causes of death far outnumber pesticide-related wildlife deaths according to available information. However, the information was presented this way specifically

because this is an IPM Plan EA examining possible detrimental uses of pesticides. It was not intended to be a wildlife management plan examining other causes of death.

Comment 40. The data presented in tables 9-11 have no relevance whatever to the potential effects of IPM practices in the Klamath Basin. Most of the data are for crops not grown and not likely to be grown in this region.

Response: While Table 9 is indeed a summary of all 61 IPM studies for a variety of commodities (including alfalfa, grains and potatoes), tables 10 and 11 are summaries of studies for crop varieties grown on the leased lands: potatoes and alfalfa.

Comment 41. The authors of this report cite concerns of university and agricultural specialists regarding unnecessary pesticide use, calendar spraying, and other errors and omissions of the agricultural community. This blanket indictment of growers as abusers of pesticides has no place in this EA. Unless specific examples can be cited with reference to the "expert" who can document local cases, this paragraph should be deleted from the draft EA
(page 4-20, paragraph 3).

Response: This information was not intended as an indictment, but rather as an examination of practices that might be reconsidered in light of alternative IPM methods. The source for citations for the interviews conducted are included in the footnote on the end of that page.

Comment 42. **Section 4.6.4** is an attempt to promote the concept of organic farming and to appease the anti-pesticide supporters. Organic farming on the scale of the leased lands will not occur. Producers would be forced out of business during the 3 pesticide-free years required to qualify for organic farming status. Production of crops on leased lands with no pesticides would serve as a reservoir for pest and disease organisms that would cause very serious losses on adjacent private farms. It would force adjacent landowners to increase use of pesticides to protect off-refuge crops.

Response: The National Environmental Policy Act requires that Agencies look at a reasonable range of alternatives to the proposed action, in this case Alternative 2. During scoping, phased-in organic farming was suggested as an alternative, and since there was no overriding reason for its dismissal, it was considered as an alternative. Regarding economic aspects, see response to Comment 17. Regarding off-site impacts of organic growing on adjacent lands, see response to Comment 37.

Comment 43. The plea for and promotion of organic agriculture in this section (**Appendix B**) is completely out of context.

Response: Promotion of organic agriculture by including this entire article was not intended. The article was included in its entirety to document and provide information about those substances regarded as organic pesticides. However, to address your concern, we have revised Appendix B.

Comment 44. Pesticides should be proven to be detrimental prior to their exclusion.

Response: See response to Comment 16.

Comment 45. A presumption that organic farming is a readily available economic alternative to present commercial agriculture is a fallacy.

Response: See response to Comment 17.

Comment 46. All pesticide alternatives should be confirmed as practical and viable by university staff.

Response: The Agencies are capable of determining, often with the help of the universities on certain aspects of such use, the practicality and viability of alternatives that include the use of chemicals. See response to Comment 16.

Comment 47. Research on detrimental effects of pesticides on wildlife in the NWRs should be published and subject to peer review.

Response: The U.S. Fish and Wildlife Service is preparing a peer-reviewed publication on the acrolein pesticide used in aquatic weed management on the canals in the Klamath Basin. Acrolein, however, is not used on the NWRs.

The Service has also prepared several in-house, peer-reviewed, reports which are available to the public from the Klamath Falls Fish and Wildlife Office, U.S. Fish and Wildlife Service, Klamath Falls, OR. These include:

Synder-Conn, E. 1997. Tule Lake leased lands pesticide rinsate study. Klamath Falls Fish and Wildlife Office, U.S. Fish and Wildlife Service. KERO-TR-97-01.

Synder-Conn, E. 1998. Tule Lake leased lands: chlorothalonil pesticide study. Klamath Falls Fish and Wildlife Office, U.S. Fish and Wildlife Service. KERO-TR-98-01.

Comment 48. The Klamath NWRs are important to migrating birds, frogs, and toads which help to control pests which hurt agriculture. The chemicals the farmers use will hurt the very wildlife which help them to grow crops. Would it not make more sense to keep farmers out of the NWRs, and help a natural form of pest control, and pay out less subsidies to other farmers who will benefit from reduced competition?

Response: The Kuchel Act allows for farming on these NWRs (see **Section 1.2.1 The Kuchel Act**), and therefore, the Agencies propose to use IPM as the preferred method to deal with pest control on the NWR leased lands. See also response to Comment 1.

Comment 49. The Klamath Basin NWRs are a treasure and shouldn't be sacrificed for agricultural dollars in a few pockets while causing the devastation of the NWRs.

Response: See response to comments 4 and 48.

Comment 50. The Service places a "0" economic value on species preservation and biological diversity while placing an unrealistically high value on agricultural output from the Basin. The EA should be redone and a realistic appraisal of what gains there would be the country without current level of pesticide use.

Response: The issues addressed in the IPM Plan EA were directly associated with implementation of an IPM program assuming the leased land program remained in place. It was beyond the scope of this EA to conduct a cost/benefit analysis on agricultural values vs. wildlife values.

Comment 51. Pesticides are at best a short-term solution. They evolve resistance to pesticides, stimulating the development of more toxic compounds.

Response: Research has shown that continued use of pesticides can result in resistance problems and this was reflected in the EA. The Agencies believe the implementation of IPM gives the greatest number of methodologies and highest long-term level of protection to leased-land growers partially due to pesticide resistance.

Comment 52. The EA should address the toxic effects of continued use of pesticides on wildlife.

Response: The toxic effects of pesticides on non-targets, including wildlife, are addressed in Chapter 4, Environmental Consequences.

