United States Department of the Interior
Bureau of Land Management
Salem District

Horning Seed Orchards
27004 Shecky Road
Salem, Oregon 97017

June 2003

Draft
Environmental Impact Statement

Integrated Pest Management

Walter H. Horning Seed Orchard
Colton (Clackamas County), OR

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

BLM/OR/WA/PL-003/028+1792

Photographs on cover:

Unit C07: Mature Douglas-fir
Greenhouse 1
Irrigation pond in Section 13
Grassy area in Section 23, with Douglas-fir orchards in background

June 6, 2003

Dear Reader [Reviewer]:

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Salem District Office
1717 Fabry Road S.E.
Salem, Oregon 97306

IN REPLY REFER TO:

Attached is the draft environmental impact statement (EIS) for a proposed integrated pest management (IPM) program at BLM's Horning Seed Orchard, located in Colton, Oregon, in Clackamas County. The proposed IPM program will manage the insect, weed, animal, and disease problems at Horning, and maintain healthy, vigorous crop trees and other plants for the production of seed and other vegetative materials, which are used primarily for reforestation and a variety of land management activities. This EIS analyzes the potential impacts of the proposed action and alternatives, and will be used in the development of the IPM program at Horning.

The *National Environmental Policy Act* requires BLM to assess the potential environmental impacts of the proposed action and alternatives, and to involve the public in its decision-making process. Executive Order 12372, *Intergovernmental Review of Federal Programs*, requires that BLM request input from other Federal, state, and local agencies and from the public on the Draft EIS.

A notice of the availability of these documents is scheduled to appear in the *Federal Register* on June 13, 2003, and in the *Molalla Pioneer,* the *Clackamas County News,* and *The Oregonian* the week of June 9, 2003. During the 60-day comment period, BLM will conduct a public meeting at Horning Seed Orchard on July 17, 2003, from 1 to 3 p.m. and 5 to 7 p.m.. The purpose of the meeting is to solicit the public's comments and concerns regarding the issues evaluated in the EIS.

You do not have to attend the public meeting to submit comments. Written comments may be provided by August 13, 2003, and should be mailed, faxed, or e-mailed directly to:

Mr. Greg Tyler, Manager
Horning Seed Orchard
27004 Sheckly Road
Colton, OR 97017
Fax: (503) 630-6888
E-mail: oripmeis@blm.gov

Sincerely,

Denis Williamson,
District Manager, Salem District

Draft Environmental Impact Statement:
Integrated Pest Management Program, BLM Horning Seed Orchard
Colton, Clackamas County, Oregon

Agency: Bureau of Land Management
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Designation: Draft Environmental Impact Statement (EIS)

Privacy Advisory

Your comments on this Draft EIS are requested by August 13, 2003. Letters or other written comments provided may be published in the Final EIS. Comments will be addressed in the Final EIS and made available to the public. Any personal information provided will be used only to identify your desire to make a statement during the public comment period or at a public meeting, or to fulfill requests for copies of the Final EIS or associated documents. Private addresses will be compiled to develop a mailing list for those requesting copies of the Final EIS. However, only commentor names will be disclosed; personal home addresses and phone numbers will not be published in the Final EIS. In addition, in accordance with the Privacy Act, individuals (but not organizations and businesses) may request their name also be withheld from public review by stating this request at the beginning of their letter.

Abstract

The Bureau of Land Management (BLM) is proposing to implement an integrated pest management (IPM) program at Walter H. Horning Seed Orchard. In compliance with the National Environmental Policy Act (NEPA) of 1969, BLM has prepared this environmental impact statement (EIS), which assesses four action alternatives and the no action alternative:

- Alternative A—Maximum Production IPM. Pests would be managed using all identified biological, chemical, prescribed fire, cultural, and other pest control methods, including aerial esfenvalerate application by helicopter.

- Alternative B—IPM with Environmental Protection Emphasis (Proposed Action). Pests would be managed using all of the methods in Alternative A, with limitations designed to protect worker health and safety and the environment. The limitations are based on the conclusions of a recent risk assessment, scoping comments, and recommendations from BLM interdisciplinary team members.

- Alternative C—Ground-Based IPM. This alternative is identical to Alternative B except for the exclusion of helicopter applications.

- Alternative D—Non-Chemical Pest Management. Pests would be managed using only the biological, prescribed fire, cultural, and other methods listed under Alternative A. No chemical pesticides would be permitted.

- Alternative E—No Action: Continuation of Current Management Approach. The current management system uses all non-chemical-pesticide pest control practices at the seed orchard, as well as chemical pesticides on a case-by-case basis. All biological, prescribed fire, cultural, and other methods would be used in accordance with current procedures. When a specific need is identified for a chemical pesticide, the action would be reviewed to determine whether it is encompassed by an existing NEPA document, or whether an environmental assessment or EIS is required.

Alternative B, the proposed action, is the preferred alternative of BLM.

Resources analyzed in the EIS include air quality, geology, water, land use, human health and safety, biological resources, noise, cultural resources, and socioeconomics and environmental justice. The EIS also assesses the potential cumulative effects of implementing the IPM program along with other actions occurring concurrently at Horning and in the surrounding area. The recently conducted risk assessment is included in the supporting record and summarized in an appendix.

Executive Summary

The U.S. Bureau of Land Management (BLM) proposes to implement an integrated pest management (IPM) program at the Walter H. Horning Seed Orchard (Horning) in Clackamas County, Oregon. The orchard is within BLM's Salem District. In accordance with the *National Environmental Policy Act* (NEPA) of 1969, as amended, which requires Federal agencies to consider environmental consequences in their decision-making process, this draft environmental impact statement (EIS) identifies potential environmental impacts from each alternative considered. This EIS must be prepared before BLM makes final decisions regarding the selection of an alternative, and be available to inform decision makers and the public of potential environmental consequences of the proposed action or an alternative. Distribution and review of this Draft EIS allows for public consideration and input concerning the proposed IPM program. After carefully considering comments on this Draft EIS, BLM will issue a Final EIS. After completing the Final EIS, BLM will publicly state which action will be implemented in a formal document called a Record of Decision (ROD). Subsequent IPM activities will be implemented over the life of the IPM plan (usually 15 to 20 years) in accordance with that decision.

BLM will use the analyses presented in this EIS to decide how to continue operations at Horning in a manner consistent with human health and safety considerations and existing environmental protection laws, while maintaining adequate seed and seedling production. Maintaining adequate production includes the implementation of an IPM approach to manage vegetation, insects, disease, and animal pests at the seed orchard. The ROD to be issued on the basis of this EIS, by the BLM Salem District Manager, will identify the specific methods that will be available for use at Horning for controlling insects, disease, vegetation, and animal pests. No further NEPA documentation relating to IPM should be required before pest management projects are undertaken, unless the seed orchard manager proposes a new IPM product or technology that was not analyzed in this EIS.

Purpose And Need For Action

The purpose of the action is to manage insects, diseases, competing and unwanted vegetation, and animal pests at Horning. Management of adverse impacts from pests is necessary to allow the seed orchard to produce improved seed for conifer seedling production, preserve valuable individual conifer trees, produce native species plants and plant species seed, and produce containerized seedlings in a greenhouse nursery. This high-quality seed is supplied to BLM and other cooperators for reforestation and restoration projects.

For many years, Horning has managed pests with very limited use of chemicals: fenvalerate and esfenvalerate were used in the 1980s, 1990s, and in one application per year from 1999 through 2002 to control cone and seed insects in the orchard units, and several fungicides and insecticides were used in the greenhouse to control disease and insect pests. Each use in the orchard has required preparation of a separate NEPA document (an environmental assessment, or EA) to analyze the potential impacts from use of these chemicals. Changes and experience with control methods at Horning have created the need to re-evaluate the pest management program to ensure that the pest management objectives at Horning continue to be met. In addition, the public demand for efficient use of resources in government, as well as for providing appropriate environmental protection, requires the selection and use of the best pest management techniques for efficient and cost-effective orchard operation over the long term. The pest management objectives at Horning include the following:

- Minimize insect damage to orchard trees, cone crops, native plants, and greenhouse seedlings.
- Remove noxious weeds and control vegetation that favors animal pests and disease conditions, and reduce fire hazard conditions.

- Reduce growth of vegetation to allow tree establishment and growth, and reduce the fire hazard.

- Treat fungal and bacterial diseases to maintain the health and vigor of the orchard trees used for seed production; and to control plant pathogens in the greenhouse and native seedling grow-out beds.

- Minimize animal damage to orchard trees, native plant beds, greenhouse seedlings, and orchard equipment and infrastructure.

The need for this action is demonstrated by research which was conducted in 1983 at 17 different seed orchards in the western U.S. This research indicated an overall loss of 70% of the filled seed as a result of cone insect pests. The loss at Horning was 76% of the total potential seed. The need for action is also demonstrated by the orchard's experience with periodic problems from insects, disease, weeds, and animals.

Pest Management Methods

There are many methods available to manage insects, disease, vegetation, and animal pests at Horning. These methods generally fall into the categories of biological, chemical, prescribed fire, cultural, and other methods.

The pest management methods that are analyzed under one or more of the alternatives in this EIS are as follows:

Biological Control

- Vegetation: grazing cooperators place their cattle in the orchard units to remove grasses (this method has been used in the past and will be considered again in the future); planting fallow crops or certain cover crops in rows between orchard trees to limit growth of undesirable vegetation and noxious weeds.

- Insects: bird and bat boxes to attract insect-eating birds and bats, naturally occurring bacteria such as *Bacillus thuringiensis* (a biological insecticide), predator mites and nematodes, lady bugs, and aphid lions.

- Animal pests: predators including coyote, fox, and cougar are present and encouraged to frequent the seed orchard grounds to aid in the control of animal pests.

Chemical Pesticides

- Vegetation: herbicides, including dicamba, glyphosate, hexazinone, picloram, and triclopyr.

- Insects: insecticides, including acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, horticultural oil, permethrin, propargite, and Safer® soap.

- Disease: fungicides, including chlorothalonil, hydrogen dioxide (in greenhouse only), mancozeb (in greenhouse only), propiconazole, thiophanate-methyl (in greenhouse only), and dazomet (a soil fumigant).

The methods that may be used to apply these pesticides at Horning are aerial (helicopter) for esfenvalerate only, airblast sprayer, high-pressure hydraulic sprayer, hydraulic sprayer with hand-held wand, tractor-pulled spray rig with boom, backpack sprayer, capsule implantation, granular spreaders, hand sprayer, chemigation, and total-release canister.

Note that not all chemicals would be used in a given year, and some might never be used. However, their analysis in an alternative in this EIS, and subsequent selection of that alternative in the ROD, would give the seed orchard manager the option of using them in the future should a specific need arise. It is also important to note that each chemical application must first be approved by the Horning seed orchard manager. All pesticides would be applied in compliance with all Federal and Oregon state laws, BLM regulations and policies, and manufacturer recommendations.

Prescribed Fire

- Vegetation: propane-fueled flame wands for vegetation removal in native plant beds prior to planting, small patches of underburning in orchard units, pile burning of cut/cleared vegetation, pile burning of spent sugar pine cones.

- Disease: burning grass straw in bed rows in the native plant gardens.

Cultural Control Methods

- Vegetation: hand-pulling, non-powered and powered hand tools to cut and clear, tractors with various blade attachments for mowing, gasoline-powered string trimmers, tilling an unvegetated buffer around native plant beds, mulch mats.

- Disease: pruning, thinning, stump grinding; in greenhouse, knocking or blowing water off seedlings and control of air flow through the use of fans and convection tubes.

- Animal pests: trapping of gophers, porcupines, and other small mammals; fencing that excludes deer and elk from orchard, Vexar tubes to protect seedlings, use of sticky traps in greenhouse, screening to exclude squirrels from seed extractory and cone shed.

Other Methods

- Pheromone bait traps for insects.

- Fertilization to promote overall tree health, cone production, and disease resistance.

It is the policy of the Department of the Interior, and all of its agencies including BLM, to use chemical pesticides only after considering the alternatives; and to develop, support, and adopt IPM strategies wherever practicable.

The focus of IPM is on long-term prevention or suppression of pests. The integrated approach to pest management incorporates the best-suited biological, chemical, and cultural controls that have minimum impact on the environment and on people. IPM is not pesticide-free management; however, a successful IPM program should result in the most efficient use of pesticides if and when they are needed.

Research into better and more effective control methods is also an essential part of an IPM program. The seed orchard manager would regularly review the pest management methods available for use, including new and developing technologies, to ensure that the seed orchard utilizes the most effective methods of control while minimizing the potential for any adverse environmental or health impacts.

The focus of this EIS is on activities directly relating to implementing an IPM program at Horning. Other routine management actions—such as establishment and maintenance of orchard units, buffer zone management, and facilities/equipment maintenance—are not directly related to IPM and therefore not evaluated in this EIS.

Alternatives

BLM identified and evaluated five alternatives to address the need for a pest management program at Horning, as follows:

- Alternative A: Maximum Production IPM
- Alternative B: IPM with Environmental Protection Emphasis (Proposed Action)
- Alternative C: Ground-Based IPM
- Alternative D: Non-Chemical Pest Management
- Alternative E: No Action—Continue Current Management Approach

Alternative B is BLM's preferred alternative. Each alternative is described in more detail below.

Pest management methods that are common to all alternatives are biological methods, cultural methods, prescribed burning, and other non-chemical-pesticide control methods. Other activities common to all alternatives include orchard management activities unrelated to pest management and protection measures that would be observed under any alternative. Protection measures are a list of "best management practices" intended to ensure the proper and safe application of pesticides at Horning and include worker protection measures as well as public, environmental, and ecological protection measures.

Alternative A—Maximum Production IPM

Under this alternative, the primary goal is the maximum production of seeds and plants with a very low level of acceptable losses. Horning's seed orchard manager would have all identified biological, chemical, prescribed fire, cultural, and other pest control methods available for use. An effective IPM strategy for all orchard pests would be implemented under this alternative; however, the primary management objective would be to maximize seed production for annual BLM and cooperator seed needs by aggressively controlling cone and seed insects and other limiting factors. The most effective insect control measures would be implemented, to maximize seed yield and reduce damage to the seed crops with low acceptable seed losses, emphasizing production above other less-effective control methods and considerations, with a low threshold for initiating treatment.

Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under this alternative, the seed orchard manager would have access to the full list of pest management methods identified above; however, chemical use would be restricted by a set of limitations. These limitations address risks predicted by the quantitative risk assessment, respond to scoping concerns, consider the results of previous monitoring, and include recommendations made by the interdisciplinary EIS preparation team. The limitations provide added protection to human health and the environment, and distinguish the details of potential treatments under Alternative B from those under Alternative A. The complete list of limitations is provided in Section 2.3.3.

Alternative C—Ground-Based IPM

Alternative C would be identical to Alternative B, except that the option to apply esfenvalerate by helicopter would be eliminated.

Alternative D—Non-Chemical Pest Management

Alternative D would allow the seed orchard manager to use only the biological, prescribed fire, cultural, and other non-chemical-pesticide methods listed above. No chemical pesticides would be permitted.

Alternative E—No Action: Continue Current Management Approach

Alternative E would allow continuation of the current management system, which is the use of all non-chemical-pesticide control practices at the seed orchard, as well as the use of chemical pesticides on a specific case-by-case basis. All biological, prescribed fire, cultural, and other non-chemical-pesticide methods would be used as needed. When a specific need is identified for a chemical pesticide, the action would be reviewed to determine whether it is encompassed by an existing EA or EIS. This could include applications for controlling cone insects or other orchard insect outbreaks, disease infestations, and any vegetation control necessary that is not covered by other BLM vegetation control NEPA documents.

Alternative Considered But Not Further Analyzed

During the scoping process, one member of the public suggested planting more crop trees than necessary to allow for some loss to pests, which was interpreted as a request to consider no pest management at all. This is not a viable alternative for several reasons. First, this approach could lead to a significant loss of the crop trees in the production units if disease were to occur. Secondly, orchard research has shown that approximately 70% of the seed crop could be lost if no pest management were practiced. To partially offset the effects of cone and seed insects and decreased tree vigor due to disease, it would be necessary to plant production trees in fields that are currently fallow, as the commentor suggested. This solution would require the seed orchard and their cooperators to accept an estimated 10-year reduction in seed production, which is the time that would be required for the newly planted trees to produce collectable seed. This decrease in production could also result in delays in reforestation projects caused by potential seed shortages, or reduced forest growth resulting from the use of genetically inferior seed from other sources. In addition, a more intensive planting regime on seed orchard grounds, with no pest management of any kind, would allow the orchard lands to become a "reservoir" for insects, disease, noxious weeds, and animal pests that would spread to neighboring public and private lands—effectively, becoming a threat and nuisance to the neighbors, particularly those who cultivate crops of their own.

Affected Environment

Horning is located approximately 23 miles southeast of the city of Portland and 40 miles north-northeast of Salem, Oregon, near the small community of Colton and within Clackamas County. The town of Estacada is about 8 miles northeast of the orchard. Horning lies within the Willamette River valley, between the Oregon Coast Range and the Cascade Mountains. Its geographical location between the Pacific Ocean and Cascade Mountains results in a maritime west coast climate, featuring mild, wet winters and cool, dry summers. Horning is located on the watershed divide between the Clackamas River and Mollalla River in the Willamette River basin.

The EIS includes a detailed discussion of the relevant environment at Horning, providing baseline information for evaluating potential environmental impacts that could result from the proposed action or an alternative action. The human environment includes natural and physical resources and the relationship of people to those resources.

The resources described in the EIS include, in order of presentation, the physical environment (air, geology, and water), followed by land use, human health, biological resources, and the human environment (noise, cultural resources, socioeconomics, and environmental justice). These resources are described in a sufficient level of detail to adequately support the impact analysis.

Environmental Impacts

Chapter 4 of the EIS details the methods of analysis and assumptions made in evaluating potential impacts to each resource. Approaches included conducting a quantitative human health and ecological (non-target species) risk assessment (summarized in Appendix C), environmental fate and transport modeling, literature review, statistical evaluations, and review of similar actions at other locations. The resource-specific subsections in Chapter 4 describe the methods and present the criteria used for determining whether there are any potential impacts.

The analysis predicted no significant impacts to air quality, geology and soils, land use, noise, cultural resources, and socioeconomics and environmental justice. Human health, biological resources, and surface water (as it relates to aquatic species) are the resources with the greatest potential for impact and are therefore of greatest concern for decision-making:

Human Health and Safety

- There are no significant risks to members of the public from the proposed use of any of the control methods under any of the alternatives. However, under Alternatives A, B, C, and E, an accidental spill of pesticide to a stream could make surface water unsafe for drinking or fishing. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

- Under Alternatives A and E, there is a possibility of health effects for workers from some chemical pesticides. No risks of worker health effects were predicted for pesticide applications under Alternatives B and C. Under Alternatives A, B, C, and E, an accidental spill onto the skin could cause health risks. Under all of the alternatives, there is a possibility of injury from cultural or prescribed fire methods.

Water Quality

- No significant impacts to groundwater quality were predicted under any alternative.

- Runoff or drift from pesticide applications could enter streams and rivers under Alternatives A, B, C, and E, as could runoff containing fertilizers under all alternatives. The effects of the estimated stream concentrations on human health and aquatic species are described under those headings. Under Alternatives B and C, limitations would be in place to control the potential for runoff and drift.

- An accidental spill of pesticide concentrate or mix could contaminate groundwater or surface water under Alternatives A, B, C, and E. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

Biological Resources

- No significant adverse impacts to non-target vegetation are expected under any of the alternatives.

- There are possible risks to terrestrial wildlife species from three of the proposed insecticides under Alternatives A and E, and from calcium nitrate fertilizer under all alternatives. Lethality would be expected for non-target insects in an area treated with insecticide under Alternatives A, B, C, and E. With the exception of localized lethal impacts to non-target insects, no significant impacts to terrestrial wildlife were predicted under Alternatives B and C.

- There are no significant risks to aquatic species from use of chemical, biological, prescribed fire, or cultural control methods under any of the alternatives. Under Alternatives A, D, and

E, there is a potential for sublethal impacts due to ammonium toxicity on special status aquatic species under maximum scenario conditions only. Under Alternatives A, B, C, and E, there could be adverse impacts to aquatic species from an accidental spill of pesticide to a stream. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

Alternative B is the proposed action, and is BLM's preferred alternative for minimizing long-term impacts to all resources, including human health.

Cumulative Impacts

According to CEQ regulations at 40 CFR 1508.7, "cumulative impact" is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. There are no other major projects proposed in the orchard vicinity that are long-term in nature or would result in significant changes in the physical characteristics of the project area. Another cumulative concern relates to the potential toxic effects of exposure to multiple chemicals. The human health risk assessment addressed cumulative risk to workers and the public from the subset of proposed chemicals that are more likely than others to be used in a given year. No risk was identified for members of the public, but risk was identified for some workers under Alternative A when very conservative assumptions were applied to avoid underestimating the potential impact.

Mitigation Measures

Based on the results of the quantitative risk assessment, the selection of Alternative A, Maximum Production IPM, could result in environmental impacts to human health and biological resources. Therefore, CEQ's regulations for implementing NEPA require that potential mitigation measures for these consequences be identified in this EIS. The identified mitigation measures, described in detail in Section 4.12, restrict rates, frequencies, and other use details for diazinon, dimethoate, dicamba, hexazinone, mancozeb, and fertilizers.

A requirement for mitigation measures has not been identified for BLM's proposed action: Alternative B, IPM with Environmental Protection Emphasis. The design of this alternative, including the limitations specified in Section 2.3.3 of the EIS, is expected to address all identified potential risks.

Similarly, Alternative C, Ground-Based IPM, incorporates all of the limitations inherent to Alternative B, so no mitigation measures were identified.

No significant impacts were associated with Alternative D, Non-Chemical Pest Management, so identification of mitigation measures is not required.

Mitigation measures for use of chemical pesticides under Alternative E, No Action, would be identified on a project-by-project basis during the specific NEPA assessments.

The ROD that will be published at the conclusion of the EIS process will specify the mitigation measures that will be implemented with the selected alternative.

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1.0 Introduction

The U.S. Bureau of Land Management (BLM) proposes to implement an integrated pest management (IPM) program at the Walter H. Horning Seed Orchard (Horning) in Clackamas County, Oregon. The orchard is within BLM's Salem District. The *National Environmental Policy Act* (NEPA) of 1969, as amended, requires Federal agencies to consider environmental consequences in their decision-making process. The President's Council on Environmental Quality (CEQ) has issued regulations to implement NEPA that include provisions for both the content and procedural aspects of the required environmental analysis (40 Code of Federal Regulations (CFR) 1500 et seq.). The environmental impact analysis process, as governed by the Department of the Interior's Departmental Manual 516, *NEPA Compliance*, and BLM's Manual H-1790-1, *National Environmental Policy Act Handbook*, is the mechanism by which BLM ensures its decisions are based on an understanding of potential environmental consequences. The CEQ regulations were used in conjunction with the Departmental and Bureau guidance to determine the appropriate level of environmental analysis for this action, which BLM has determined to be an Environmental Impact Statement (EIS).

Preparation of this EIS must precede final decisions regarding the selection of an alternative, and be available to inform decision makers and the public of potential environmental consequences. Distribution and review of this Draft EIS allows for public consideration and input concerning the proposed IPM program, and will provide to decision makers and the public the information required to understand the future environmental consequences of the proposed action or an alternative. After carefully considering comments on this Draft EIS, BLM will issue a Final EIS. After completing the Final EIS, BLM will publicly state which action will be implemented in a formal document called a Record of Decision (ROD). Subsequent IPM activities will be implemented over the life of the IPM plan (usually 15 to 20 years) in accordance with that decision. No further NEPA documentation relating to IPM would be required, unless the seed orchard manager proposes to use a new IPM product or technology that was not included in the alternative selected in the ROD. The NEPA review requirements in this situation are discussed in Section 2.4.4.

This introductory chapter identifies the purpose and need for action, provides a general description of the location of the seed orchard, summarizes scoping comments and issues, and discusses the relationship of this document to other plans, policies, and programs. It concludes by describing the organization of the remainder of this EIS.

1.1 Purpose And Need For Action

1.1.1 Purpose of Action

The purpose of the action is to manage competing and unwanted vegetation, diseases, insects, and animal pests at Horning. Management of adverse impacts from pests is necessary to allow the seed orchard to produce improved seed for conifer seedling production, preserve individual valuable conifer trees, produce native species plants and plant species seed (including grass, forb, brush, and other), and produce containerized seedlings in a greenhouse nursery. This high-quality seed is supplied to BLM and other cooperators for reforestation and restoration projects.

For many years, Horning has managed pests using an IPM program that included limited use of chemicals: fenvalerate and esfenvalerate were used in the 1980s, 1990s, and in one application per year from 1999 through 2002 to control cone and seed insects in the orchard units, and several fungicides and insecticides were used in the greenhouses to control disease and insect pests. Each use in the orchard has required a separate NEPA document (an environmental assessment, or EA) to analyze the potential impacts from use of these chemicals. Changes and experience with control methods at Horning have created the need to re-evaluate the pest management

program to ensure that the pest management objectives at the seed orchard continue to be met. In addition, the public demand for efficient use of resources in government, as well as for providing appropriate environmental protection, requires the selection and use of the best pest management techniques for efficient and cost-effective orchard operation over the long term. The pest management objectives at Horning include the following:

- Minimize insect damage to orchard trees, cone crops, native plants, and greenhouse seedlings.
- Remove noxious weeds and control vegetation that favors animal pests and disease conditions, and reduce fire hazard conditions.
- Reduce growth of vegetation to allow tree establishment and growth and to minimize damage to orchard equipment and infrastructure.
- Treat fungal and bacterial diseases to maintain the health and vigor of the orchard trees used for seed production and to control plant pathogens in the greenhouse and native seedling grow-out beds.
- Minimize animal damage to orchard trees, native plant beds, greenhouse seedlings, and orchard equipment and infrastructure.

1.1.2 Need for Action

The need for this action is demonstrated by research which was conducted in 1983 at 17 different seed orchards in the western U.S. This research indicated an overall loss of 70% of the filled seed as a result of cone insect pests. The loss at Horning was 76% of the total potential seed. The need for action is also demonstrated by Horning's experience with periodic problems in the orchard units and greenhouses from insects, disease, weeds, and animals. These pests are described in the following paragraphs. Appendix A contains detailed information on the more common and damaging insects and diseases at Horning.

1.1.2.1 Insects

Many insects known to be capable of causing serious injury to Douglas-fir, pines, and other orchard species are present in the lands in and near the orchard. These include Douglas-fir cone gall midge (*Contarina oregonensis*), Douglas-fir cone worm (*Dioryctria* spp.), Douglas-fir cone moth (*Barbara colfaxiana*), seed bug (*Leptoglossus occidentalis*), Douglas-fir seed chalcid (*Megastigmus spermotrophus*), and western redcedar gall midge (*Phytophaga thuja*).

Most types of detrimental insects cause limited amounts of tree damage, including stress; deformation of tree stem, roots, branches, needles, or buds; damage to pollen, cones, and seeds; and mortality. Generally, the adult insects lay eggs on trees. The larval stages of these insects then tunnel into tree parts and eat tissue, destroying or deforming the tree parts, or the adult insect will bore into seeds to remove the contents. Larvae will often form pupae in or on the tree parts, such as in the bark or cones, and overwinter until the following spring when they emerge as adults, thus completing the life cycle.

Healthy vigorous trees are able to withstand occasional or limited attacks of foliar, bark, or root insects and recover with little damage. However, large numbers of cone and seed insects are present in the orchards every year and, under the correct conditions, are capable of causing heavy damage to seed crops. A variety of control measures can generally limit the effects of most insects to minor or acceptable amounts of damage. The exceptions are cone and seed insects, and insect population bursts and very localized small outbreaks of other insects. Also, insect populations will slowly increase in the orchards and surrounding areas as the trees become older and produce more cones (due to a slow building and survival of these insect populations), increasing the risk of population bursts and resulting damage.

Insects have destroyed 60 to 100% of the seed crop in Douglas-fir seed production orchards. Similar infestations have resulted in severe insect damage in Douglas-fir breeding and preservation orchards.

Currently, endemic insect populations have not posed a severe threat to cone seed production in the western hemlock, and western redcedar production orchards. In the future, if insect populations increase, losses may reach unacceptable levels and trigger a need for pest management.

The sugar pine and western white pine orchards have not reached cone production age. Within two to four years, they should reach maturation and be producing viable cone crops. As this begins, insects are expected to reduce crop potential at a rate of 20 to 60%, consistent with losses experienced by other pine seed orchards within the region.

Infestations by insects such as aphids, leaf hoppers, bark beetles, grasshoppers, sawflies, scales, mites, hemlock woolly adelgids, and defoliating caterpillars are relatively infrequent, and usually below threshold levels that pose a significant threat. However, they have the capacity to cause significant damage should their populations increase to high levels, such as has occurred in other geographic areas.

Greenhouse insect pests that occasionally require control include aphids, leafrollers, needleminers, fungus gnats, and root weevils.

1.1.2.2 Disease

Because of Horning's location on old forest lands, some pathogens common to local Douglas-fir forest stands have been identified in the seed orchard, including *Armillaria* root rot (*Armillaria* spp.), annosus root rot (*Fomes annosus*), laminated root rot (*Phellinus weirii*), *Phytophthora* root rot (*Phytophthora crytogea*), and black stain root rot (*Leptographium wageneri*). Tree stumps have been treated with Tim-bor® (a borate compound), which controls some of these diseases, so no significant effect on the orchards is anticipated in the near term. In trees under 40 years of age, such as those at Horning, these soil-borne diseases are more passive and slow to result in symptoms that would affect tree growth. The practice of stump removal during clearing and within the orchards leaves little potential for root diseases to advance.

Foliar diseases have also had little impact on orchard trees to date. A few outbreaks of *Phomopsis* canker (*Phomopsis occulta*) and needlecasts (*Rhabdocline pseudotsugae* and *Phaeocryptopus gaumanni*) have caused some needle loss and stem damage to trees. Other minor foliar diseases include Douglas-fir rust (*Melampsora occidentalis*) and rusts in the western white pine and sugar pine orchards. The trees planted in these orchards were selected based on levels of blister rust resistance and so far have displayed only slight damage. Western gall rust (*Endocronartium harknessii*) and white pine blister rust (*Cronartium ribicola*) have been noted in local orchards, but are not expected to cause major problems at Horning due to the trees' disease resistance.

Because of the overall good health and vigor of the seed orchard trees, it is expected that these diseases would usually cause only minor damage such as needle loss, and branch and stem loss or deformation. However, if future conditions change and environmental stresses occur, these diseases could cause significant problems to valuable orchard trees.

In the greenhouse, the main diseases of concern are seed-borne and foliar diseases. The wide range of native conifers, grasses, shrubs, and hardwoods present in the greenhouse is associated with a greater potential for various disease problems. Some of the more prominent diseases identified in the greenhouse include grey mold (*Botrytis cinerea*); *Fusarium roseum*, *F. solani*, and *F. oxysporum*; *Cylindrosporium* leaf spot and stem canker; *Phomopsis* blight; *Anthracnose* leaf spot; *Alternaria* leaf spot; and *Lophodermium* needle cast. *Rhizoctonia*, *Pythium* spp., and *Phytophthora* spp. can also create problems in susceptible plants under stressed environmental conditions.

1.1.2.3 Vegetation

Undesirable vegetation (grasses, forbs, brush, and small and large trees, including invasive and exotic species of many kinds) grows in orchard units and native species beds; along fence lines, ditches, and roads; around developed areas such as structures and parking lots; and on fallow lands.

Unwanted woody hardwood and conifer tree and shrub species grow from sprouts or seeds in border or edge areas along fence lines and roads or in fallow areas. Blackberry species, black cottonwood, red alder, cedars, sedges, scotch broom, willows, and poison oak often create hazards or impediments to normal orchard operations. In addition, plants such as Canada thistle, tansy ragwort, knot weed, and others are noxious weeds requiring control. Other vegetation introduces contaminating "weed" seed into pure native plant seed beds, affecting the quality of the source seed being produced.

Unwanted and uncontrolled vegetation provides fuels for potential wildfires. Horning is in a rural environment surrounded by farms and homes with acreage. The risk of wildfire in the interface of orchard with public roads and homes is very high. The control of vegetation height in the orchard units, fallow open land areas, and borders is essential to reduce the rapid spread of grass fires.

Competition for water, nutrients, and light among the orchard trees, and cover crop vegetation in the orchard units, occurs during the active growing season. Reduction of vegetation increases available soil moisture and nutrients to the trees. Unwanted and uncontrolled vegetation near orchard trees is also a physical barrier to efficient spray patterns from sprinklers and micro jet emitters, and to safe and efficient foot and vehicular travel.

Uncontrolled vegetation also provides protective hiding and nesting cover for rodents and other animals which cause damage to orchard trees, building foundations, road surfaces, and the surface lands in the orchard units. Rodents chew and eat tree roots and bark, and sometimes eat foliage; chew and damage electrical wiring; burrow under concrete foundations, undermining building integrity; and burrow into roadways and throughout orchard units, causing erosion, degradation, and an uneven surface. Any uneven surface, in turn, creates a safety hazard when using ladders, high lifts, utility vehicles, or all-terrain vehicles. Keeping vegetation low reduces animal cover and increases the opportunity for predation on these animals by raptors and carnivores, thereby reducing the damage.

Because the eight-foot tall perimeter fences surrounding the orchard represent a very high capital investment, vegetation has been controlled along these fence lines. If left uncontrolled, this vegetation would ultimately overgrow and affect the structural integrity of these fences and their ability to act as barriers.

1.1.2.4 Animal Pests

A broad range of animal habitat exists in and around the seed orchard, including grass- and tree-covered orchard units, open grass-covered fallow areas, open woodlots, brushy hedgerows and edge areas, fence lines, year-round and intermittent stream courses, riparian areas, culverts, ponds, and roadsides. These habitats attract a wide mixed variety of animal life which lives and feeds on the orchard grounds.

Animals at Horning that may require control to minimize damage to seeds, trees, plants, and equipment include deer, elk, rabbits, voles, porcupines, mountain beavers, opossum, domestic dogs, fox, skunk, raccoon, ground squirrels, coyotes, mice, rats, and moles.

The 11.2 miles of eight-foot high woven wire fence at Horning excludes big game from the orchard. The fences are essential for keeping deer, elk, and stray livestock from small tender seedlings and grafted trees, as well as expensive graft-compatible rootstock. As the trees grow out of browsing reach from the deer, the fence continues to be an important deterrent to deer from

doing antler damage to tree stems and to any other large animals from doing damage to the trees or irrigation system.

Rodents such as the western pocket gopher, deer mouse, and a variety of other mice and voles all cause damage to young tree roots and lower stems by eating plant tissue. Older trees can be damaged by porcupines, which eat inner bark tissue and girdle the tree stem. At Horning, porcupines caused serious damage to several orchard units in the early 1990s, until the animals were trapped and relocated. Ground squirrels tunnel around the foundations of buildings, in and near roads, and in the orchard lands, creating hazards to facilities and people.

Other animals cause damage to portions of the irrigation systems (1-inch poly supply line, ½-inch poly supply line, and drip emitters). The coyote, gray and red foxes, opossum, striped and spotted skunk, raccoon, domestic dogs, and some of the rodents listed above chew off and remove, or chew holes in, the irrigation system parts, which causes leaks and water loss, requires time and money to repair, and prevents the trees from getting water.

At Horning, the Douglas squirrel can cause damage and loss to cones on the trees. The squirrels come into the orchard units from adjacent woodlands or riparian areas to hunt for food, including the cones hanging on orchard trees in the pollen exclusion bags.

Some animals causing damage are also predators for other animals that damage orchard crops. Animals are generally welcome and accepted at Horning until populations rise, food preferences shift to orchard crops, or damage becomes unacceptable.

1.2 Location Of Walter H. Horning Seed Orchard

Horning is located approximately 23 miles southeast of the city of Portland and 40 miles north-northeast of Salem, Oregon, near the small community of Colton and within Clackamas County. It lies within the Willamette River valley, between the Oregon Coast Range and the Cascade Mountains. Figure 1.2-1 shows the seed orchard location.

1.3 Scoping Comments And Issues

Numerous scoping-related activities were conducted for this EIS between 1999 and 2002. These are described in BLM's scoping report for Horning (BLM 2002a) and summarized in Section 5.1 of this document. Scoping comments received during this time are described in detail in BLM's public comment summary report for Horning (BLM 2002b), and summarized herein. Twenty public comments were received from seven responders during the 1999-2002 timeframe. Many commentors had no comments or concerns about the proposed IPM program, or were interested only in finding out how to control their pests at home. These latter interests are considered to be out-of-scope comments and are not addressed in this EIS. Comments relevant to the scope of the EIS focused primarily on the alternatives and potential environmental impacts from using chemical pesticides. Table 1.3-1 summarizes the number of comments by major category. Note that some commentors had more than one comment. These comments reflect the major issues that require consideration by the decisionmaker in developing the ROD for this EIS.