Comment 53. I visited the Tule Lake and Lower Klamath NWRs in August and found them to be an agricultural area, not a national wildlife refuge. The Service should manage these NWRs for wildlife, not agriculture.

Response: See responses to comments 4 and 11.

Comment 54. Clarify in the EA whether the IPM Plan applies to co-op land on the refuges.

Response: See **Section 1.5 Scope of this Document** in the EA. The proposed IPM program addresses IPM practices to be carried out only on the leased lands and associated berms, canals, and levees on the Tule Lake and Lower Klamath NWRs. Certain IPM practices may be appropriate for co-op land, which are not part of the leased lands; this will be determined by the refuge via the cooperative farming agreements and discussions with the permittees on a case-by-case basis.

Comment 55. The EA should address the potential for negative environmental impacts to adjoining private lands for each alternative.

Response: There is the potential for environmental impacts to adjoining private property for each of the alternatives, and this is addressed in **Chapter 4, Environmental Consequences.** There is also the potential for environmental impacts occurring on private lands to impact the refuges.

Comment 56. NEPA requires full disclosure on incomplete or unavailable information together with a discussion of its relevance and likely impacts. Nothing of the sort is presented in the EA.

Response: See **Chapter 4, Environmental Consequences.**

Comment 57. We would like to see the use of a poison, legal in California, combined with oat groats, to control mice and voles. This could be applied during planting, hidden under vegetation and unavailable to wildlife.

Response: See the **Vertebrate Pests** section of the IPM Plan. Since it is the purpose of the IPM Plan to minimize the use of pesticides, Recommendation #22 in the IPM Plan was formulated.

Comment 58. Why are these refuges being put on the Most Endangered Placed list? Why aren't you doing the job you are supposed to be doing to protect fish and wildlife?

Response: The Wilderness Society identified fifteen wild places that they considered to be the most endangered. Their subjective judgement was that the Klamath Basin National Wildlife Refuges were threatened by a number of things: including water, agricultural practices, and ecological succession. The IPM plan will assist all concerned in efforts to minimize pesticide use and maximize all appropriate pest management methods; the plan will not, however, solve water quality/quantity issues, affect off-refuge land management practices, or influence ecological succession outside of the leased agricultural lands on Lower Klamath and Tule Lake NWRs.

Comment 59. The EA process cannot continue until the Final IPM Plan has been distributed, otherwise how can the public assess its impacts and give productive comments?

Response: Using the comments on the draft EA, the agencies have considered public comments and corrected errors or discrepancies in the revised EA. Any errors or discrepancies have been corrected in the final IPM plan. The IPM Plan will be updated periodically and this process will include the opportunity for public involvement. IPM and agricultural information is constantly changing and being updated through research. Additionally, the draft EA contained in Appendix A, a list of all administrative and field recommendations for the final IPM Plan; the remainder of the IPM Plan is voluntary.

Comment 60. Alternative 3 bears no resemblance to the alternative proposed by growers and supported by the [Modoc] County.

Response: Alternative 3 was developed in conjunction with the Tulelake Irrigation District, Tule Lake Leased Land Advisory Committee, and other agricultural representatives over a period of about a week. Final wording of the proposed alternative was submitted to the Agencies. Critical elements suggested in the proposed alternative remained intact.

Comment 61. The [Modoc] County believes the EA and IPM Plan process should be postponed until lawsuits are litigated. The Settlement Agreement has been voided, so the only justification to continue is the Interior policy.

Response: The agencies intended to write an IPM Plan and began that process in 1993 before the agencies were sued. It is appropriate to finish both the Plan and the EA rather than wait for the conclusion of litigation.

Comment 62. "Pests" only became so because of the introduction of large-scale agriculture to the NWRs. Were these areas left in their natural state, the problem would not exist and solutions would not be proposed that continue to undermine the natural ecosystem.

Response: Pests are a cultural phenomenon that rarely exist in nature when systems are in balance. Historic Tule Lake and Lower Klamath were altered during the construction of the reclamation project. The refuges were created after the lakebeds were converted to agriculture. The task at hand is to manage agricultural leased lands with minimal use of pesticides; through the use of IPM. Many of the methods proposed in the IPM Plan do use natural phenomena, such as beneficial pest habitat, to control unwanted insects.

Comment 63. Why can't the Service investigate other means of controlling pests, other than the use of pesticides?

Response: In the IPM Plan, the Agencies' proposed approach to minimizing the use of pesticides over time via the use of cultural, mechanical, biological, and reduced chemical methods.

Comment 64. The EA is deficient in that there is no project description, only a summary.

Response: The National Environmental Policy Act requires a brief description of the proposed action: who will carry it out, what it is, where it will occur, and when it will occur. Since many projects and proposals are complex, it is customary to summarize the description of a proposed project in a few paragraphs. Also, the specific recommendations of the proposed action were released with the scoping document distributed during the scoping period for this EA, and are also contained in Appendix A of the EA. For a more complete description, see the IPM Plan.

Comment 65. The draft EA repeatedly suggests IPM is new, or is objectionable to growers. This is not true.

Response: During the research, interviews, and data collection for the IPM Plan, it appeared that varying levels of familiarity with and acceptance of IPM techniques existed among leased land growers, and the agricultural community in general.

Comment 66. The Draft EA fails to articulate an adequate purpose or need for the preferred alternative. To state it is 'policy' does not establish need.

Response: The **Section 1.1 Purpose and Need** lists three primary reasons the Agencies are proposing this IPM Plan: (1) to carry out Department of the Interior policy, a legitimate purpose in its own right; (2) to minimize the use of pesticides associated with agricultural practices on the leased lands over time; and (3) to provide crop- and pest-specific, technical information about IPM to leased land growers since there is little site-specific IPM information available to them.

Comment 67. The Agencies are inconsistent in relying on the Settlement Agreement as justification for the Plan.

Response: See response to comments 24 and 66.

Comment 68. On page 1-8, add to the list, "IPM is practiced now, to a high degree, and growers don't object to it."

Response: This list of issues was developed during the scoping for this EA, and cannot be changed now. Many current IPM practices by growers and the Agencies were recognized and listed under **Section 2.1.1.1 No Action - Current Management by the Agency/Current Practices by Growers**. See response to Comment 80.

Comment 69. On page 1-9, add, "There are no known environmental problems associated with current pest control practices."

Response: See response to Comment 47. The Agencies recognize in the EA that there are risks to the environment from pesticides in **Chapter 4, Environmental Consequences.**

Comment 69. On page 2-2, we do not concur with the definition of the no-action alternative. It is of significant concern that the Agencies say now there would be no berm management and no new PUP approvals without a new plan. What is the basis for these conclusions?

Response: The EA does not say there would be no berm management (**see section 2.1.1.1, Alternative 1 No Action- Current Management by the Agency/Current Practices by Grower.**)

It says berm management would likely proceed more slowly and on a more limited area because a plan and attached funding would not occur. See response to Comment 24.

Comment 70. The draft EA suggests that sump rotation will ensure that agriculture remains consistent with waterfowl management. The draft EA should clearly state that neither farming nor current pest control is the "problem" or the cause of the problem that sump rotation is intended to address. If current farming ceased, conditions would be less favorable for waterfowl.

Response: Refuge biologists have identified that food availability is not a limiting factor to waterfowl or other wildlife. The availability of ecologically dynamic wetlands is one limiting factor. Conditions occurring on and off of the refuges have influenced the condition of the existing wetlands in the sumps. See the further description in **Chapter 3, 3.3.3 Pesticides on the NWRs**. Under the Kuchel Act, farming is an important part of the refuge management program.

Comment 71. Comparison of alternatives 2 and 3 (pages 2-17 through 2-34) is based on a great deal of speculation. The table mis-states the reason the growers support Alternative 3 rather than Alternative 2. Alternative 3 ensures that new measures are feasible in the Klamath Basin. Alternative 2 doesn't achieve this essential objective.

Response: The comparison in the first table is a summary of the description of the alternatives previously described in the same chapter; the comparison in the second table is a summary of the analysis in Chapter 4. Your last two statements have been added to the revised EA.

Comment 72. On page 3-6, other benefits of row crops should be identified, including soil-building characteristics, extraction of minerals, hand-weeding of sugarbeets and onions, and other information we have provided you.

Response: The intent of this document is neither to advocate for or condemn row crops.

Comment 73. On page 3-8, in the second paragraph of section 3.2.2.3, clarify that these conditions are watershed-wide issues that will not be addressed by the proposed action.

Response: We made the change in **Chapter 4, Environmental Consequences**.

Comment 74. On page 3-9 in section 3.3.3, clarify that historic or current pesticide effects on wildlife may relate to actions occurring throughout the Pacific Flyway.

Response: **Chapter 4, Environmental Consequences** has been revised.

Comment 75. Indicate whether the quoted statement from Benbrook (page 3-11) refers to the lease lands.

Response: Benbrook was referring to risks from using pesticides in general, nationwide his statement was used in this context because it is applicable to the risks of using pesticides on the leased lands as well as elsewhere.

Comment 76. On page 3-12, the draft EA states that sucker populations are at the state where "collapse" is approached. Yet, it also states that the population is not self-sustaining, implying continued recruitment from other areas. There is no stated reason that this will not continue.

Response: Chapter 3, Section 3.3.4.2 Lost River and Shortnose Suckers was amended to address this.

Comment 77. The statement that there is "minimal" hand-hoeing of onions is not correct. This practice is common and significant.

Response: Chapter 3, Section 3.7.2.3 Current Agricultural Practices has been revised.

Comment 78. On page 4-12, in the final paragraph, the terms "regional" and "operator" should be defined. The lease lands represent ten percent of the irrigated land in the Klamath Project, and some of the best land.

Response: The economic region included Modoc, Siskiyou, and Klamath counties. Statistics on the number of agricultural operators within the region were taken from the Census of Agriculture. The EA recognizes the excellent quality of the soils within the leased lands.

Comment 78A. On page 4-20, there is no identification of the "university and nationwide agricultural specialists" who were interviewed, let alone their knowledge of the conditions in the Klamath Basin.

Response: Refer to the footnote on bottom of page. It states that citations for the interviews made with these specialists are on file at the Klamath Basin National Wildlife Refuge Complex Office.

Comment 79 Pesticides should be phased out more quickly; agriculture should be allowed only if it doesn't impact the primary public purpose of wildlife preservation. Public land should be managed for public good, which in this case is wildlife and natural ecology preservation.

Response: One of the purposes of the IPM Plan was to balance pest control practices on the NWRs with the goals of agricultural production and profitability, consistent with waterfowl management as called for in the Kuchel Act. See discussion in **Section 1.2.1 The Kuchel Act** in the EA, especially on page 1-4.

Comment 80. The Tule Lake NWR was destroyed when the BOR went from a cereal grain operation to diversified farming; it's not compatible with wildlife refuges.

Response: The Service has determined that diversified farming is compatible with the wildlife refuges and meets the requirements specified in the Kuchel Act and other laws, policies, and cooperative agreements.