Comments on alternatives generally were in favor of implementing less hazardous pest management practices, particularly no chemical pesticide use. One member of the public was interested in using bluebirds to control insect pests and also recommended that the orchard manage for cavity dwellers such as nuthatches, chickadees, and juncos. An adjacent landowner and a grazing cooperator both expressed concern about the potential human health impacts from pesticides: the landowner requested notification before any spraying so they could keep their child inside, to protect against exposure to spray drift; and the grazing cooperator was concerned about the potential health effects of consuming cattle that graze at the seed orchard. These commentors

Figure 1.2-1: Location of Horning Seed Orchard

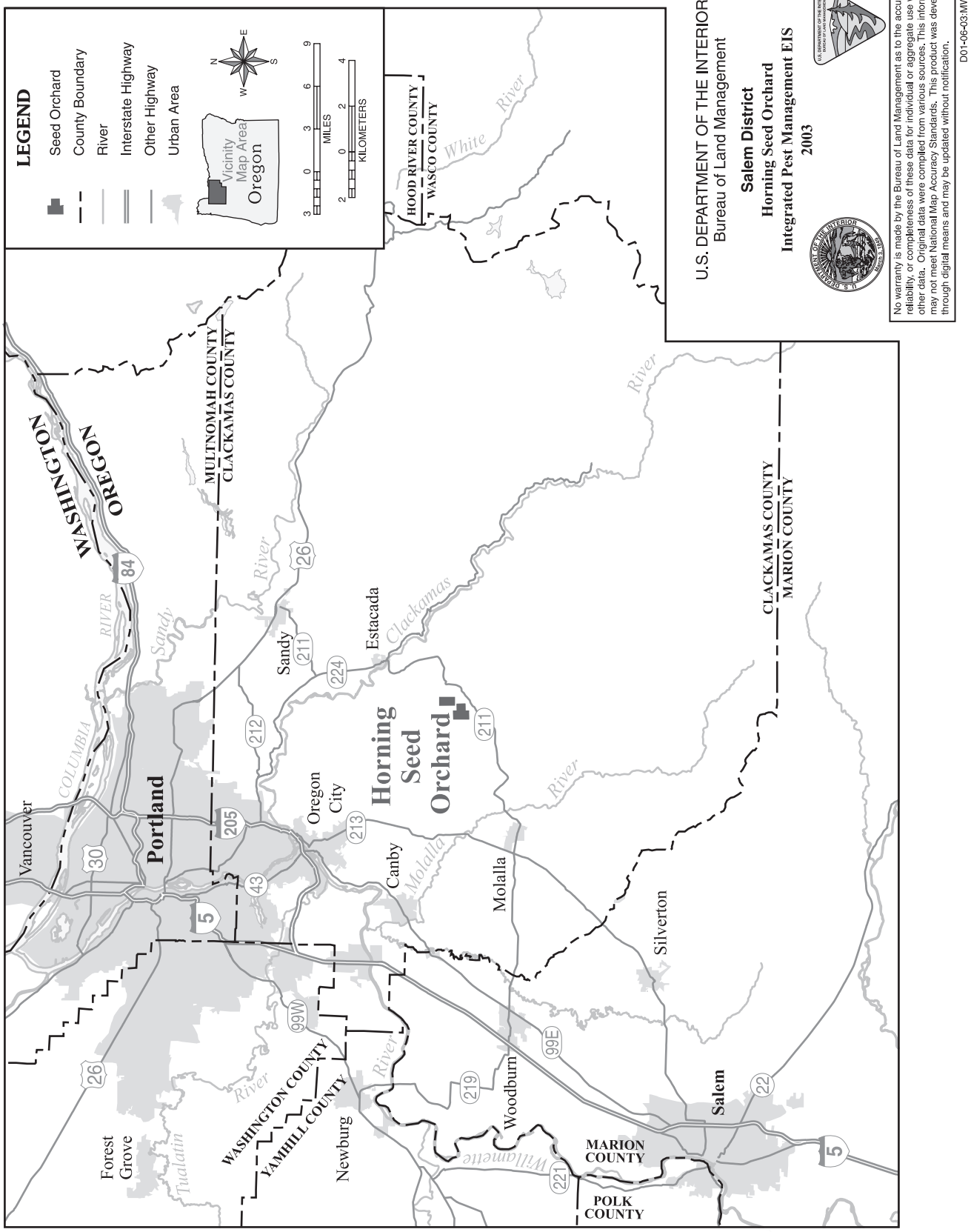


Table 1.3-1. Major Comment Categories

Comment Category	Number of Comments
Alternatives	2
Human health and safety impacts	4
Economic impacts	2
Ecological impacts	2
Soil impacts	1
Water quality impacts	1
General opposition to chemical pesticides	1
No comment/out of scope	7
Total Comments	**20**

were also concerned about the potential economic impacts of pesticide use on their activities. Specifically, the adjacent landowner was concerned about the economic effects on his organic farm status and revenues, while the grazing cooperator thinks any pesticide use could result in undue hardship and limit the acreage available for grazing by her cattle and sheep. Finally, one commentor, who represented herself as well as the Coast Range Guardians and Canaries Who Sing, opposed chemical use and was in favor of non-chemical alternatives. She expressed concern about the effects of insecticides in particular (specifically esfenvalerate) on soil, tree health, and ecological resources, including plants, wildlife, and coho salmon. She provided copies of two recent court decisions relating to salmon and pesticide use, and to pesticides entering waters of the U.S.

All of the scoping comments received and considered to be within scope are addressed in this EIS. Specific environmental resources of concern identified during scoping and analyzed in Chapter 4 are human health and safety, soils, ecological resources (including vegetation, terrestrial wildlife, and aquatic species), water quality, and socioeconomics. This EIS also addresses potential impacts to other resources that were not identified during scoping, but required evaluation to determine if any impacts were possible: air quality, land use, noise, and cultural resources.

1.4 Relationship To Plans, Policies, And Programs

1.4.1 Related BLM Plans, Policies, and Programs

The Salem District Resource Management Plan (RMP) (BLM 1995) included the seed orchard within the Administratively Withdrawn land allocation. This allocation recognized existing management direction previously established for protection of specific resources, flora and fauna, and other values. These seed orchard values included preservation of genetic materials, production of improved seed, and various orchard developments and facilities.

The provisions of the Salem District RMP found in the resource program sections for Energy and Minerals; Land Tenure Adjustments; Rights-of-Way, Access, and Withdrawals; and the information in Appendices C—Best Management Practices-Roads, and E—Forest Genetics Program, apply to Horning. Except for these specific sections, the objectives and management actions/direction described in the Salem District RMP are not applicable to Horning.

Horning is administratively withdrawn. Section 204 of the *Federal Land Policy and Management Act* (FLPMA) of 1976 (43 U.S.C. 1700 et seq.) describes "withdrawal" as "withholding an area of Federal land from settlement, sale, location, or entry, under some or all of the general land laws, for the purpose of limiting activities under those laws in order to maintain other public values in the area or reserving the area for a particular public purpose or program." It was noted as a public land withdrawal in the Salem District RMP (BLM 1995). Specifically, Public Land Orders 3015 and 3609 withdrew a total of 480 acres at the seed orchard from surface entry and mining under general land laws and mining laws.

BLM's Oregon State Office concluded that this intensively developed, administratively withdrawn site was not intended to meet the standards and guidelines for forest health as generally provided in the Salem District RMP, which incorporated and superceded the Northwest Forest Plan (BLM 2000). In addition, standards and guidelines for various resources, such as Survey and Manage and Protection Buffer Species, while applicable to many administrative withdrawals, are not intended to be applied to intensively developed and used areas, such as Horning (BLM 2000). The orchard is not considered appropriate or available for conversion to a late-successional reserve or any other land use allocation which might directly serve as scarce or important habitat (BLM 2000). BLM's findings distinguish the unique nature of this site from other administrative withdrawals, such as Research Natural Areas, which are designed and designated to be important components of the broad ecosystem management direction under the RMP.

BLM prepared and supplemented a programmatic level EIS for Northwest Area Noxious Weed Control (BLM 1987). The ROD authorized use of specific herbicide formulations to control noxious weeds. The herbicide products contain dicamba, glyphosate, picloram, or 2,4-D as the active ingredient. Noxious weed control projects at Horning using these herbicides would be authorized under this 1987 ROD. Subsequently, BLM prepared an EIS and ROD for the Western Oregon Program for Management of Competing Vegetation (BLM 1992). This ROD selected an IPM approach with a preference for non-herbicide methods, and applies to all BLM-administered land in the Coos Bay, Eugene, Medford, Roseburg, and Salem Districts (Horning), and part of the Lakeview District. Actions covered under the 1987 Noxious Weed Control EIS are excepted from this decision.

BLM is undertaking a programmatic EIS for vegetation treatment on public lands administered by the BLM in the western U.S., including Alaska. This programmatic EIS will consolidate, update, and replace analyses contained in existing BLM vegetation treatment EISs, as well as include lands not analyzed in the existing documents. The programmatic EIS is not intended to affect specific Agency management decisions developed under local land-use plans, but will provide a baseline cumulative impact assessment that local BLM offices, including the Salem District Office, can use as they develop or update each district land use plan/EIS. The public scoping comment period on the programmatic EIS ended March 29, 2002. The draft EIS is scheduled for completion in mid-2003.

There is currently an injunction prohibiting BLM from applying herbicides. It has been partially lifted to allow applications for noxious weeds, as covered under the NEPA documents described in the preceding paragraph. Except for these uses, the injunction would have to be lifted (in its entirety or specifically for the seed orchard) before herbicides could be used as described in this EIS.

In the absence of this IPM EIS, project-specific EAs have been prepared for Horning for past esfenvalerate use to spray for cone and seed insects in production orchards, most recently in 1999, 2000, and 2001. The spring 2001 spray project EA at Horning was completed in February 2001, with a finding of no significant impact (FONSI) for the proposed action of aerially spraying esfenvalerate one time only in selected fields (BLM 2001). This EA was determined to also provide adequate NEPA analysis and documentation for a similar esfenvalerate spray project that was conducted in the spring of 2002. Once a decision is issued on the basis of this EIS, such project-specific NEPA documentation should no longer be required at Horning, since the ROD would make available to the seed orchard manager a variety of pest control methods that can be implemented to control specific pests in a manner that best fulfills orchard goals.

BLM's Eugene and Medford Districts in western Oregon are developing pest management EISs for their three seed orchards concurrently with this one for Horning. Specifically, the Eugene District is developing an EIS for the Tyrrell Seed Orchard, and the Medford District is developing an EIS for pest management at both the Provolt and Sprague Seed Orchards. Both EISs are being prepared under the same project schedule as this EIS for Horning.

1.4.2 Relevant Federal, State, and Local Statutes and Guidelines

Pest management at Horning would follow all relevant Federal, state, and local laws and regulations. Major legislation relating to this EIS includes the following:

- *National Environmental Policy Act* of 1969 (42 U.S.C. 4321 et seq.), as amended: requires Federal agencies to prepare an EIS if a proposed action has a potential for significant environmental impacts.

- The *Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA) of 1947, as amended (7 U.S.C. 136 et seq.): establishes procedures for the registration, classification, and regulation of all pesticides. The Environmental Protection Agency (EPA) is responsible for implementing FIFRA; primary enforcement responsibilities for use-related violations are assigned to states with approved programs. Before any pesticide may be sold legally, it must be registered by EPA. EPA may classify a pesticide for unrestricted use if it determines that the pesticide is not likely to cause unreasonable adverse effects on applicators or the environment. States may classify pesticides for restricted use (which means they may be applied only by or under the direct supervision of a certified applicator or in accordance with other restrictions), even though EPA may not have done so.

- The *Clean Air Act*, as amended (42 U.S.C. 1857 et seq.): sets national primary and secondary ambient air quality standards, requires that specific emission increases be evaluated to prevent a significant deterioration in air quality, and provides EPA with authority to set national standards for performance of new stationary sources of air pollutants and standards for emissions of hazardous air pollutants.

- The *Clean Water Act* (33 U.S.C. 1251-1387) of 1984, as amended: charges EPA with protecting the nation's water resources and wetlands, and controlling the discharge of toxic chemicals. The Act defines water quality standards for priority toxic pollutants, oversees the industrial pre-treatment program, and provides local governments with the authority to control non-industrial discharges of toxics.

- The *Safe Drinking Water Act* (SDWA) of 1974 (42 U.S.C. 300(f) et seq.): established a national structure for drinking water protection activities. The Act authorized EPA to establish national, enforceable health standards for contaminants in drinking water; provided for public water system compliance through a Federal-state partnership; established public notification to alert customers to water system violations; and set up procedures to protect underground sources of drinking water.

  The 1996 amendments to SDWA required states to develop source water assessment programs (SWAPs) that outline an approach for conducting source water assessments, delineate the boundaries of areas from which public drinking water systems receive drinking water, and identify the origins of regulated and unregulated contaminants. In Oregon, the Oregon Department of Environmental Quality (ODEQ) has state primacy for implementing the SDWA and administers both the SWAP and the underground injection control (UIC) program through this authorization. Through both the SWAP and UIC programs, ODEQ seeks to ensure the protection of groundwater that is used for drinking water. BLM supports ODEQ's efforts by contributing data and information to ODEQ's UIC registry of sites. Among the sites registered under ODEQ's UIC program are Class V injection wells. EPA Region 10 defines Class V injection wells to be systems, structures, or activities that allow for subsurface placement of fluid directly. In most instances, a hole or a trench using piping would qualify if the purpose

or intent is for subsurface discharge either through infiltration or injection. Operation and maintenance activities at Horning do not involve subsurface placement (that is, injection) of potential contaminants and therefore have not been registered with ODEQ. However, because the potential for an unintended spill or discharge always exists, best management practices for spill recovery that reference ODEQ's UIC best management practices (ODEQ 1999) would be developed and included in Horning's Spill Prevention, Containment, and Countermeasure Plan. In addition, design features included in the Orchard Water Management Plan and the EIS preferred alternative are expected to minimize the impacts of an unintended spill to groundwater.

- The *Endangered Species Act* (ESA) of 1973 (as amended): establishes Federal policies and procedures for protecting endangered and threatened species of fish, wildlife, and plants. Section 7 requires Federal agencies to consult with the U.S. Fish and Wildlife Service (FWS) or the National Oceanic and Atmospheric Administration's Office of Fisheries (NOAA Fisheries) (formerly known as the National Marine Fisheries Service, or NMFS) to ensure that any action that they authorize, fund, or carry out is not likely to jeopardize the continued survival of a listed species or result in the adverse modification or destruction of its critical habitat (16 U.S.C. 1536 (a) (2)). In addition, the Act requires that if species proposed for listing are likely to be jeopardized, consultation must be held with the FWS or NOAA Fisheries. This consultation may result in modification or abandonment of an action.

- *Migratory Bird Treaty Act* (16 U.S.C. 703-711): except as allowed by implementing regulations, this act makes it unlawful to pursue, hunt, kill, capture, possess, buy, sell, purchase, or barter any migratory bird, including the feathers or other parts, nests, eggs, or migratory bird products.

- *Fish and Wildlife Coordination Act* of 1980 (16 U.S.C. 2901 et seq.): encourages Federal agencies to conserve and promote conservation of nongame fish and wildlife and their habitats to the maximum extent possible within each agency's statutory responsibilities.

- *Magnuson-Stevens Fisheries Conservation and Management Act*, as amended by the *Sustainable Fisheries Act* of 1996: requires the identification and protection of essential fish habitat (EFH) for important Federally managed fisheries resources (that is, marine and anadromous fisheries). In freshwater, EFH includes habitats for spawning and incubation, juvenile rearing, juvenile migration corridors, and adult migration corridors. Federal agencies are required to consult with NOAA Fisheries if their actions may adversely affect EFH.

With respect to the ESA, the U.S. District Court in Seattle ruled on a case between the Washington Toxics Coalition and EPA on July 3, 2002 (*Washington Toxics Coalition et al. v. Environmental Protection Agency and Christine Todd Whitman, Administrator*). The purpose of this lawsuit was to compel EPA to consult with NOAA Fisheries (formerly NMFS) over its registrations of pesticides known to affect fish. The court found that EPA was in violation of ESA because EPA had not consulted with NOAA Fisheries, and determined that EPA needed to consult with them on 55 of the pesticides identified in the case, eight of which are proposed for use at Horning (acephate, chlorothalonil, chlorpyrifos, diazinon, dicamba, dimethoate, propargite, and triclopyr). The EPA-NOAA Fisheries consultation has not been completed as of the date of this Draft EIS.

In another lawsuit, the League of Wilderness and seven other environmental groups appealed a district court finding to the U.S. Court of Appeals for the Ninth Circuit, challenging the U.S. Forest Service's annual aerial insecticide spraying program covering over 628,000 acres of national forest lands in Washington and Oregon [*League of Wilderness Defenders et al. v. Harv Forsgren and U.S. Forest Service,* 309 F.3d 1181 9th Cir. (2002)]. The spraying was aimed at controlling a predicted outbreak of the Douglas-fir tussock moth, and included planned direct overspray of natural bodies of water during the course of treating forested areas. The plaintiffs asserted that the EIS was inadequate, and that the Forest Service failed to obtain a National Pollutant Discharge Elimination System (NPDES) permit, which is required by the *Clean Water Act* for point source pollutant discharges to water. Although the district court had granted summary judgment in favor

of the Forest Service, the Ninth Circuit reversed the decision on appeal in an opinion issued on November 4, 2002. The Forest Service has been prohibited from further spraying until it acquires an NPDES permit and completes a revised EIS. At this time, this judicial decision does not appear relevant to pest management activities at Horning, since no discharge to, or direct spray of, surface water is planned under any of the alternatives.

BLM's pest management would be conducted in accordance with all applicable state and local government regulations, including two laws specific to the Department of the Interior and BLM: the *Sikes Act* (16 U.S.C. 670 et seq.), as amended, and FLPMA. The *Sikes Act* authorizes the Department of the Interior, in cooperation with state agencies responsible for the administration of fish and game laws, to plan, develop, maintain, and coordinate programs for the conservation and rehabilitation of wildlife, fish and game on public lands within its jurisdiction. FLPMA requires BLM to manage public lands and their resources for multiple use, and to develop resource management plans for lands under BLM's jurisdiction.

State and county weed control laws place responsibility for noxious weed control on individual land owners, including the Federal government. Permittees and grantees operating rights-of-way on BLM-administered land are required to comply with Department of the Interior herbicide use regulations. BLM must also coordinate with appropriate state agencies in managing state-listed plant and animal species when a state has formally made such designations.

1.5 Organization Of This Eis

This document is organized into four main chapters. Background and support information, including a summary of the human health and ecological risk assessment, is provided in the appendices. The Draft EIS presents five alternatives for managing pests at Horning, including the no action alternative, and examines the potential environmental impacts of each alternative. Chapter 1, Purpose and Need, identifies the purpose and need for action, provides an introduction to typical pests found at the orchard, and discusses the public issues surrounding pest management and other considerations. Chapter 2, Alternatives, presents and compares the alternatives, with information on how they would be implemented with measures to protect the environment. Chapter 3, Affected Environment, includes a description of the physical, biological, and social setting of the orchard. Chapter 4, Environmental Consequences, addresses changes likely to occur with implementation of any of the alternatives.

In addition to the four main chapters, the document contains these sections: Executive Summary; Table of Contents; Chapter 5—Consultation and Coordination (including scoping process, consultation list and a list of agencies, organizations, and individuals to whom copies of the statement were sent); Chapter 6—List of Preparers; Chapter 7—References; a list of acronyms; a glossary; and an index.

Additional detail and background information is presented in appendices:

A. Seed Orchard Pests
B. Monitoring Plan
C. Risk Assessment Summary
D. Risk Analysis for Special Status Aquatic Species

2.0 Description Of Alternatives, Including Proposed Action

2.1 Background

2.1.1 Seed Orchard, Tree Improvement Program, and Genetics

BLM manages four centralized tree seed orchards in western Oregon: Horning in the Salem District, Tyrrell in the Eugene District, and Provolt and Sprague in the Medford District. Historically, the seed orchards' role was to provide genetically improved Douglas-fir and sugar pine seed and seedlings to the five western Oregon districts and the western Klamath Falls resource area for reforestation and progeny test programs. A major shift in management emphasis in the districts' RMPs sharply decreased the need for seeds for reforestation. Therefore, the seed needed for BLM purposes from the BLM seed orchards was greatly reduced. To allow BLM to cost-effectively manage the seed orchards, an effort has been made to share the seed orchards with other cooperators. Consequently, the seed needs from many of the orchard units have increased because of strong cooperator interest.

Orchard Operations

There are two types of BLM seed orchards, each serving a different purpose. In *breeding and preservation orchard units*, trees from the same clone/family are planted in tight spacing and located together. The main purpose of these orchard units is to breed for advanced generation programs and/or preserve genetic material (clone banks). They do not represent the total genetic variation selected within the breeding zone. This variation is more appropriately preserved in the progeny test sites. In *seed production orchard units*, trees from different clones/families within the same seed zone are planted at wider spacing and are designed to facilitate good mixing of pollen and reduce self-pollination. The main purpose of the seed production orchard units is to produce genetically improved seed for reforestation. There are Phase I and Phase II seed production units. In most cases, the Phase I units have been established with the first generation clonal material, and will be the main source of seed for the current and next decade. Most of the Phase II units are undeveloped and are reserved for advanced generation orchards.

Currently, there are approximately 222 acres devoted to conifer seed production at Horning. The species include Douglas-fir, noble fir, western hemlock, western redcedar, sugar pine, and western white pine. The seed production orchards may produce 1,600 to 3,500 bushels of cones annually, depending on customer needs and crop stimulation success. In Douglas-fir and western hemlock, cone crops are stimulated using a combination of techniques including girdling, gibberellic acid (GA 4/7) injected into the trees, and calcium nitrate fertilizer at 200 pounds (lb) of nitrogen per acre applied at the drip-lines. A typical year would involve 200 trees treated with GA 4/7 and 800 trees treated with calcium nitrate. Between the success of stimulation efforts and natural cone crops, an average of 1,000 bushels of cones is harvested annually, based upon seed needs and customer requests.

Breeding and preservation orchards currently occupy approximately 69 acres. Another 106 acres have been cleared and established with ground cover. These are for development of second generation tree improvement and minor species orchards. Approximately 191.5 acres are occupied by structural facilities (including the building compound) or vegetated riparian stream buffers.

Figure 2.1-1 depicts the layout of Horning and its seed production and breeding and preservation units.

Figure 2.1-1: Layout of Horning Seed Orchard

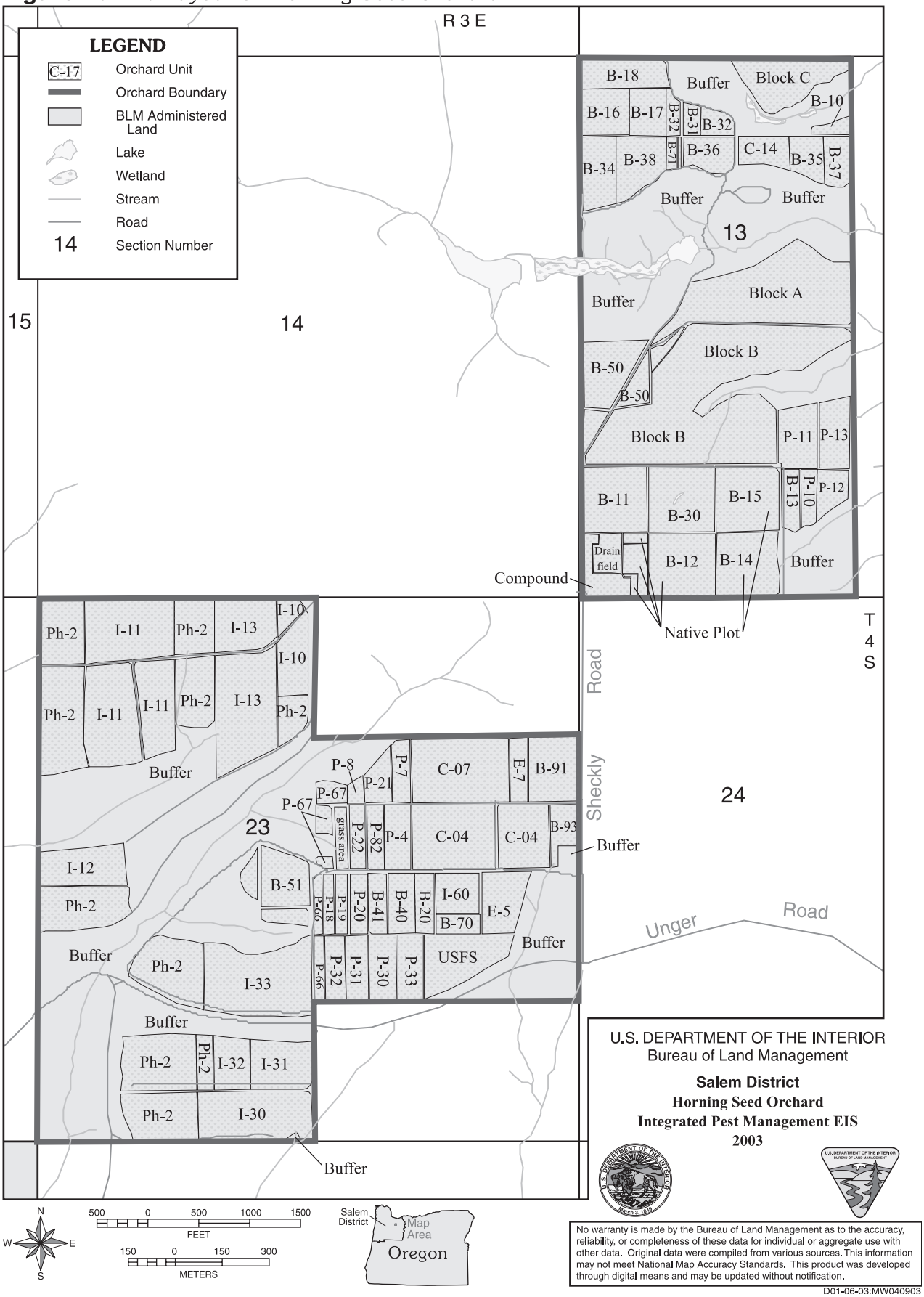
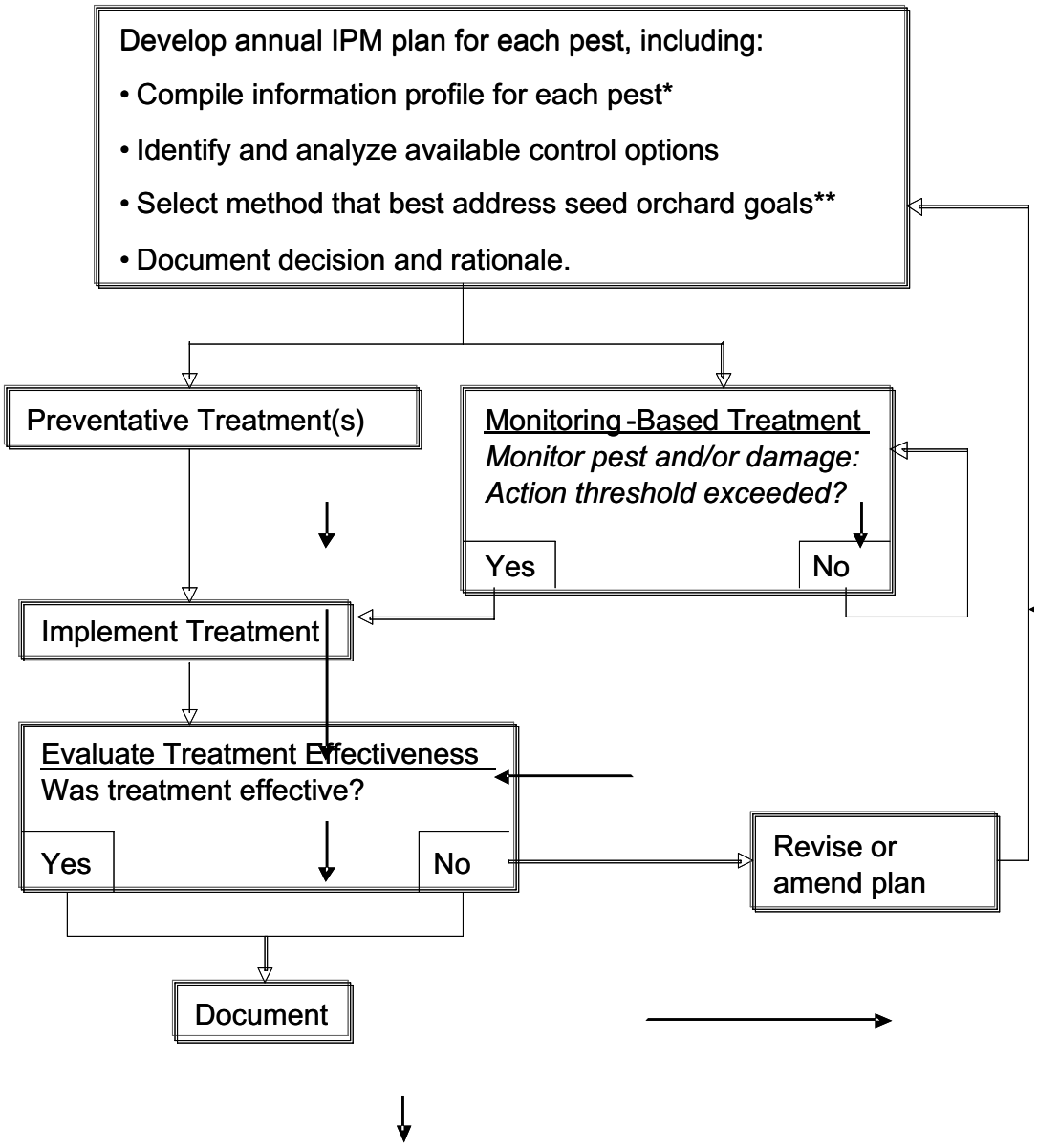


Figure 2.2 -1. Seed Orchard IPM Process



*Profiles will vary in depth and included information based on t hreat from any particular pest; may consist of a group of files, reports, and on -line data sources.

**Goals may vary between locations and ownerships, and over time . Possible goals might include high seed production, protection of human health, protec tion of the environment, and cost-efficiency.

Cone and Seed Processing

Horning houses a seed plant/extractory which processes an average of 1,400 pounds of seed (approximately 2,500 bushels of cones) annually. Aside from processing the crop produced at Horning, it also processes cones and seed from other BLM orchards and field collections. As workloads have allowed during the last few years, Horning has processed cones and seed for several other state, county, and city agencies. The facility provides state-of-the-art cone storage, seed testing, packaging, shipping, and seed storage services.

Growing Containerized Seedlings in Greenhouses

The greenhouse complex consists of two greenhouses, a center-span holding area, a nursery work building, several container storage areas, a loading dock, a pump house, and 500 square feet of cooler space. The greenhouses have 19,000 square feet (ft^2) of growing space which can accommodate 940,800 container seedlings at maximum production based on 100 seedlings/ft^2 (using three-cubic-inch growing containers). The holding area can accommodate another 64,000 container seedlings of the same size, with 640 ft^2 of growing space.

The nursery's pure well water provides a neutral base for growing seedlings. Soluble fertilizers providing both macro and micro nutrients required for healthy plant growth are added through an overhead drop-riser irrigation system. This system is regulated automatically and provides specific delivery of fertilizers and pesticides by quadrants. Additionally, watering schedules and bench watering can be used for small specialty lots. The greenhouse is also equipped with a small mist bench area for vegetative propagation.

Native Species Grow-Out Beds

Ten acres were developed for grow-out of native species at Horning in 2001, and up to 60 additional acres are currently in various stages of development for this program. Approximately three acres are now in production for native grasses and forbs.

2.1.2 Ongoing Orchard Activities

Under all alternatives, routine management actions for orchard establishment and maintenance activities would continue to occur. However, these actions—which include orchard establishment, orchard maintenance, buffer zone management, and facilities/equipment maintenance—are not directly related to IPM and therefore are not evaluated in this EIS. See also discussion of District RMP in Section 1.4.1.

Orchard Establishment

Most land clearing at Horning has been completed. Any future site preparation would consist of preparing an area for a new orchard by removing existing stumps, subsoiling, rototilling or disking, leveling, and cover crop seeding. These site preparation activities would also occur as older orchards are recycled; that is, as trees become too large to harvest cones and are replaced with advanced generation orchard material.

New orchards would periodically be established in the Phase II fallow areas and in orchards that are being recycled. Approximately 10 acres of orchard are likely to be recycled over the next decade, and approximately 30 acres in the following decade. Individual tree positions in new orchards would be rototilled to prepare the area for planting. Trees would be planted by shovel, tree spade, or power augur, mulched with porous fiber or poly mats to help control competing vegetation and retain soil moisture, shaded with cards or screens to reduce seedling basal heat damage and overall tree stress, and tubed with mesh cylinders or fencing material to prevent animal damage and vegetation loss. Future development of Phase II fallow areas adjacent and within 200 feet of perennial streams would favor the planting of preservation orchards that generally do not require the level of pest management required by seed production orchards.

Most of the first generation seed orchard units are clonal and contain the best parent trees selected from natural forest stands and tested in progeny testing programs. Cuttings would be taken from the best parent trees and grafted onto rootstock in the orchard units. Orchard trees would occasionally be transplanted with various sizes of tree spades. All genetic improvements at Horning are based on selective breeding; Horning is not equipped and has no program for direct genetic manipulation.

In addition to conifer tree seed production orchards, some small areas would be established for native grasses, forbs, hardwood trees, and shrub gardens, and bed rows for seed and vegetation production. There are currently 10 acres of these other orchard areas, and establishment of approximately 60 acres of new production areas is likely over the next decade. Actions for establishment and maintenance of these other orchard areas would not be substantially different from the conifer tree seed production orchards.

Orchard Maintenance

Orchard trees would be pruned to remove unwanted rootstock vegetation (as graft unions become established), to remove lower limbs to improve access for equipment operation, and to thin and shape tree crowns. In addition, some orchard trees would be topped to reduce tree height and thereby facilitate cone collection.

Orchard trees would be periodically stimulated for flower production by girdling (double half-circumference overlapping technique) and/or application of fertilizer or GA 4/7. Cones would be collected using tree climbing, orchard ladders, or high lifts. Cones would be removed from trees, bagged, transported to cone storage facilities, and dried and stored.

Orchards would be thinned to increase the light for increased tree crown development and improved pollen flow. Thinning would also be used to remove the lower ranked clones (roguing), which would usually occur when the trees are from 5 to 18 years old. Trees would be felled, limbed, and removed. Approximately 20 to 50% of the trees in an orchard unit would typically be removed during the roguing process. Thinned trees and woody debris from pruning would be disposed of by piling and burning, chipping, or would be sold for firewood.

Other orchard maintenance activities would include tree staking, tree identification tag maintenance, and bark scoring to improve graft compatibility.

Buffer Zone Management

The buffer zones are non-usable areas between seed orchard units that are too steep or wet for orchard units, have riparian characteristics, are vacant land areas, or are otherwise unsuitable or not planned for seed orchard unit development. These areas are not intensively managed and are maintained as pollen buffers, as wildlife corridors, and for stream protection.

Facilities/Equipment Maintenance

Gravel access roads within the orchard would be maintained every year by grading, rocking (as necessary), and occasionally surfacing with chip seal to provide year-round access to the primary project areas of the orchard. The road maintenance work would sometimes include bar ditch cleaning and culvert maintenance. Road maintenance activities would occur on approximately 9.1 miles of road per year. New road segments might occasionally be built to provide access into newly established or new emphasis areas, but no new construction is anticipated at this time. Any new road construction would include grading, rocking, rolling, and ditch and culvert installation.

The deer and elk exclusion fence and gates around the perimeter of the orchards would receive regular maintenance, repair, and improvements.

Buildings, utilities, and a variety of vehicles and equipment would receive regular maintenance, repair, and improvements.

2.2 Integrated Pest Management In The Walter H. Horning Seed Orchard

This section describes the principles of an IPM program and options for controlling insects, disease, vegetation, and animal pests at the seed orchard.

2.2.1 Integrated Pest Management

It is the policy of the Department of Interior, and all of its agencies including BLM, to use chemical pesticides only after considering the alternatives; and to develop, support, and adopt IPM strategies wherever practicable (DOI 1981).

The following description of IPM was condensed from information published by the IPM Institute of North America, Inc. (IPM Inc. 2002).

IPM is an approach to solving pest problems by applying our knowledge about pests to prevent them from damaging crops, harming animals, infesting buildings or otherwise interfering with our livelihood or enjoyment of life. IPM means responding to pest problems with the most effective, least-risk option. Under IPM, actions are taken to control pests only when their numbers are likely to exceed acceptable levels. Any action taken is designed to target the troublesome pest, and limit the impact on other organisms and the environment. Applying pesticides to crops, animals, buildings or landscapes on a routine basis, regardless of need, is not IPM. Applications of pesticides are always the last resort in an IPM program. [Components of an IPM program include the following:]

- Forecasting: Weather data is consulted to predict if and when pest outbreaks will occur. Treatments can then be properly timed, preventing crop damage and saving sprays.
- Pest trapping: Traps that are attractive to insects are used so that growers can pinpoint when the pest has arrived and decide whether control is justified.
- Monitoring: Growers inspect representative areas of the fields regularly to determine whether pests are approaching a damaging level.
- Thresholds: Before treating, growers wait until pest populations reach a scientifically determined level that could cause economic damage. Until that threshold is reached, the cost of yield and quality loss will be less than the cost for control.
- Cultural controls: The pest's environment is then disrupted by turning under crop residues, sterilizing greenhouse tools, and harvesting early.
- Biological controls: It is necessary for growers to conserve the many beneficial natural enemies already at work. They import and use additional biologicals where effective.
- Chemical controls: Growers select the most effective and appropriate pesticide and properly calibrate sprayers. They then verify that weather conditions will permit good coverage without undue drift.
- Recordkeeping: Records of pest traps, weather and treatment are kept for use in pest management decisions.

IPM for seed orchards is the maintenance of seed orchard pests at tolerable levels by the planned use of a variety of preventive, suppressive, or regulatory methods (including no action) that are consistent with orchard management goals. Each pest management activity is the end result of a decision-making process where pest problems and their impact on hosts are considered, and control methods are analyzed for their effectiveness, as well as their impacts on economics, human health, and the environment. Deciding which particular method would be used depends on several factors. Initial questions at the seed orchard might include, "Is it really necessary to control this pest? Can we live with the damage and still have the trees survive and produce suitable amounts of seed?" If the answers are yes and no, respectively, then decisions must be made as to what method(s) of control to use. Figure 2.2-1 graphically displays the steps involved in carrying out an IPM program in BLM seed orchards.

The focus of IPM is on long-term prevention or suppression of pests. The integrated approach to pest management incorporates the best-suited biological, chemical, and cultural controls that have minimum impact on the environment and on people. IPM is not pesticide-free management; however, a successful IPM program should result in the most efficient use of pesticides if and when they are needed.

Research into better and more effective control methods is also an essential part of this program. The seed orchard manager would regularly review the pest management methods available for use, including new and developing technologies, to ensure that the seed orchard utilizes the most effective methods of control while minimizing the potential for any adverse environmental or health impacts.

2.2.2 Pest Management Methods

There are many methods available to manage vegetation, insects, disease, and animal pests at Horning. These methods generally fall into the following categories:

- Biological controls, such as bird or bat boxes to attract insect-eaters, or encouraging predators that can control animal pests.
- Chemical herbicides, insecticides, fungicides, and fumigants.
- Prescribed fire to remove vegetation.
- Cultural methods, including mechanical (tractor mowing) and manual (pruning) methods, mulch mats, and fences.
- Other methods, such as pheromone bait traps for insects and fertilization to promote overall tree health.

The subsections that follow outline each of these pest management methods in more detail.

2.2.2.1 Biological Control Methods

Biological pest control is the deliberate use of natural enemies such as parasites, predators, or disease organisms to reduce pest populations. Four types of biological control are under consideration to manage insect pests.

- Bird boxes are located on perimeter fences throughout the orchard. Birds are seen predating insects throughout the year, though their overall effect has not been quantified. Bat boxes are also used to attract insect-eating bats.
- *Bacillus thuringiensis* (*B.t.*), a biological insecticide, has been used in the greenhouses and is being considered to help reduce insect damage at the orchard.

- Grazing using sheep, goats, or cattle could also be used to help control undesirable vegetation. Cattle grazing has been used in past years in the orchard units to remove undesired grasses.

- Planting fallow crops or cover crops in the rows between orchard trees also can limit growth of undesirable vegetation and noxious weeds.

Control of animal pests has been and would continue to be partially accomplished by encouraging the presence of predators which frequent the orchard, including coyote, fox, and cougar.

Summary: Biological Control Methods

- Vegetation: grazing cooperators place their cattle, sheep, or goats in the orchard units to remove grasses (this method has been used in the past and would be considered again in the future); planting fallow crops or certain cover crops in rows between orchard trees to limit growth of undesirable vegetation and noxious weeds.

- Insects: bird and bat boxes to attract insect-eating birds and bats, naturally occurring bacteria such as *B.t.*, predator mites and nematodes, lady bugs, and aphid lions.

- Animal pests: predators including coyote, fox, and cougar are present and encouraged to frequent the seed orchard grounds to aid in the control of animal pests.

2.2.2.2 Chemical Pesticide Methods

Four categories of chemical pesticides may be used at Horning:

- herbicides to control weeds,
- insecticides to control insects,
- fungicides to control diseases caused by fungi, and
- fumigants to control weeds, insects, and diseases.

Many private landowners and commercial operations (including those in the vicinity of Horning) rely extensively on chemical pesticides to control unwanted pests.

For many years, Horning has managed pests with very limited use of chemicals: esfenvalerate was used in a research project in 1990 and 1991, and was used to control cone and seed insects in one application per year from 1999 through 2002.

Pesticides may be applied using various types of equipment. These include:

- aerial, using helicopter (esfenvalerate application only),
- airblast sprayer,
- high-pressure hydraulic sprayer,
- hydraulic sprayer with hand-held wand,
- tractor-pulled spray rig with boom,
- backpack sprayer,
- capsule implantation,
- granular spreader,
- hand sprayer (greenhouse only),
- chemigation (greenhouse only), and
- total-release canister (greenhouse only).

Each of these methods is described in detail in an attachment to Appendix C.

Table 2.2-1, provided as an attachment at the end of this chapter, lists the chemical pesticides that are included in the alternatives for pest management at Horning, including formulations, target pests, application methods, areas that could be treated, application rates, application frequency,

and months when use could occur. Note that not all chemicals would be used in a given year, and some might never be used. However, their analysis in this EIS gives the seed orchard manager the option of using them in the future should a specific need arise. It is also important to note that each chemical application must first be approved by the Horning seed orchard manager. All pesticides would be applied in compliance with all Federal and Oregon state laws, BLM regulations and policies, the pesticide label, and manufacturer recommendations.

Table 2.2-1 lists pesticides by both active ingredient (a.i.) and trade name. The *active ingredient* is the pesticidally active chemical contained in the product proposed for use, such as esfenvalerate or glyphosate. The *trade name* is the name of the formulated product that is currently expected to be used, such as Asana® XL or Roundup®. A trade name's *formulation* is described by a specific composition of active ingredient(s) and other ingredients. The formulation associated with a trade name may change over time. The chemical pesticide methods proposed in this EIS are described fully as the active ingredients listed in Table 2.2-1. The trade names provided in the table and the associated % a.i. are examples, and are current at the time of EIS publication. The trade names illustrate the formulations that may be used, but are not intended to limit the proposed IPM program to exclusive use of those formulations that are named in the table. Other formulations of the listed active ingredients may be substituted, at the same rate of application described in the table. The table presents application rates in terms of a.i. per acre or per tree, and will therefore remain applicable to any trade name or formulation of the listed active ingredients.

Summary: Chemical Pesticide Methods

- Vegetation: herbicides, including dicamba, glyphosate, hexazinone, picloram, and triclopyr.
- Insects: insecticides, including acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, horticultural oil, permethrin, propargite, and Safer® soap.
- Disease: fungicides, including chlorothalonil, hydrogen dioxide (in greenhouse only), mancozeb (in greenhouse only), propiconazole, thiophanate-methyl (in greenhouse only), and dazomet (a soil fumigant).

2.2.2.3 Prescribed Fire

Prescribed fire may be used for removing vegetation in native species beds prior to planting or in limited areas in some orchard units. High temperatures, created through the use of a propane-fueled flame wand, kill any existing herbaceous material, providing a weed-free bed for growing native plants, and quickly remove dead plant litter. Pile burning may be used to dispose of cut or cleared vegetation or spent sugar pine cones. Grass straw may also be burned between the rows in the native plant garden to control disease.

Summary: Prescribed Fire

- Vegetation: propane-fueled flame wands for vegetation removal in native plant beds prior to planting, small patches of underburning in orchard units, pile burning of cut/cleared vegetation, pile burning of spent sugar pine cones.
- Disease: burning grass straw in bed rows in the native plant gardens.

2.2.2.4 Cultural Methods, Including Manual and Mechanical Methods

Cultural control refers to the use of methods that make the habitat less suitable for pests or prevents, suppresses, or removes them. Cultural methods include both manual and mechanical control methods.

Cultural control methods for vegetation include hand-pulling or using non-powered and powered hand tools and machinery to cut and clear vegetation.

- Mulch mats made of polypropylene and nylon mesh can protect seedlings from competing vegetation. They are placed over bare mineral soil following planting. The matting is typically three or four feet square and is held in place with metal or plastic pins placed in the corners. The tree protrudes through a slit in the middle of the sheet. Maintenance is minimal and the mats can be left on indefinitely.

- Hand weeding removes undesired vegetation from the native grass beds two to three times during the growing season. Hand weeding also takes place several times a year around the office compound.

- Tractors are used for mowing, with various blade attachments. Seed production orchards (28 ft x 28 ft spacing) are mowed diagonally. Breeding and preservation orchards (14 ft x 14 ft spacing) are mowed and cross-mowed using flail mowers. This leaves a 6-ft unmowed area around the base of each tree. Orchards are typically mowed three times during the summer, during the end of March/April, during May/June, and then again in July/August. Mower heights are set at about 2½ inches to avoid scalping the ground surface, which would open up growing space for other unwanted vegetation. Close mowing, using a 4-ft flail mower or a walk-behind rotary mower, is often done around trees in young orchards to cut vegetation that remains following treatment with the large mowers. A 5-ft swath is mowed several times during the growing season along roadsides for controlling low vegetation. Taller, overhanging vegetation is mowed every year using an articulating mower with an 18-ft reach. Fence lines, where accessible, are mowed with 5- or 6-ft rotary mowers to provide clear access around the orchard perimeter and to create a fire break.

- Brush in the orchards is generally controlled by mowing. However, hand cutting (using hand shears, loppers, and chain saws) of brush is often done around the base of the tree.

- Gasoline-powered string trimmers are utilized for cutting tall grass around the office compound.

- Tilling is used to physically remove the weedy vegetation at some locations. A 4- or 5-ft tiller is used around the native plant beds to maintain an unvegetated buffer. Tilling is usually done in spring and fall.

Pruning is done in western white pine and sugar pine stands to remove lightly infected branches having blister rust; severely infected trees are removed. During orchard development, stumps and roots were removed to a depth of three feet, to eliminate much of the potential for root diseases. Although these diseases are present in adjacent stands, the likelihood for them to cause significant damage prior to recycling the orchards (at which time the stumps would be removed and ripping would occur again) would be minimal. At present, stumps are cut flush to the ground surface. In the greenhouse, knocking or blowing water off seedlings and control of air flow through the use of fans and convection tubes helps to control disease.

Orchards are rogued and thinned to allow desirable clones to thrive and produce bountiful crops. Thinning opens up the crowns, allowing additional light to reach the crown surface. Thinning also increases available soil moisture to residual trees.

For animal pests, particularly gophers, live trapping and relocation or kill trapping are possible alternatives. Deer and elk exclusion fencing reduces browsing damage. An eight-foot steel mesh fence surrounds the orchard. Vexar™ tubes, approximately one-foot tall, are placed around newly planted seedlings. These tubes provide a barrier to voles, moles, and rabbits, which can damage the cambium layer of seedlings. Sticky traps in the greenhouse and screening to exclude squirrels from seed extractory and cone shed are other barrier methods used to control animal pests.

In the greenhouses, cultural controls include overhead convection tubes that provide heat and good air circulation to promote drying and disease control. Greenhouse 1 uses incandescent and fluorescent lighting to extend the photoperiod and meet special growing conditions for some species. Polyvinyl chloride pipes are used to knock water off plants after watering, and blowers are used to facilitate drying. Bird netting excludes birds and mice.

Summary: Cultural Control Methods

- Vegetation: hand-pulling, non-powered and powered hand tools to cut and clear, tractors with various blade attachments for mowing, gasoline-powered string trimmers, tilling an unvegetated buffer around native plant beds, mulch mats.
- Disease: pruning, thinning, stump grinding; in greenhouse, knocking or blowing water off seedlings and control of air flow through the use of fans and convection tubes.
- Animal pests: trapping of gophers, porcupines, and other small mammals, fencing that excludes deer and elk from orchard, Vexar™ tubes to protect seedlings, use of sticky traps in greenhouse, screening to exclude squirrels from seed extractory and cone shed.

2.2.2.5 Other Control Methods

Simon Fraser University, British Columbia, previously tested pheromones that attract the Douglas-fir gall midge at Horning. Results were mediocre to promising, depending on formulation. Research may continue in the future on this method.

To promote overall tree health, cone production, and disease resistance in the orchards, fertilization and cone stimulation are used. Calcium nitrate is used in specific orchards in March to help stimulate flower production for the following year's cone crop. It is applied with a fertilizer spreader mounted on a cushman around the drip-line of trees at a rate of about 200 lb of nitrogen/acre. Every three to four years, a general fertilization is completed to improve the nutrient levels of the trees and grass cover crop. Although mowing is more intense for the first year, the nutrient boost appears to keep the desirable ground cover thriving and invasive species at bay. Fertilizer mixes and rates are determined based on foliar and soil analyses. Application details for fertilizers are included in Table 2.2-1.

Summary: Other Methods

- Pheromone bait traps for insects.
- Fertilization to promote overall tree health, cone production, and disease resistance.

2.3 Alternatives

2.3.1 General Description and Features Common to All Alternatives

Five alternatives based on the pest management approaches described in Section 2.2.2 were identified and evaluated by BLM to address the need for a pest management program at Horning, as follows:

- Alternative A—Maximum Production IPM
- Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)
- Alternative C—Ground-Based IPM
- Alternative D—Non-Chemical Pest Management
- Alternative E—No Action: Continue Current Management Approach

There are several features common to all alternatives. Pest management methods that are common to all alternatives are biological methods, cultural methods, prescribed burning, and other non-chemical-pesticide control methods. Additional activities common to all alternatives include orchard management activities unrelated to pest management (see Section 2.1.2) and protection

measures that would be associated with a given pest control method under any alternative in which it is included. These protection measures are described in the following paragraphs.

Protection measures are intended to ensure the proper and safe application of pesticides at Horning. FIFRA requires pesticide manufacturers to register their chemicals with EPA, and list the allowable uses, application rates, and special restrictions on each pesticide's label. The pesticides considered for use at Horning are all registered under FIFRA. Application operations would comply with the label rates, uses, and handling instructions, in accordance with Federal law. In addition, the following procedures would be designed and implemented by Horning, and routinely observed in pesticide applications. If output from the monitoring plan (see Appendix B) indicates that more protection is needed, these protection measures may be altered over the life of this IPM program to provide more (but not less) protection to workers, the public, the environment, and ecological resources:

Worker Protection Measures

- Pesticide treatments would frequently be completed under contract by licensed pesticide applicators. BLM would administer the contracts for compliance.

- A Job Hazard Analysis for pesticide applications would be developed, providing a detailed description of the jobs and associated risks involved with pesticide use and application, and identifying requirements for personal safety equipment, training, and certification to perform specific tasks.

- The seed orchard would utilize its Pesticide Safety Plan.

- Pesticide applications would be conducted in compliance with all aspects of EPA's Worker Protection Standard under FIFRA, including protection during applications, restricted entry intervals, personal protective equipment, notification of workers, decontamination supplies, emergency assistance, pesticide safety training and safety posters, and access to labeling and site-specific information.

- All workers involved in pesticide applications would be required to participate in a pesticide exposure monitoring program. Testing for cholinesterase inhibition would be conducted on BLM employees applying organophosphates. Also, workers with declared hypersensitivity or who display symptoms of hypersensitivity to pesticides would not be assigned to application projects.

- Material safety data sheets would be posted at storage facilities and made available to workers.

- Appropriate protective clothing would be worn by all workers, as required by each pesticide's label.

- All applicators would be trained and licensed; this training would be confirmed by the seed orchard manager.

- For all application methods except spot treatments using hand-held application equipment, treated areas would not be re-entered until sprays have dried or until the stated label re-entry period has been met, unless protective clothing is worn and early re-entry is permitted by the label.

Public, Environmental, and Ecological Protection Measures

General

- Prior to pesticide application, Horning would notify downstream water users within one-half mile of the project area, and adjacent landowners who could be directly affected by accidental drift or water transport from the pesticide application area.

- Warning signs would be posted to discourage entry into treated areas.

- Pesticides would be applied within the parameters of prescribed environmental conditions stated on the label.

- Temperatures would be monitored carefully.

- If possible, spraying would be conducted during the early morning or late evening, allowing foliage to dry before pollinators become active.

- Orchard fields would be mowed or grazed prior to insecticide applications, to remove floral components on ground cover that would attract pollinators, such as bees (only if pollinators are active).

- Application for invasive weeds within the area of the stream bank would be made by properly licensed applicators using only the Rodeo® formulation of glyphosate. These treatments would include precautions such as application during lowest flow, spray shields to protect any open water, and transportation of only the required small amounts of the product to the application site to limit the potential for spill impacts.

- To avoid the potential for rapid transport to the aquatic system, only application for control of invasive weeds (as described in the previous paragraph) would occur within the grassed waterway zones containing tile. These tile zones would be marked on the ground. The width of the buffer along these tiled waterways could vary based on the topographic condition of the tiled area; however, a minimum of 25 feet on each side of the tile zone would be used. The tile zones would not be mowed, to allow the development of a grass and shrub canopy that can assist in capturing any drift from adjacent application areas.

- Aerial application in adjacent seed production orchards would be designed to minimize drift into the tile zones by means such as not applying aerially in portions of the orchard units. In native plant areas, the tile zones would be used to produce riparian species without the application of chemical pesticides; these species could assist in preventing any mobile chemicals contained in overland runoff from entering the stream system. If water quality monitoring indicates the presence of any applied chemical pesticides in the tile zones, temporary control of drainage in the specific tile would be implemented and pesticide application in the drain tile area would be discontinued until appropriate controls are designed to avoid introduction into tile.

- The monitoring program, detailed in Appendix B to this EIS, would be implemented as described for chemical pesticide applications.

<u>Runoff</u>

- Applications would be timed, to the extent predictable by weather forecasts, to not coincide or closely precede a large storm event that could result in substantial runoff. Specifically, there will be no application of pesticides or fertilizers when rainfall is expected to exceed 0.5 inches per hour within the three days following application. This is the most reliable forecast window and will minimize the likelihood of exceeding the infiltration rates of the dominate orchard soil. Application will not occur on days that rainfall or fog is likely to occur.

- Soil aeration equipment would be used in orchard blocks prior to application to promote rainfall infiltration into the soil surface and decrease risk of runoff.

- If rain has preceded an intended application window, units would be checked for their infiltration capacity, avoiding application when standing water is visible on the soil surface.

- At a minimum, stream course and wetland buffers would be established within guidelines prescribed by the pesticide label.

- No chemical pesticides would be applied to road or ditch surfaces that directly contribute to stream channel flow, nor to fencelines within 50 feet on either side of stream channels.

Spill

- Equipment used for pesticide transport, mixing, and application would be properly maintained to avoid leaking pesticides into water or soil.

- Pesticides would be mixed and equipment cleaned in areas protected (e.g., paved and bermed, or on a portable bermed mixing pad) from the potential for runoff to surface waters or leaching to groundwater in the case of a spill. Chemical containers would be kept in plastic drip pans that are large enough to hold the entire volume of each container in case the containers develop leaks.

- To prevent the impacts to aquatic species associated with a spill, chemical pesticides would not be transported by air or ground over the perennial tributaries to Nate Creek in Section 23.

- To prevent the impacts to aquatic species associated with a spill, tank-mixed pesticides would not be transported along the gravel road east of orchard unit B14 within 50 feet of the stream channel.

- All chemical loading operations would occur within the orchard building compound except for applications planned for the area north of the Swagger Creek tributary in Section 13. Applications to be made in this area would be prepared in a mixing area 500 feet from stream channels in that subsection. The pesticide to be used would be brought over to this area in a spill containment enclosure and only the amount needed for the tank mix would be transported. Tank-mixed insecticides or fungicides would not be transported by ground over the perennial tributary to Swagger Creek in Section 13.

- A spill containment kit would be on-site in the orchard building compound.

- Procedures outlined in an orchard Spill Prevention, Containment, and Countermeasure Plan would be followed if there is any spill of oil or hazardous materials, including pesticides.

Drift

- All applications of liquid pesticides would occur early in the morning when wind is minimal (<6 mph). Wind speed will be monitored on-site prior to and during spray applications. Operations will be suspended if wind speeds exceed 6 mph. Application will not occur when wind direction is toward flowing streams.

- Factors such as relative humidity, wind speed, and air temperature would be considered to determine the timing of applications that would minimize the potential for off-target drift.

- Pesticide applications would not be made during temperature inversions.

- Drift cards would be placed on all sides of areas to be treated when liquid pesticides are used, and applications would cease if there is any indication that chemical is moving out of the target area.

Aerial

- Before reconnaissance and operational flights, BLM would discuss objectives and concerns with the pilot performing the operation. The project boundaries would be reviewed using aerial

photos and appropriate maps on the ground by the pilot and BLM project leader immediately prior to beginning application.

- BLM would clearly mark the application units and buffer boundaries with visible cones and flagging in such a manner that would allow visual identification from the air. BLM would deploy smoke flares in each unit prior to application to provide for pilot recognition of wind speed and direction.

- BLM would place drift cards along all sensitive buffers and along stream channels where drift or drip entry is possible. These would generally be placed along stream buffers and under the designated flight path when crossing the main tributary to Swagger Creek (Stream 6).

- Flight paths during operation would not be located over surface water bodies except for a designated corridor across the main tributary to Swagger Creek (Stream 6).

- BLM would flag a designated corridor for a helicopter flight path across Stream 6. The helicopter would travel from the load area to application areas in units north of the main tributary to Swagger Creek (Stream 6) using this corridor, making the least number of crossings possible. This is intended to reduce the potential for drip to enter Stream 6.

- Any reconnaissance flights over water bodies would be made with empty tanks.

- Areas immediately adjacent to no-spray buffers would be treated prior to spraying the remainder of the unit. Initial application flight paths would be flown parallel to the buffer with the boom closest to the sensitive area turned off during the nearest pass. This would reduce the likelihood of accidental overspray into buffer areas with stream channels.

- To minimize the potential for overspray and drift, the pilot would avoid any banked turns against the protection buffers.

- The minimum practical boom length should be used, and must not exceed 75% of the rotor diameter.

- Spray would be released at the lowest height consistent with pest control and flight safety. This would optimize the amount of spray reaching the target trees and reduce the amount reaching the ground.

- Spray "clean out" areas would be designated in orchard units B50 and B11 (greenhouse effluent irrigation area) or in areas which have no flowing streams within 500 feet.

2.3.2 Alternative A—Maximum Production IPM

Under this alternative, the primary goal is the maximum production of seeds and plants with a very low level of acceptable losses. Horning's seed orchard manager would have all the methods of pest management listed in Section 2.2.2 available for use, including all identified biological, chemical, prescribed fire, cultural, and other pest control methods. An effective IPM strategy for all orchard pests would be used under this alternative, including monitoring pest levels and treating if action thresholds are exceeded. However, the primary management objective, which would be reflected in the annual IPM plan (see Figure 2.2-1), would be to maximize seed production for annual BLM and cooperator seed needs by aggressively controlling cone and seed insects and other limiting factors. The most effective insect control measures would be implemented, to maximize seed yield and reduce damage to the seed crops with low acceptable seed losses, emphasizing production above other less-effective control methods and considerations, with a low threshold for initiating treatment.

2.3.3 Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Alternative B is BLM's preferred alternative. An effective IPM strategy for all orchard pests would be used under this alternative, including monitoring pest levels and treating if action thresholds are exceeded.

Under this alternative, the seed orchard manager would have access to the full list of pest management methods identified in Alternative A, with the exceptions listed below. These limitations were identified by reviewing the results of the quantitative risk assessment (summarized in Appendix C), considering the scoping comments, in response to the findings of monitoring conducted following the 2001 and 2002 spray projects, and responding to recommendations made by district interdisciplinary team members.

These limitations, listed below, address each risk identified during the risk assessment for Alternative A (summarized in Table 4.6-2 for human health and Table 4.7-2 for wildlife and aquatic species). Each quantitative limitation was calculated by varying the application scenario parameters in the model spreadsheet until the risk was lowered to the acceptable level. Parameters that were varied were those that the seed orchard manager can limit when approving the application, such as application rate, frequency, length of time to re-entry, total area or number of trees treated, and distance from area assumed to receive drift in the risk assessment scenario. The resulting risks correspond in each case to the negligible risk levels for human health, terrestrial wildlife, and aquatic species (see Section 4.6.1 for human health risk methodology and Section 4.7.1 for non-target species risk methodology).

To protect worker health:

- Diazinon would be applied to no more than 250 trees in one day at a maximum rate of 0.015 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of diazinon applied more than 3.75 lb a.i.) by any individual worker who is conducting both the mixing/loading and application activities.

- Dimethoate would be applied to no more than 22 trees in one day at a maximum rate of 0.13 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of dimethoate applied more than 2.86 lb a.i.) by an individual using the high-pressure hydraulic sprayer, and an individual other than the applicator would conduct the mixing/loading activities. If more than one applicator sprays trees during a single day, different mixer/loaders would prepare each pesticide mixture.

- An individual conducting hand pollination activities would not work on trees that had been treated with diazinon until at least 11 days post-application.

- An individual applying dicamba using a backpack sprayer would apply no more than 0.61 lb a.i. during any given day.

- An individual applying hexazinone using a backpack sprayer would apply no more than 6.5 lb a.i. during any given day.

- The frequency of mancozeb use in the greenhouses will typically be only twice per year, with a maximum frequency of 10 times per year. Weighing and monitoring personnel will allow 24 hours to elapse before handling seedlings treated with mancozeb.

To protect ecological resources:

- Chlorpyrifos would not be applied within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the

distance associated with no drift from the proposed application methods).[1] It would not be applied to more than three acres in any twelve-acre area within a 14-day period, at a rate no greater than 1 lb a.i. per acre .[2]

- Diazinon would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods).[3] It would not be applied to more than 150 trees at a rate of 0.015 lb a.i. per tree (nor any combination of number of trees and application rate more than 2.25 lb a.i. applied) in any 12-acre area within an 11-day period.[4]

- Dimethoate would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods).[5] It would not be applied to more than five trees at a rate of 0.13 lb a.i. per tree (nor any combination of number of trees and application rate more than 0.65 lb a.i. applied) in any three-acre area within a seven-day period.[6]

- In areas north of the main tributary to Swagger Creek, non-chemical vegetation control would be emphasized to protect the organic herb farm, private livestock breeders, and the road crossing the dam at Horning Reservoir; however, limited quantities (to reduce any spill impacts) of propiconazole, the Rodeo® formulation of glyphosate, and triclopyr triethylamine salt may be tank-transported for use in a few select areas.

- No pesticide would be applied through aerial, airblast, or high-pressure hydraulic sprayer methods within 200 feet of perennial or intermittent streams to limit the potential for drift. From the edge of the 200-foot buffer to 50 feet from the stream bank, pesticide application would be limited to methods that preclude drift. These methods could include backpack sprayers with wicks or wands, implants, and foams or other no-drift technologies. Both of these buffer zones may be reduced if drift monitoring results are obtained that demonstrate a reduced buffer would not introduce chemicals into the waterways.

- From the stream bank to the 50-foot buffer area, only cultural methods, implants, injections, stump painting, and hand-held wands with wicks would be used to control highly invasive weeds. Chemical treatments would only be used on highly invasive non-native species—such as knotweeds (Japanese, Himalayan, and giant), and purple loosestrife—that would not be effectively controlled with other methods. As stated above, this buffer zone may be reduced if drift monitoring results are obtained that demonstrate a reduced buffer would not introduce chemicals into the waterways.

- Fertilizer application rates would be limited to those identified in the typical scenarios in the risk assessment (summarized in Appendix C).

- If calcium nitrate is applied to trees that are within 500 feet of streams after April 30, the fertilizer in these areas would be "watered in" if there is no rainfall within a week.[7] During calcium nitrate application, orchard employees would be vigilant for nests of ground-nesting bird species, particularly the Oregon vesper sparrow and common nighthawk, to avoid applying fertilizer to any nests.

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[1] To protect the song sparrow, western meadowlark, streaked horned lark, and western pond turtle.
[2] To protect all terrestrial species.
[3] To protect the song sparrow, Pacific tree frog, western meadowlark, streaked horned lark, and western pond turtle.
[4] To protect all terrestrial species.
[5] To protect the song sparrow, western meadowlark, streaked horned lark, and western pond turtle.
[6] To protect all terrestrial species.
[7] To protect western pond turtles which, if present, would be nesting from approximately May 15 to July 31.

How is Alternative B Different from Alternative A?

Under Alternative B, all of the same pest control methods are available to the seed orchard manager as under Alternative A. However, Alternative B contains specific limitations (see list above) on certain aspects of chemical pesticide and fertilizer use to provide added protection to human health and the environment. Commonly, during the preparation of an EIS, the analysis of impacts occurs wholly during the EIS development process. In the case of the proposed IPM program at Horning, a quantitative risk assessment of the proposed chemical pesticides and fertilizers was completed *before* development of the EIS alternatives. The assumptions made during this risk assessment correspond to the pesticide application details of Alternative A. The conclusions of this assessment, and the interaction among the interdisciplinary team members during the assessment, directly resulted in developing a new alternative—Alternative B—that addresses all the predicted risks in the risk assessment scenarios, and protects resources based on these experts' site-specific knowledge of overall potential chemical transport pathways at the seed orchard.

What are Limitations, Protection Measures, and Mitigation Measures?

These three concepts may seem similar, but they have distinct definitions within this EIS:

Limitations are the list of exceptions in Section 2.3.3 that distinguish the details of potential pesticide and fertilizer applications under Alternative B from those under Alternative A. These limitations were designed by the interdisciplinary team preparing this EIS to address predicted risks, respond to scoping concerns, and provide additional environmental protection.

Protection measures are best management practices (BMPs), including BMPs for water quality protection under the *Clean Water Act*,[1] that would be implemented during any use of chemical pesticides by Horning, regardless of the alternative selected. Protection measures are listed in Section 2.3.1.

Mitigation measures are defined by CEQ (40 CFR 1508.20) as (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or (e) compensating for the impact by replacing or providing substitute resources or environments. Mitigation measures are not specifically included in an alternative, but are additional measures in response to the potential environmental impact(s) that an alternative may have. Potential mitigation measures for the alternatives in this EIS are listed in Section 4.12, and, if needed, would be specifically identified in the ROD to correspond to the selected alternative.

[1]BMPs in relation to water pollution are defined by EPA as "methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources."

2.3.4 Alternative C—Ground-Based IPM

Alternative C would be identical to the proposed action (Alternative B) except that the option to apply esfenvalerate by helicopter, as identified in Table 2.2-1, would be eliminated. Thus, under Alternative C, the seed orchard manager would be permitted to use any of the biological, prescribed fire, cultural, ground-based chemical, or other methods included in Alternative B. Esfenvalerate could be applied by an airblast sprayer, a high-pressure hydraulic sprayer, a hydraulic sprayer with a hand-held wand, or a backpack sprayer.

2.3.5 Alternative D—Non-Chemical Pest Management

Alternative D would allow the seed orchard manager to use only the biological, prescribed fire, cultural, and other non-chemical-pesticide methods listed under Alternative A. No chemical pesticides would be permitted.

2.3.6 Alternative E—No Action: Continue Current Management Approach

Alternative E would allow continuation of the current management system, which is the use of all non-chemical-pesticide pest control practices at the seed orchard, as well as the use of chemicals on a specific case-by-case basis. All biological, prescribed fire, cultural, and other non-chemical-pesticide methods would be used in accordance with current procedures. When a specific need is identified for a chemical pesticide, the action would be reviewed to determine whether it is encompassed by an existing NEPA document. For example, weed control projects could be within the scope of the Northwest Area Noxious Weed Control Program EIS and Supplemental EIS, and the EIS for Vegetation Treatment on BLM Lands - Thirteen Western States. Section 1.4.1 provides more information on existing NEPA documents related to pest management. When specific proposed pesticide applications are not within the scope of an existing EA or EIS, another NEPA document would be prepared. This would include applications for cone insect control, control of other orchard insect outbreaks, disease infestations, and any vegetation control necessary that is not covered by other BLM vegetation control NEPA documents. (Using this approach, project-specific EAs were prepared for esfenvalerate use to spray for cone and seed insects in production orchards in 1999, 2000, 2001, and 2002.)

2.3.7 Alternative Considered But Not Further Analyzed

During the scoping process, one member of the public suggested planting more crop trees than necessary to allow for some loss to pests, which was interpreted as a request to consider no pest management at all. This is not a viable alternative for several reasons. First, this approach could lead to a significant loss of the crop trees in the production units if disease were to occur. Secondly, orchard research has shown that approximately 70% of the seed crop could be lost if no pest management were practiced (Schowalter et al. 1985). To partially offset the effects of cone and seed insects and decreased tree vigor due to disease, it would be necessary to plant production trees in fields that are currently fallow, as the commentor suggested. This solution would require the seed orchard and their cooperators to accept an estimated 10-year reduction in seed production, which is the time that would be required for the newly planted trees to produce collectable seed. This decrease in production could also result in delays in reforestation projects caused by potential seed shortages, or reduced forest growth resulting from the use of genetically inferior seed from other sources. In addition, a more intensive planting regime on seed orchard lands, with no pest management of any kind, would allow the orchard grounds to become a “reservoir” for insects, disease, noxious weeds, and animal pests that would spread to neighboring public and private lands—effectively, becoming a threat and nuisance to the neighbors, particularly those who cultivate crops of their own.

2.4 Approval Of New Products And Technologies

It is likely that, over the life of the proposed IPM program, BLM seed orchard personnel will become aware of chemicals or non-chemical control methods that are currently available but were not described in this EIS, or that represent new technologies not currently available or practiced. This section describes how BLM would ensure compliance with U.S. laws (including NEPA) and regulations, and evaluate these new approaches for inclusion in the seed orchard’s pest management plans, in terms of both their efficacy and their potential environmental impacts. This information applies both to full-scale use as a control method, as well as to field research projects investigating the potential for larger applications.

This approach includes descriptions of how new chemical products or technologies would be examined for consideration by BLM, what data would be relied upon to assess a product or technology's effectiveness for use on public lands, what data would be relied upon to conduct human health hazard and risk assessment, and the level of NEPA documentation required to support a decision to use or not use a product or technology.

2.4.1 Identification of New Chemical Products and Technologies

The seed orchard manager and employees may become aware of new pest control products and technologies through three general mechanisms: professional networking, technical research and publications, and vendor marketing.

Networking

Participation in professional networks is the principal method for staying current on new pest control approaches, and yields information on the technical, regulatory, efficacy, and environmental aspects of methods, both those in the development phase and those currently on the market. The primary professional association for BLM seed orchard managers in Oregon is the Northwest Seed Orchard Managers Association (NWSOMA), and particularly its Northwest Pest Management Committee. For nursery and greenhouse managers, the primary professional associations are the Western Forest and Conservation Nursery Association and the Intermountain Container Seedling Growers Association.

The Southwest Oregon Forest Insect and Disease Service Center is a group of U.S. Forest Service pathologists and entomologists that provide forest insect and disease technical assistance, field consultation, modeling, risk assessments, and historical information to Federal resource managers in southwest Oregon. A field service center is located near BLM's Medford District seed orchards at the Forest Service's J. Herbert Stone Nursery in Central Point. Similar services are also available in the Forest Service's regional office in Portland.

Useful information can also be obtained by staying in contact with other non-regional professional networks with similar goals, such as the Southern Seed Orchard Pest Management Subcommittee of the Southern Forest Tree Improvement Committee (part of the North Carolina State University Industry Cooperative Tree Improvement Association). Similarly, the British Columbia Seed Orchard Association, which often has formal interactions and collaborations with NWSOMA, is another professional network focusing on seed orchard management.

Technical Research and Publications

The U.S. Forest Service conducts extensive research activities that support tree improvement and re-forestation activities. The web page USDA/FS Research Publications (http://216.48.37.142/) provides a search function that indexes Forest Service research publications, by keyword or by research station.[8] The Forest Service's Reforestation Nurseries and Genetics Resource web page (http://www.rngr.fs.fed.us/) includes current information on seed orchard and tree nursery practices and pest management.

The IR-4 Ornamentals Research Program, organized by the state land grant universities and the U.S. Department of Agriculture (USDA), assists in collecting data that can be used to add minor crop (including seed orchard tree species) uses to existing chemical and biological pesticide registrations. The program's activities are described in detail at its web site (http://pestdata.ncsu.edu/ir-4/).

[8] This and other Internet citations (uniform resource locators, or URLs) in this EIS were accurate at the time of publication. However, websites change frequently due to changes in data availability or reorganization of information, and the cited URLs may not work in the future. If this occurs, "backing up" to a less specific web address or using an Internet search function may allow retrieval of the information.

The Washington State Commission on Pesticide Registration is a state-funded regional program with a similar mandate (http://wscpr.org/).

Vendor Marketing

Vendors of pest control technologies, including chemical company representatives, occasionally contact BLM's seed orchards to introduce new products. These contacts may come in the form of mailed brochures or advertisements, or telephone contacts to request a visit to the seed orchard.

From time to time, members of the public who are interested in various approaches to pest management send information to the seed orchard manager describing these methods. As with pest control methods identified through other avenues, if the seed orchard manager determines that the approach may have some utility for the seed orchard's needs, a product demonstration or additional information may be requested.

2.4.2 Assessment of Effectiveness

The seed orchard manager would be the one to judge whether a previously unconsidered pest control product or technology is likely to be effective in meeting the specific seed orchard's pest control needs. The decision would be based on details such as previous use reports at other sites and their outcomes, availability, cost, expected effectiveness compared to any currently used methods, training and personnel requirements, factors that could limit efficacy, and any other relevant factors (including hazards and risks—see Section 2.4.3 below).

Any new chemical or biological pesticide considered for use by the seed orchard must be registered under FIFRA, which requires product performance data relating to its effectiveness. This requirement was designed "to ensure that pesticide products will control the pests listed on the label and that unnecessary pesticide exposure to the environment will not occur as a result of the use of ineffective products" [40 CFR 158.202(i)]. Therefore, any new pesticide registered under FIFRA is expected to be generally effective for the labeled uses. To further assess the potential for site-specific effectiveness prior to an actual application in the seed orchard, the seed orchard manager would investigate its use through professional networks, technical publications, and/or research reports, such as those described in the previous section.

For a pest control technology that is not required to be registered under FIFRA, the avenues of research described in the previous section would be the likely initial means for discovering its advantages and limitations over currently used methods. This could pertain to cultural control practices, tools or equipment, or other means that are not considered pesticides under the purview of FIFRA.

2.4.3 Assessment of Hazards and Risks

As stated in the previous section, BLM only uses pesticide products that are registered under FIFRA. Therefore, for any chemical or biological pesticide that may be considered for use in the seed orchard, there would exist a body of EPA-reviewed toxicological, environmental fate, and ecotoxicity data that were submitted by the pesticide manufacturer to support its registration application. These data can be used to conduct a site-specific assessment of the potential human health and ecological risks from the pesticide's use at the seed orchard, including the following components:

- Identification of potential use patterns, including target pest(s), formulation, application method(s), locations to be treated, application rate, and anticipated frequency.

- Review of chemical hazards relevant to human health risk assessment, including systemic and reproductive effects, skin and eye irritation, dermal absorption, allergic hypersensitivity, carcinogenicity, neurotoxicity, immunotoxicity, and endocrine disruption.

- Estimation of exposure to workers applying the chemical or re-entering a treated area.
- Environmental fate and transport, including drift, leaching to groundwater, and runoff to surface streams and ponds.
- Estimation of exposure to members of the public.
- Review of available ecotoxicity data, including hazards to mammals, birds, reptiles, amphibians, fish, and aquatic invertebrates.
- Estimation of exposure to terrestrial and aquatic wildlife species.
- Characterization of risk to human health and wildlife.

If the available toxicity or ecotoxicity data are inconclusive, or substantial disagreement occurs among the results of technical studies that could affect the potential risk conclusions for the chemical, BLM could conduct a formal peer review of the available scientific information to develop a consensus as to the endpoint(s) in question. The peer review process would include the following steps, based largely on EPA's peer review process (EPA 2000):

- BLM would conduct a literature search of studies submitted to EPA, studies published in professional journals, and research projects conducted by other government agencies or universities. The identified literature would be indexed and abstracted.
- A peer review committee would be formed, consisting of reviewers with recognized technical expertise that bears on the subject matter under discussion, who represent a balanced range of technically legitimate points of view, and who do not have any real or perceived bias or conflict of interest. The peer reviewers would be supplied with their charge, the results of the literature review, and a description of the issue at hand.
- The input of each reviewer would be sent to BLM. If the results of the peer review are not consistent at this point, a working session would be convened, in which the peer reviewers would come together to discuss the technical aspects of the questions and attempt to reach a consensus.

The details of the peer review process would be determined by the question to be answered and the nature of the controversy. To the extent they are relevant, the guidelines and processes in EPA's *Peer Review Handbook* (EPA 2000) would be followed.

For assessment of the hazards and risks from non-pesticide methods (biological controls, cultural controls, and other methods), BLM would review the potential for impacts to worker health and safety, public health and safety, and special status[9] species and their habitat. Limited-scale field trials could assist in identifying potential hazards from a non-pesticide method under consideration, as well as in determining the effectiveness of any new approach.