Comment 81. I recently toured a local organic farm and found they had to use well water because the local irrigation water can't be used to grow organic crops. So if Alternative 4 was implemented, where would the water come from?

Response: Whether available water quality would meet organic growing standards is unknown at this time.

Comment 82. The two largest threats to the NWRs are loss of wetland habitats, and contamination by agricultural pesticides. Strive to reduce runoff of pesticides and further loss of wetland habitat.

Response: See responses to comments 1 and 5. IPM methodologies should further protect wetland habitats on the NWRs. See discussions in the EA on water quality and aquatic habitat and in **Section 3.1.1 Sump Rotation**.

Comment 83. Saving pristine lands and restoring marshes is extremely important from an economic sense. There is no excuse for any pollution in a wildlife refuge.

Response: See **Section 3.1.1. Sump Rotation**. While the IPM Plan was not intended to address restoring marshes, the Agencies are pursuing sump rotation to restore wetland habitat over time on Tule Lake NWR. See also, response to Comment 1.

Comment 84. We were angered the Service is not proposing to reduce pesticides herbicides, and fertilizer runoff into the NWRs. The wetlands deserve better protection from the agency charged with preserving our nation's fish and wildlife.

Response: See response to Comment 1.

Comment 85. Table 12 seems confusing, too cut and dry. Marketing costs would be uneconomical. If the refuge crops were all organic, the bottom line would fall out of the market.

Response: Changes were made to 12 and Section 4.6.4 of the EA.

Comment 86. Is crop scouting cost-effective with changing economic values for crops?

Response: See **Chapter 4**, **4.6.1 Crop Scouting**. The conclusion drawn from research of current crop scouting on grains is that it would only be cost-effective if costs could be kept low, possibly by growers becoming Refuge-certified crops scouts.

Comment 87. Farmers should be held responsible for controlling weeds on berms by giving them lease incentives.

Response: The U.S. Fish and Wildlife Service, Bureau of Reclamation, Tule Lake Irrigation District, and lessees recognize that a comprehensive, coordinated approach to integrated weed management on the berms will allow a more thorough effort on the weeds, protect endangered species, and provide wildlife habitat.

Comment 88. It should be stated that 'Monitor' is not allowed on the refuges.

Response: **Table 5, Pesticide Related Avian Mortality in the Klamath Basin Region**, and in **Section 3.3.3.** indicates that none of the cited pesticides (in the table), including Monitor, are approved for use on the Lower Klamath or Tule Lake National Wildlife Refuges.

Comment 89. If the NWRs went organic, the number of pests and diseases would go up and migrate out to adjoining private lands.

Response: This is a potential impact of Alternative 4 in the short-term until organic and IPM pest control methods were established. This is discussed in **Section 4.6.4.3 Effects on Agricultural Practices** in the EA. See also response to Comment 55.

Comment 90. NEPA mandates the consideration of cumulative impacts, but the draft EA does not consider the past history of pesticide use on the refuges. This is a serious omission.

Response: Cumulative impacts are addressed in Chapter 4.

Comment 91. NEPA requires an interdisciplinary approach but only effects on individual organisms are presented. The draft is devoid of population modeling or any attempt to predict the affects on populations of wildlife from the effects on individual organisms.

Response: Effects of several wildlife species are examined in the EA, but the examination of the effects on wildlife populations, which may or may not spend all of their life-cycle on these national wildlife refuges, is outside the scope of the EA.

Comment 92. You should make a new table that shows all the pesticides allowed in California and Oregon vs. those allowed on the NWRs.

Response: This table would not help the decision-makers determine if there would be a significant impact from the proposed action – that is the purpose of the EA, not an encyclopedic listing of information.

Comment 93. The EA should add more information about the conditions on the refuges in the 1950s.

Response: See response to Comment 92.

Comment 94. The draft EA fails to assess a reasonable range of alternatives. The Service should have included an alternative that would 1) eliminate row crops and permitted crops consumed by wildlife and that do not adversely affect fish and wildlife or their habitats, 2) eliminate use of farm chemicals; 3) require leaseholders to leave a significant amount of standing crop for wildlife, 4) restore 2,000 acres on Tule Lake NWR and 4,000 acres on Lower Klamath NWR to native marshes that are currently in grain production.

Response: The EA addresses a reasonable range of alternatives. IPM uses a variety of techniques to manage pests, including some chemicals. Refuge biologists have noted that the available waterfowl and wildlife food (e.g., barley and alfalfa) are not the limiting factors for wildlife. Successional changes in wetlands/marshes appear to be a limiting factor, and one of the benefits of the sump rotation concept/project will be to move that habitat back to an early successional stage as well as deepen aquatic habitats.

Comment 95. The draft EA fails to adequately address the environmental consequences of the alternatives.

Response: The EA does address environmental consequences, but it is difficult to respond to your comments without more details.

Comment 96. The draft EA and preferred alternative violate the Kuchel Act – current agricultural practices are inconsistent with wildlife conservation.

Response: We do not believe that the preferred alternative nor any of the alternatives in the draft EA violate the Kuchel Act.

Comment 97. The draft EA and preferred alternative violate the National Wildlife Refuge System Improvement Act.

Response: We do not believe that the preferred alternative nor any of the alternatives in the draft EA violate the National Wildlife Refuge Improvement Act of 1997, Public Law 105-57.

Comment 98. The intensity of environmental effects is high, an EIS is required because the wetlands act as a concentration point for migratory waterfowl, the actions planned are controversial, many of the effects are risky and uncertain, and will admittedly affect endangered species.