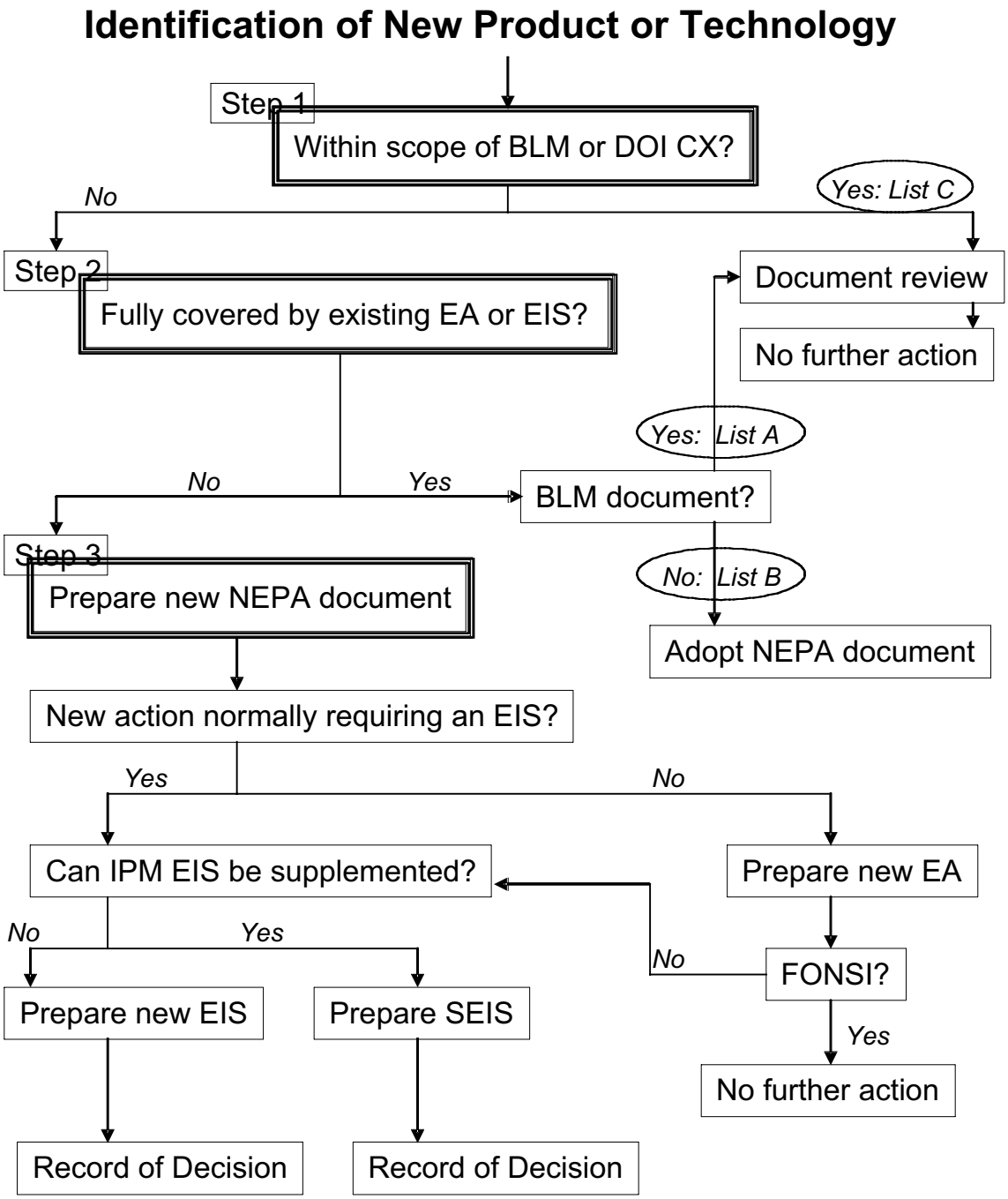
2.4.4 NEPA Documentation

The potential use of new technologies or products for pest control in the seed orchard would require a review to ensure compliance with NEPA. The review would follow the process outlined in the BLM NEPA Handbook (H-1790-1), Chapter 1 (BLM 1988), and would consist of the basic steps described below and outlined in Figure 2.4-1.

Step 1. Conduct a CX Review

The first step in this review is to determine whether the new action is within the scope of a Department of Interior or BLM categorical exclusion (CX) (516 DM 2, Appendix 1; and 516 DM 11.5, respectively) (DOI 1980). These two lists constitute *List C*, as identified in Figure 2.4-1.

Figure 2.4-1. NEPA Review of New Products and Technologies



Based on an initial review of this list, there appear to be only two CXs, both within the Forestry areas on the BLM list, that have the potential to cover a new technology or product relating to seed orchard operations (516 DM 11.5 c (1) and (3)):

- Land cultivation and silvicultural activities (excluding herbicides) in forest tree nurseries, seed orchards, and progeny test sites.

- Seeding or reforestation of timber sales or burn areas where no chaining is done, no pesticides are used, and there is no conversion of timber type or conversion of non-forest to forest land. Specific reforestation activities covered include: seeding and seedling plantings, shading, tubing (browse protection), paper mulching, bud caps, ravel protection, application of non-toxic big game repellant, spot scalping, rodent trapping, fertilization of seed trees, fenced construction around out-planting sites, and collection of pollen, scions and cones.

Therefore, some non-pesticide methods could be within the scope of an existing CX.

The CX review actually involves three steps: (1) ensure conformance with existing land use plan; (2) identify potential CX—see above; and (3) review the current list of exceptions to CX at 516 DM 2, Appendix 2.

If the new action is within the scope of a CX, and none of the exceptions applies, the CX review would be documented and then no further action would be required. If a CX was not identified or one or more of the exceptions were met, then BLM would proceed to **Step 2.**

Step 2. Review Existing EAs and EISs

The following types of existing NEPA documents would be reviewed to determine whether any have fully covered the use of the proposed new product or technology:

BLM NEPA Documents (List A)

- This seed orchard-specific IPM EIS.

- EISs associated with the District RMP or Plan amendments.

- Programmatic documents such as the EIS for Vegetation Treatments, Watersheds and Wildlife Habitats on Public Lands Administered by the BLM in the Western United States, Including Alaska (currently in preparation).

- Any seed orchard-specific EAs that have been prepared for pest management or operations.

- NEPA documents prepared by other Federal agencies, with BLM as a cooperating agency.

<u>Other Agency NEPA Documents (List B)</u>

- NEPA documents for which BLM was not listed as a cooperating agency, but for which the scope is relevant to evaluation of the proposed pest management method. Possible source agencies could include the Forest Service, National Park Service, Animal and Plant Health Inspection Service, and the military services.

Generally, existing NEPA documents may be used when: (1) a current proposed action was previously proposed and analyzed (or is part of an earlier proposal that was analyzed); (2) resource

[9] Special status species are species which are proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the Endangered Species Act; those listed by a state in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each BLM State Director as sensitive.

conditions and other relevant circumstances have not changed significantly, and there is no significant new information germane to the proposed action; and (3) there is no suggestion by the public of a significant new and appropriate alternative (BLM 2001).

The review would focus on the following questions to determine whether the existing document(s) satisfy NEPA analysis requirements for the proposed new pest management method (BLM 2001):

- Is the current proposed action substantially the same action (or is a part of an action) as previously analyzed?

- Is the range of alternatives analyzed in the existing NEPA document(s) appropriate with respect to the current proposed action, given current environmental concerns, interests, resource values, and circumstances?

- Is the existing analysis adequate and are the conclusions adequate in light of any new information or circumstances (including, for example, riparian proper functioning condition [PFC] reports; rangeland health standards assessments; Unified Watershed Assessment categorizations; inventory and monitoring data; most recent Fish and Wildlife Service and NOAA Fisheries lists of threatened, endangered, proposed, and candidate species; most recent BLM lists of special status species)? Can you reasonably conclude that all new information and all new circumstances are insignificant with regard to analysis of the proposed action?

- Do the methodology and analytical approach used in the existing NEPA document(s) continue to be appropriate for the current proposed action?

- Are the direct and indirect effects of the current proposed action substantially unchanged from those identified in the existing NEPA document(s)? Does the existing NEPA document sufficiently analyze site-specific impacts related to the current proposed action?

- Can you conclude without additional analysis or information that the cumulative impacts that would result from implementation of the current proposed action are substantially unchanged from those analyzed in the existing NEPA document(s)?

- Are the public involvement and interagency review associated with existing NEPA document(s) adequately [sic] for the current proposed action?

If all the criteria are met and the existing document is a BLM document or one with BLM as a cooperating agency, then the analysis and results would be documented using the Documentation of Land Use Plan Conformance and NEPA Adequacy, described in BLM Instruction Memorandum No. 2001-062 (BLM 2001). Reliance on existing NEPA documents requires the establishment of an administrative record that clearly shows a "hard look" has been taken at whether new circumstances, new information, or environmental impacts not previously anticipated or analyzed warrant new analysis or supplementation of existing analyses, and whether the impact analysis supports the proposed action. The review must be conducted through an interdisciplinary process, and the resulting documentation must adequately address the criteria included in the worksheet contained in BLM (2001). If existing NEPA documentation is found to be adequate, this must be documented on the worksheet, which must also include a signed conclusion statement. Approval of the proposed action requires a FONSI decision document.

If existing NEPA documentation is found to be adequate, but BLM is not formally a cooperating agency on the document, then BLM would adopt the document to comply with NEPA; adoption would be in accordance with the requirements set forth in 40 CFR 1506.3. If existing NEPA documentation was determined to be inadequate, completion of the worksheet is not required and either the proposal would be rejected or BLM would proceed to **Step 3**.

Step 3. Prepare a New NEPA Document

This step can be further broken down into two sub-steps: (a) what level of NEPA review is required (EA or EIS); and (b) can portions of an existing document(s) be used in preparation of the new NEPA document?

To determine the level of NEPA review needed, the action should be compared to the actions typically requiring preparation of an EIS (516 DM 11.4). Depending on the outcome, it may be appropriate to tier to, supplement, or incorporate by reference parts or all of existing document(s) as part of the document preparation process:

- *Tiering* (40 CFR 1508.28) could be used to prepare new more specific or more narrow environmental documents (such as an EA for the proposed activity) without duplicating relevant parts of previously prepared, more general or broader documents (such as the IPM EIS). Tiering is mostly used to avoid unnecessary paperwork. Documents can be tiered only if decisions made in the new document would not change or modify the decision(s) of the more general document.

- *Supplementing* (40 CFR 1502.9c) is most often used to address alternatives not previously analyzed and may lead to a new decision. In this instance, a supplemental EIS (SEIS) could be prepared to the IPM EIS. Supplemental documents are generally prepared when there is a substantial change in the proposed action that is relevant to environmental concerns; that is, if there are significant new circumstances or facts relevant to environmental concerns and bearing on proposed action or impacts that were not addressed in existing analysis. If the existing IPM EIS is supplemented, the same standard procedural and documentation requirements for EISs are followed (see Chapter 5 of BLM Handbook), except that additional scoping is optional. In addition, the SEIS must identify the EIS being supplemented and explain the relationship to the prior analysis early in the text. Further, the SEIS should identify changes in the proposed project and/or significant new information or changed circumstances that necessitate preparation of the supplement.

- *Incorporating by reference* (40 CFR 1502.21) is a technique used to avoid redundancies in analysis and to reduce the bulk of a NEPA document. An EA or EIS must identify the documents that are incorporated by reference and indicate where they are available for public review. Relevant portions of the incorporated analysis must be referenced by page number, and summarized in the EA or EIS to the extent necessary to provide the decisionmaker and public with an understanding of significance of the referenced material to the current analysis. The new NEPA document must be able to stand alone.

Preparation of a new EA would follow the procedures outlined in the BLM NEPA Handbook, Chapter 4. Preparation of a new EIS or SEIS would follow the procedures outlined in the BLM NEPA Handbook, Chapter 5 (including, where appropriate, tiering, supplementing, and incorporating by reference, as noted above). The EA process would end in issuance of a FONSI or a determination of the need to prepare an EIS. The EIS process would end with issuance of a ROD.

2.5 Ongoing And Reasonably Foreseeable Future Actions In Study Area

Implementing the proposed action or an alternative at Horning would be concurrent with other actions at the orchard and adjacent lands; these actions could contribute to cumulative impacts to some resources. The seed orchard plans only routine operations, and expects no construction or other unusual activities that would contribute to cumulative impacts (BLM 2002).

On some properties adjacent to Horning, several companies conduct Christmas tree and other timber operations, including logging, the use of heavy machinery, and IPM activities. These companies apply chemicals using a variety of methods, including applications of granular fertilizer by helicopter and of chemical pesticides by tractor/boom and backpack sprayers. There are no other activities known to occur on adjacent properties that would contribute to cumulative impacts (BLM 2002).

2.6 Summary Of Environmental Impacts By Alternative

Areas of potential concern for the proposed action and alternatives were identified based on input from BLM interdisciplinary team members, consultation with Federal and state agencies, scoping comments, and comparisons with similar activities. The potential impacts were evaluated and are described in Chapter 4.

As defined in CEQ's regulations for implementing NEPA, determining whether an environmental impact is "significant" requires consideration of both context and intensity. In the resource-specific subsections of Chapter 4 of this EIS, the criteria used to define each impact's significance are described under the sub-heading "Analysis Approach and Assumptions."

Table 2.6-1 summarizes the environmental impacts for each resource by alternative. Table 2.6-1 is provided as an attachment at the end of this chapter, following Table 2.2-1.

The resource-specific assessments in Chapter 4 are organized according to a logical flow of analysis. Effects on the physical environment (for example, surface water) must be determined before effects on the associated resources (such as aquatic species) can be assessed. This same sequence of resources is maintained in Table 2.6-1. However, scoping concerns would dictate a different priority for considering the results, in which the following five resources are of greater importance than the others for purposes of decisionmaking: human health and safety, water quality, wildlife and aquatic species, socioeconomics, and soils. The analysis predicted no significant impacts in two of these areas: socioeconomics and soils. Comparison of potential impacts among the remaining three resources provides the critical information to be considered by the decisionmaker in preparing the ROD for this EIS:

<u>Human Health and Safety</u>

- There are no significant risks to members of the public from the proposed use of any of the control methods under any of the alternatives. However, under Alternatives A, B, C, and E, an accidental spill of pesticide to a stream could make surface water unsafe for drinking or fishing. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

- Under Alternatives A and E, there is a possibility of health effects for workers from some chemical pesticides. No risks of worker health effects were predicted for pesticide applications under Alternatives B and C. Under Alternatives A, B, C, and E, an accidental spill onto the skin could cause health risks. Under all of the alternatives, there is a possibility of injury from cultural or prescribed fire methods.

<u>Water Quality</u>

- No significant impacts to groundwater quality were predicted under any alternative.

- Runoff or drift from pesticide applications could enter streams and rivers under Alternatives A, B, C, and E, as could runoff containing fertilizers under all alternatives. The effects of the

estimated stream concentrations on human health and aquatic species are described under those headings. Under Alternatives B and C, limitations would be in place to control the potential for runoff and drift.

- An accidental spill of pesticide concentrate or mix could contaminate groundwater or surface water under Alternatives A, B, C, and E. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

Biological Resources

- No significant adverse impacts to non-target vegetation are expected under any of the alternatives.

- There are possible risks to terrestrial wildlife species from three of the proposed insecticides under Alternatives A and E, and from calcium nitrate fertilizer under all alternatives. Lethality would be expected for non-target insects in an area treated with insecticide under Alternatives A, B, C, and E. With the exception of localized lethal impacts to non-target insects, no significant impacts to terrestrial wildlife were predicted under Alternatives B and C.

- There are no significant risks to aquatic species from use of chemical, biological, prescribed fire, or cultural control methods under any of the alternatives. Under Alternatives A, D, and E, there is a potential for sublethal impacts due to ammonium toxicity on special status aquatic species under maximum scenario conditions only. Under Alternatives A, B, C, and E, there could be adverse impacts to aquatic species from an accidental spill of pesticide to a stream. Under Alternatives B and C, the probability of any accidental spill to surface water would be decreased by limits on pesticide transport over specific streams.

Alternative B, the proposed action, is BLM's preferred alternative for minimizing long-term impacts to all resources, including human health.

Table 2.2-1. Pesticide and Fertilizer Application Summary[a]

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency[b]
Insecticides					
Acephate: Acecap® 97 (97% a.i. in an implant capsule) *Target pests: root weevil, gypsy moth, tussock moth, Douglas-fir needle midge*					
Implants	Individual trees in any seed production or breeding & preservation orchard	1 capsule/4 inches circumference 1 application to 600 trees	1 capsule/4 inches circumference 1 application to 600 trees	Apr - May	Infrequent
Acephate: Orthene® Turf, Tree & Ornamental WSP (75% a.i. in a water soluble bag) *Target pests: root weevil, gypsy moth, tussock moth, Douglas-fir needle midge*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand	Individual trees in any seed production or breeding & preservation orchard	0.01 lb a.i./tree, in water at 2 gal/tree 1 application to 600 trees	0.01 lb a.i./tree, in water at 2 gal/tree 1 application to 600 trees	Apr - Sep	Infrequent
Hand sprayer	Greenhouses 1 and 2 and center-span	0.0075 lb a.i./gal, in water at 1 gal/100 ft^2 1 application to 3 tables (96 ft^2)	0.0075 lb a.i./gal, in water at 1 gal/ 100 ft^2 2 applications to 3 tables (96 ft^2)	Jun - Sep	Infrequent
Acephate: 1300 Orthene® TR (12% a.i. in 4- or 12-oz. total release canisters) *Target pests: root weevil*					
Total-release canisters	Greenhouse	Two (4-oz.) cans per greenhouse 1 application to both greenhouses	Two (4-oz.) cans per greenhouse and one (4-oz.) can in center-span 2 applications to both greenhouses and center-span	Jun - Sep	Infrequent

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency*
B.t.: Deliver® (18% a.i. as a wettable granular bioinsecticide) *Target pests: gypsy moth, Douglas-fir tussock moth, spruce budworm, tent caterpillar*					
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand	Any orchard	0.27 lb a.i./acre, in water at 100 gal/acre 1 application to trees on 75 acres	0.27 lb a.i./acre, in water at 100 gal/acre 1 application to trees on 150 acres	Apr - Sep	Infrequent
Chlorpyrifos: Dursban 50W (50% a.i. as a wettable powder in water-soluble packets) *Target pests: adelgids, Cooley spruce gall aphids, gypsy moth, Douglas-fir tussock moth, spruce budworm, Lygus spp., maple leaf cutters, oak skeletonizers, pitch pine moths, weevils, bark beetles*					
Airblast sprayer	Any orchard	1 lb a.i./acre, in water at 100 gal/acre 1 application to 75 acres	2 lb a.i./acre, in water at 100 gal/acre 1 application to 150 acres	Apr - Sep	Infrequent
Diazinon: Diazinon 50W (50% a.i. as a wettable powder) *Target pests: two-spotted mites, aphids, budmoths, root weevils, tent caterpillars, obscure root weevil*					
High-pressure hydraulic sprayer	Individual trees in any orchard or in native plant beds	0.015 lb a.i./tree, in water at 3 gal/tree 1 application to 1,500 trees	0.075 lb a.i./tree, in water at 5 gal/tree 2 applications to 1,500 trees	Apr - Sep	Infrequent
Dimethoate: Digon 400 (43.5% a.i. as a liquid concentrate) *Target pests: Douglas-fir cone moth, Douglas-fir cone gall midge, Douglas-fir seed wasp, cone worm*					
High-pressure hydraulic sprayer	Individual trees in any seed production orchard	0.13 lb a.i./tree, in water at 2 gal/tree 1application to 1,000 trees	0.34 lb a.i./tree, in water at 4 gal/tree 2 applications to 1,000 trees	Apr - Jun	Only if esfenvalerate was unavailable

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency*
Esfenvalerate: Asana® XL (8.4% a.i. as an emulsifiable concentrate) *Target pests: Douglas-fir cone moth, cone worm, seed bug, seed chalcid, pine conelet bug, pine needle midge, spruce budworm, balsam woolly adelgid*					
Aerial (helicopter)	Seed production orchards	0.19 lb a.i./acre, in water at 10 gal/acre 1 application to 75 acres	0.19 lb a.i./acre, in water at 10 gal/acre 2 applications to 150 acres	Apr - Jul	Annually, rotating among units
Airblast sprayer	Seed production orchards	0.05 lb a.i./acre, in water at 100 gal/acre 1 application to 75 acres	0.088 lb a.i./acre, in water at 175 gal/acre 2 applications to 150 acres	Apr - Jun	
High-pressure hydraulic sprayer -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Individual trees in any orchard	0.001 lb a.i./tree, in water at 2 gal/tree 1 application to 1,000 trees	Cumulative maximum = 1.6 lb a.i./acre per year 0.002 lb a.i./tree, in water at 4 gal/tree 2 applications to 1,000 trees	Apr - Jun	
Horticultural Oil: Dormant Oil 435 (98.8% paraffinic hydrocarbon oil) *Target pests: spider mites, scales*					
High-pressure hydraulic sprayer	Individual trees in any orchard, as an additive to other insecticides, fungicides, or miticides; or alone as a dormant spray	0.03 gal oil/tree, in water at 3 gal/tree 1 application to individual trees on 10 acres	0.05 gal oil/tree, in water at 5 gal/tree 2 applications to individual trees on 10 acres	Mar - Sep (as an additive) Sep - May (as a dormant oil)	Infrequent

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency*
Permethrin: Pounce® 3.2 EC (38.4% a.i. as an emulsifiable concentrate) *Target pests: Douglas-fir coneworm, seed bug*					
Airblast sprayer	Pine orchards	1.05 lb a.i./acre, in water at 100 gal/acre 1 application to 9 acres	1.05 lb a.i./acre, in water at 100 gal/acre 2 applications to 9 acres	May - Aug	Only if esfenvalerate was unavailable
High-pressure hydraulic sprayer	Individual trees in pine orchards	0.01 lb a.i./tree, in water at 5 gal/tree 1 application to 900 trees	0.02 lb a.i./tree, in water at 10 gal/tree 2 applications to 900 trees	May - Aug	
Potassium salts of fatty acids: Safer® Soap (49.0% a.i. as a ready-to-use liquid) *Target pests: aphids*					
Hand sprayer	Greenhouse, individual trees or tree branches in any orchard	As needed	As needed	Apr - Sep	Infrequent
Propargite: Omite® CR (32% a.i. as a wettable powder in water soluble bags) *Target pests: spider mites*					
High-pressure hydraulic sprayer	Individual trees in any orchard	1.4 lb a.i./acre, in water at 100 gal/acre 1 application to 20 acres	2.4 lb a.i./acre, in water at 100 gal/acre 2 applications to 20 acres	Apr - Oct	Infrequent
Fungicides					
Chlorothalonil: Bravo® 500 (40.4% a.i. as a liquid concentrate) *Target pests: Swiss needlecast, Rhabdocline needlecast, Botrytis seedling blight, Phoma twig blight, Sirococcus tip blight*					
High-pressure hydraulic sprayer	Individual trees in any orchard	2.1 lb a.i./acre, in water at 100 gal/acre 1 application to 250 trees	4.2 lb a.i./acre, in water at 100 gal/acre 2 applications to 500 trees	Feb - Jun	Infrequent

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency*
Chlorothalonil: Daconil Ultrex® (82.5% a.i. as water-dispersible granules) *Target pests: Alternaria, Anthracnose, Botrytis, Cercospora, and Fusarium leaf spots; and Scirrhia brown spot*					
Chemigation -or- Hand sprayer	Greenhouses 1 and 2 and center-span	1.65 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/ greenhouse) 17 applications to 1 greenhouse	4.12 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 17 applications to 1 greenhouse	May - Dec	Every 2 weeks
Hydrogen Dioxide: ZeroTol® (27% a.i. as a liquid concentrate) *Target pests: Algae, Botrytis, Fusarium, Pseudomonas, Pythium, Phytophthora, Rhizoctinia*					
Chemigation	Greenhouses 1 and 2 and center-span	100 fl. oz. product/quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 47 applications to both greenhouses and center-span	250 fl. oz. product/quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 47 applications to both greenhouses and center-span	Mar 15 and Jul - Jan 15	Every week
Mancozeb: Dithane T/O (75% a.i. as a microgranular product) *Target pests: Anthracnose, Cylindrosporium, Cercospora and Phomopsis blight, Lophodermium needlecast, pine gall rust, Scirrhia brown spot, cedar-apple rust, Alternaria, and Phyllosticta leaf spots*					
Chemigation -or- Hand sprayer	Greenhouses 1 and 2 and center-span	1.12 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/ greenhouse) 14 applications to 1 greenhouse	1.12 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 14 applications to 1 greenhouse	May - Nov	Infrequent

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency*
Propiconazole: Banner® MAXX (14.3% a.i. as a liquid concentrate) *Target pests: mildew, rust*					
Tractor-pulled spray rig with boom -or- Hydraulic sprayer with hand-held wand	Native plant beds	0.12 lb a.i./acre, in water at 100 gal/acre 2 applications to 2 acres	0.20 lb a.i./acre, in water at 100 gal/acre 3 applications to 3 acres	Mar - Nov	Infrequent
Thiophanate-Methyl: Cleary's 3336® WP (50% a.i. as a wettable powder in 8-oz. water soluble bags) *Target pests: Botrytis and Fusarium stem rots*					
Chemigation -or- Hand sprayer	Greenhouses 1 and 2 and center-span	0.38 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/ greenhouse) 17 applications to 1 greenhouse	0.75 lb a.i./quadrant, in water at 100 gal/quadrant (= 400 gal/greenhouse) 17 applications to 1 greenhouse	Jun 15 - Jan 15	Every 2 -3 weeks

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency*
Herbicides					
Dicamba: Banvel® (48.2% a.i. as a water-soluble liquid) *Target vegetation: broadleaf weeds*			**Note**: The risk assessment (summarized in Appendix C) evaluated aerial application of dicamba to fallow fields. Aerial dicamba application is no longer under consideration by BLM, and is not part of any alternative in this EIS.		
Tractor-pulled spray rig with boom -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Spot treating weeds in fallow areas and any orchard	1 lb a.i./acre, in water at 10 to 100 gal/acre 1 application to 91.5 acres	2 lb a.i./acre, in water at 10 to 100 gal/acre 1 application to 91.5 acres	May - Sep	Infrequent
Glyphosate: Roundup® (41.0 % a.i. as isopropylamine salt; water-soluble liquid) *Target vegetation: unwanted vegetation*					
Tractor-pulled spray rig with boom -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	36 ft^2 around each tree or spot treatment in young orchards and around edges of native plant beds	3 lb a.i./acre of treated area (in water at 10 to 40 gal/acre) = 0.19 lb a.i./orchard acre 1 application to 25 acres	4 lb a.i./acre of treated area (in water at 10 to 40 gal/acre) = 0.25 lb a.i./ orchard acre 2 applications to 25 acres	Apr - Jul	Annually on a rotational basis

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency*
Glyphosate: Roundup® (41.0 % a.i. as isopropylamine salt; water-soluble liquid) (continued) *Target vegetation: unwanted vegetation*					
Tractor-pulled spray rig with boom	5-ft strips on each side of tree rows in breeding and preservation orchards	3 lb a.i./acre of treated area (in water at 10 to 40 gal/acre) = 1.1 lb a.i./orchard acre 1 application to 16 acres	4 lb a.i./acre of treated area (in water at 10 to 40 gal/acre) = 1.4 lb a.i./ orchard acre 2 applications to 16 acres	Apr - Jul	Annually on a rotational basis
Tractor-pulled spray rig with boom	Gravel orchard roads	3 lb a.i./acre, in water at 10 to 40 gal/acre 1 application to 8.5 acres	4 lb a.i./acre, in water at 10 to 40 gal/acre 2 applications to 8.5 acres	Apr - Jul	Annually on a rotational basis
Backpack sprayer	Spot treatments in orchards and around buildings	3 lb a.i./acre, in water at 10 to 40 gal/acre 1 application to 3 acres	4 lb a.i./acre, in water at 10 to 40 gal/acre 2 applications to 6 acres	Mar - Oct	Annually
Glyphosate: Rodeo® (53.8% a.i. as isopropylamine salt; water-soluble liquid) *Target vegetation: Japanese knotweed, purple loosestrife, bindweed, knapweed, other invasive species*					
Backpack sprayer	Spot treatments in orchards, around buildings, in buffers, and in tiled or riparian areas	3 lb a.i./acre, in water at 10 to 40 gal/acre 1 application to 3 acres	4 lb a.i./acre, in water at 10 to 40 gal/acre 2 applications to 6 acres	Mar - Oct	Annually
Hexazinone: Velpar® (90% a.i. as a soluble powder) *Target vegetation: unwanted vegetation*					
Tractor-pulled spray rig with boom (roads) -or- Backpack sprayer (fencelines)	Fencelines and roads	1.8 lb a.i./acre, in water at 25+ gal/acre 1 application to 10.5 acres	7.2 lb a.i./acre, in water at 25+ gal/ acre 1 application to 10.5 acres	Mar - Apr	Annually or less

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency*
Hexazinone: Velpar® (90% a.i. as a soluble powder) (continued) *Target vegetation: unwanted vegetation*					
Tractor-pulled spray rig with boom -or- Hydraulic sprayer with hand-held wand -or- Backpack sprayer	36 ft^2 around each tree in seed production orchards and around edges of native plant beds	1.8 lb a.i./acre of treated area (in water at 25+ gal/acre) = 0.11 lb a.i./orchard acre 1 application to 10 acres	2.7 lb a.i./acre of treated area (in water at 25+ gal/acre) = 0.17 lb a.i./ orchard acre 1 application to 10 acres	Mar - Apr	Annually or less
Tractor-pulled spray rig with boom	5-ft strips on each side of tree rows in breeding and preservation orchards and around edges of native plant beds	1.8 lb a.i./acre of treated area (in water at 25+ gal/acre) = 0.65 lb a.i./orchard acre 1 application to 5 acres	2.7 lb a.i./acre of treated area (in water at 25+ gal/acre) = 0.97 lb a.i./ orchard acre 1 application to 5 acres	Mar- Apr	Annually or less
Picloram: Tordon® 22K (24.4% a.i. as a liquid concentrate) *Target vegetation: scotchbroom, bindweed, other noxious weeds*					
Hydraulic sprayer with hand-held wand -or- Backpack sprayer	Spot treat noxious weeds in all orchards	0.25 lb a.i./acre, in water at 10 to 50 gal/acre 1 application to 2 acres	1 lb a.i./acre, in water at 10 to 50 gal/acre 2 applications to 2 acres	May - Aug	Annually or less

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Label Application Rate and Max Area	Application Date Range	Anticipated Frequency*
Triclopyr: Garlon® 3A (44.4% a.i. as a liquid concentrate) *Target vegetation: bindweed, tansy ragwort, poison oak, thistle*					
Backpack sprayer	Fencelines, stump treatment in any orchard	1.5 lb a.i./acre, in water at 10 to 100 gal/acre -or- Undiluted for stump treatment 1 application to 2 acres	9 lb a.i./acre, in water at 10 to 100 gal/acre -or- Undiluted for stump treatment 1 application to 2 acres	May - Aug	Annually or less
Triclopyr: Garlon® 4 (61.6% as a liquid concentrate) *Target vegetation: bindweed, tansy ragwort, poison oak, thistle*					
Backpack sprayer	Fencelines, basal bark treatment in any orchard	1.5 lb a.i./acre, in water at 10 to 100 gal/acre -or- As a 0.04 to 0.2 lb a.i./gal mixture in oil for basal bark treatment 1 application to 2 acres	8 lb a.i./acre, in water at 10 to 100 gal/acre -or- As a 0.04 to 0.2 lb a.i./gal mixture in oil for basal bark treatment 1 application to 2 acres	May - Aug	Annually or less
Fumigant					
Dazomet: Basamid® Granular (99% as a granular material) *Target pests: nematodes, weeds, fungi*					
Ground pull fertilizer-type spreader	Native plant beds	173 lb a.i./acre 1 application to 2 acres	300 lb a.i./acre 1 application to 3 acres	Apr - Jul	Annually or less, depending on the plant species

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Application Rate and Max Area	Application Date Range	Anticipated Frequency*
Fertilizers					
Ammonium-phosphate sulfate (16-20-0-15), ammonium nitrate (34-0-0), monoammonium phosphate (11-52-0), sulfate of potash (0-0-50), and Perfection Standard Blends (16-16-16-7, 15-20-8, 20-10-10-10, 18-18-18-2, and 13-39-0-7)		**Note:** The risk assessment listed typical and maximum ammonium phosphate-sulfate application rates of 300 and 600 lb/acre, respectively; and a typical monoammonium phosphate application rate of 95 lb/acre. The following lists include revisions to those numbers, showing the current expected use rates. Urea was evaluated in the risk assessment, but is no longer proposed for use. The risk assessment modeled use of diammonium phosphate and ammonium nitrate, so the results of the analysis are not affected by these revisions.			
Granular spreader	All orchard units	200 lb/acre ammonium phosphate-sulfate -or- 200 lb/acre ammonium nitrate -or- 100 lb/acre monoammonium phosphate -or- 200 lb/acre sulfate of potash -or- 200 lb/acre Perfection Standard Blend 16-16-16-7 -or- 200 lb/acre Perfection Standard Blend 15-20-8 -or- 200 lb/acre Perfection Standard Blend 20-10-10-11 -or 200 lb/acre Perfection Standard Blend18-18-18-2 -or- 200 lb/acre Perfection Standard Blend 13-39-0-7 -or- 400 lb/acre diammonium phosphate 1 application to 200+ acres on Mar 15	300 lb/acre ammonium phosphate-sulfate -or- 300 lb/acre ammonium nitrate -or- 200 lb/acre monoammonium phosphate -or- 300 lb/acre sulfate of potash -or- 300 lb/acre Perfection Standard Blend 16-16-16-7 -or- 300 lb/acre Perfection Standard Blend 15-20-8 -or- 300 lb/acre Perfection Standard Blend 20-10-10-11 -or- 400 lb/acre Perfection Standard Blend 18-18-18-2 -or- 300 lb/acre Perfection Standard Blend 13-39-0-7 -or- 800 lb/acre diammonium phosphate 1 application to 200+ acres on Mar 15	Feb - Apr	Annually or less

Table 2.2-1. Pesticide and Fertilizer Application Summary (continued)

Application Method	Location	Typical Application Rate and Area	Max Application Rate and Max Area	Application Date Range	Anticipated Frequency*
Calcium nitrate: 15.5-0-0					
Granular spreader	All orchard units	9.30 - 41.03 lb/tree, equivalent to 200 lb N/acre 1 application to 65 acres on Apr 30	9.30 - 41.03 lb/tree, equivalent to 200 lb N/acre 1 application to 95 acres on Apr 30	Mar - May	Annually or less

[a] The formulations listed are those currently expected to be used. If other formulations of the same active ingredient are used, the application methods, locations, area, date range, frequency, and active ingredient application rates listed in this table would still apply.
[b] "Infrequent" applications are expected to be required no more often than every three years.

Table 2.6-1. Summary of Potential Impacts by Alternative

Resource	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Air Quality	NS*	NS	NS	NS	NS
Geological Resources	NS	NS	NS	NS	NS
Water Resources	**Groundwater:** No significant impacts: Although some of the proposed insecticides, herbicides, and fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** No significant impacts: Although some of the proposed insecticides, herbicides, and fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** No significant impacts: Although some of the proposed insecticides, herbicides, and fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** No significant impacts: Although some of the proposed fertilizers could leach, the predicted concentrations were far below levels of concern for human health and ecological protection.	**Groundwater:** Pesticide and fertilizer chemicals could leach to groundwater, depending on project-specific details, limitations, and mitigations. Impacts would be identified in project-specific EAs.
	Streams and Rivers: Runoff or drift from pesticide or fertilizer applications could enter surface water. (The effects of the estimated stream concentrations on human health and aquatic species are described under those headings.)	**Streams and Rivers:** No significant impacts to surface water, since limitations would be implemented that control runoff and drift potential. (The effects of estimated stream concentrations on health and aquatic species are described under those headings.)	**Streams and Rivers:** No significant impacts to surface water, since limitations would be implemented that control runoff and drift potential. (The effects of estimated stream concentrations on health and aquatic species are described under those headings.)	**Streams and Rivers:** Runoff from fertilizer applications could enter surface water. (The effects of estimated stream concentrations on health and aquatic species are described under those headings.)	**Streams and Rivers:** Runoff or drift from pesticide or fertilizer applications could enter surface water, depending on project-specific details. Impacts from pesticides would be identified in project-specific EAs.
	Accidents: Spill of pesticide concentrate or mix could contaminate surface water or groundwater.	**Accidents:** Spill of pesticide concentrate or mix could contaminate surface water or groundwater. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Accidents:** Spill of pesticide concentrate or mix could contaminate surface water or groundwater. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Accidents:** NS	**Accidents:** Spill of pesticide concentrate or mix could contaminate surface water or groundwater.
Land Use	NS	NS	NS	NS	NS

Table 2.6-1. Summary of Potential Impacts by Alternative (continued)

Resource	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Human Health and Safety	**Members of the Public:** No significant impact from use of any proposed control method. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing.	**Members of the Public:** No significant impact from use of any proposed control method. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Members of the Public:** No significant impact from use of any proposed control method. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Members of the Public:** NS	**Members of the Public:** No significant impact from use of any proposed control method, if used as described under any action alternative. Unknown risks if pesticides other than those included in this EIS are used. An accidental pesticide spill into a stream would make it unsafe for drinking or fishing.
	Workers: Adverse health effects possible from some pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.	**Workers:** No significant impact predicted from pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.	**Workers:** No significant impact predicted from pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.	**Workers:** Possible injuries from cultural or prescribed fire methods.	**Workers:** Adverse health effects possible from some pesticide applications. Health risks predicted for accidental spill onto skin of pesticide concentrates or dilutions. Possible injuries from cultural or prescribed fire methods.