Response: We believe it is important to proceed with an EA that considers a full range of reasonable alternatives to determine if there would be significant impact that might trigger an EIS.

Comment 99. The Service should withdraw the draft EA and prepare an EIS that adequately analyzes the environmental consequences of a full range of reasonable alternatives and select an alternative that puts fish and wildlife first as required by law.

Response: See response to Comment 98.

Comment 100. We request you incorporate by reference previous comments on the IPM Plan. Consideration of comments and amendments to the IPM Plan were a separate process from the EA.

Response: We have noted previous comments and made appropriate changes.

Comment 101. Alternative 3 is contrary to the Kuchel Act and difficult to distinguish from Alternative 2.

Response: Alternative 3 would take longer to implement than Alternative 2 because field trials would be used to test **all** IPM techniques in the Klamath Basin, including those techniques such as crop scouting or use of green manure crops that are accepted IPM practices throughout the U.S. We do not believe that this alternative is contrary to the Kuchel Act.

Comment 102. The draft EA doesn't discuss the possibility that pesticide contamination may affect the immune system of wildlife.

Response: This discussion was added to **Chapter 4, Environmental Consequences**.

Comment 103. The draft EA contains no evaluation of the impacts of pesticides on the thirteen species of bats found at Lower Beds National Monument, adjacent to Tule Lake NWR.

Response: The EA does not evaluate the pesticide effects on all species of fish and wildlife, or all non-targets, found on the two refuges**.** The EA does acknowledge risk to wildlife from pesticide use**.**

Comment 104. The draft EA contains no analysis of the effects of alternatives on human health.

Response: The EA acknowledges pesticide associated risks to human health.

Comment 105. Assertions are made about benefits of certain crops to wildlife on NWRs without providing information on the use of such crops by refuge wildlife.

Response: Although the EA does not provide specific wildlife census data for each farm crop in the leaselands, the EA does contain wildlife use information for crops grown on the leased lands.

Comment 106. The draft EA asserts IPM will result in a reduction in pesticide use without providing much evidence to support this assumption. Refer to response to Comment 5.

Response: See response to Comment 5.

Comment 107. Under Alternative 2 and 4, the draft EA says habitat and wildlife diversity would improve – not clear what these statements mean.

Response: Habitat diversity might include a reduction of noxious weeds and cause increase in desirable plant species numbers. Wildlife diversity might include a greater variety of wildlife (e.g., birds, fish, reptiles, mammals, insects, invertebrates).

Comment 108. The draft EA states that under Alternative 4, some growers who have little land of their own might go out of business but there is no information on the number of farmers who lack land of their own.

Response: This is difficult to assess because it relies on proprietary information about income.

Comment 109. The preferred alternative violates the compatibility requirement contained in the National Wildlife Refuge System Administration Act because the Service determined in 1994 that farming on Tule Lake NWR was incompatible with the purposes for which the refuge was established, without significant modifications.

Response: Two of the stipulations necessary to insure compatibility in 1994 Compatibility Determination were to develop an IPM Plan for leased lands and restrict or eliminate onions and sugarbeets. An IPM Plan has been developed and onions and sugarbeets have been restricted via the Kuchel Act.

Comment 110. The preferred alternative violates the 1994 Settlement Agreement concerning pesticides because it condones the continued, widespread use of a great variety of chemicals.

Response: The preferred alternative is consistent with the Settlement Agreement.

Comment 111. While preferable to other alternatives, Alternative 4 will have its own adverse effects on refuge fish and wildlife. The draft EA fails to define synthetic vs. organic pesticides, nor identifies the process for assessing threats to wildlife, forage, or habitats that would trigger using synthetic pesticides.

Response: The EA gives examples of organic compounds in Appendix B. Organic pesticides would be subject to PUP review. The determination to use synthetic pesticides would be made by Refuge Manager.

Comment 112. The draft EA discusses no alternatives that would restore wetlands nor does it address solutions to major water quality and habitat-related problems.

Response: Wetland restoration via Sump Rotation will be evaluated in a separate National Environmental Policy Act (NEPA) document; pilot studies of Sump Rotation are on-going. Major water quality problems, affected by IPM practices in the IPM Plan, are evaluated in the EA. Major water quality and habitat related problems existing watershed-wide are outside the scope of the EA. See responses to Comment 6.

Comment 113. The refuge should see as part of its mission to follow its own policies pertaining to restrictions on pesticide use (Service Manual 7 RM 14.4G, 30 AM 12.4B).

Response: Service policies are followed in the EA. The Service is in compliance with statutes, regulations, and policies.

Comment 114. How can the Service say it is adopting IPM if it takes 5-10 years to implement?

Response: Some IPM practices are currently in place on the refuges. The comprehensive IPM practices detailed in the IPM Plan, and the preferred alternative analyzed in the EA require time to implement. We believe the time period is reasonable for comprehensive implementation. Some new practices, such as systematic crop scouting, would be implemented immediately.

Comment 115. If rodenticides are considered inappropriate on NWRs, why isn't it a concern that wildlife will catch sickened insects, sprayed with insecticides and be adversely affected?

Response: See **Chapter 4, Section 4.2 Wildlife**.

Comment 116. How long would it take for Alternative 3 to be fully implemented?

Response: It would take longer than the 5-10 years needed to implement the preferred alternative.

Comment 117. Why, under Alternative 2 and 3, aren't Pesticide Use Proposals (PUPs) required to be reviewed annually for problems associated with chemicals from the previous year?

Response: PUPs are reviewed annually under each alternative in the EA.

Comment 118. Alternatives 1 through 3 violate refuge policy and law because they have adverse effects on wildlife. Alternative 4 is the only reasonable alternative.

Response: Alternatives 1, 2, 3, and 4 all have the potential to affect fish and wildlife to varying degrees.

Comment 119. The EA incorrectly characterizes the Kuchel Act as requiring the current level of agriculture. However, the Kuchel Act says, "continue the present pattern of leasing." Clearly sugarbeets weren't grown on the refuge when the Kuchel Act passed.

Response: The U.S. Fish and Wildlife Service defines the "present pattern of leasing" to mean the percentage of row crops to forage and soil building crops. Sugarbeets are a row crop, and they are permitted under the Kuchel Act.

Comment 120. On page 3-13, the statement "no adverse impacts on peregrine falcons are expected due to the limited occurrence on NWR lands is contradicted by the 2/2/96 biological opinion which states on page 13," The Service anticipates two peregrine falcons and four bald eagles could be taken during application of the proposed pesticides and associated haying activities. The draft EA fails to mention this or discuss impacts to other refuge fish or fish-eating wildlife species not listed as endangered.

Response: The EA analyzes the effect in many fish and wildlife species, but it is not an encyclopedic analysis for every invertebrate, vertebrate, fish, mammal, or bird species found on the two national wildlife refuges. Refer to **Chapter 4, Section 4.2 Wildlife**.

Comment 121. How can the Service, under current policies and law, allow the occasional and irretrievable loss of threatened or endangered suckers due to pesticides?

Response: The Service is responsible for the threatened and endangered species on the refuge, and conditions are placed on the use of approved pesticides by the PUP Committee to reduce non-target effects to threatened and endangered species. The Endangered Species Act allows for incidental take of species after consultation with endangered species biologists at the Service field office. This process ensures that all appropriate measures are taken to reduce impacts to endangered and threatened species.

Comment 122. How can repeated use of water for irrigation (page 1-15) be considered "consistent therewith for purposes of waterfowl management as required by the Kuchel Act" when the refuge acknowledges that this practice exacerbated these extremely lethal water conditions?

Response: This repeated use of water is a function of Klamath Project operations which the NWRs are dependent on for their supply of water. Water use is outside the scope of this EA.

Comment 123. On page 3-25 there are approximately 100 PUPs approved that are in use. The 1994 Settlement Agreement said no pesticides could be submitted after 1/1/97 unless an IPM Plan was in place. The final plan hasn't been approved, but the pesticides are still being used.

Response: Current pesticide use on the leased lands are consistent with the Settlement Agreement.

Comment 124. On page 4-21, it says "the number of approved chemicals might increase over short and long terms but at a slower rate than in the past" — this is contradicted by the IPM definitions which says chemicals are the last line of defense against pests.

Response: There is no contradiction. Furthermore, although the number of approved chemicals might increase, the overall use of pesticides should decrease using compulsive IPM. Refer to Comment 5. New, less toxic pesticides would likely replace older pesticides. Pesticides along with other techniques are important components of IPM.

Comment 125. On page 3-3, there are no fields on refuge lands where the entire crop as food source is being left since refuge staff no longer farm.

Response: This is correct, but the information remains valid. If refuge biologists decide that waterfowl food is in short supply and a limiting factor, the refuge staff could again provide that an entire crop would be grown with 100 percent of that crop left for waterfowl.

Comment 126. Sump rotation concurrent with the IPM Program as an alternative dismissed but this contradicts a letter (8/13/96) from the Service's Regional Director to Oregon Natural Resources Council stating "as one part of the IPM Plan (and as a part of the NEPA document) we intend to consider sump rotation as an alternative."

Response: A pilot project for sump rotation is underway. We expect the pilot project to provide the U.S. Fish and Wildlife Service with information needed for the larger sump rotation project including analysis for NEPA. The complexity of the sump rotation project including NEPA, coupled with information obtained from the pilot project, required that sump rotation be separated from the IPM Plan.

Comment 127. On page 2-13, sump rotation is considered to be impractical as an alternative yet the restoring wetlands alternative isn't possible because it violated the Kuchel Act and because the same benefits "can be achieved through implementation of a sump rotation program" — these are contradictions.

Response: Sump rotation has potential to fully restore wetland values to the 13,000 acres of wetlands on the Tule Lake NWR. Therefore, the current ratio of croplands to wetlands can remain the same. Also, See response to Comment 126.

Comment 128. An EIS is required when substantial public interest or controversy surrounds an action — over 160 individuals and organizations have been involved in the NEPA process.

Response: See response to Comment 99.

Comment 129. The draft EA seeks to defer sump rotation without adequate consideration. The analysis of environmental effects of sump rotation should have been presented.

Response: See response to comments 126 and 127.

Comment 130. The term cumulative in the glossary is defined wrong; it refers to spatial area only, not to time.

Response: The glossary definition has been revised according to CEQ (CEQ Regulation §1508.7).

Comment 131. The draft EA does not present the number of acres of NWR lands that would have to be converted to organic farming, nor how many acres of hunting and fishing lands will be converted.

Response: The organic farming acreage in the EA has been further defined**.** Refer to **Chapter 4, 4.7 Recreation**.

Comment 132. One commentor was extremely disappointed with the method by which his comments on the draft Plan were handled; since the final plan was not scheduled for release until the dissemination of the final EA, he had no opportunity to see how his comments were handled.

Response: Refer to Comment 100.

Comment 133. Instead of emphasizing the positive aspects of IPM, the draft EA, as written, largely supports the status quo by recommending only minimal commitments to an IPM Plan and by, for the most part, emphasizing only the most pessimistic, worst case scenarios for implementing IPM on refuge lands.