Table 2.6-1. Summary of Potential Impacts by Alternative (continued)

Resource	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Biological Resources	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS	**Non-Target Vegetation:** NS
	Terrestrial Wildlife: Possible risks to birds, amphibians, and special status species under typical and maximum conditions (and mammals under maximum conditions only) from three proposed insecticides and calcium nitrate fertilizer. Many non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire methods.	**Terrestrial Wildlife:** Many non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire, or other methods.	**Terrestrial Wildlife:** Many non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire, or other methods.	**Terrestrial Wildlife:** Possible risks to special status species from calcium nitrate fertilizer.	**Terrestrial Wildlife:** Risks to non-target wildlife possible, depending on project-specific details, limitations, and mitigations. Possible risks to special status species from calcium nitrate fertilizer. Many non-target insects in an area treated with insecticide would be killed. No significant impacts from biological, cultural, prescribed fire methods.
	Aquatic Species: No significant risks from chemical, biological, prescribed fire, or cultural control methods. Potential sublethal effects from fertilizers to special status aquatic species in maximum scenario only. An accidental pesticide spill into a stream would have adverse effects on aquatic species.	**Aquatic Species:** No significant risks from use of any proposed control methods. An accidental pesticide spill into a stream would have adverse effects on aquatic species. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Aquatic Species:** No significant risks from use of any proposed control methods. An accidental pesticide spill into a stream would have adverse effects on aquatic species. Pesticide transport over specific streams would be prohibited, decreasing probability of an accidental spill to surface water.	**Aquatic Species:** No significant risks from biological, prescribed fire, or cultural control methods. Potential sublethal effects from fertilizers to special status aquatic species in maximum scenario only.	**Aquatic Species:** No significant risks from chemical, biological, prescribed fire, or cultural control methods, if used as described under any action alternative. Potential sublethal effects from fertilizers to special status aquatic species in maximum scenario only. An accidental pesticide spill into a stream would have adverse effects on aquatic species.

Table 2.6-1. Summary of Potential Impacts by Alternative (continued)

Resource	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Noise	NS	NS	NS	NS	NS
Cultural Resources	NS	NS	NS	NS	NS
Socioeconomics and Environmental Justice	NS	NS	NS	NS	NS

*NS = no significant impacts predicted; see Chapter 4 for details.

3.0 Affected Environment

3.1 Introduction

This chapter describes the relevant environment at Horning, providing baseline information to allow the evaluation of potential environmental impacts that could result from the proposed action or an alternative action. As stated in 40 CFR 1508.14, the human environment includes natural and physical resources and the relationship of people to those resources. The environmental baseline resources described in this chapter were selected after identifying the potential issues and concerns related to the proposed action and alternatives. The relevant resources are described in a sufficient level of detail to adequately support the impact analysis. Those resources which are potentially affected most significantly, such as human health and biological resources, are described in greatest detail. Those resources which are likely to be impacted least, such as cultural resources and noise, are described in lesser detail.

The following resources would not be affected and are therefore not described in this chapter, nor evaluated in Chapter 4, in accordance with 40 CFR 1502.15:

- Visual resources: No structures would be built or demolished, nor would there be any activities that would affect visual or aesthetic resources as a result of the proposed action or an alternative. The closest wilderness area to the orchard is BLM's Table Rock Wilderness, located about 15 miles south of the orchard. In addition, the Mount (Mt.) Hood Wilderness Area (a Class I area), is located about 30 miles to the east.

- Transportation: No construction vehicles would be involved with any action, nor would there be any changes to vehicular traffic near Horning.

The chapter begins with a discussion of the resources that may be affected by the proposed action or an alternative. The order of resource description is based on introducing the physical environment (air, geology, and water), followed by land use, human health, biological resources, and the human environment (noise, cultural resources, socioeconomics, and environmental justice).

3.2 Air Resources

This section discusses the climate, meteorology, and regional air quality of the area around Horning.

3.2.1 Climate and Meteorology

Horning is approximately 23 miles southeast of the city of Portland, situated in rolling hills west of Mt. Hood National Forest. The town of Estacada is about eight miles northeast of the orchard. Elevation at Horning ranges from 900 to 1,140 feet above sea level. Its geographical location between the Pacific Ocean and Cascade Mountains results in a maritime west coast climate, featuring mild, wet winters and cool, dry summers. The average July temperature at Estacada is 66° F, the average January temperature is 40° F, and average annual precipitation is 59 inches. Most of the precipitation occurs between the months of October and March, consistent with the frequent Pacific storm patterns (see Table 3.2-1). Precipitation during the spring and summer months is typically very light. Annual average relative humidity ranges from a high of about 86%, typically in early morning, to a low of 59%, typically in the early afternoon. As recorded at the Portland Airport, winds are predominantly from the northwest throughout the months of April through September and from the east and southeast from October through March. Table 3.2-2 presents wind speed data from the Portland Airport, 29 miles to the north; average wind speeds usually range from 7 to 10 miles per hour year round.

Table 3.2-1. Climate Characteristics[a]

	Month												
Characteristic	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Year**
Mean temperature (° F)	39.7	42.7	46.5	50.7	55.9	60.8	65.9	66.0	61.4	52.6	44.9	39.8	52.2
Mean precipitation (in)	8.04	6.95	6.18	5.08	4.04	2.68	1.07	1.28	2.47	4.77	8.45	8.47	59.48
Average days with 0.5 or more inches of rain	6.0	4.8	4.2	3.2	2.5	1.4	0.5	0.8	1.8	3.2	6.2	5.9	40.4

[a]Data are for Estacada for the period of record 1971 - 2000 (Oregon Climate Service 2002a).

Table 3.2-2. Wind Characteristics[a]

	Month											
Characteristic	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Prevailing direction[b]	ESE	ESE	ESE	NW	NW	NW	NW	NW	NW	ESE	ESE	ESE
Average wind speed (mph)[c]	8.7	7.5	7.1	5.8	5.4	5.4	6.1	5.6	4.9	5.4	6.8	8.6
Percent occurrence of wind speeds for all directions:												
Calm	6.8	12.3	10.8	10.8	10.4	10.3	7.2	9.5	12.5	15.3	13.5	8.9
1-3 mph	17.0	20.6	23.0	28.9	28.3	26.6	21.5	23.9	31.9	29.1	24.0	17.3
4-7 mph	22.4	22.4	24.6	29.9	34.3	35.5	37.3	37.7	33.9	28.7	23.8	22.7
8-12 mph	26.8	22.9	23.7	21.2	21.3	23.2	29.1	25.5	17.4	18.0	20.4	22.6
> 12 mph	27.0	21.8	17.9	9.1	5.6	4.4	5.0	3.4	4.2	8.9	18.3	28.5

[a]Data are for the Portland Airport for the period of record 1949 - 1958 (Oregon Climate Service 2002b).
[b]Highest total percentage per direction observed during month.
[c]Averaged for all directions observed per month.

3.2.2 Regional Air Quality

The National Ambient Air Quality Standards (NAAQS), established by EPA and adopted by ODEQ, define the maximum allowable concentrations of pollutants that may be reached but not exceeded within a given time period. Primary standards protect public health, and secondary standards protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. Section 110 of the *Clean Air Act* requires states to develop air pollution regulations and control strategies to ensure that state air quality meets the NAAQS established by EPA. These ambient standards, established under Section 109 of the *Clean Air Act*, currently address six criteria pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), lead (Pb), particulate matter (PM), and sulfur dioxide (SO_2). Particulate matter is further regulated by size for particles smaller than 10 microns in diameter (PM_{10}). Exceeding the NAAQS concentration is referred to as “nonattainment” of the pollutant standard.

Table 3.2-3 presents the current NAAQS and the Oregon Ambient Air Quality Standards for the six criteria pollutants, along with regional air quality data for 2001, during which time all standards were met.

The *Clean Air Act* Amendments of 1970 established three Federal air quality control regions (AQCRs) in western Oregon. Horning is located in the Portland Interstate AQCR. Air quality throughout this area currently meets Federal standards. However, a portion of the Portland urban area (the Portland Air Quality Maintenance Area) has been under a maintenance plan for ozone since June 1997 because, for a time prior to that, the area was in nonattainment of the NAAQS for ozone. Horning is about six miles east and ten miles south of this maintenance area. The Portland Metro Service District Boundary has been in maintenance for CO since October 1997. Horning is about 12 miles outside of this area. The seed orchard and its vicinity are in attainment for all criteria pollutants; that is, the national primary and secondary standards are met.

Table 3.2-3. National and State Ambient Air Quality Standards and Data[a]

Pollutant	Averaging Time	Standard[b]			2001 Air Quality Data (ppm)[d]
		Primary NAAQS	Secondary NAAQS	Oregon AAQS	
O_3	1 hr	0.12 ppm (235 μg/m^3)	—	0.12 ppm	0.069
	8 hr[c]	0.08 ppm (157 μg/m^3)[c]		—	0.099
CO	1 hr	35 ppm (40 mg/m^3)	—	35 ppm	7.5
	8 hr	9 ppm (10 mg/m^3)		9 ppm	6.0
NO_2	Annual arithmetic mean	0.053 ppm (100 μg/m^3)	Same as primary NAAQS	0.053 ppm	0.052[e]
SO_2	3 hr	0.50 ppm (1,300 μg/m^3)	—	0.50 ppm	ND[f]
	24 hr	0.14 ppm (365 μg/m^3)	—	0.10 ppm	ND
	Annual arithmetic mean	—	0.03 ppm (80 μg/m^3)	0.02 ppm	ND
PM_{10}	Annual arithmetic mean	50 μg/m^3	Same as primary NAAQS	50 μg/m^3	19.8
	24 hours	150 μg/m^3		150 μg/m^3	45
$PM_{2.5}$[c]	Annual arithmetic mean[c]	15 μg/m^3 [c]	Same as primary NAAQS	—	8.9
	24 hours[c]	65 μg/m^3 [c]			50
Pb	Quarterly	1.5 μg/m^3	Same as primary NAAQS	1.5 μg/m^3	0.02

[a]40 CFR 50, OAR 340-202, ODEQ 2002a.
[b]mg/m^3 — milligrams per cubic meter; μg/m^3 — micrograms per cubic meter; ppm — parts per million.
[c]A 1999 Federal court ruling has blocked implementation of these standards; they are included for information purposes only at this time.
[d]Maximum reading from 2001 in the Portland and Salem areas.
[e]1-hour average; annual arithmetic mean not available.
[f]ND = no data available.

3.3 Geological Resources

3.3.1 Physiography and Topography

Horning is located within the Willamette Valley near the Cascade Mountains in an area of rolling hills with slopes from 2 to 36 percent. Elevations at Horning range from about 900 to 1,140 feet. Slopes are generally to the west and southwest in Section 23 and to the east and northeast in Section 13. Tributaries to Nate Creek in Section 23 and to Swagger Creek in Section 13 have cut moderately to steeply sloped valleys into the local hills.

3.3.2 Geology

Horning is located within an area known as the Eola Surface, the oldest erosional surface in the Willamette Valley. This surface is gently inclined between the Cascade Mountains and the Willamette Valley, and is covered with material which has been eroded (known as colluvium), and continues to erode, from the mountains. The colluvium ranges in size from fine material (clays and silts) to coarser materials such as sand, gravel, and boulders. Much of the eroded material has been in place for a long period of time and is highly weathered, containing a high proportion of clay. The colluvium is about 100 feet thick, overlying thin lava flows and volcanic bedrock. Silt and clay are interbedded with the sand and gravel and there are areas with boulders at or near the surface. The colluvium is derived from volcanic material, primarily basalt and andesite, which has eroded from the Cascade Mountains. An area of sandstone underlies a small part of the seed orchard. The sandstone underlying the site and surrounding areas is very permeable and contains shallow aquifers. The water table is typically about 10 feet below the surface and well depths in the area range from 25 to 700 feet (USGS 1994).

3.3.3 Soils

Soil is formed by physical and chemical processes that are determined by parent material (from which the soils are derived), climate, living organisms (plants, animals, and microorganisms), topography, and time. Cool, dry summers and cool, moist winters at Horning result in a mixture of deciduous and conifer trees, shrubs, and grasses. A relatively high amount of organic material is returned to the soil each year from leaves and the annual dieback of vegetation. The topographic position of these soils has resulted in well-drained soils. These soils have been weathered for a long period of time, producing a high clay content and relative low amount of some minerals.

Four types of soil are present at Horning: Cottrell silty clay loam, Jory silty clay loam, Klickitat stony loam, and Springwater loam (SCS 1985). The cation exchange capacity of each of these soils (except for the Klickitat series, for which it is undetermined) is in the range of 10 to 25 milliequivalents per 100 grams, indicating that they contain smectite clay and a moderate amount of organic matter, which adsorbs pesticides and fertilizers and retards their movement through the soil. The following paragraphs describe the soils identified on the seed orchard. Table 3.3-1 presents soil characteristics relevant to the environmental mobility of fertilizers and pesticides.

Cottrell silty clay loam is a deep, moderately well-drained soil on high terraces and rolling uplands and formed in silty material and colluvium derived mainly from basalt. At Horning, this soil occurs in and along streambeds. This soil is highly weathered. Typically, the surface layer is very dark grayish brown and dark brown silty clay loam about 12 inches thick. The upper 12 inches of the subsurface is dark brown silty clay loam, and the lower 31 inches is mottled dark brown silty clay. The substrate to a depth of 60 inches is reddish brown silty clay loam. The available water holding capacity is 0.15 to 0.21 inches of water per inch of soil. The rooting depth is 40 to 60 inches. Runoff is slow, and hazard of erosion by water is slight. The hazard of erosion by wind is very slight. The main limitation for tree growth is a moderate to high susceptibility for compaction due to wetness. Soil pH is from 5.1 to 6.0. These soils occur in creeks and drainage ways and are not managed areas at the seed orchard.

Jory silty clay loam is a deep, well-drained soil on the hill slopes throughout the seed orchard, including nearly all the managed lands. It formed in colluvium derived mainly from basalt, and is highly weathered. Typically, the surface layer is a dark brown silty clay loam about seven inches thick. The upper six inches of the subsoil is dark reddish brown silty clay loam, the next 30 inches is dark red and yellowish red silty clay, and the substrate down to 60 inches is dark reddish brown and dark red silty clay. The available water holding capacity is 0.15 to 0.21 inches of water per inch of soil. This soil is droughty in the summer. The potential rooting depth is 60 or more inches, with an effective rooting depth of about 24 inches. Runoff ranges from slow to rapid, increasing with slope. The hazard of erosion by water also depends on slope, ranging from slight to severe. The hazard of erosion by wind is very slight. The main limitation for tree growth is a high susceptibility for compaction, especially when the soil is wet. A tillage pan (a layer of compacted soil) forms easily if the soil is tilled when wet. Soil pH is from 4.5 to 6.5. The majority of seed production areas occur in this soil, particularly where the slope is less than 8%. The amount of coarse material in the soils (including large boulders) increases with increasing slope. Areas with a slope of 15% or more are not developed as orchard tree units.

Klickitat stony loam occurs in a small area along the eastern border of the portion of the orchard located in Section 13. These soils are located in mountainous uplands in areas of 30 to 60% slope. At Horning, they are located in the valley of an unnamed stream draining into the Swagger Creek. They were formed in colluvium derived from basalt and andesite. These soils are moderately weathered. The topsoil is dark brown to dark reddish brown stony loam about 15 inches in depth. The subsoil is dark reddish brown very gravelly clay loam grading to very cobbly clay loam. From 35 to 48 inches in depth, the soil is reddish brown extremely cobbly loam. Fractured basalt typically occurs at a depth of 48 inches. The available water holding capacity is 0.08 to 0.10 inches of water per inch of soil. The rooting depth is 40 to 60 inches. Runoff is rapid, and hazard of water erosion is severe. The hazard of wind erosion is very slight. The main limitation for tree

Table 3.3-1. Soils at the Horning Seed Orchard

Soil Series	Depth (in.)	Perme-ability (in/hr)	Depth to Water Table (ft)	Runoff	Slope (%)	Organic Matter (%)	Clay (%)	Soil Sensitivity[1]
Cottrell	0 - 24	0.6 - 2.0	2 - 3 (winter), > 6 (summer)	slow	2 - 8	3 - 4	27 - 35	very low
	24 - 55	0.2 - 0.6				0.5 - 3	40 -50	
	55 - 86	0.2 - 0.6				0 - 0.5	30 - 45	
Jory	0 - 13	0.6 - 2.0	> 6	slow to rapid	2 - 30	3 - 6	27 - 40	very low
	13 - 60	0.2 -0.6				0.5 - 2	45 - 60	
Klickitat	0 - 15	0.6 - 2.0	> 6	rapid	30 - 60	3 - 6	20 - 27	low
	15 - 35	0.6 - 2.0				0.5 - 3	27 - 33	
	35 - 48	0.6 - 2.0				0 - 0.5	20 - 27	
	48 - 52	---				---	---	
Springwater	0 - 7	2.0 - 6.0	> 6	medium	8 - 15	4 - 6	20 - 27	low
	7 - 37	0.6 - 2.0				0.5 - 4	27 -35	
	37 - 47	---				---	---	

Sources: SCS 1985, OSUES 1998.
[1]The Oregon State University Extension Service developed soil sensitivity ratings for groundwater contamination based on leaching characteristics (permeability, soil depth, depth to groundwater, annual precipitation, and runoff as compared to infiltration) and sorption potential (the amount of organic matter and the cation exchange capacity) (OSUES 1998).

growth is the stone content of the soil, the steepness of the slope, and the instability of the soil. Soil pH is from 4.5 to 6.0. The acreage of this soil at Horning is minor, and forms a stream buffer supporting mixed vegetation.

Springwater loam occurs in a small area along the eastern border of the portion of the seed orchard located in Section 13. These soils are located in rolling uplands in areas of 8 to 15% slope. They were formed in colluvium derived from sandstone. They are moderately weathered. The topsoil is dark brown loam and clay loam about 15 inches in depth. The subsoil is brown clay loam to gravelly clay loam. Fractured sandstone typically occurs at a depth of 37 inches (the depth varies from about 20 to 40 inches). The available water holding capacity is 0.14 to 0.21 inches of water per inch of soil. The rooting depth is restricted by the depth of the sandstone. Runoff is medium, and hazard of erosion by water is moderate. These soils are not subject to wind erosion. The main limitation for tree growth is the restricted rooting depth due to the sandstone. Soil pH is from 5.6 to 6.0. The acreage of this soil at Horning is minor and is found in the orchard units.

3.4 Water Resources

Water is a key resource because it is influenced by, and in turn influences, activities and resources outside the seed orchard. Water also provides habitat for fish and aquatic animals, as well as plants and animals that use streamside and pondside areas. Water entering the seed orchard can be a source of pollutants, bringing in organisms that cause tree diseases or bringing in pesticide residues from other agricultural operations. There is also the potential for water to take pollutants out of the seed orchard.

Horning is located on the watershed divide between the Clackamas River and Molalla River in the Willamette River basin, north of Colton. The orchard is divided into two primary areas, in Sections 13 and 23, both located within Township 4 South and Range 3 East.

The Willamette Basin is the subject of several studies conducted by the Oregon Water Resources Department (OWRD) and the U.S. Geological Survey (USGS) (OWRD 2000, USGS 1998, USGS 2000). In addition, ODEQ began investigating the status of the health of the Willamette River Basin in the early 1990s. The results of five years of water quality studies, many of which were conducted in cooperation with USGS, are available to the public at ODEQ websites http: //www.deq.state.or.us/wq/Willamet/tetrareports.htm and http:/www.deq.state.or.us/wq/Willamet/ Will_hom.htm.

3.4.1 Groundwater

There is no site-specific information on groundwater for Horning with respect to flow direction or quality. However, the seed orchard does not cross any EPA- or state-designated sole-source aquifers, wellhead protection areas, or groundwater management areas.

Although not site-specific to Horning, information is available for the Willamette Basin. One example is a joint study conducted by the USGS and OWRD in the mid 1990s on groundwater resources of the Willamette Basin. The Oregon USGS website (http://oregon.usgs.gov/projs_dir/ willgw/) contains a complete description of the study, including a project overview and summary, as well as links to resulting publications (OWRD 2000).

A variety of rock types underlie the Willamette Basin, ranging from predominantly marine sedimentary rock in the western portion (Coast Range) to a variety of lava flows and volcanic sediments in the eastern part (Cascade Range). The Willamette Valley, which lies between the two ranges, includes a substantial thickness of basalt lava that flowed into the region during the early stages of basin development. The basalt lava has been folded and faulted, and now forms a series of uplands that separate the Willamette Valley into a series of sediment-filled sub-basins. The basalt lava is exposed in the uplands that separate the sub-basins, and lies beneath the valley-filling

sediments in the intervening areas. Materials left below the area's rolling topography by these processes have given variable permeability and uneven depth to zones that would act as aquifers. In addition, because of folding and faulting, the basalt is less a single aquifer than it is several small, unconnected aquifers.

Storage of water in the basalt is limited, so it is likely that most water accessed by area wells is from above the basalt. Records from well logs in the area indicate that there are a total of 17 domestic wells over the area of Sections 13 and 23, including one within the grounds at Horning (OWRD 2002a). Based on the well drilling logs (OWRD 2002a), well depths in Sections 13 and 23 range from 82 to 287 feet, with "first water" reached between 53 feet and 155 feet; the average "first water" depth for these wells was approximately 102 feet. Once collected, the static water level in these wells ranged from 10 to 150 feet, with an average static water level of approximately 51 feet.

There are three active wells on the orchard property. The first well was drilled in 1966 in Section 13. The latest well test shows that it produces 52 gallons per minute. "First water" was noted at a depth of 61 feet, with a static level currently at 32 feet below the ground surface. This is a change from 26 feet at the time of drilling. The second well was drilled in 1975 in Section 23 and has a static level of 10 feet. Renovations were made in August 1999, and a change in the static water level, now at 18 feet below land surface (down from 1975 level of 10 feet), was noted. Well yield was 4 gallons per minute. It is temporarily out of use and will probably be reactivated in 2003. There is another active well in Section 23 that was drilled in the early 1970s by the previous landowner. That well was 60 feet in depth with a static level of 20 feet and produces 2½ gallons per minute. It is currently being used for a drip irrigation system.

In general, groundwater availability in the Willamette Basin varies locally and depends on several factors, including (1) interference with surface water sources withdrawn from further appropriation, (2) seasonal well-to-well interference, (3) long-term water level declines caused by overpumping, (4) low-yield aquifers, and (5) natural groundwater quality problems, such as high salinity and high arsenic concentrations, which limit potability (OWRD 2000).

3.4.2 Surface Water

Horning is located on the watershed divide between the Clackamas River and Molalla River Basins, northeast of Colton. In this position, the orchard serves as the headwaters for a number of small streams within its boundaries. Streams in the Section 13 portion of the orchard flow into Swagger Creek, a tributary to Clear Creek, which in turn flows into the Clackamas River. Streams in the Section 23 portion flow into Nate Creek, a tributary to Milk Creek, or directly into Milk Creek, which in turn flows into the Molalla River.

The closest streamflow gage to the orchard that provides a current indication of the relative timing and amount of flow of a similar watershed in terms of size, precipitation, land use, and vegetation is USGS streamflow gage 14200300 on Silver Creek, approximately 25 miles south of the seed orchard. Data indicate a streamflow pattern consistent with precipitation levels, with the higher flows and precipitation occurring between November and April, and a reduction in storm flows after the month of May. Historical streamflow records (1936 and 1937 only) show a streamflow for Milk Creek (gage 14199600, near Colton, OR) generally ranging between 0 and 10 cubic feet per second (cfs), with a peak of 22 cfs in July; and a streamflow for Clear Creek (gage 14210650, at Viola, OR) generally ranging from 10 cfs in the summer and fall to between 100 and 200 cfs from February to June (OWRD 2002b).

Since Horning is located on a topographic divide, most of the streams that drain the area have ephemeral and intermittent flow characteristics. Ephemeral streams flow in direct response to storm events while the intermittent streams flow during the late fall, winter, and spring periods of higher precipitation. There is one larger perennial stream that bisects the Section 13 portion of the seed orchard, and several smaller perennial streams. The extent of historic ephemeral channels and their associated wet areas have been reduced in the past through the installation of subsurface

drainage ("tiling") to increase the area available for tree production. In Section 23, Stream 8 is ephemeral north of Unger Road, and when it flows, it goes underground before reaching the road. Flow resurfaces near the BLM property line. There is no direct surface connection between Streams 8d and 8e and Milk Creek. Figures 3.4-1 (Section 13) and 3.4-2 (Section 23) illustrate the orchard's water resources, including a number for each stream segment. Table 3.4-1 contains hydrologic and riparian information for these streams.

There is one unnamed perennial reservoir in the western half of Section 13 that provides the orchard with water for irrigation and fire suppression. It has a surface area of approximately one acre and a storage water right of 2.5 acre-feet. A perennial stream channel occurs at both the inlet and outlet.

Downstream beneficial uses of record for streams in and below the Section 13 (Clear Creek drainage) and Section 23 (Milk Creek drainage) portions of Horning are shown in Table 3.4-2. These beneficial uses represent the first use to be encountered downstream of the orchard in each of their categories. A full listing of non-canceled water rights on record in the Oregon Water Resources Department's Water Rights Inventory System (WRIS) is available at the Salem District BLM Office and on the web at http://www.wrd.state.or.us/. Irrigation represents the majority of recorded beneficial uses in the water rights records for the Clear Creek and Milk Creek watersheds.

Table 3.4-1. Surface Water Information for Horning Seed Orchard

Stream # from Figures 3.4-1 and 3.4-2	Duration of Flow	Estimated Discharge / Average Width of Channel*	Flow Type	Type of Riparian Vegetation
8e, 8d, 93, 9g, 9h	During and for short periods after winter storms	0.2 cfs / <1 ft. width	Ephemeral	Mature conifer and hardwood; well-developed understory
5c	During and for short periods after winter storms	0.2 cfs / <1 ft. width	Ephemeral	Scattered hardwood and shrub; breaks in overstory
11c	During and for short periods after winter storms	0.2 cfs / <1 ft. width	Ephemeral	Grass, minor overstory
5b, 6c, 6d, 6e, 6f, 6g, 6h, 6i, 7b, 8a, 8b, 8c, 9b, 9d, 9f	Estimated to flow from November through April in most years	0.0-0.2 cfs / 0.1 to 1 ft. width	Intermittent	Mature conifer and hardwood; well-developed understory
10, 11b	Estimated to flow from November through April in most years	0.0-0.2 cfs / 0.1 to 1.0 ft. width	Intermittent	Scattered hardwood and shrub
1, 2, 5a, 7a, 9c, 11a	Year-round	0.2 -0.5 cfs / 1.0 to 2.5 ft. width	Perennial	Mature conifer; hardwood understory
6a	Year-round	0.5-6.0 cfs / 2.0 to 6.0 ft. width	Perennial	Mature conifer; hardwood understory
6b	Year-round	0.5-6.0 cfs / 2.0 to 30.0 ft. width	Perennial	Mature conifer; hardwood understory; many beaver dams
9a	Year-round	0.25-3.0 cfs / 2.0 to 4.0 ft. width	Perennial	Mature conifer; hardwood understory

* cfs = cubic feet per second, based on channel dimensions observed during site visits.

Figure 3.4-1: Water Resources at Horning- Section 13 of T4S, R3E

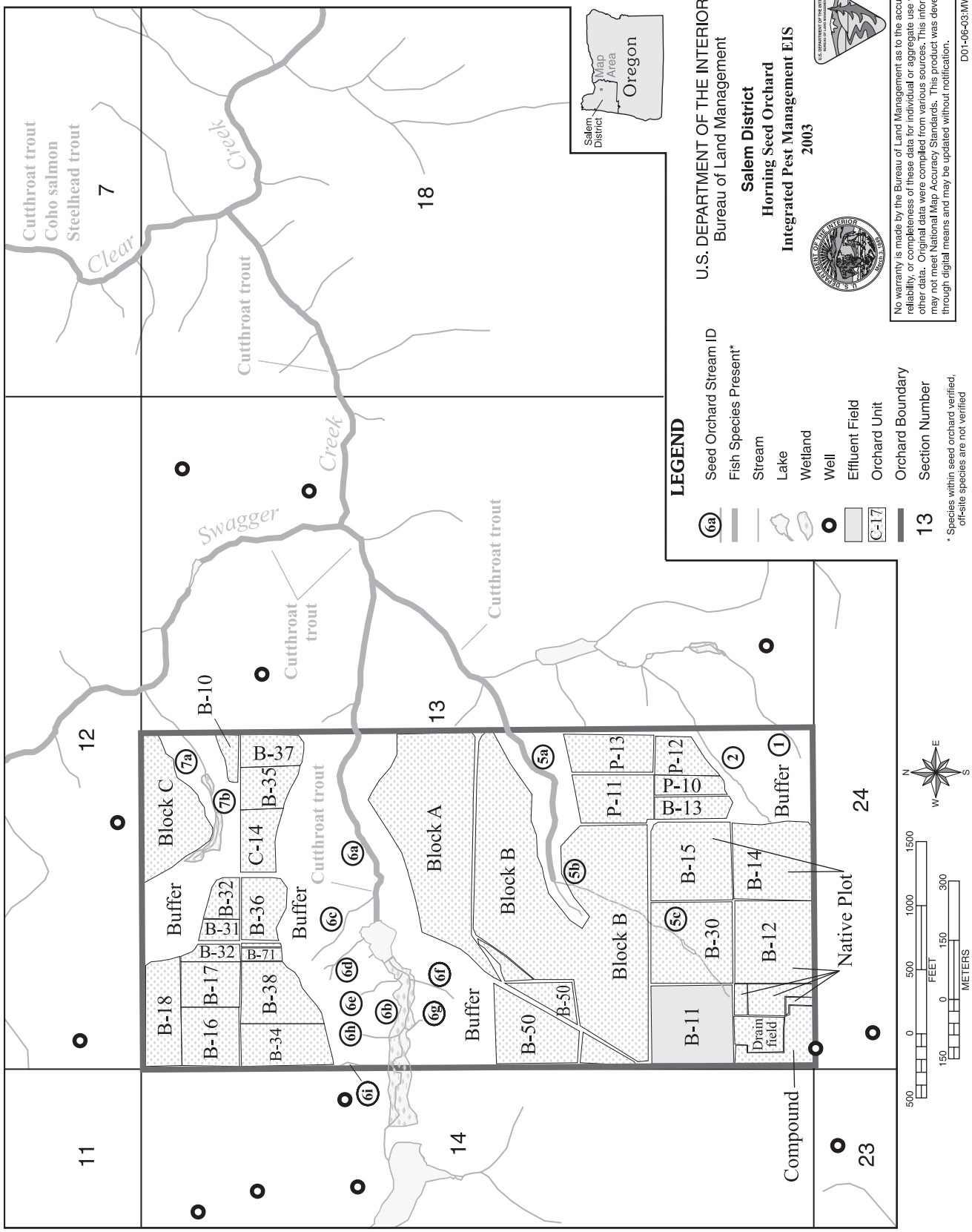


Figure 3.4-2: Water Resources at Horning- Section 23 of T4S. R3E

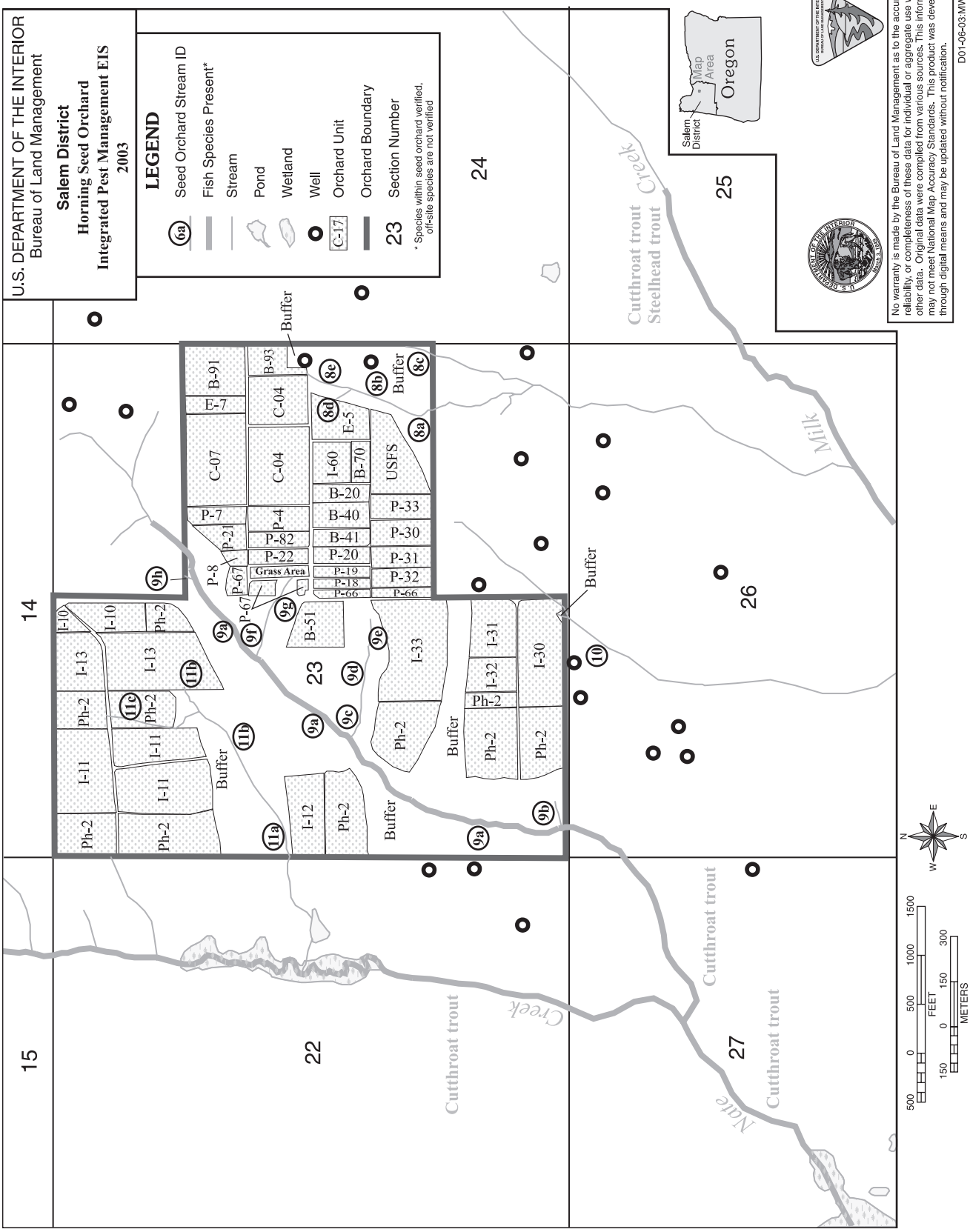


Table 3.4-2. Downstream Beneficial Uses

Water Body	Distance from Orchard	Downstream Beneficial Use[a]
Section 13		
Unnamed tributary to Swagger Creek	Perennial stream on orchard property	Resident fish rearing and spawning
Unnamed reservoir in Swagger Creek	2,500 feet	Livestock and recreation
Edna's reservoir, located in Swagger Creek	2,500 feet	Fish culture
Unnamed stream/reservoir tributary to Swagger Creek	Less than 0.5 mile	Irrigation
Clear Creek	1 mile	Winter steelhead and coho rearing and spawning[b]
Swagger Creek	1.5 miles	Irrigation/domestic
Clackamas River	27 miles	Municipal
Section 23		
Unnamed tributary to Nate Creek	Perennial stream on orchard property	Resident fish rearing and spawning
Unnamed tributary to Nate Creek	0.25 mile	Irrigation
Reservoir diversion from Nate Creek	3.5 miles	Fish culture
Milk Creek	5 miles	Winter steelhead rearing and spawning[b] (suspected)
Molalla River	25 miles	Municipal use

[a]BLM 2003, except where otherwise noted.
[b]ODFW 2002a, ODFW 2002b, Streamnet 2002

BLM has monitored the water quality of selected streams within the seed orchard since 2001. Chapter 4 includes a discussion of the ongoing monitoring program and results to date.

Section 305(b) of the Federal *Clean Water Act* requires each state to prepare a water quality assessment report every two years. The most recent assessment for Oregon was prepared in 2000 and includes stream assessment data, information on water quality trends, results of biological and habitat surveys, and the state's water quality protection efforts (ODEQ 2000). In addition, water quality data are routinely collected by the ODEQ laboratory from 159 monitoring sites on major rivers and streams throughout the state. Data collected from the Molalla and Clackamas sub-basins for the period 1986 to 1995 are summarized in the following paragraph (ODEQ undated).

The absence of major point sources and favorable hydrologic conditions enable the Molalla River, within the Middle Willamette Basin, to readily assimilate pollution. The Molalla River at Canby experiences elevated levels of total phosphates, nitrate and ammonia nitrogen, fecal coliform, and biochemical oxygen demand in the fall, winter, and spring. High temperature, high biochemical oxygen demand, and low dissolved oxygen concentrations are evident in the low flow summer months. This is the result of non-point source pollution in the low-lying agricultural areas along the lower half of the river. These impacts appear to have increased over time, as water quality significantly declined during the reporting period. On average, however, the water quality index scores are good throughout the year. Water quality in the Clackamas River is generally good

throughout the year. Much of the sub-basin drains the Western and High Cascades and is used for silvicultural and recreational purposes. The Clackamas River has three impoundments at and above the city of Estacada. Water quality is occasionally affected by moderately high levels of biochemical oxygen demand, which indicates the introduction of organic materials to the water. Moderately high concentrations of fecal coliform and total phosphates have been noted during high flow periods, indicating runoff from fields, ditches, and storm drains carrying organic material to streams and rivers in the sub-basin. High temperatures and dissolved oxygen supersaturation during summer low flow periods indicate occasionally increased levels of eutrophication. However, the frequency of these occasional and moderate impacts has decreased over time and water quality in the Clackamas River has significantly improved.

Section 303(d) of the *Clean Water Act* requires states to list impaired water bodies and determine allowable total maximum daily loads (TMDLs) that would provide for restoration of those impaired bodies. The list identifies those water bodies that do not meet all applicable water quality standards necessary to protect beneficial uses. The 1998 ODEQ 303(d) list includes the Molalla River at its confluence with Milk Creek as water quality limited due to bacteria and temperature (approximately 19 miles below the orchard boundary); the draft 2002 303(d) list includes flow modification with the qualifier that a TMDL was not needed (ODEQ 2002b). The Clackamas River and its confluence with Clear Creek (approximately 17 miles below the orchard boundary) are listed as water quality limited for temperature (1998) and bacteria (for the period June 1 to September 30, 2002) (ODEQ 2002b).

There are no outstanding resource waters, national or state-designated wild and scenic rivers, or public watershed areas in the vicinity of the seed orchard.

3.4.3 Floodplains

Horning is located between the Clackamas and Molalla Rivers in an area of undetermined but possible flood hazards (FEMA 2002). Given its location on a topographic divide, and considerable distance from these two major rivers, the probability of flooding at the orchard is very low.

3.4.4 Drinking Water

Groundwater is the primary source for drinking water in Oregon. It is also the primary source for public drinking water supplies in the seed orchard area. Groundwater may vary significantly in elevation and depth, depending on proximity to surface waters, topographic variations, and season.

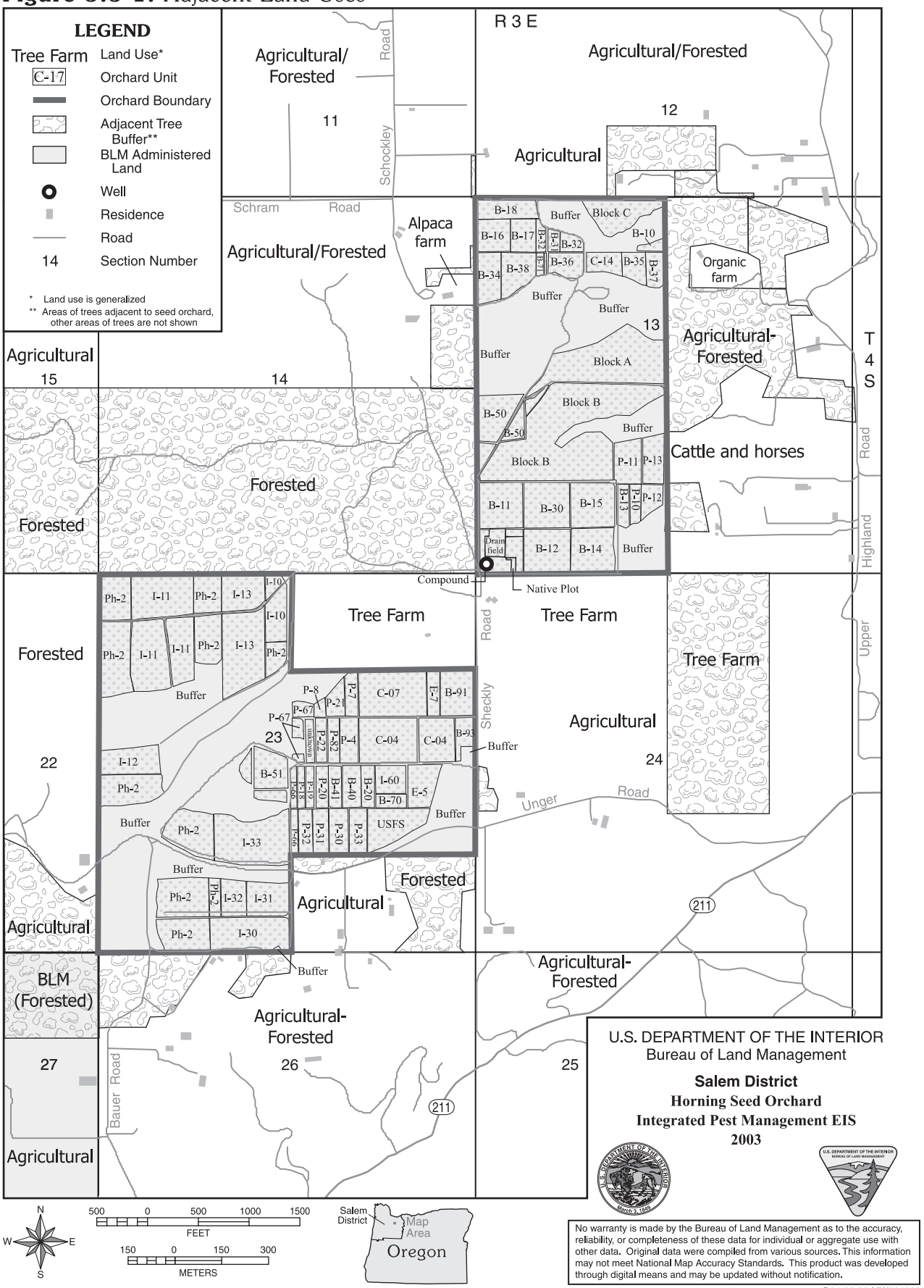
All municipal public drinking water in the vicinity of Horning is obtained from groundwater wells. One nearby resident obtains drinking water from a spring located south of Section 23. The water is diverted from the spring to the residence; however, streams on the orchard property do not contribute to the flow of this spring. There are no potable surface water intake structures in the orchard area. No municipal water intake structures occur on any surface water found in the downstream vicinity of the seed orchard (BLM 2003).

3.5 Land Use

Horning is located in Clackamas County within a rural, wooded area about 12 miles south of the Portland urban area. Neighboring land uses include small farms and acreages, timber operations, Christmas tree farms, livestock grazing, rural residences, and an organic farm. Adjacent land uses are illustrated in Figure 3.5-1. There are approximately 23 residences adjacent to or near the orchard boundary.

Clackamas County is nestled in the southeast corner of the Portland metropolitan area. The county extends from the agriculturally rich Willamette Valley in the west to the forested slopes of the Cascade Range in the east, and borders the Portland area's urban core to the north. The county is

Figure 3.5-1: Adjacent Land Uses



endowed with productive farmlands and forests and provides easy access to abundant recreational activities, including fishing, rafting, hiking, and skiing. Points of interest within the region include the End of the Oregon Trail Interpretive Center, Mt. Hood National Forest, and Mt. Hood herself – Oregon's tallest peak (11,235 feet), with one of the longest ski seasons in the U.S. About seven-eighths of the land area in the county is considered rural. Some of the richest farmland in Oregon is located around Canby, Sandy, Boring, Wilsonville, and Molalla, making agriculture one of the area's principal industries. Four major rivers flow through the region: the Willamette, Clackamas, Sandy, and Molalla (OED 2002, CCO 2002).

As part of the Portland-Vancouver Metropolitan Statistical Area (see Section 3.10), Clackamas County is substantially more densely settled than the U.S. average, with a population density of 181.1 persons per square mile (USBC 2002a). Nearly 80% of the county's population is considered urban, which is comparable to Oregon and the U.S. Most of its urban population is within the larger "urban areas" rather than smaller communities,[1] with less than 12 percent in the smaller "urban clusters."

Reflecting the county's diverse nature, nearly 10% of Clackamas County's rural residents (and 2% of total residents) reside on farms, a higher proportion than either Oregon or the U.S. (USBC 2002a). Table 3.5-1 presents urban and rural characteristics for Clackamas County, Oregon, and the U.S.

Most of the lands surrounding the orchard boundary are privately owned. Lands adjacent to both Sections 13 and 23 are generally forested or agricultural, and include horse farms, small acreages supporting livestock (cattle and alpacas) operations, tree farms, Christmas tree farms, small residential acreages, and a certified organic farm that grows herbs and mushrooms.

Horning encompasses 800 acres, of which 320 acres are in Section 13 and 480 acres are in Section 23. Figure 2.1-1 illustrates land use on the orchard property, and Table 3.5-2 shows orchard acreages by type of use.

3.6 Human Health

3.6.1 Public

Horning is located in a rural area with little nearby development and few close neighbors. Aerial photographs were examined to determine approximate distances to nearby residences (BLM 1999). Approximately 23 residences were identified adjacent to or near the seed orchard. Figure 3.5-1 illustrates the surrounding land uses.

Horning and its immediate surroundings lie within Clackamas County Census Tract 236 (Blocks 2022, 2037, 2038, 2039, and 2040) and Census Tract 241 (Blocks 1000, 1013, and 3025) (ESRI 2002).[2] Population data were assessed for these blocks to determine population numbers near the orchard and identify any sensitive sub-populations, such as young children or the elderly. Census Blocks 2037, 1000, and 1013 contain no residents. Table 3.6-1 shows relevant demographic characteristics for the remaining census blocks (in total), along with county, state, and U.S. figures for comparison. As the table shows, the median age for the area surrounding the orchard is higher than the comparison areas, while the percentages of young children (under age 5) and the elderly (above age 65) are lower. However, the proportion of older children (ages 5-14) and teens (ages 15-19) is higher than the comparison areas (USBC 2002a).

[1] The U.S. Bureau of the Census divides "densely settled territory" into urbanized areas and urbanized clusters. "Densely settled territory" is defined as a cluster of one or more block groups or census blocks, each with a population density of at least 1,000 people per square mile, or the surrounding block groups and census blocks, with a population density of at least 500 people per square mile. Urban areas contain 50,000 or more people, while urban clusters contain between 2,500 and 50,000 people (USBC 2002b).

[2] The USBC divides counties into census tracts, which are subdivided into block groups, which are further subdivided into census blocks. The relative geographic size of these units is determined by their population; the greater the population, the more subdivisions each unit will have, and hence the subdivisions will be relatively smaller. The USBC attempts to divide a county in such a manner that sub-units within a larger unit will have approximately similar populations; however, migration in and out of an area will affect this balance over time and can result in "empty" census blocks.

Table 3.5-1. Urban and Rural Characteristics, Clackamas County and Comparison Areas

	Clackamas County	Oregon	U.S.
Total Population	338,391	3,421,399	281,421,906
Population density[1]	181.1	35.6	79.6
Urban Population	266,559	2,692,680	222,358,309
as percent of total population	*78.8%*	*78.7%*	*79.0%*
Inside urbanized areas[2]	234,914	1,975,622	192,338,121
as percent of urban population	*88.1%*	*73.4%*	*86.5%*
Inside urban clusters[2]	31,645	717,058	30,020,188
as percent of urban population	*11.9%*	*26.6%*	*13.5%*
Rural Population	71,832	728,719	59,063,597
as percent of total population	*21.2%*	*21.3%*	*21.0%*
Farm population	6,990	64,128	2,987,531
as percent of rural population	*9.7%*	*8.8%*	*5.1%*
Nonfarm population	64,842	664,591	56,076,066
as percent of rural population	*90.3%*	*91.2%*	*94.9%*

Data source: USBC 2002a.
[1]Population density (persons per square mile) is calculated by dividing total population by total land area.
[2]USBC divides "densely settled territory" into urbanized areas and urbanized clusters. "Densely settled territory" is defined as a cluster of one or more block groups or census blocks, each with a population density of at least 1,000 people per square mile, or the surrounding block groups and census blocks, with a population density of at least 500 people per square mile. Urban areas contain 50,000 or more people, while urban clusters contain between 2,500 and 50,000 people (USBC 2002b).

Table 3.5-2. Horning Seed Orchard Land Use

Description	Acres
Planted Developed Orchard Acreage	
Douglas-fir seed production orchards (B Orchards)	42
Douglas-fir seed production orchards (I Orchards)	96
Multi-species seed production orchard	39
Breeding and preservation orchard	69
Native plant grow-out beds	40
Seedling seed production orchards (C orchards)	45
Subtotal	331
Other Acreage	
Developed but fallow (Phase II, second generation)	52
Non-usable buffer zones (mostly riparian areas; also includes certain areas unsuitable for cultivation due to slope or other factors)	392
Roads	15
Administrative site (buildings, grounds, and parking area)	10
Subtotal	469
Total	800

Table 3.6-1. Selected Demographic Characteristics

	Total for Adjacent Blocks[1]	Clackamas County	Oregon	U.S.
Total population	312	338,391	3,421,399	281,421,906
Total households	103	128,201	1,333,723	105,480,101
Median age[2]	41.5	37.5	36.3	35.3
Age distribution				
Under 5 years	3.8%	6.0%	6.5%	6.8%
5 To 14 years	15.1%	14.0%	13.9%	14.6%
15 To 19 years	8.7%	7.2%	7.1%	7.2%
20 To 44 years	26.6%	31.5%	35.9%	37.0%
45 To 64 years	36.5%	25.4%	23.7%	22.0%
Over 65 years	9.3%	16.0%	12.8%	12.4%

Data source: USBC 2002a.

[1]Census Tract 236 (Blocks 2022, 2037, 2038, 2039, and 2040) and Census Tract 241 (Block 1000, 1013, and 3025).

[2]Median age for the combined "Adjacent Blocks" is estimated using a weighted average technique.

The seed orchard is open to the public Monday through Friday from 7:30 to 4:00, except for Federal holidays. Visitors are required to check in and out at the office. The typical visitor is on an educational tour that has been arranged in advance by a local institution or group, such as the Portland Public Schools, Clackamas Community College, Mt. Hood Community College, Small Woodland Owners Association, Northwest Seed Orchard Managers Association, or Oregon State University. Tour groups typically vary in size from 2 to 30 people, although there were 115 elementary school children in a 2001 tour.

A commercial Christmas tree grower has a right-of-way agreement to use Horning's on-site roads to access one of its farms located on the north side of Horning, in the northwest corner of Section 13. Access is limited to late October through mid December during normal business hours.

The orchard provides training opportunities for minimum security inmates from the nearby Sheridan Federal Correctional Institute and for student interns. The inmates perform a variety of horticultural activities. The composition of inmate labor teams varies according to orchard labor needs at the time and inmate availability, and few inmates work regularly at the orchard for more than a few months at a time. In 2001, the inmates spent 284 hours at the seed orchard. Young people from a variety of youth-at-risk programs serve as interns at the orchard, and are scheduled to work from three or four days to several weeks per year.

Horning also participates in Experience International, a training program that allows students from outside the U.S. to work at the orchard and its greenhouse to learn horticultural practices and orchard management. An intern from Bulgaria is currently residing in the bunkhouse at Horning as part of this program.

Horning is investigating the establishment of a "host" volunteer agreement with an individual, perhaps employed by a local law enforcement agency, who would be allowed to live on the orchard property in return for providing security when the orchard is closed. Currently, no such individual resides on the orchard property.

Horning has an active public outreach program, which includes a display of native conifers, visits to local schools, and educational tours of the orchard featuring demonstrations on orchard, forestry, wildlife, and fisheries topics. About five times per year, local horseback riding and carriage clubs schedule events, generally on weekends between May and September. These events are authorized under special recreation permits and are restricted to gravel roads within the orchard acreage or trails on adjacent private property. Horning also allows collection of a variety of forest products, mainly firewood and boughs, by the general public each year. In a typical year, the seed orchard has approximately 40 permittees, who are restricted to collection during normal business hours.

3.6.2 Workers

Horning has eleven full-time employees who work 40 hours per week year-round; workers may follow flex-time schedules to complete 40 hours in less than five days within a given period. The orchard also has one permanent part-time employee, who works 32 hours per week year-round, and two seasonal employees, who work between nine and 12 months per year. A retired BLM employee volunteers 20 to 40 hours per week year-round, working mostly in the greenhouse. The length of orchard employment for Horning's current employees ranges from 10 to 27 years.

3.7 Biological Resources

The following sections describe the vegetation, terrestrial wildlife, and aquatic species found at and near Horning. In addition to the abundant or common species observed, several species present or potentially present at Horning have a special status under Federal or state laws or recommendations. These species include four birds, one reptile, and three fish, as listed in Table 3.7-1.

The Federal ESA applies to all actions on all lands, whether they are undertaken by Federal agencies, state agencies, commercial entities, or private individuals. Species of concern are designated by the Oregon state office of FWS. These species receive no legal protection. Many species of concern are former Category 2 species that were candidates for listing under the ESA until 1996. Category 2 candidate species were those species for which information indicated that a proposal to list the species as endangered or threatened was possibly appropriate, but sufficient data on biological vulnerability and threats were not available to support proposed rules.

The Oregon *Threatened and Endangered Species Act* applies only to actions of state agencies on state-owned or leased lands, and therefore its regulatory scope does not extend to the proposed activities at the seed orchard. However, these species are evaluated as special status species in this EIS. The Oregon Department of Fish and Wildlife (ODFW) also maintains a "watchlist" of species that might qualify for state listing in the future. These species may be designated as critical, vulnerable, peripheral or naturally rare, or of undetermined status.

BLM has three designations that may be applied to particular species. "Bureau Sensitive" species include species that could easily become endangered or extinct in a state; and are not listed, proposed, or candidate species under Federal laws, but are eligible. "Bureau Assessment" species are plant or animal species that are not presently eligible for official Federal or state status but are of concern. "Bureau Tracking" species act as an early warning for species which may become of concern in the future; BLM districts are encouraged to collect information on these species, but they are not considered special status species for management purposes. The State of Oregon has state-listed species, and these are on the BLM special status species list, as "State Listed."

Special status species are described within the appropriate sub-section below.

3.7.1 Vegetation

Orchard Areas

Horning is a plantation for the seed production of Douglas-fir, western hemlock, western red cedar, western white pine, and sugar pine. Managed stands of these species are scattered in small even-aged patches throughout the seed orchard. These areas were cleared or tilled of native vegetation and replanted with the desired species. The understory in these areas is dominated by grasses with some areas of forbs. Little woody debris is present on the forest floor. Giant sequoia have also been planted along the orchard perimeters or fence lines as wind and pollen barriers.

Riparian Areas

Riparian buffers at Horning contain scattered stands of mid-age conifer stands that were salvage-logged in the past. As a result of prior management, these areas lack old-growth trees and large snags; however, they contain higher diversity than the orchard areas. The canopy of these stands is dominated by Douglas-fir and western red cedar, with an understory of western hemlock, red alder, bigleaf maple, California hazel, cascara, vine maple black cottonwood, and Pacific dogwood. Common shrubs in the understory include salal, thimbleberry, and red huckleberry.

At a few locations adjacent to the riparian areas or within mid-age conifer stands, there are patches of pure hardwood trees.

Table 3.7-1. Special Status Species At or Near Horning

Species	Federal Status	State Status
Steelhead trout (*Oncorhynchus mykiss*)	Threatened	Sensitive-vulnerable
Oregon vesper sparrow (*Poocetes gramineus affinis*)	Species of concern (FWS) Sensitive (BLM)	Sensitive-critical
Streaked horned lark (*Eremphila alpestris strigata*)	Species of concern (FWS) Sensitive (BLM)	Sensitive-critical
Pacific lamprey (*Lampetra tridentata*)	Species of concern (FWS)	Sensitive-vulnerable
Western pond turtle (*Clemmys marmorata*)	Species of concern (FWS) (Northwestern subspecies only) Sensitive (BLM)	Sensitive-critical
Common nighthawk (*Chordeiles minor*)	Sensitive (BLM)	Sensitive-critical
Western meadowlark (*Sturnella neglecta*)	Sensitive (BLM)	Sensitive-critical
Cutthroat trout (*Oncorhynchus clarki clarki*)	Sensitive (BLM)	Sensitive-vulnerable

Shrublands

Shrublands occur at two locations within the orchard where areas were logged for plantations, but were never cleared. These areas were allowed to grow into dense patches of hazel, cascara, red alder, blackberry, and Scotch broom, with a few scattered Douglas-fir.

Upland Meadows

The upland meadows at Horning are all man-made, created by clearing the native forest and allowing these areas to be invaded by grass. A few Douglas-fir are found in some of the meadows. Mowing is used occasionally to reduce ground cover. These areas are generally transitional, with replanting to consist of trees as more seed orchard is needed.

Wetlands

Small wetland areas are found at the head of some of the small streams that run through the seed orchard and around the small pond at the site. Various species of sedges, rushes, and pondweeds are found at these areas.

Noxious Weeds

Several noxious weed species have been documented at Horning, including Himalayan blackberry, evergreen blackberry, butter and eggs, bull thistle, Klamath weed, Canada thistle, tansy ragwort, and Scotch broom.

Special Status Plants

No special status plant species are known to occur at Horning.

3.7.2 Terrestrial Species

The wildlife on the seed orchard grounds consist mainly of animal species that are adapted to early-successional vegetation environments and are tolerant of disturbance. Eight habitat types can be found within the 800-acre seed orchard. These range from highly managed upland meadows to mid-age conifer stands. Most of the land has been disturbed in some fashion in the past. Approximately 300 acres (40% of the orchard) is covered with stands of young (1 to 30-year-old) conifers that are evenly spaced with no shrubs or woody debris. These areas have each at some time been completely tilled, and the groundcover now consists of managed grasses and some forbs. Another 160 acres (20% of the orchard) is covered with upland meadows that are periodically mowed. These two highly managed habitat types serve as early successional environments for wildlife.

Even though more than half of the site is highly managed, small areas of diverse habitat such as ponds (one acre) and wetlands (three acres) provide environmental conditions important to many species of wildlife. Six narrow bands of riparian corridor (20 acres) and patches of hardwood (five acres) support the majority of the wildlife present. Mid-age conifer stands (180 acres) are scattered directly next to the riparian habitat and add to the riparian diversity. About 60 acres are covered in thick shrub patches. These patches were once cleared for plantations, but were never used and grew thick with tall shrub species and an occasional tree.

The plantations within the orchard are enclosed by a perimeter fence. This perimeter partially or completely excludes many wildlife species that occur in the surrounding habitats. Particularly, large mammals such as deer, elk, black bears, and mountain lions are excluded by the fence. However, other species have been encouraged to use the orchard grounds with nesting or roosting box installations. These flying species include bats, swallows, bluebirds, and wrens.

Deer occupy the limited unfenced areas on the site. These include riparian habitats that are used for thermal cover, and shrub patches which provide high quality cover and foraging areas. Medium-sized animals such as coyotes, rabbits, and raccoons prefer to utilize these dense habitats rather than the more open areas such as the meadows or the young conifer stands. These denser riparian areas are usually located next to wetland habitats, streams, and ponds, which the larger mammals use as water sources. The wetland areas are inhabited by beavers that forage and collect building materials in the surrounding shrub and riparian areas. These mammals have altered the stream channels and have formed several ponds along the streams.

Denser riparian and wetland areas provide habitat for an assortment of small mammals. But unlike the larger mammals that remain in or close to the denser shrubby areas, small mammals are found all over the site, including the open upland meadows and young conifer stands. The short ground cover in the young conifer stands provides habitat for gophers, voles, and moles, which are also common in the surrounding areas. Small mammals forage in the low ground cover of the meadows.

Aside from mammals, other small species inhabit the denser and moister areas of the seed orchard. Amphibians are present in the moist environment of the wetland areas. Frogs and salamanders breed in the ponds and wetland areas. Frogs inhabit the riparian habitats. Reptiles also occur on the orchard grounds. Garter snakes can be found in the stands of young conifers.

The most visible inhabitants of the orchard are birds. A large variety of bird species nest, breed, and forage at Horning. Canada geese, and water birds such as mallard ducks, use the wetland areas and ponds for breeding, nesting, and foraging. Some ground-nesting species utilize the short ground-cover of the meadows and plantations in the spring and summer. The woody and riparian habitats provide nest areas for a variety of birds, including raptors. These raptors forage for prey in the surrounding grasslands and more open young conifer stands. Raptors on the orchard grounds include red-tailed hawks, great-horned owls, and kestrels. A large number of song birds and neotropical bird migrants inhabit the riparian and woody habitats during nesting season or year-round. Some of the species that prefer the riparian areas include grosbeaks, song sparrows, cedar waxwings, and spotted towhees. Pileated woodpeckers, flycatchers, kinglets, brown creepers, and varied thrushes can often be found nesting in the woody areas of the mid-age conifer stands, while hummingbirds and some song birds prefer to nest in the dense cover of the shrub patches.

Special Status Terrestrial Wildlife Species

The Oregon vesper sparrow (*Poocetes gramineus affinis*) is a FWS species of concern and a BLM sensitive species. This sparrow was formerly common throughout the Willamette Valley, but has largely disappeared from much of its northwest Oregon range. Recent studies indicate that Christmas tree farms, especially those in which weeds and grass are not as frequently controlled, provide usable habitat structure and food for this species. Small trees or low shrubs for singing perches; some percentage of area in bare ground, grass, and other weed seeds; and insects are all important habitat components for this species. Parts of Horning would provide suitable breeding habitat for vesper sparrows.

The streaked horned lark (*Eremphila alpestris strigata*) is a FWS species of concern and a BLM sensitive species. This subspecies inhabits open fields, particularly with bare ground or sparse vegetation, and nests and forages on the ground. It could use newly created plantations at Horning that have been tilled or mowed, and the adjacent edge habitat in older plantations. It may occur in meadow areas, particularly those that have been grazed or mowed. It is very rare in the Willamette Valley.

The western pond turtle (*Clemmys marmorata*) is an Oregon state-listed sensitive species and BLM sensitive species. Although it is unknown if they occur at Horning, the water temperature in the stream above the reservoir was 63 °F when measured during the early spring of 1999, which is warm enough to support turtles. They prefer habitat to be a combination of quiet and fairly

clear water, with emergent rocks or logs that serve as basking areas, some aquatic vegetation, and nearby sunlit ground. Lack of basking areas, emergent vegetation, and siltation are limiting factors that may preclude them from using Horning's aquatic and riparian habitats. The subspecies northwestern pond turtle (*Clemmys marmorata marmorata*) is also a Federal species of concern.

The common nighthawk (*Chordeiles minor*), a BLM sensitive species and state-listed sensitive species, is becoming increasingly rare in the Willamette Valley. Nighthawks feed over a wide range of habitat types, particularly wet areas which produce a large insect population. They are ground nesters in open areas, occasionally on little used roads, clearcuts, and landings. However, since most of the roads and open areas at Horning are subject to high levels of human disturbance, nesting at the seed orchard is unlikely.

The western meadowlark (*Sturnella neglecta*) is a BLM sensitive species that inhabits open grasslands, pastureland, and open woodlands. It perches on short trees, shrubs, and fence posts, and is a ground nester in medium to high grass. Meadowlarks are becoming increasingly rare in the Willamette Valley during the nesting season, but can be seen in open pasture grassland in large flocks in the winter.

3.7.3 Aquatic Species

Horning serves as the headwater area for a number of small streams within its boundaries. Figures 3.4-1 and 3.4-2 show maps of stream locations and fish distribution within and in the vicinity of Horning.

Streams in the Section 13 portion of Horning flow into Swagger Creek, a tributary to Clear Creek, which flows into the Clackamas River. Fish species which may be present in the Clear Creek drainage include winter steelhead, coho salmon, chinook salmon, cutthroat trout, reticulate sculpin, largemouth bass, western brook lamprey, and Pacific lamprey. Largemouth bass have been observed in the irrigation pond and in Stream 6a above the irrigation pond, but do not constitute a major fishery; it is suspected that they came from an upstream millpond on private land.

Streams in the Section 23 portion of Horning flow into Nate Creek, a tributary to Milk Creek, which flows into the Molalla River. This section of the seed orchard is bisected by the headwater segment (Stream 9a) of Nate Creek. Fish species that may be present in the Milk Creek drainage include fall chinook salmon, coho salmon, winter steelhead, cutthroat trout, sculpins, and western brook lamprey. In 1983, coho salmon were observed in Nate Creek about two miles downstream of Horning (ODFW 2002a). Hatchery releases of coho salmon into the upper Willamette River basin were discontinued in 1988, and viable coho runs are not thought to still occur. It is not known if the coho salmon observed in 1983 were spawned naturally or if they were released from a hatchery.

There is no habitat for any anadromous fish on the seed orchard. Resident cutthroat trout is the only salmonid species that occurs on the orchard property. Cutthroat trout are found in Nate Creek tributary Stream 9a and in Swagger Creek tributaries Streams 5a and 6a. A survey of Stream 9a, conducted in June 1999, found cutthroat trout and sculpin in the perennial reaches of the stream within the seed orchard. Cutthroat trout have also been collected below a barrier dam at the orchard's irrigation pond on Stream 6a within Section 13 (see Figure 3.4-1). No cutthroat were collected upstream of the dam, but it is likely that they are found in the irrigation pond and further upstream. Cutthroat are also found in the perennial portions of Stream 5a.

Crayfish were collected in the perennial reaches of Streams 6b (Section 13) and 9a (Section 23) within the seed orchard boundaries. The intermittent streams at the orchard do not support fish.

Special Status Aquatic Species

Steelhead Trout

Certain distinctive groups, termed evolutionarily significant units (ESUs), of anadromous rainbow trout (*Oncorhynchus mykiss*) are listed as threatened under the ESA. Steelhead are the anadromous members of this species, meaning that they migrate from the ocean to spawn in fresh water. Members of this species may also have a life cycle completely in fresh water; these fish are commonly called rainbow or redband trout, and are not included under the ESA listing. Steelhead eggs incubate in gravel nests in freshwater rivers, and then hatch as the larval stage called alevins, who depend on food stored in a yolk sac. After the yolk sac is absorbed, juvenile steelhead emerge from the gravel nest as fry and live in fresh water for one to two years, after which they migrate to the ocean as smolts. Typically, they will spend two to three years in the ocean before returning to spawn in the river where they were hatched. Unlike other Pacific salmon, steelhead may spawn more than once before they die.

The Lower Columbia ESU includes all naturally spawned populations of steelhead in streams and tributaries to the Columbia River between the Willamette and Hood Rivers in Oregon, and the Cowlitz and Wind Rivers in Washington; this ESU was listed as threatened under the ESA on March 19, 1998 (63 FR 13347). The Upper Willamette River ESU—which includes all naturally spawned winter-run populations of steelhead in the Willamette River and its tributaries, from Willamette Falls to the Calapooia River—were listed as threatened under the ESA on March 25, 1999 (64 FR 14517).

Upper Willamette steelhead trout are native to Milk Creek and are present approximately five miles downstream from Horning at the confluence with Nate Creek (ODFW 2002a). There is a 1983 record of coho salmon in Nate Creek; however, there are no records indicating that steelhead utilize this stream. Although steelhead are found in Milk Creek to the southeast of the orchard, there are no surface flowing tributaries that connect the orchard to this part of Milk Creek. In addition, steelhead from the Lower Columbia River ESU are present in Clear Creek in the vicinity of its confluence with Swagger Creek, approximately one mile downstream from Horning (ODFW 2002b). Upstream migration of steelhead in Clear Creek is blocked by barrier falls on both forks just above the confluence of Clear Creek and the north fork of Clear Creek, approximately two miles above the Swagger Creek confluence. It is not known if steelhead use Swagger Creek, but the very lower portion of Swagger Creek appears to be accessible; Swagger Creek is not identified as steelhead habitat by ODFW. There appears to be a topographic barrier to upstream fish movement on Swagger Creek about 0.5 miles above the confluence with Clear Creek, on private land. Based on a USGS topographic map, the elevation change is approximately 300 feet within less than 1/4 mile.

Chinook salmon

Populations of Lower Columbia and Upper Willamette chinook salmon (*Oncorhyncus tshawytscha*), a Federally listed threatened species, are found 12 miles downstream from the seed orchard in Clear Creek and 15 miles downstream in Milk Creek, respectively. These fish utilize the lower portions of Clear Creek and Milk Creek for spawning and rearing purposes, but do not use the upper portions of the watersheds.

Other Special Status Aquatic Species

The Pacific lamprey (*Lampetra tridentata*) may be present in the Clear Creek drainage. This fish is a FWS species of concern and a state-listed sensitive species.

Anadromous (sea-run) cutthroat trout (*Oncorhynchus clarki clarki*) in Clear Creek, approximately one mile downstream from the orchard, are a BLM sensitive species and state-listed sensitive species. These fish are part of the Southwestern Washington/Lower Columbia River distinct

population segment. (The FWS use of the term "distinct population segment" is equivalent to the NOAA Fisheries term ESU.)

Naturally spawned populations of Lower Columbia River/SW Washington ESU coho salmon (*Oncorhynchus kisutch*), a Federal candidate species and state-listed endangered species, are found approximately one mile downstream from the orchard in Clear Creek. Very little information is available for coho salmon in Clear Creek. The primary production area for this ESU occurs in the Clackamas River above North Fork Reservoir.

Resident cutthroat trout found on the orchard property, and coho salmon found in the Milk Creek drainage, are not considered to be FWS or state species of concern or BLM-sensitive.

Essential Fish Habitat

Pacific salmon habitat that is found in Clear Creek, Nate Creek, and Milk Creek has been identified as freshwater EFH for chinook and coho salmon (Pacific Fishery Management Council 1999). Coho salmon habitat is located approximately one mile downstream of the orchard in Clear Creek, and two miles downstream in Nate Creek. Chinook salmon habitat is found 12 miles downstream from the orchard in Clear Creek and 15 miles downstream in Milk Creek. The upstream extent of EFH in these streams is based primarily on the known or historic distribution of coho salmon. NOAA Fisheries is charged to designate and protect EFH in accordance with the provisions of the *Magnuson-Stevens Fishery Conservation and Management Act*, as amended by the *Sustainable Fisheries Act* of 1996.

3.8 Noise

Noise is defined as any unwanted sound that interferes with normal activities or in some way reduces the quality of the environment. Ambient noise levels vary greatly in magnitude and character from one location to another, depending on the normal activities conducted in the area. In general, noise levels around Horning result primarily from traffic and agricultural and timber operations.

3.8.1 Noise Descriptors

Community response to noise is not based on a single event, but on a series of events over the day. Factors that have been found to affect the subjective assessment of the daily noise environment include the noise levels of individual events, the number of events per day, and the time of day at which the events occur. Most environmental descriptors of noise are based on these three factors, although they may differ considerably in the manner in which the factors are taken into account. Two types of noise measures are used to describe impacts on an existing environment. These include the decibel and the equivalent sound level. These measures and their application to noise environments are discussed below.

A decibel (dB) is the physical unit commonly used to describe sound levels. Sound measurement is further refined by using an "A-weighted" decibel (dBA) scale that emphasizes the audio frequency response curve audible to the human ear. Thus, the dBA measurement more closely describes how a person perceives sound. For example, typical noise levels include a quiet urban nighttime (40 dBA), an air conditioner operating 100 feet away (55 dBA), and a heavy truck moving 50 feet away (85 dBA). Table 3.8-1 shows noise levels for various human activities.

Typical noise at the orchard generated by trucks, tractors, mowers, and other power equipment is described over an eight-hour time period, using the equivalent sound level (L_{eq}). L_{eq} is calculated using the dBA levels of noise events averaged over time, taking into account the usage factor (the proportion of time that a maximum level of noise is generated) of various types of equipment. Table 3.8-2 provides approximate sound levels for a typical mix of orchard equipment, estimated with L_{eq}.

Table 3.8-1. Typical Decibel Levels Encountered in the Environment

Sound Level (dBA)	Source of Noise	Subjective Impression
10	--	threshold of hearing
20	rustling leaves	
30	quiet bedroom	
35	soft whisper at 5 ft; typical library	
40	quiet urban setting (nighttime); normal level in home	threshold of quiet
50	light traffic at 100 ft; quiet urban setting (daytime)	
55	--	desirable limit for outdoor residential area use
65	automobile at 100 ft	acceptable level for residential land use
70	pickup truck at 50 ft; Freight train at 100 ft	threshold of moderately loud
80	tractor at 50 ft; power saw at 50 ft	most residents annoyed
85	heavy truck at 50 ft; helicopter flyover at 30 ft altitude at 600 feet distance	threshold of hearing damage for prolonged exposure
95	freight train at 50 ft; large lawn mower	
100	heavy diesel equipment at 25 ft; chainsaw	threshold of very loud
120	jet plane taking off at 200 ft	threshold of pain
135	civil defense siren at 100 ft	threshold of extremely loud

Sources: 14 CFR 36.805, Cavanaugh 1998, Suter 1991, U.S. Army 1976, EPA 1974

Table 3.8-2. Approximate Sound Levels (dBA) of Orchard Equipment

Equipment	Averaging Time	Sound Levels (dBA) at Various Distances (ft)[a]					
		50	100	200	400	800	1,600
Chain saw	8 hours	101	95	89	83	77	71
Mower	8 hours	90	84	78	72	66	60
Tractor	8 hours	79	73	67	61	55	49
Power saw	8 hours	73	67	61	55	49	43
Pickup truck	8 hours	66	60	54	48	42	36
Composite	8 hours	75	69	63	57	51	45
Composite	24 hours	78	72	66	60	54	48

[a]Noise attenuation of 6 dBA for each doubling of distance assumes flat terrain with no trees or buildings. Trees and buildings would increase the attenuation, reducing noise levels at various distances. Assumes a background noise level of 45 dBA for a typical rural (farm) area (Cavanaugh 1998)

Sources: U.S. Army 1976, Cavanaugh 1998, Cunniff 1977.

Helicopter sound levels have been estimated for a helicopter 30 feet off the ground, with an averaging time of eight hours; the estimated noise levels are 85, 79, 73, and 67 dBA at 600, 1,200, 2,400, and 4,800 feet, respectively (U.S. Army 1976, Cavanaugh 1998, Cunniff 1977). This estimate also assumes a background noise level of 45 dBA for a typical rural area (Cavanaugh 1998).

Noise generated near the ground generally attenuates 6 dB for each doubling of distance from a noise source; trees and terrain can further increase attenuation. Noise generated above ground level (above 50 ft) generally attenuates about 2 dB for every doubling of distance. Attenuation of outdoor noise sources is complex, influenced by atmospheric conditions (wind speed and direction, relative humidity, and cloud cover), topography (flat terrain versus hills and mountains), tree cover, and other barriers such as buildings.

3.8.2 Existing Noise Environment

Horning is located in an area of small farms and acreages, timber operations, and forested areas about 12 miles south of the Portland urban area. Typical ambient noise levels for the mix of land use would average around 45 dBA.

About 23 residences are within ¼ mile of the orchard. There are buffers of trees between the orchard and about half of these residences.

Noise at Horning is generated by trucks, tractors, and power equipment used for daily operations. Typically, a mix of equipment would intermittently generate around 75 dBA at a distance of 50 feet, averaged over an eight-hour period. Not including the effects of terrain and trees, these estimated noise levels would be expected to attenuate to 69 dBA at 100 feet and to 45 dBA at 1,600 feet (see Table 3.8-2).

Neighboring timber companies and Christmas tree farms use helicopters for pesticide applications (BLM 2002). Several small airports and landing strips are also located in the vicinity of Horning, with the closest one about five miles north of the seed orchard. Various types of helicopters and fixed-wing aircraft contribute intermittent noise to the noise environment in the vicinity of the seed orchard.

3.9 Cultural Resources

While no prehistoric archeological materials have been found in the seed orchard itself, reports of prehistoric artifacts on private lands in the surrounding two miles indicate that the area around the seed orchard was used by native people prior to Euro-American settlement. Artifacts reported from these private lands include stone flakes, scrapers, and one grinding stone. At least three and possibly four sites may be within the vicinity, with one possible site less than one-half mile away.

During the period of Euro-American settlement, Kalapuyan and Molalla Indians inhabited this area. The Kalapuya focused much of their subsistence activities on the Willamette Valley, the Cascade and Coast Range foothills, and the lower reaches of Willamette River tributaries. The Molalla Indians inhabited the Cascade Mountains, usually at higher elevations than the Kalapuya, with winter camps in the area of the seed orchard, along the lower reaches of the Molalla River. The Kalapuya were known to have practiced burning as a means of manipulating vegetation for plant production and hunting purposes. Whether the lands at Horning were purposefully or periodically burned is unknown.

Euro-American settlement in the lands around Horning was well underway by the 1850s, but no land claims were made within the present boundaries of the seed orchard. Logging and lumbering became important in this area in the early part of the twentieth century. Starting in 1920, large portions of the seed orchard were logged by the Molalla Lumber Company (later the Clackamas

Eastern Railway). Molalla Lumber built railroad logging lines and spurs over much of this area. A.F. Lowes Lumber Co. and John Buche continued logging efforts through 1956.