Response: There are numerous positive aspects and methodologies outlined in the IPM Plan for reducing pesticide use. The proposed IPM Plan embodies compromises; it is not the most aggressive approach to IPM, partially because the development of the Plan was guided by a *variety* of interests. Under the guidance of the IPM Advisory Group, made up of a diverse set of interest groups, both grower and environmental interests were taken into account while developing the IPM Plan. Also, constraints were placed on IPM practices that would be harmful to wildlife because these leased lands are on NWRs.

Comment 134. Another arbitrary and wrongful change that has been made throughout the draft EA is changing the word "waterfowl" to "wildlife," thus broadening the intentful language of the Kuchel Act (by thus distorting the intent of the Kuchel Act, a pest management action unfavorable for waterfowl actually could be used if it were considered favorable for some other wildlife). The commentor suggests changing all references from "wildlife" to "waterfowl."

Response: The Kuchel Act states the refuges are "dedicated to wildlife conservation" and that they shall be administered "for the major purpose of waterfowl management."

Comment 135. Under the Kuchel Act, the Service has the authority to stipulate which crops can and cannot be grown on the NWR leased lands. Therefore, consistent with the first basic option for IPM, in the interest and (welfare) of refuge waterfowl, the Service should immediately eliminate the growing of onions, sugarbeets, and potatoes on refuge leased lands. As there is not one paper published in a peer-reviewed scientific journal documenting that onions, sugarbeets or potatoes are beneficial for waterfowl, one hopes the Service will find the courage to do this. Eliminating onions, sugarbeets, and potato production might result in reductions in profits, but it would significantly reduce the types and volumes of pesticides applied to refuge lands. The currently recommended actions associated with an IPM Plan phased in over a long period of time will have little or no impact on changing farming strategies or reducing pesticide use.

Response: Refuge biologists and others have noted wildlife use in potatoes as this crop is harvested. Two peer reviewed papers have documented white-fronted goose use on potatoes (See Frederick and Takekawa, **Chapter 8 References**). The FWS is now conducting research on waterfowl use of sugarbeet and onion fields.

Comment 136. On other NWRs, the IPM Program associated with mosquito control/management was initiated because of Service's concern for adverse pesticide effects associated with non-target organisms. When the Service has worked hard to eliminate the same insecticides (or their close relatives) from being used for mosquito control on other refuges, it is baffling how it can continue to approve the use of such pesticides at such important refuges as Tule Lake and Lower Klamath.

Response: A corollary effort at the Klamath Basin refuges was the development of the IPM Plan.

Comment 137. In order to comply with the DOI (Department of Interior) pesticide use policies, the PUP Committee associated with any IPM Plan (except Alternative 4) needs to be expanded to include ecologists and pesticide specialists representing national interests. National representation would have the potential of being bias free and would provide a broader spectrum of knowledge (particularly if the committee had a few ecologists), and it would improve public confidence in PUP recommendations. Also, for such an important aspect of the proposed IPM Plan, an appendix or table should be added that lists the membership of the PUP Committee and the area of expertise of each member.

Response: The PUP Committee makes technical recommendations on pesticides and other appropriate IPM strategies. It is not intended to be a land management nor habitat management effort. Ecological principles certainly come into consideration during management, but are not essential to the PUP Committee; our Klamath Refuge staff concentrate on these management areas. We would be happy to provide information on the PUP Committee if such an inquiry is received by the Portland Regional Office, U.S. Fish and Wildlife Service.

Comment 138. It is extremely disturbing to read the lame excuses offered (page 27, paragraph 2) for recommending "...a phased implementation of IPM" which would include only a "few essential elements of IPM immediately..." This paragraph, and the following bulleted items are just too weak to be creditable. Another excuse for not implementing an immediate IPM program on the NWRs was that the "...alternative did not seem to address the primary issues raised by the public." (Page 2-15, last paragraph) In view of the comments made by a large number of environmental/conservation organizations supported by very large memberships, I very much doubt this conclusion.

Response: It is the remainder of the last paragraph on page 2-15 that explains the rationale for phasing: "It is recognized by all parties involved in IPM that locally proven techniques are going to be the most effective, and that immediate changeover to new techniques could cause economic hardship to growers that could be avoided by phasing."

Comment 139. Throughout the draft EA there is an undue emphasis placed on the lack of "local" action thresholds for different crops, and this is used to justify the phased implementation of IPM on refuge lands. However, a long-term, phased approach to implementing IPM has a negative "downside" not disclosed in the draft EA. First, it permits the continued use of large volumes, and many types, of pesticides, and secondly, without a synchronous change to implement all IPM actions known to be successful in California, the following negative aspect will occur. If only some IPM methods are used, and only some farmers are using IPM, farmers choosing to use IPM will not likely receive full IPM benefits. This is because those farmers continuing to rely mostly on pesticides will be killing a large percentage of the beneficial organisms expected to reduce pests in field/crops using IPM -- thus defeating the intent of IPM. The University of California has been a leader in IPM research since this concept first originated in the late 1950's/early 1960's. U.C. IPM Pest Management Guidelines are updated three times a year, written by researchers, specialists, and farm advisors as pesticides registrations change, and new methods become available. These updated guidelines should be used now.

Response: Local testing of techniques, as identified in the field trials, leads to credibility of the specific IPM practices under conditions in the Klamath Basin. We recognize that the U.C. IPM Guidelines are appropriate, but weren't specifically established for conditions in the Klamath Basin.