Railroad rights-of-way were granted to Molalla Lumber in 1930 to cross portions of what is now the seed orchard. However, lumber companies were operating in the area long before the railroad was built. The Clackamas Fir Lumber Company built a large sawmill in Section 15 around 1920, and by 1928, the Molalla Lumber Co. was running a sawmill in adjacent Section 14. Clackamas Eastern Railway grades cross Horning and are visible in some locations. (In Section 23, a locomotive headlight was reportedly found many years ago near a creek; rumor has it that a train derailed on the south side of the creek in this area.) Logging continued as an important part of the local economy and as a land use in the area until very recent times, if not today.

Numerous small sales for firewood, posts and poles, cull logs, saplings, and cedar posts took place in the area, concentrated particularly in the early1940s, although continuing into the 1950s. Grazing leases were in effect over much of what would become Horning, starting in 1946 and continuing through 1956.

Three systematic cultural resource inventories have been conducted on various portions of the seed orchard. Inventories C795 (in 1977), C8113 (in 1981), and C859 (in 1983) did not locate any significant historic or prehistoric sites or materials. The surveyor did note the visible presence of the Clackamas Eastern Railway grade. These railroad remnants are isolated from other extant portions of the railroad system. As such, these segments do not retain their integrity and are not eligible for the National Register of Historic Places (NRHP). While evocative of an earlier era of land use, these railroad grade segments do not contribute additional knowledge to understanding the past.

3.10 Socioeconomics And Environmental Justice

Socioeconomic resources are described in this section using employment, income, and demographic measures. Economic and demographic elements are key factors influencing changes in demand for goods and services within a local economy. Because there are no personnel changes associated with the proposed action or alternatives, the local housing market, schools, community services, and infrastructure will not be discussed in this document.

Horning is located northeast of the city of Salem, Oregon, near the rural unincorporated community of Colton. The nearest small town is Estacada. The orchard is in Clackamas County, the region of influence (ROI) for this analysis. Clackamas County is also part of the Portland-Vancouver, OR-WA Primary Metropolitan Statistical Area (MSA)[3].

3.10.1 Community and Population

Clackamas County is a large county in area, containing over a dozen municipalities ranging in population from a few hundred to 30,000, as well as the mostly suburban and rural areas surrounding those towns. Approximately 52% of the county's population of 338,391 resides in these towns, with the remaining 48% in unincorporated areas (OED 2002). The area immediately adjacent to the seed orchard is rural in character, as discussed in Section 3.5.

Clackamas County is the third-most populous county in Oregon, representing 10% of Oregon's population of 3,429,399. The county's population increased by 21% during the 1990s. Population growth was somewhat slower during the 1980s, with an increase of 16% (USBC 2002a, USBC 2002c, OED 2002).

[3]An MSA is a region having a high degree of economic interdependence, with geographically integrated labor, retail, and housing markets. Such regions generally consist of a central city or several cities and the surrounding communities or counties.

The state population grew by 21% between 1990 and 2000, but had increased by only 8% during the 1980s. The population of Molalla in 2000 was 5,647 (USBC 2002a).

3.10.2 Economic and Income Characteristics

Clackamas County had a labor force of 188,280 in 2000, a 43% increase over 1990 employment, which in turn had increased by less than 5% between 1980 and 1990. The county's employment represents about 9% of the state's total. As of 2000, Clackamas County had a diversified economy, with nearly one-third of employment in the services sector, about one-fourth in wholesale and retail trade, and 10% in manufacturing. The financial, insurance, and real estate sector and construction were the other major non-governmental employment sectors, accounting for 10% and 7% of jobs, respectively. Government provided 9% of all county jobs, with local government accounting for about three-fourths of the government jobs. Federal civilian employment constitutes nearly 12% of government jobs and 1% of all jobs in Clackamas County. Farm employment and the agricultural, forestry, and fisheries sector together provide 6.1% of the county's employment, nearly double the proportion of employment for the U.S. as a whole (BEA 2002).

In 2000, the unemployment rate in Clackamas County was only 3.2%, compared to 7.5% for the MSA as a whole, 4.8% for Oregon, and 4.0% for the U.S. The July 2001 unemployment rate was 6.1% for the Portland MSA, 6.2% for Oregon, and 4.7% for the U.S. (OED 2002, OLMIS 2002).

Total personal income (TPI) for 2000 in Clackamas County was $11 billion. Per capita income (PCI), which is calculated by dividing an area's TPI by its total population, is used to compare income across regions. The 2000 PCI in Clackamas County was $34,525, which was 117% of the U.S. PCI of $29,469, and 125% of Oregon's PCI of $27,660 (BEA 2002).

Horning has an annual budget of between $679,000 and $855,000, approximately two-thirds of which is spent for payroll for its 11 full-time, one part-time, and two seasonal employees. At least six volunteer workers also contribute to the orchard's production efforts. The estimated annual value of plant materials products and related services exceeds $1,640,000. Cooperative agreements to provide seed to other agencies and private sector consumers are expected to yield at least $20,000 in fiscal year 2003, with increases anticipated in future years. Grants for native plant material production totaled more than $81,000 in fiscal year (FY) 2002 and $89,000 in FY2003. In addition, BLM and other agencies contribute funding specifically for the production of a variety of small, very specialized lots of native plant materials. Approximately $35,000 is spent annually for various types of pest control.

3.10.3 Environmental Justice

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was signed by the President on February 19, 1994. Environmental Justice has been defined by the EPA's Office of Environmental Justice as follows (EPA 1998):

> The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies.

The environmental justice EO requires that each Federal agency identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. Environmental justice

also takes into consideration EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, which was signed by the President on April 21, 1997. This EO requires that each Federal agency identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on children, who are more at risk because of developing body systems, comparatively higher consumption-to-weight ratios, behaviors that may expose them to more risks and hazards than adults, and less ability than adults to protect themselves from harm.

The environmental justice ROI, Clackamas County, is the same as for socioeconomic resources. To evaluate these potential effects, this section describes the minority and low-income characteristics of the ROI, based on data from the 2000 Census of Population and Housing. Demographic data regarding children are presented in Table 3.6-1.

The terms "low-income" and "minority" are defined according to guidance published by CEQ in 1997 and adopted by EPA. Under this guidance, "low-income" is defined as persons below the poverty level. The poverty threshold, which is a function of family size and is adjusted over time to account for inflation, was designated by the Federal government as $17,524 for a family of one adult and three children in 2000. "Minority" means persons designated in census data as Black (African-American), not of Hispanic origin; American Indian, Eskimo, or Aleut (Native American); Asian or Pacific Islander; or of Hispanic origin (CEQ 1997). According to the USBC definition, the Hispanic origin designation is separate from the ethnic (racial) designation, as people who identify their origin as Spanish, Hispanic, or Latino may be of any race (USBC 2001). Minority populations should be identified for environmental justice consideration where the minority population of the affected area exceeds 50% of the total population or is "meaningfully greater" than the minority population percentage in the general population of the assessment area (CEQ 1997). Table 3.10-1 presents ethnic data for census blocks containing and adjacent to Horning, Clackamas County, and comparison areas.

Table 3.10-1. Ethnic Characteristics of Adjacent Census Blocks and Comparison Areas

Characteristic	Adjacent Census Blocks[1]		Clackamas County		Oregon		U.S.	
	Number	%	Number	%	Number	%	Number	%
Total population	312	100	338,391	100	3,421,399	100	281,421,906	100
One race[2]	310	99.4	330,061	97.5	3,316,654	96.9	274,595,678	97.6
White	306	98.1	308,852	91.3	2,961,623	86.6	211,460,626	75.1
Black	0	0.0	2,233	0.7	55,662	1.6	34,658,190	12.3
Native American	1	0.3	2,416	0.7	45,211	1.3	2,475,956	0.9
Asian[3]	3	1.0	8,292	2.5	101,350	3.0	10,242,998	3.6
Native Hawaiian/PI[3]	0	0.0	569	0.2	7,976	0.2	398,835	0.1
Other[4]	0	0.0	7,699	2.3	144,832	4.2	15,359,073	5.5
Two or more races[4]	2	0.6	8,330	2.5	104,745	3.1	6,826,228	2.4
Hispanic	0	0.0	16,744	4.9	275,314	8.0	35,305,818	12.5

Source: USBC 2002a.
[1]Census Tract 236 (Blocks 2022, 2037, 2038, 2039, and 2040) and Census Tract 241 (Block 1000, 1013, and 3025).
[2]"Black" = Black or African American; "Native American" = Native American or Alaska Native; "Native Hawaiian/PI" = Native Hawaiian/Other Pacific Islander; "Other" = Some other race.
[3]The 2000 Census separated the Asian and Native Hawaiian/Other Pacific Islander categories; they were previously combined under one category and are addressed as such in the CEQ and EPA Guidance.
[4]The 1997 CEQ Guidance did not address the new census categories "other" and "two or more races" for this analysis; those categories are also considered as minorities.

According to the 2000 census, the area surrounding Horning is overwhelmingly white and non-Hispanic, with only 6 persons (less than 2%) in non-white ethnic categories. There were no Hispanics counted within the adjacent population.

The 2000 census found that only 6.6% of Clackamas County's population was below the poverty threshold, while 11.6% of the population of Oregon and 11.3% of the U.S. population fall into this category (USBC 2002a). Data on poverty status are not yet available at the census block level, but data for the two block groups containing the census blocks adjacent to the orchard indicate that 6.9 percent of the block groups' population[4] fall below the poverty threshold, reflecting a slightly higher rate of poverty than for the county as a whole (USBC 2002d).

There are few residences near the boundaries of Horning, and no disproportionate numbers of low-income or minority individuals are found there. The 2000 census found that the census blocks adjacent to Horning contained 12 young children (under five years) and 47 older children (aged 5 to 14) (USBC 2002a). Section 3.6 contains more detail on the age distribution of the local population.

[4] The population for Census Tract 241, Block Group 3, was omitted from this calculation, because the census blocks within this group that are adjacent to Horning have no population.

4.0 Environmental Consequences

Chapter 3 introduced and described the resources that could be affected by implementing the proposed action or an alternative; Chapter 4 assesses the potential impacts. As defined in 40 CFR 1508.14, the human environment includes natural and physical resources, and the relationship of people with those resources. Accordingly, this analysis has focused on identifying types of impacts and estimating their potential significance. Table 2.6-1 in Chapter 2 summarizes the potential environmental consequences of the proposed action and alternatives.

4.1 Introduction

This chapter is organized by resources, with information presented in the same sequence as in Chapter 3, providing a logical flow for analysis of potential environmental impacts. Section 2.6 identifies the specific resources that generated concern during scoping and EIS planning, and are therefore highlighted for the decisionmaker in that chapter.

Each resource-specific subsection provides (1) a summary of the potential impacts of implementing the proposed action or an alternative; (2) the analysis methods and significance criteria for determining significance, as defined in 40 CFR 1508.27; and (3) a discussion of the potential impacts of the proposed action and each alternative. The chapter concludes with an evaluation of cumulative impacts, discussion of potential mitigation measures, a discussion of unavoidable adverse impacts, an evaluation of the relationships between short-term uses of the environment versus long-term productivity, and a summary of irreversible and irretrievable commitments of resources.

The concept of "significance" used in this assessment considers both the context and the intensity or severity of the impact, as defined by 40 CFR 1508.27. The criteria used to characterize impacts are introduced at the beginning of each resource section. Significant impacts are effects that are most substantial and should receive the greatest attention in decision-making. Impacts described as minimal are identifiable and may be present, but the intensity or severity is below any threshold of concern, based on the criteria described in the specific resource discussion. Insignificant impacts result in little or no effect to the environment and cannot be easily detected; such impacts may also be referred to as negligible. If a resource would not be affected by a proposed activity, a conclusion of no impact was stated.

Impacts Common to All Alternatives

Under all alternatives, management actions not directly related to IPM, described in Section 2.1.2, would continue. These activities include administrative actions, such as facilities and equipment maintenance, which are comparable to the administrative actions described in the Salem District RMP (ROD-Administrative Actions). Orchard establishment and maintenance and buffer zone management are comparable to the silvicultural and harvest practices described for management of young stands described in the Salem District RMP. The impacts of these actions at Horning would be similar to the impacts described in Chapter 4 of the Final EIS for the Salem District RMP.

4.2 Air Quality

There would be insignificant impacts on air quality at and around Horning from vehicle emissions, from prescribed burns, and temporary very localized drift from pesticide applications. The seed orchard is located in an attainment area for all criteria pollutants, and emissions from proposed activities would not affect nearby non-attainment areas in the Portland metropolitan area. Air quality impacts under any alternative would be insignificant. The no action alternative would not change existing air quality at the seed orchard.

4.2.1 Analysis Approach and Assumptions

The analysis was based on a review of existing air quality in the region, information on Horning's air emission sources, projections of emissions from the proposed IPM implementation, a review of Federal regulations, and the use of air emission factors from EPA. Current emissions were estimated using the latest available information on the types of equipment used at the seed orchard.

The significance of air quality impacts is based on Federal, state, or local regulations or standards. A significant impact would be a violation of standards, or an exposure of sensitive receptors to excessive quantities of fugitive dust or smoke. A short-term impact that did not exceed standards would not be significant. A reduction in baseline emissions would improve air quality. No standards have been established for aerial concentrations of pesticides.

4.2.2 Potential Impacts of Alternative A—Maximum Production IPM

Small increases in equipment use, and occasional helicopter flights, would minimally increase mobile source emissions. The number of vehicles and the amount of equipment would not substantially differ from existing usage at the orchard. Emissions generated from these activities would be slight, would not exceed ambient air quality standards, and would not be significant. Helicopter flights are anticipated only once or twice a year, and their emissions would be negligible. Manual or mechanical IPM methods could produce small, localized amounts of fugitive dust, but impacts would be insignificant.

One IPM method proposed for use at Horning is prescribed fire, which would generate particulate matter, volatile organic compounds, nitrogen oxides, and CO. To minimize the effects of these emissions, Horning would comply with local smoke management restrictions, which coordinate burns within a region to reduce cumulative impacts. To further reduce impacts, Horning would also manage the timing, vegetation type, size of burned area, fuel arrangements and moisture, ignition techniques, and patterns of prescribed burns, while taking into account weather conditions. Prescribed fire at Horning is used only infrequently, on small native plant plots and occasionally to burn diseased trees (see Section 2.2.2.3). Air quality impacts would be insignificant. Impacts to human health from prescribed fire are discussed in Section 4.6.2.3.

Aerial, ground vehicle, and hand methods of pesticide applications could result in spray drift and volatilized chemicals. The recently conducted risk assessment (summarized in Appendix C) found soil deposition of pesticides no further than 300 feet from the orchard boundary. Options for reducing drift include using spray equipment designed to produce 200- to 800-μm-diameter particles, since particles of 100 μm or less are more likely to drift farther, and prohibiting spraying when the wind speed exceeds 6 miles per hour or is blowing toward a sensitive receptor (for example, the organic farm located northeast of the seed orchard) or a nearby residence, or during an inversion. With the use of protection measures, which are an inherent part of all alternatives and are described in Section 2.3.1, impacts to air quality would be insignificant.

No other activities associated with this alternative would affect air quality.

4.2.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under the proposed action, the more restricted application procedures (see Section 2.3.3) would further reduce the risk of pesticide drift to neighboring land parcels, including the organic farm. Impacts from mechanical and manual methods, and from prescribed fire, would be the same as those described under Alternative A. Impacts to air quality would be insignificant.

4.2.4 Potential Impacts of Alternative C—Ground-Based IPM

Under Alternative C, impacts would be similar to those described under Alternative B. Impacts to air quality would be insignificant. Although it is often assumed to be otherwise, aerial application of pesticides can be associated with decreased drift compared to some ground-based methods. The risk assessment predicted that aerial pesticide application, conducted as proposed by the seed orchard, would be associated with less drift potential than ground-based airblast sprayer application. Therefore, the potential risk of drift from application of esfenvalerate, while still below the threshold of significance for air quality impacts, would be slightly increased compared to Alternative B. Risks from bio-logical, cultural, and prescribed fire methods would the same as for Alternative B.

4.2.5 Potential Impacts of Alternative D—Non-Chemical Pest Management

Under Alternative D, no chemical pesticides would be used, so there would be no possibility of pesticide drift. Impacts from mechanical and manual methods, and from prescribed fire, would be similar to those described under Alternatives B and C. Impacts to air quality would be insignificant.

4.2.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

Under Alternative E, the current insignificant air quality impacts would continue. Before BLM undertook a pesticide application, an EA would be prepared to determine potential impacts of that application. That EA would include an assessment of air quality impacts.

4.3 Geological Resources

No significant impacts to geological resources or soil are expected from the proposed action or alternatives.

4.3.1 Analysis Approach and Assumptions

Potential impacts were assessed by evaluating current conditions at the orchard (including geology, topography, soil types and properties, and hydrology) and components of the various alternatives to predict conditions occurring after implementation of these alternatives.

4.3.2 Potential Impacts of Alternative A—Maximum Production IPM

Impacts from pesticides and fertilizers applied to specified areas at Horning could be either impacts to the soils directly, or impacts where soils provide a pathway of potential contamination to another medium, such as water. Impacts to soils could occur through chemical changes to the soil, or physical changes (primarily compaction from heavy machinery). Chemicals could leach through the soil into the groundwater or run off to adjacent streams. Impacts where soil provides a pathway to another medium are evaluated in the respective sections of this chapter that address the affected resources (such as water quality or human health). Section 3.0 of the risk assessment (summarized in Appendix C) provides a detailed description of the potential for chemical transport through and on the soil, which can result in leaching or runoff of pesticides and fertilizers, leading to impacts on other resources.

Erosion Potential

All of the perennial streams at Horning are surrounded by vegetative buffers between the stream and orchard production units, consisting of mature hardwoods, conifers, and understory. Most of these buffers are about 50 to 100 feet or more in width. These buffers would be maintained, with only spot treatments for noxious weeds; therefore, no increase in erosion potential due to de-vegetation is expected from any of the control methods-

Impacts from Chemical Pesticides and Fertilizers

Impacts from the application of pesticides and fertilizers to soil can be divided into two groups – those occurring from chemicals which are highly mobile in soils and have a high water solubility, and impacts from chemicals with a low mobility in soil (high adsorption rate) and are only slightly soluble in water. Six of the pesticides proposed for application at Horning are highly mobile in soil – acephate, dimethoate, dicamba, hexazinone, picloram, and triclopyr. The risk assessment predicted that five of these (acephate, diazinon, dimethoate, hexazinone, and picloram) and ethylbenzene contained in the permethrin formulation would leach to the groundwater. The depth to bedrock varies from 20 to 40 inches in the Springwater soils, but is 60 inches or more in the Jory soils. The root zone extends to the bedrock in the Springwater soils; any leaching past this zone would reach the underlying bedrock. The application of the pesticides would not use a sufficient amount of water to move chemicals past the surface of the soil. (At a rate of 50 to 150 gallons per acre of water mixed with the chemical, this would be equivalent to about 0.02 to 0.05 inches of water applied to the area.) Any applied pesticides would likely remain near the surface and begin degrading, until subsequent rainfall or irrigation would move any remaining residues into the soil horizon. Mobile pesticides leaching through the soil column would not persist in the soil or bedrock, but would disperse and degrade to lower concentrations. Any impacts to geologic layers below the soils would be insignificant.

The remaining chemicals proposed for application have a low mobility in soil due to a higher rate of adsorption. These chemicals would likely remain near the surface of the soil and degrade over time. Most degradation occurs by microbial metabolism. Other methods of degradation include hydrolysis (the splitting of a molecule by the addition of the elements of water), photolysis (degradation by radiant energy), and chemical degradation. Except for two herbicides (hexazinone and picloram) with soil half-lives in the five to six month range, the soil half-life of most of these chemicals is less than three months. The fate and transport modeling conducted for the risk assessment (Section 3.0 of the risk assessment report) indicated that negligible accumulation was expected.

Impacts to the soils from the application of fertilizers would be insignificant. Nitrate and other components of the fertilizers remaining in the soil would be absorbed by plants over time.

Use of vehicles to apply pesticides or fertilizers could also contribute to soil compaction.

Impacts from Biological Controls

Impacts from control methods using sheep or goats to graze areas to control unwanted vegetation would be insignificant. Negligible amounts of compaction or erosion could occur, but would not substantially impact soils.

Impacts from Prescribed Fire

Prescribed fire would be utilized in small areas to remove unwanted vegetation in native plant beds, and to burn cut or cleared vegetation, insect-damaged branches and trees, insect-damaged cones, cones not harvested for seed production, and branches and trees affected by disease. The prescribed fires are anticipated to remove much of the vegetation and organic layers on top of the soils. This would increase potential runoff and the potential for soil erosion in these localized areas. The amount of vegetation and debris left after the fires depends on the intensity and

duration of the fire. A low- to medium-intensity prescribed fire would generally not burn much of the organic layer of the soil. Most of the vegetation is well adapted to fire and would recover quickly, limiting the amount of potential erosion. Other impacts to the soil include reduced porosity of the soil from fine ash particles clogging the pore spaces of the soil and, depending on the intensity of the fire, a physical or chemical crust near the upper surface of the soil. With low- to medium-intensity fires in limited areas, the short-term impacts to soils would not be significant. Erosion would be more likely to occur in areas of steeper slopes, but litter and debris remaining after the prescribed fire would somewhat reduce potential erosion. The dense root system of existing plant communities would also limit soil erosion. Areas burned would not be sufficiently large to generate substantial erosion. Any erosion occurring would not likely be transported more than a few feet and would not cause siltation of streams.

Impacts from Cultural Controls

Soil would be compacted by machinery during mowing. The degree of compaction would depend on soil moisture conditions. All of the soils at Horning are vulnerable to compaction when the soil is wet. Compaction of soil would increase the amount of runoff and the potential for erosion.

4.3.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Impacts on soil and geologic resources from this alternative would not be significantly different than under Alternative A. Limitations on pesticide use could decrease the potential for impacts to soil chemistry from pesticide residues retained in the soil horizon. Impacts to soils from biological controls and prescribed fires would be the same as under Alternative A. Impacts to geological resources and soils occurring from implementation of Alternative B would be insignificant.

4.3.4 Potential Impacts of Alternative C—Ground-Based IPM

Impacts to soils from this alternative would be similar to those described under Alternative B, with one exception. There would be a slightly higher potential for soil compaction due to a greater likelihood of using heavy vehicles to apply esfenvalerate to a given orchard unit.

4.3.5 Potential Impacts of Alternative D—Non-Chemical Pest Management

Impacts to soil chemistry from pesticide residues would not be an issue under this alternative. As under Alternative A, impacts to the soils from the application of fertilizers would be insignificant. Depending on the frequency and timing of mechanical, hand, and cultural methods of controlling pests, soil compaction could be somewhat greater compared to Alternatives A, B, or C.

4.3.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

Use of non-chemical-pesticide methods would continue under this alternative, with no projected change in impacts from biological, cultural, or prescribed fire control methods. Potential soil impacts from chemical methods of control would be reviewed on a case-by-case basis if pesticide chemicals were proposed for use.

4.4 Water Resources

The primary water resource concern relating to the proposed IPM activities at Horning is how pest control methods, particularly the use of pesticides, would affect the surface water and groundwater as a result of pesticide transport and storage, as well as the associated potential exposures to downstream water users (primarily drinking water) and aquatic ecosystems.

Potential effects to water resources of most non-accident pesticide uses are expected to be minimal to negligible, based on the conclusions of the risk assessment (summarized in Appendix C). However, there could be risks from an accidental spill of pesticides directly into a tributary to either Nate or Swagger Creek. Protection measures incorporated into all of the alternatives are expected to minimize the potential water quality impact from runoff and spills. These measures are listed in Section 2.3.1. All of the alternatives include monitoring the use and effectiveness of these measures, and adjusting application procedures based on monitoring results.

The risk assessment estimated pesticide and fertilizer concentrations in surface water and ground water; see Tables C-1 to C-3 in Appendix C. The potential impacts of surface water and groundwater contamination to human health, such as from the ingestion of drinking water or contaminated fish, are addressed in Section 4.6 (Human Health and Safety). Potential impacts to the aquatic ecosystem, including special status species, are addressed in Section 4.7 (Biological Resources). Because the drainage patterns and natural topography of the orchard and surrounding area would not be affected by the proposed IPM activities, there would be no adverse impacts to floodplains. Therefore, floodplains are not discussed further in this section.

4.4.1 Analysis Approach and Assumptions

The major public scoping concern regarding water quality is the potential for pesticide contamination. Computerized fate and transport modeling was conducted to estimate concentrations of pesticides in the surface water and groundwater. The Groundwater Loading Effects of Agricultural Management System (GLEAMS) model, which models pesticide behavior in soils and water, was used to characterize the leaching and runoff behavior of the pesticides. This model used the best available data for orchard soil, watershed, and pesticide-use characteristics. Section 3.2.1 of the risk assessment report provides a detailed description of the model, input parameters, and assumptions. In summary, there are four major components to GLEAMS: hydrology, erosion, nutrients, and pesticides. Factors considered included:

- Soil organic matter content and pH;
- Soil porosity and water retention characteristics;
- Pesticide decomposition rates and tendencies to be adsorbed;
- Pesticide solubility and vapor pressure;
- Pesticide application rates, methods, and timing;
- Surface and subsurface hydrological characteristics; and
- Local precipitation, irrigation practices, and climatic conditions.

To further distinguish the typical and maximum scenarios beyond any application rate and frequency differences listed in Table 2.2-1, the results of GLEAMS were handled as follows: In the typical scenarios, the mean of the 10 highest runoff concentrations over the modeling period was selected for use in the risk assessment. In the maximum scenarios, the single highest runoff concentration was used in the risk assessment.

The GLEAMS model predicted runoff of chemicals and water as they might be measured at the edge of each orchard unit. The Horning seed orchard units generally have significant areas of untreated field edges and well-vegetated buffers between treated acreage and receiving streams (between 50 and 100 feet). These untreated intervening areas (collectively termed “buffer zones”) play a major role in reducing the amount of chemicals that actually reaches stream water. The seed trees and well-managed surface vegetation present at the orchard make it more similar to a

well-managed forest and, although runoff does reach streams, it is mostly via subsurface shallow flow. In addition, both the climate, which is characterized by fairly even precipitation, and surface conditions at the seed orchard are conducive to percolation rather than direct runoff of rainfall. The limited amounts of irrigation required also limit contributions to runoff. As a result, streamflow from the orchard area also is primarily due to subsurface flow.

To account for the attenuating affect of the buffer zones on runoff, the USGS Method of Characteristics model was used to estimate concentrations in groundwater, onsite streams in Sections 13 and 23, Swagger Creek, Nate Creek (at the first point where all orchard tributaries have joined in), Milk Creek, and Clear Creek. These values are presented in Table C-1 of Appendix C to this EIS, and can be considered to represent 24-hour average concentrations. For groundwater, the GLEAMS simulations estimated the mass per unit area of each chemical leaching below the rooting zone. Estimated groundwater concentrations are presented in Table C-2 in Appendix C.

Finally, the Exposure Analysis Modeling System (EXAMS) model was used to predict downstream concentrations in Swagger Creek and Nate Creek if an accidental spill of pesticide concentrate or tank mix were to occur. Estimated concentrations in groundwater in the vicinity of the domestic well near the Horning orchard office also were estimated. Five potential spill sites were considered in the risk assessment.

4.4.2 Potential Impacts of Alternative A—Maximum Production IPM

4.4.2.1 Groundwater

Chemical contamination of groundwater would depend on the extent to which pesticides and fertilizers may leach through the soils into the groundwater and the depth of the water table. The extent of leaching would, in turn, depend on the physical properties of the soils affected (permeability, organic matter, percent clay, depth of soil horizons, and properties of geological materials underlying the soils) and the chemical properties of the pesticide or fertilizer (primarily its water solubility and partition coefficient – ratio of chemical absorbed to the soil to the amount in soil solution).

In the typical and maximum scenarios (see Section 4.6.1 for descriptions of scenarios), several pesticides and other ingredients were seen to leach below the rooting zone: acephate, diazinon, dimethoate, hexazinone, triclopyr, and picloram, as well as ethylbenzene in permethrin. Even in the maximum scenarios, the estimated groundwater concentrations of pesticides at Horning are below levels that would be associated with any risks to human health (see Table 6-1 of the risk assessment report), and movement of groundwater away from the orchard units would lead to even lower concentrations, due to dispersion, adsorption, and degradation. Therefore, impacts to groundwater would be negligible.

The risk assessment predicted that nitrate from the application of ammonium phosphate-sulfate and calcium nitrate fertilizers would leach to the groundwater. Estimated concentrations in the groundwater were about 0.8 mg/L nitrate from ammonium phosphate-sulfate, 1.0 mg/L nitrate from calcium nitrate, and 0.01 mg/L phosphate. Impacts to the groundwater would be negligible, however, particularly given reduced concentrations in groundwater as it moves offsite away from the orchard units and becomes further diluted. No human health risks were associated with these concentrations for exposure through drinking water (see Section 4.6 and Appendix C).

Impacts to groundwater (specifically, drinking water) from an accidental spill of a container of pesticide concentrate at the mixing area are addressed in Section 4.6.

All of the alternatives would include an on-site water quality monitoring program. Groundwater from nearby orchard domestic wells would be monitored in the event of a spill to identify any groundwater contamination and the resulting pesticide concentration(s). Periodic monitoring of the shallow groundwater wells located in the greenhouse effluent field also would be conducted to

identify concentrations of any greenhouse effluent pesticides in the local groundwater. Detailed information on the proposed Water Quality Monitoring Plan for Horning is found in Appendix B.

Biological and cultural control methods, such as mechanical methods, include no activities that would adversely affect groundwater. *B.t.*, a biological insecticide, is a naturally occurring soil bacteria. Applications of *B.t.* formulations do not increase levels of *B.t.* in soil. *B.t.* spores and crystals persist for a relatively short time. Like all soil microbes, *B.t.* does not percolate through the soil and its presence is confined to the top 10 inches of soil. Thus no groundwater contamination concerns are present (EPA 1998a).

4.4.2.2 Surface Water

Surface water contamination could potentially occur from the use of chemical pesticides or fertilizers and, to a lesser extent, from implementing biological and cultural IPM methods and prescribed fire. Each of these is discussed below. Potential impacts from pesticide and fertilizer use were analyzed for both normal applications and accidental spills.

Impacts from Pesticide and Fertilizer Applications

Surface water contamination could occur indirectly from runoff (overland flow) of pesticides or fertilizers after application. This occurrence would depend largely on the characteristics of the soil, including the amount of vegetation present, the slope of the affected area, and the chemical applied. For example, if a chemical adsorbs well to the soil, it will tend to stay in the soil and be broken down in place. A chemical that does not adsorb to the soil could be washed away via soil surface or subsurface movement with irrigation or rainwater, and would more likely be a potential contaminant. In general, the risk assessment predicted negligible surface runoff losses of pesticides and fertilizers at the orchard (see Table C-1 in Appendix C). The primary reasons for negligible runoff, as mentioned previously, include the extensive buffer zones between treated acreage and receiving streams which significantly reduce the amount of chemicals that actually reach stream water. Timing of chemical applications in relation to rainfall and irrigation is also important. Longer time periods between irrigation and pesticide applications reduce the concentrations of the pesticide in the water, because of pesticide degradation. Some runoff would reach streams by interflow (flow just beneath the surface) where slope is sufficient.

Any chemical concentrations in runoff to Milk Creek are likely to be less than those predicted in the risk assessment. The risk assessment assumed that any chemical in runoff to Stream 8, in the southwest portion of Section 23, could enter Milk Creek (see Figure 3.4-2 for location of Stream 8). Stream 8 is ephemeral north of Unger Road (see Figure 2.1-1 for location of Unger Road); however, this flow goes underground before reaching the road. Flow resurfaces near the BLM property line. There is no direct surface connection between Streams 8d and 8e and Milk Creek.

The risk assessment predicted about 0.001 μg/L of chlorpyrifos, and lower concentrations of other pesticides and fertilizers, would reach Section 13 streams in a typical use scenario. In Section 23, the predicted concentration of chlorpyrifos was 0.002 μg/L. The risk assessment predicted a concentration of 0.07 μg/L of dimethoate, and lower concentrations of other pesticides and fertilizers, would reach Section 13 streams in a maximum use scenario. In the maximum use scenario, a concentration of 0.05 μg/L of diazinon, and lower concentrations of other chemicals, was predicted to reach Section 23 streams. No significant change in the potential for sediment delivery to surface water is expected as a result of vegetation control using chemical herbicides.

Measures are taken to ensure that no off-target drift occurs during pesticide application, including drift to surface water. Spray nozzles are specifically designed to minimize drift. Buffer strips around streams and restrictions on spraying based on wind speed also would reduce the chance of drift reaching sensitive areas, such as streams. Equipment washing would be conducted in designated areas where the wash water would not contaminate surface water or groundwater. Section 2.3.1 lists the protection measures inherent in the proposed action and all alternatives.

In addition to the risk assessment results, water quality monitoring has been conducted after past esfenvalerate use and determined that surface runoff from the orchard units was an insignificant pathway for pesticide transport. The specific types of monitoring conducted and the results are summarized below.

The seed orchard conducted water quality monitoring of the onsite streams in Section 13 for possible chemical contaminants. Specifically, esfenvalerate was applied in April 2002 using a helicopter with boom application at a rate of 0.19 lb a.i./acre. The sequence of application included orchard units B-35, B-36, P-13, P-11, P-12, and P-10 in Section 13; and P-33 and P-30 in Section 23. The perennial flowing tributary to Swagger Creek (below Horning Reservoir) was crossed once in order to spray units B-35 and B-36.

Three types of monitoring were performed at the orchard in an effort to better characterize the effects of orchard pesticide spraying in April 2002, as well as provide a continued assessment of selected fields also sprayed with esfenvalerate in 2001. These include implementation, effectiveness, and validation monitoring. The implementation monitoring was intended to document the features that have been implemented to minimize potential impacts to the orchard from pesticide spraying conducted in 2002. The effectiveness monitoring documented how well the design features performed in keeping pesticides out of the aquatic system, and the validation monitoring documented the water quantity and quality of runoff predictions and assumptions modeled in the 2001 EA (BLM 2001). The monitoring procedures and results are described in detail in the monitoring report (BLM 2002). In general, the effectiveness monitoring results for drift revealed no detectible concentrations of esfenvalerate in the 24 hours following the spray project. The results for spring runoff reflected non-detectible concentrations at a detection limit of 0.02 μg/L (samples taken after two stormflow events since there was no precipitation within 72 hours following the spray). Effectiveness monitoring for the fall/winter runoff also resulted in no detectable concentrations. Finally, results of the validation monitoring of the GLEAMS model as conducted for the 2001 EA, showed a disparity between the prediction of runoff and pesticide loss and the amount actually measured from the edge of the plots. Measured values for surface runoff amount and pesticide loss were less than predicted by GLEAMS during this modeling exercise specific to BLM's preparation of that EA. In particular, the predicted model values have inherent uncertainty in terms of pesticide movement through subsurface pathways of preferential flow or macro pore movement of water. Through previous monitoring and observation, it is evident that lateral subsurface flow and tile drain flow are a significant component of water movement from the orchard units to the stream systems. Results have been used to develop recommendations for future monitoring at the site, which have been incorporated into Horning's currently proposed Monitoring Plan (Appendix B). Such monitoring would be conducted as part of the proposed IPM program to check for contamination and ensure protection. The proposed plan encompasses the same components as before: implementation monitoring to document that design features have actually been implemented; effectiveness monitoring to document how well the design features have performed in avoiding the introduction of pesticides to the surface and groundwater systems; validation monitoring which would use the effectiveness data to validate the water quality modeling; and, as a fourth component, compliance monitoring, to document domestic water quality and pesticide fate in terms of irrigation effluent.

Impacts from Accidental Chemical Spill

Chemical pesticide contamination of surface water could occur in the case of an accidental spill during pesticide transport or application.

The EXAMS modeling predicted that maximum residues from spills into the larger perennial streams or intermittent streams of significant flow would reach Swagger Creek or Nate Creek within an hour. In the event of an accidental spill, members of the public and workers may be exposed to greater amounts of a pesticide than from normal applications. These risks are discussed in Section 4.6.

Impacts from Biological and Cultural Methods

Potential effects to surface water resources from biological methods, such as livestock grazing and *B.t.* in field runoff, would be minimal. Livestock grazing has occurred in past years at Horning with no noted adverse impacts. *B.t.*, even if it reached the streams, is not known as an aquatic bacterium and is not expected to proliferate in aquatic habitats. It is also considered very non-toxic, especially when used only in terrestrial applications.

Potential effects to water resources from cultural methods, such as sedimentation, also would be minimal. While soil-disturbing operations and soil compaction caused by the use of heavy machinery can lead to increased runoff and stream sedimentation, very little sediment, or bacteria in the case of biological methods, is likely to reach the orchard's onsite streams due to the extensive buffers of untreated vegetation. During periods of heavy rain, there is some potential for sediment or bacteria residues to be released into the local streams; however, concentrations are still expected to be minimal.

Impacts from Prescribed Fire

Potential effects to water resources from prescribed fire would be minimal. Fire can remove the top vegetation and organic layers of soils, which could increase the potential for runoff and soil erosion (particularly in areas of steeper slope). However, any erosion would not likely be transported more than a few feet and is not expected to cause siltation of streams. Litter and debris remaining after the prescribed fire would serve to reduce potential erosion, as would the dense root system of existing plant communities. Finally, the burn areas would not be sufficiently large to generate substantial erosion.

4.4.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Impacts to surface water and groundwater would be the same under the proposed action as in Alternative A for biological and cultural control methods. Impacts to water resources from pesticide and fertilizer application would be less than those identified in Alternative A because limitations incorporated into project design would control the potential for runoff or drift (see Section 2.3.3).

4.4.4 Potential Impacts of Alternative C—Ground-Based IPM

Impacts from this alternative would be similar to those described under Alternative B, except there is a greater potential for drift from some broadcast ground methods, such as airblast sprayer, than from aerial application. However, the potential impacts to water resources from a slight increase in drift are still expected to be negligible.

4.4.5 Potential Impacts of Alternative D—Non-Chemical Pest Management

Under this alternative, potential runoff and leaching of pesticides to water would not be a concern since no chemical pesticides would be applied. Fertilizers could be present in runoff, with the same impacts as under Alternative A. Overall impacts would be less compared to Alternatives A, B, or C. Greater reliance on cultural and biological methods may result in slightly greater potential for runoff and sedimentation in streams. However, impacts would be negligible due to the extensive buffers of untreated vegetation.