Comment 140. The U.C. Guidelines for insecticide treatments of various crops do not recommend the same compounds recommended in the IPM Plan. As an example, for the green peach aphid, the U.C.

Guidelines recommend only Methamidophos (Monitor) and Endosulfan (Thiodan). The draft IPM Plan recommends Admire and Provado. In future, actions the PUP-approved chemicals should conform with the recommendations of the U.C. IPM Guidelines.

Response: The U.C. IPM Guidelines were not developed specifically for pest management on national wildlife refuges administered by the U.S. Fish and Wildlife Service where fish and wildlife and their habitats are highest priority as opposed to private agriculture where fish and wildlife may not be the highest management priority. Management of leased land agriculture on Lower Klamath and Tule Lake NWRs under the Kuchel Act must meet fish and wildlife considerations.

Comment 141. Alternative 4 should be recommended as the option of choice because it is the most consistent with perpetuating natural ecological processes that enhance living conditions for waterfowl and other wildlife. All comparisons in Tables 1 and 2 clearly show that Alternative 4 confirms with every cited goal of the DOI.

Response: See new discussion under Chapter **Section 4.2.1 Wildlife** and **Section 4.6.4 Socioeconomics**.

Comment 142. A change in total organic agriculture could be accomplished by the year 2004. All the negative market considerations associated with organic farming are inaccurate as they are based on present day circumstances. Such erroneous speculation should, therefore, be deleted.

Response: While a total changeover to organic growing might be possible a few years earlier than presented in the EA, the most realistic scenario within which to represent the alternative appeared to be a gradual transition. In spite of the desires of various interest groups, the reality is that farmers would be on the ground dealing with either new methods or new ground on which to base an organic operation under this alternative. A 10-year phase, transitioning out of conventional agriculture also allowed existing operators an adjustment period.

As for market considerations, the EA specifically stated that projections used in the analysis were often speculative, but based on the best and most current information available. Extrapolations from current-day information were, in some cases, the only way to make logical predictions. However, we stand by the statements made that the analysis is speculative; organic markets, as with all farm commodities, are volatile. Under the National Environmental Policy Act, preparers are to predict the probable environmental consequences of an alternative based on the best available information. References used in this analysis are given in the reference section of the EA. Qualified specialists at the offices of ATTRA, trained in organic methodologies and research, conducted the organic alternative analysis in this EA.

Comment 143. The Agencies should not have to "offer incentives" for growers to implement IPM practices researched and developed by U.C. IPM scientists and widely used by farmers in other parts

of the state. Furthermore, farmers throughout the state now pay for IPM costs on their private land and private lands leased by them. By what rationale are farmers not expected to be responsible for the same costs on refuge leased lands?

Response: Incentives were considered as a means of assisting agriculture in the transition to full-scale IPM on these national wildlife refuges Incentives would be offered to those growers volunteering to conduct field trials. Further, IPM requirements could continue to be stipulated in lease contracts and new requirements added in the future.

Comment 144. Neither the IPM Plan nor the draft EA proposes or discusses a program of education for growers to learn about IPM techniques or sustainable organic agricultural techniques.

Response: Read **B. IPM Plan Goals** on page 5 of the **Plan Introduction**. There you will find that nearly every one of the goals of the Plan involves education, outreach, coordination and communication about IPM between Agency mangers, growers, and researchers. Under the **Recommendations**, see recommendations 3, 4, 5, 7, 9,11,12,13, and 14. Each of these recommendations involve education, research, coordination, and/or outreach.

Comment 145. The Agencies involved and the lessees need to immediately fund an IPM Program. An IPM Plan for the refuges cannot be implemented (and will not be valid) without having long-term committed funding for all associated aspects. Immediate funding of an IPM project should have priority over sump rotation or other refuge projects.

Response: The Agencies agree that a strong, pro-active IPM Program can not be accomplished on the national wildlife refuge system and Klamath Basin NWRs unless there is specific annual IPM-dedicated funding. The Recommendation and Implementation section of the Plan details some funding estimates. The Agencies are proceeding with their budget requests. For example, the U.S. Fish and Wildlife Service has requested funding in FY 2000 as part of the U.S. Department of Interior Exotic and Invasive Species Initiative for work on weeds on a number of projects in our Region 1 (Klamath Basin Refuges are part of Region 1) including: (1) Integrated
weed management on berms, dikes, and roadsides on the Klamath Basin Refuges and (2) Integrated perennial pepperweed management in R-1.

Comment 146. The draft EA does not consider reducing pesticide use through such modern pesticide applications methods such as electrostatic spraying.

Response: The EA does not analyze all possible pesticide application techniques, including electrostatic spraying. The EA does analyze risk associated with pesticide use including wicking, wiping, spot treatment via ground application, and aerial application.

Comment 147. Restrictions should be placed on harvesting immediately adjacent to irrigation ditches so tall vegetation are maintained for non-migratory waterfowl, other birds, and resident mammals. Leasees should be required to leave a specific percentage of their crops standing for the use of wintering waterfowl.

Response: Restrictions are in place on areas immediately adjacent to the irrigation ditches; the leased lots (ditch banks, road banks, drains, canals, and sumps) are not to be sprayed, burned or disced and are left for nesting birds. Adjacent areas outside the leased lots (ditch banks, road banks, drains, canals, and sumps) are not to be sprayed, burned or disced by leases and are left for nesting birds. According to Refuge biologists, food is not the factor limiting waterfowl but rather it is habitat quality within refuge wetlands. Consequently improvement of wetland quality is proposed through sump rotation.

ENVIRONMENTAL ASSESSMENT COMMENTORS

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