4.4.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

Use of non-chemical-pesticide methods would continue under this alternative, with no projected change in impacts. Any potential use of chemical pesticide methods of control would require a separate NEPA review each time a specific use was proposed. Impacts would be similar to Alternatives A or B (depending on project-specific details), but may be slightly less since fewer chemicals would likely be applied in the orchard on an annual basis, given the schedule limitations, costs, and administrative demands of preparing EAs on a case-by-case basis.

4.5 Land Use

Land use impacts are related to changes in the productive use of land as the result of an action. Insignificant impacts on land use are projected for the proposed action and all alternatives.

4.5.1 Analysis Approach and Assumptions

The most recent information about surrounding land uses—including aerial photos, census data, and scoping comments—was used to determine current land uses and evaluate potential impacts. A significant impact to land use would be a permanent or long-term (several years) change in how a parcel could be used. Neither the proposed action nor any alternative includes activities that would change existing land use at the seed orchard or neighboring parcels directly.

The potential for indirect impacts, from off-site transport of chemicals, was evaluated by reviewing the conclusions of the risk assessment (summarized in Appendix C). The only area of potential impact identified was ineligibility of land to be used for organic farming, which could occur if deposition from offsite pesticide transport exceeded limits for organic agricultural production set by the U.S. or Oregon Departments of Agriculture. The neighboring land parcels include a certified organic farm growing herbs and mushrooms, located northeast of the seed orchard; see Figure 3.5-1. The individual impact to the organic farm would be significant if any resulting pesticide residues were sufficient to cause the farm to lose its organic certification and, consequently, its ability to certify and market its produce as organic.

4.5.2 Potential Impacts of All Alternatives

No direct land use impacts are predicted under any alternative.

The risk assessment predicted negligible pesticide drift to neighboring land parcels (shown in Figure 3.5-1) under Alternative A (Maximum Production IPM), which emphasizes aggressive pest management and has the highest potential for use of pesticide chemicals. The potential for indirect land use impacts from pesticide transport to neighboring land units is even smaller for Alternatives B, C, E, and D, with the probability for impact decreasing successively under each alternative in that order. Alternative B (IPM with Environmental Protection Emphasis, the proposed action), includes limitations (see Section 2.3.3) that would reduce the potential for offsite pesticide transport to neighboring land parcels, below the levels predicted for Alternative A. Under Alternative C (Ground-Based IPM), impacts on land use would be similar to those predicted for Alternative B, since drift and runoff can occur from ground-based as well as from aerial applications. Under Alternative E (No Action), the current practice of preparing a NEPA document prior to pesticide use would continue. Any potential impacts to land use from pest management under this alternative would be identified in each project-specific NEPA document. It is likely that potential impacts would be insignificant, similar to those from Alternatives A, B, or C, depending on the details of the pesticide application. Finally, under Alternative D (Non-Chemical Pest Management), no chemical pesticides would be used, so there would be no possibility of pesticide transport to nearby land parcels.

While the probability of pesticide drift contaminating adjacent parcels (including the organic farm) is extremely low, unforeseen weather conditions, coupled with a failure to quickly respond to adverse conditions by ceasing aerial or airblast sprayer applications, could increase the possibility of such an impact. However, the overall impact on land use would be insignificant to other landowners surrounding the orchard and to others in the region under any alternative.

Biological, cultural, and prescribed fire control methods under all alternatives would have insignificant land use impacts at Horning or to neighboring parcels.

4.6 Human Health And Safety

Human health impacts as a result of any of the pest control methods could include chemical toxicity as a result of exposure to chemical pesticides, injury during use of cultural methods, and injury or smoke exposure during use of prescribed fire. No health impacts were identified for biological control methods or fertilizers. A quantitative human health risk assessment evaluated the potential effects to members of the public and seed orchard workers from using chemical pesticides and fertilizers under Alternative A. No risks to members of the public were predicted for non-accident exposures, but some pesticides (diazinon, dimethoate, propiconazole, dicamba, hexazinone, and mancozeb) were predicted to present risks to some workers in certain situations. In response to these identified risks, Alternative B was designed, which incorporates limitations on chemical pesticide use that reduce these estimated workers risks to negligible levels. These limitations are also incorporated into Alternative C. Alternative D does not include the use of chemical pesticides, and Alternative E would result in less frequent pesticide application.

No risks are predicted for members of the public from non-accident exposure to chemical pesticides under any of the alternatives. Under Alternatives A, B, C, and E, an accidental spill into a stream could result in surface water that would be unsafe for drinking or fishing. There are potential risks to workers from six of the proposed pesticides under Alternative A, and no predicted risks to workers from pesticides under Alternatives B, C, D, and E. Potential impacts on human health due to injury, heat, fire, and smoke are possible under all the alternatives, but the most likely of these impacts are temporary (muscle strain, eye and throat irritation due to smoke). These risks are slightly increased under Alternative E (no action), since less use would be made of chemical pesticides, and increase further under Alternative D, since these methods would take the place of all pesticide use.

4.6.1 Analysis Approach and Assumptions

Risks from biological, cultural, and prescribed fire methods were evaluated qualitatively, based on potential types of injuries or health effects associated with the specific method, and the frequency of such injuries or effects at Horning in the past.

To assess risks from use of chemical pesticides and fertilizers proposed under Alternative A, a quantitative risk assessment was conducted that estimated the risks to members of the public and workers as a result of using the proposed pesticides and fertilizers at Horning. The supporting record for this EIS contains the full risk assessment; a summary is provided in Appendix C, including tables summarizing the modeling predictions for surface and groundwater concentrations and drift deposition. The human health risk assessment methodology is summarized briefly in the following paragraphs. Detailed information on inputs, methods, assumptions, and outputs can be found in Sections 4.0, 5.0, and 6.0 of the risk assessment report.

Computerized fate and transport modeling was conducted to estimate concentrations of pesticides and fertilizers in environmental media at the point of exposure. Section 4.4.1 describes the surface water and groundwater modeling. AgDRIFT was used to estimate off-target pesticide drift from aerial applications, airblast applications, and applications using a tractor-pulled rig with a boom. Field studies reported in the published literature provided the basis for estimates of drift from other

ground-based pesticide application methods. Section 3.0 of the risk assessment report provides details of the models, their inputs, and the results obtained.

The risk assessment employed the three principal analytical elements that the National Research Council (1983) described and EPA (1989, 2000) affirmed as necessary for characterizing the potential adverse health effects of human exposures to existing or introduced hazards in the environment: hazard assessment, exposure assessment, and risk characterization.

The risk assessment addresses risks from fertilizers and 19 pesticide active ingredients[1], as well as "other" ingredients in the pesticide formulations, formerly termed "inert" ingredients.[2]

Human Health Hazard Assessment

Hazard assessment requires gathering information to determine the toxic properties of each chemical and its dose-response relationship. Human hazard levels are derived primarily from the results of laboratory studies on animals. Toxic effects were divided into two categories, with different analytical approaches used: noncarcinogenic effects (for example, toxicity to the liver or nervous system) and carcinogenicity. The goal of the hazard assessment is to identify acceptable doses for noncarcinogens, and identify the cancer potency of potential carcinogens.

For noncarcinogenic effects, it is generally assumed that there is a threshold level, and that doses lower than this threshold can be tolerated with little potential for adverse health effects. EPA has determined threshold doses for many chemicals; these are referred to as reference doses (RfDs). The oral RfD is an estimate of the highest possible daily oral dose of a chemical that will pose no appreciable risk of deleterious effects to a human during his or her lifetime. The uncertainty of the estimate usually spans about one order of magnitude. RfDs are expressed in units of milligrams of chemical per kilogram of body weight per day (mg/kg/day).

Data on carcinogenic potential were reviewed for each chemical. Acephate, permethrin, propargite, and thiophanate-methyl are considered possible human carcinogens; and chlorothalonil, mancozeb, and hexachlorobenzene (a contaminant in picloram) are considered to be probable human carcinogens. For these compounds, cancer slope factors that have been calculated by EPA or other appropriate sources are used in this risk assessment. The cancer slope factor of a chemical represents the probability that a 1-mg/kg/day chronic dose will result in formation of a tumor, and is expressed as a probability, in units of "per mg/kg/day" or $(mg/kg/day)^{-1}$.

The RfDs and cancer slope factors used in this risk assessment are summarized in Table 4.6-1.

Human Health Exposure Assessment

Exposure assessment involves estimating doses to persons potentially exposed to the pesticides or fertilizers. In the exposure assessment, dose estimates were made for typical, maximum, and accidental exposures. These exposures are defined as follows:

- *Typical:* For this risk assessment, the word "typical" refers to a level of exposure within a scenario, and does not indicate whether the scenario itself is likely to occur. Typical exposure reflects the average dose an individual may receive if all exposure conditions are met. Typical exposure assumptions include the application rate usually used at the seed orchard, usual number of applications per year, the average of the ten highest values for chemical concentrations predicted to be present in runoff over a 10-year period of annual typical applications, and other similar assumptions.

[1] The biological insecticide B.t. and Safer® Insecticidal Soap were not included in the quantitative risk assessment. Potential environmental impacts are evaluated separately for these two control methods. See discussion at the end of Section 4.6.1.
[2] The risk assessment evaluated the formulations that are expected to be used. It is possible that other formulations of the same active ingredients may be substituted at times. The risks from other formulations containing the same active ingredients would be similar to the risks predicted in the risk assessment.

Table 4.6-1. Toxicity Endpoints

Chemical	RfD (mg/kg/day)	Dermal Absorption (%)	Cancer Slope Factor (per mg/kg/day)
Acephate	0.004	0.4 (1-hr)	0.0087
Chlorothalonil	0.015	0.15	0.00766
Chlorpyrifos	0.0003	1.78 (4-hr)	NA[a]
Dazomet	0.016	10	NA
Formaldehyde	0.020[b]	NA	0.000013 per $\mu g/m^3$
MITC	0.00365[b]	NA	NA
Monomethylamine	6.4[b]	NA	NA
Carbon disulfide	0.7[b]	NA	NA
Diazinon	0.0002	2	NA
Dicamba	0.045	10	NA
Dimethoate	0.0005	11	NA
Esfenvalerate	0.02	3 (8-hr)	NA
Glyphosate	2	1.42 (24-hr)	NA
Hexazinone	0.05	1	NA
Horticultural oil	1	1	NA
Hydrogen dioxide	NA	NA	NA
Mancozeb	0.03	1	0.0601
Permethrin	0.05	1.7	0.016
Picloram	0.2	0.2	NA
Hexachlorobenzene	NA	23	1.7
Propargite	0.04	14.5 (8-hr)	0.201
Propiconazole	0.013	40 (10-hr)	NA
Thiophanate-methyl	0.08	0.5	0.0039
Triclopyr	0.5	1.65 (8-hr)	NA
Inert Ingredients			
Cyclohexanone	5	10	NA
Ethylbenzene	0.1	3.4 (4-hr)	NA
Light aromatic solvent naphtha	0.02	10	NA
Xylene	2	3.9 (4-hr)	NA
Nitrate	1.6	NA	NA

[a]NA = Not applicable
[b]Inhalation RfC, units are mg/m^3

- *Maximum:* Maximum exposure defines the upper bound of credible doses that an individual may receive if all exposure conditions are met. Maximum exposure assumptions include the maximum application rate according to the label, maximum number of applications per year, the highest chemical concentration predicted to be present in runoff over a 10-year period of annual maximum applications, and other similar assumptions.

- *Accidental:* The possibility of error exists with all human activities. Therefore, it is possible that during seed orchard operations, accidents could expose individuals to unusually high levels of pesticides or fertilizers. To examine these potential health effects, several accident scenarios were evaluated for health effects to members of the public and workers.

It is important to note that these exposure scenarios estimate risks from clearly defined types of exposure. If all the assumptions in an exposure scenario are not met, the dose would differ from that estimated here, or may not occur at all.

For members of the public, the exposure scenarios analyzed in this risk assessment consist of the following:

- Ingestion of groundwater.
- Ingestion of water from Swagger Creek east of Section 13 or Nate Creek west of Section 23. (These creeks are not known sources of drinking water; therefore, drinking water from their tributaries is even less likely and these risks were not quantified).
- Ingestion of fish from Swagger Creek east of Section 13 or Nate Creek west of Section 23.
- Ingestion of grouse or quail hunted on or near grounds.
- Ingestion of mushrooms with pesticide residues.
- Dermal exposure to insecticide/fungicide drift residues on vegetation, or herbicide treatment residues on vegetation, during recreational hiking/hunting/mushroom gathering on orchard grounds.
- Dermal exposure to residues on dogs following recreational use of site.

The categories of workers evaluated in this risk assessment for occupational exposure to pesticides are as follows:

- Helicopter pilot.
- Helicopter mixer/loader.
- High-pressure hydraulic sprayer mixer/loader/applicator.
- Hydraulic sprayer with hand-held wand mixer/loader/applicator.
- Tractor-pulled spray rig with boom mixer/loader/applicator.
- Backpack sprayer mixer/loader/applicator.
- Granular spreader loader/applicator.
- Hand pollinator.
- Hand sprayer mixer/loader/applicator in greenhouse.
- Chemigation mixer/loader in greenhouse.
- Weighing and monitoring personnel in greenhouse.

Several accidental exposure scenarios were also evaluated:

- Ingestion of groundwater after a spill of concentrate.
- Ingestion of fish and water containing runoff from a spill of concentrate.
- Ingestion of fish and water downstream of a spill of tank mix directly into a stream.
- Spill of pesticide concentrate onto worker's skin.
- Spill of pesticide mixture onto worker's skin.
- Spray of worker with tank mix of pesticide.

Human Health Risk Characterization

Characterizing risk that results from different levels of exposure illustrates a principle tenet of risk assessment, set down by Paracelsus in the 16th century:

> All substances are poisons; there is none which is not a poison. The right dose differentiates a poison from a remedy.

Toxicity is a chemical-specific property that does not vary based on the exposure situation; it is determined by a substance's ability to cause effects at certain doses. That is why the exposure analysis is required, to determine whether any exposures will occur at the levels associated with

those effects: even a highly toxic chemical can be "safe" at very low levels of exposure, while a relatively nontoxic chemical can cause effects if the exposure is sufficiently high.

In this risk assessment, the potential noncarcinogenic risks were evaluated by comparing the representative doses (estimated in the exposure assessment) with the RfDs (identified in the hazard assessment). All the RfDs used in this risk analysis take into account multiple exposures over several years and represent acceptable dose levels. The comparison of dose to RfD consists of a simple ratio, called the hazard index:

$$\textit{Hazard Index} = \textit{Estimated Dose (mg/kg/day)} \div \textit{RfD (mg/kg/day)}$$

If the estimated dose does not exceed the RfD, the hazard index would be one or less, indicating the dose is within the range generally considered to pose no adverse effects to humans.

A dose estimate that exceeds the RfD, although not necessarily leading to the conclusion that there will be toxic effects, clearly indicates a potential risk for adverse health effects. Risk is presumed to exist if the hazard index is greater than one. However, comparing one-time or once-a-year doses (such as those experienced by the public or in an accident) to RfDs derived from long-term studies with daily dosing tends to exaggerate the risk from those infrequent events.

To estimate cancer risk, the dose is averaged over a lifetime (75 years), and multiplied by the chemical's cancer slope factor. The resulting cancer probability is compared to a benchmark value of one in one million, a value commonly accepted in the scientific community as representing a cancer risk that would result in a negligible addition to the background cancer risk of approximately one in four in the U.S.

Analysis of B.t. and Safer® Insecticidal Soap

B.t., is a rod-shaped bacterium that produces a protein (a delta endotoxin) that is toxic to insects. *B.t.* is a naturally occurring microorganism that is found in the soil. According to EPA, no known mammalian health effects have been demonstrated in any infectivity/pathogenicity study (EPA 1998a). Some strains of *B.t.* have the potential to produce various toxins that may exhibit toxic symptoms in mammals; however, the manufacturing process includes monitoring to prevent these toxins from appearing in products.

Safer® Insecticidal Soap contains potassium salts of fatty acids. Fatty acids are naturally occurring compounds. The safety of this class of compounds is exemplified by the fact that they are permitted for direct addition to food for human consumption by the U.S. Food and Drug Administration (21 CFR 172.863). They exhibit low acute toxicity by the oral route of exposure, but can be irritating to the skin or eyes (EPA 1992).

No significant health effects are expected for either workers or members of the public from seed orchard use of either *B.t.* or Safer® Insecticidal Soap.

4.6.2 Potential Impacts of Alternative A—Maximum Production IPM

4.6.2.1 Biological Control Methods

No significant impacts on human health are expected from the use of biological controls, including the use of the biological insecticide *B.t.*, cattle grazing to remove grass from orchard units, and the use of bird and bat boxes to attract insect-eaters.

4.6.2.2 Chemical Control Methods

The assumptions used in the risk assessment regarding application rates, frequency, and areas potentially treated correspond to the details of Alternative A. Hazard indices and cancer risks for each chemical and scenario are presented in tables in Section 6.0 of the risk assessment report.

The chemicals and scenarios for which risks were identified are summarized in the following paragraphs and in Table 4.6-2.

Members of the Public

For members of the public, hazard indices were less than one for all typical and maximum exposure scenarios, and cancer risks were all less than 1 x 10^{-6} (one in one million), with non-zero cancer risks ranging up to 1.22 x 10^{-9} (1.22 in one billion). Therefore, no significant risks are predicted for members of the public.

Workers

For typical scenarios, all worker hazard indices are less than one, with the following exceptions:

- A high-pressure hydraulic sprayer mixer/loader/applicator applying diazinon or dimethoate, and
- A backpack sprayer applying propiconazole, dicamba, or hexazinone.

In the maximum scenarios, the hazard indices exceed one for the following workers:

- A high-pressure hydraulic sprayer mixer/loader/applicator applying diazinon or dimethoate;
- A backpack sprayer applying dicamba or hexazinone; and
- A hand pollinator encountering residues of diazinon.

The estimated cancer risk to greenhouse weighing/monitoring personnel encountering residues of mancozeb is 5.15 in one million, exceeding the standard point of departure of one in one million. All other cancer risks to workers were less than one in one million.

Table 4.6-2. Summary of Scenarios with Predicted Human Health Risks Under Alternative A

Chemical	Scenario	Risk
Risks to Members of the Public		
None	None	None
Risks to Workers		
Diazinon	High-pressure hydraulic sprayer mixer/ loader/applicator	Hazard index = 1.17 (typical) and 5.84 (maximum)
	Hand pollinator (after spraying with high-pressure hydraulic sprayer)	Hazard index = 20.3 (maximum)
Dimethoate	High-pressure hydraulic sprayer mixer/ loader/applicator	Hazard index = 24.7 (typical) and 64.8 (maximum)
Mancozeb	Greenhouse weighing/monitoring personnel	Cancer risk = 5.15 x 10^{-6}
Dicamba	Backpack sprayer	Hazard index = 8.35 (typical) and 16.7 (maximum)
Hexazinone	Backpack sprayer along fencelines	Hazard index = 1.40 (typical) and 5.59 (maximum)

Accidents

For a spill of a container of pesticide concentrate at the mixing area, no risks to the public from drinking groundwater contaminated by leached chemical were predicted. If precipitation caused runoff of spill residues to surface water from the spill site, risks were predicted from diazinon, dimethoate, permethrin, and chlorothalonil to adults and children consuming fish or surface water from Swagger Creek. All estimated cancer risks were less than one in one million.

For a spill of an application tankload of mixed pesticide into the onsite stream east of Horning Reservoir, risks to the public from drinking water and eating fish from Swagger Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, picloram, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

For a spill of an application tankload of mixed pesticide into the onsite stream east of Orchard Unit B14, risks to the public from drinking water and eating fish from Swagger Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, picloram, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

For a spill of an application tankload of mixed pesticide into the onsite stream west of Orchard Unit P67, risks to the public from drinking water and eating fish from Nate Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

In the accident scenario in which a worker spills liquid pesticide concentrate on the skin, hazard indices exceed one (ranging up to 10,100 for dimethoate) for all liquid concentrates except horticultural oil, glyphosate, picloram, and triclopyr. Estimated cancer risks were all less than one in one million.

In the accident scenario in which a worker spills tank-mixed diluted pesticide on the skin, hazard indices are greater than one for chlorpyrifos, diazinon, dimethoate, and dicamba. All estimated cancer risks are less than one in one million.

Hazard indices for the accident scenario in which a worker was directly sprayed exceed one for chlorpyrifos, diazinon, and dimethoate. Estimated cancer risks are all less than one in one million.

4.6.2.3 Prescribed Fire

Potential impacts on human health from prescribed burning as a vegetation control measure were evaluated in the *Final EIS for Vegetation Management in 13 Western States* (BLM 1991). Possible effects are summarized as follows:

Risks from Fire

Prescribed burning presents various hazards to ground crews, who could possibly receive injuries ranging from minor burns to severe burns that may result in permanent tissue damage. However, standard safety procedures, protective gear, and training are integrated into every prescribed burn plan and are expected to reduce or eliminate most hazards. If a burn escapes and causes a wildfire, members of the public in adjacent areas may be endangered, and the potential is higher for severe worker injuries (both for orchard workers and firefighters responding to the incident).

Risks from Smoke

Substances that may be found in wood smoke include particulate matter, carbon dioxide, nitrogen oxides, aldehydes, and ketones. The proportion of each varies widely, depending on factors such as moisture content in the vegetation and the temperature of the fire.

Particulate matter is a result of incomplete fuel combustion. Fine particulate matter, with a diameter less than 2.5 μm, has a greater ability than do larger particles to avoid the body's defense mechanisms and reach the lungs. Carbon dioxide, nitrogen oxides, and other gaseous compounds of smoke generally decompose or diffuse into the atmosphere relatively quickly. However, some may attach to particulate matter and remain more concentrated and protected from decomposition. For example, aldehydes, which inhibit the removal of foreign material from the respiratory tract, may be adsorbed onto the surface of particles. Polynuclear aromatic hydrocarbons (PAHs) are of significant toxicological concern in evaluating the health effects of wood smoke. The PAHs in wood smoke contain at least five carcinogenic chemicals: benzo(a)pyrene, benzo(c)phenanthrene, perylene, benzo(g,h,i)perylene, and the benzofluoranthenes.

Exposures to the carcinogenic and possibly carcinogenic PAHs in wood smoke from burning vegetation were estimated for exposures to prescribed burns by BLM (1991). Estimated cancer risks were not expected to exceed the benchmark of 1 in 1 million for any member of the public or worker, even in extreme cases. Because smoke from prescribed fires will affect local air quality for a short time, sensitive individuals may experience eye, throat, or lung irritation from these exposures. Possible effects on workers with closer exposure may include eye irritation, coughing, and shortness of breath.

The effects (if any) on an individual from a prescribed fire or pile burn can vary greatly, and would depend on the size of the burn, the atmospheric conditions at the time of the burn, and the proximity of the individual.

4.6.2.4 Cultural Controls

Cultural controls include manual and mechanical methods of vegetation control, involving manual labor, and the use of hand tools and machinery. Examples of hand tools include hoes, rakes, and various types of pruners and cutters. Machinery includes tractors, mowers, chainsaws, gasoline-powered string trimmers, and other equipment. Impacts on safety and health could include falls, sprains, and other accidental injuries; cuts caused by tools; injuries from accidental contact with equipment or its attachments (blades, mowers, plows); and the possible initiation or aggravation of chronic health problems such as tendon or ligament damage or arthritis. There is some risk to workers of falling or being hit by limbs or tree trunks when pruning orchard trees. When temperatures are high, workers may experience fatigue, heat exhaustion, or heat stroke. Individuals who are sensitive to irritants present in some materials (sawdust, mulch, irritating plant hairs, and spines), or who are severely allergic to insect bites or stings, may experience moderate to severe health effects if exposed to these irritants in the course of conducting cultural pest management activities. No risks to members of the public are expected from cultural control methods.

4.6.2.5 Other Control Methods

No risks to human health are expected from the use of pheromone bait traps or from potential public exposure to nitrates following fertilizer use, as modeled in the risk assessment (see Chapter 4.0 of the risk assessment report).

4.6.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Alternative B was designed in response to the results of the quantitative risk assessment, by incorporating limitations to specifically address any non-accident risks under Alternative A (which are summarized in Table 4.6-2). The risks from Alternative A (from Table 4.6-2) and the corresponding limitations that address the risks (from Section 2.3.3) are correlated in Table 4.6-3. With these risk-responsive limitations as part of Alternative B, no adverse effects to human health are expected from the use of chemical pesticides under this alternative, except if an accident were to occur. The risks from accidents are the same as those identified under Alternative A. Risks from biological, prescribed fire, cultural methods, and other methods of pest control are the same as under Alternative A.

4.6.4 Potential Impacts of Alternative C—Ground-Based IPM

Since no risks are predicted for workers or members of the public from aerial esfenvalerate application, the omission of that method from the alternative does not change the risks. The

Table 4.6-3. Risk-Responsive Limitations to Protect Human Health Under Alternative B

Identified Risk from Alternative A			Alternative B Limitation that Addresses Risk
Chemical	**Scenario**	**Individual**	
Diazinon	High-pressure hydraulic sprayer	Mixer/loader/ applicator	Would be applied to no more than 250 trees in one day at a maximum rate of 0.015 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of diazinon applied more than 3.75 lb a.i.) by any individual worker who is conducting both the mixing/loading and application activities.
		Hand pollinator	An individual conducting hand pollination activities would not work on trees that had been treated with diazinon until at least 11 days post-application.
Dimethoate	High-pressure hydraulic sprayer	Mixer/loader/ applicator	Would be applied to no more than 22 trees in one day at a maximum rate of 0.13 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of dimethoate applied more than 2.86 lb a.i.) by an individual using the high-pressure hydraulic sprayer, and an individual other than the applicator would conduct the mixing/ loading activities. If more than one applicator sprays trees during a single day, different mixer/loaders would prepare each pesticide mixture.
Mancozeb	Greenhouse use	Greenhouse weighing/ monitoring personnel	The frequency of mancozeb use in the greenhouses will typically be only twice per year, with a maximum frequency of 10 times per year. Weighing and monitoring personnel will allow 24 hours to elapse before handling seedlings treated with mancozeb.
Dicamba	Backpack sprayer	Mixer/loader/ applicator	An individual applying dicamba using a backpack sprayer would apply no more than 0.61 lb a.i. during any given day.
Hexazinone	Backpack sprayer along fencelines	Mixer/loader/ applicator	An individual applying hexazinone using a backpack sprayer would apply no more than 6.5 lb a.i. during any given day.

risks from Alternative C would be the same as from Alternative B: no risks to members of the public or workers from chemical pesticides except in the case of accidents. Risks from biological, prescribed fire, cultural methods, and other methods of pest control are the same as under Alternatives A and B.

4.6.5 Potential Impacts of Alternative D—Non-Chemical Pest Management

Under Alternative D, the chance for injury would exist for workers from prescribed fire and cultural control methods. There would be no risks from chemical pesticides since they would not be used.

4.6.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

If BLM continued its current management approach, overall health risks would be intermediate between those of Alternative A and Alternative D. Chemical pesticides would likely be used less frequently, due to the need to conduct individual NEPA analyses for each project. Therefore, the potential for risks from chemical pesticides, including accidents, would be lower. There would be a risk of injury to workers from prescribed fire and cultural control methods.

4.7 Biological Resources

Risks to non-target species from biological, cultural, and prescribed fire methods were evaluated qualitatively. No impacts are expected from these pest control methods under any alternative.

A quantitative non-target species risk assessment evaluated the potential effects to terrestrial wildlife and aquatic species from using chemical pesticides and fertilizers under Alternative A. In most cases, little or no adverse impact to terrestrial wildlife populations is expected from the pesticides proposed for use at Horning under typical conditions of use, with the possible exception of impacts to bird and amphibian species from applications of three of the insecticides (chlorpyrifos, diazinon, and dimethoate). Most of the estimated wildlife exposures are extremely low, and are several orders of magnitude below the levels of concern. No acute lethal risks to aquatic species were predicted for pesticides or fertilizers under Alternative A. An analysis of the potential for sublethal effects on special status fish species identified no risks in areas where they are present and there is a hydrologic connection to Horning.

In response to the risks identified for Alternative A, Alternative B was designed, which incorporates limitations on chemical pesticide use that reduce these estimated risks to negligible levels. These limitations are also incorporated into Alternative C. Alternative D does not include the use of chemical pesticides, and Alternative E would result in less frequent pesticide application. Therefore, negligible risks from chemical pesticides and fertilizers are expected from Alternatives B, C, and D, while risks from Alternative E would continue to be identified and evaluated on a project-by-project basis.

Under Alternatives A, B, C, and E, an accidental chemical spill could result in surface water concentrations that would be harmful to both terrestrial wildlife and aquatic species. Alternatives B and C incorporate limitations on routes for transporting chemical pesticides at Horning; therefore, the probability that such a spill would occur is decreased under these alternatives.

4.7.1 Analysis Approach and Assumptions

Risks from biological, prescribed fire, and cultural methods of pest control were evaluated qualitatively, based on the types of impacts possible.

4.7.1.1 Non-Target Species Risk Assessment

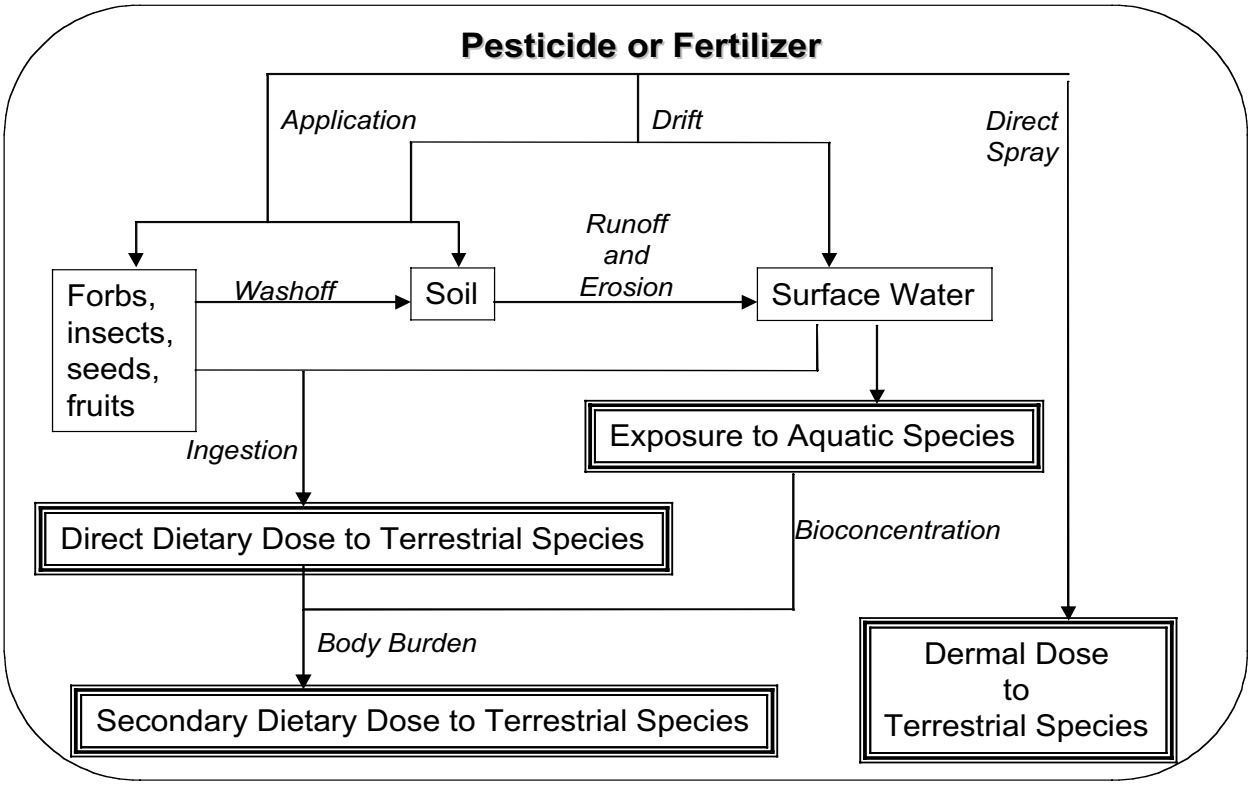
A quantitative non-target species risk assessment was conducted to evaluate the potential effects of the proposed chemical pesticides and fertilizers on terrestrial and aquatic wildlife species. The methodology is summarized briefly in the following paragraphs; detailed information on inputs and methodology can be found in Sections 7.0, 8.0, and 9.0 of the risk assessment report. Additional analysis was conducted for impacts to special status aquatic species that may be present at or near Horning; this is described in detail in Appendix D.

The non-target species risk assessment follows the steps of problem formulation, analysis, and risk characterization, as described in EPA's Guidelines for Ecological Risk Assessment (EPA 1998b). This risk assessment also identifies uncertainties that are associated with the conclusions of the risk characterization. Risks to non-target species were evaluated for the pesticides, fertilizers, and List 1 or 2 "other" ingredients in the pesticide formulations.[3] A conceptual model was developed to illustrate the relationships between stressors (pesticides or fertilizers), exposure routes, and receptors. The conceptual model is presented in Figure 4.7-1.

The list of representative terrestrial species evaluated in the risk assessment is as follows:

Mammals
- Cow (domestic)
- Sheep (domestic)
- Coyote (carnivore)
- Jack rabbit (small herbivore)
- Long-eared myotis (insectivore)

Figure 4.7-1. Conceptual Model



[3] The risk assessment evaluated the formulations that are expected to be used. It is possible that other formulations of the same active ingredients may be substituted at times. The risks from other formulations containing the same active ingredients would be similar to the risks predicted in the risk assessment.

Birds
- Black-capped chickadee (conifer seed-eater)
- California quail (game bird)
- Mallard duck (water fowl)
- Red-tailed hawk (raptor)
- Song sparrow (seed-eater)

Reptiles/Amphibians
- Pacific tree frog

These particular wildlife species were selected because they represent the majority of the species present, or the seed orchard has suitable habitat and is within their range (e.g., selection of black-capped chickadee as conifer seed-eater), and because they represent several types of coverage: a range of phylogenetic classes, body sizes, foraging habitat, and diets for which parameters are generally available. In addition, several special status terrestrial species were evaluated for potential risk:

- Western pond turtle
- Common nighthawk
- Oregon vesper sparrow
- Western meadowlark
- Streaked horned lark

Risks were also estimated for aquatic species for which ecotoxicity data are available: rainbow trout as a representative coldwater fish species, the water flea *Daphnia magna* as a representative aquatic invertebrate, and tadpoles of the Pacific tree frog as a representative amphibian aquatic stage. Risks were also evaluated for steelhead trout, a Federally listed threatened species and state-listed critical species that is present in Clear Creek and Milk Creek near Horning. At the time of the risk assessment, cutthroat trout were proposed for Federal listing as threatened, so they were evaluated as if they were a special status species. However, subsequent to the risk assessment's completion, it was determined that these cutthroat trout would not be listed.

Stressor-response profiles were prepared for each pesticide, other ingredient, and fertilizer proposed for use at Horning. These profiles addressed ecotoxicity to both terrestrial and aquatic species, with the goal of identifying endpoints relevant to the types of exposure and methodology used in the assessment. The focus of this research was to identify the following toxicity endpoints:

- Median lethal dose (LD_{50})—the amount of a substance that will kill 50% of a group of laboratory animals after one dose. It is usually expressed in milligrams of the chemical per kilogram of body weight (mg/kg).

- Median lethal concentration (LC_{50})—the concentration in water of a substance that will kill 50% of the test animals (aquatic species) after they are exposed for a specified amount of time, often 24, 48, or 96 hours. It is usually expressed in milligrams of chemical per liter of water (mg/L).

- Maximum acceptable toxicant concentration (MATC)—the geometric mean of the no-observed-effect concentration and the lowest-observed-effect concentration, representing a concentration in water that is expected to be tolerated by the test species.

The stressor-response profiles for all chemicals are presented in Section 8.3 of the risk assessment report.

Exposures to non-target species were modeled for both typical and maximum scenarios, as in the human health risk analysis summarized in Section 4.6. The results of computerized fate and

transport modeling were used to estimate concentrations of chemicals at points of exposure for non-target species, and are included in Tables C-1 to C-3 in Appendix C. Details of the methods and models can be found in Sections 3.0 and 8.0 of the risk assessment report.

The risk assessment principle that "the dose makes the poison," discussed in Section 4.6.1 under "Human Health Risk Characterization," also applies to risk characterization for wildlife and aquatic species. Both chemical-specific toxicity and estimated levels of exposure must be considered before risk can be predicted.

By comparing the exposure profile data (estimated dose or water concentration) to the stressor-response profile data (LD_{50}s, LC_{50}s, MATCs), an estimate of the possibility of adverse effects can be made. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs. The quotient is the ratio of the exposure level to the hazard level. For acute exposures, the levels of concern at which a quotient is concluded to reflect risk to non-target species are as follows:

- Terrestrial species (general): 0.5, where dose equals one-half the LD_{50}.
- Terrestrial species (special status): 0.1, where dose equals one-tenth the LD_{50}.
- Aquatic species (general): 0.5, where water concentration equals one-half the LC_{50}.
- Aquatic species (special status): 0.05, where water concentration equals one-twentieth the LC_{50}.

Due to the high level of concern for protecting threatened salmonids in the watershed, the predicted water concentrations are also compared to the MATC for a chemical, if available.

4.7.1.2 Risk Analysis for Sublethal Effects to Special Status Aquatic Species

The non-target species risk assessment (summarized in Appendix C) evaluated the potential for lethal effects on fish from pesticides or fertilizers in surface runoff or from drift during application. For each chemical, the risk assessment identified the LD_{50} for the most sensitive coldwater species for which data were available. Risks were estimated for all aquatic species using this approach. However, additional analysis was determined to be necessary for special status species, since chemical exposures may adversely affect vulnerable populations by impacts other than the death of individuals, such as by interfering with migration or reproduction. These are termed "sublethal effects." This analysis is presented in detail in Appendix D, and summarized in the following paragraphs.

Along with impacts to general aquatic species, risks of sublethal effects to a special status species known to be present in the Clear Creek and Milk Creek watersheds—the steelhead trout—were estimated in the non-target species risk assessment. As identified in Section 3.7.4, three additional special status aquatic species (chinook and coho salmon, Pacific lamprey) are located in the watershed; however, acute risks were not quantified for these species in the risk assessment, due to lack of information on populations of coho salmon and Pacific lamprey, and to the distance from the seed orchard of chinook salmon (more than 10 miles downstream), which is associated with a negligible potential for measurable mortality impacts. These additional special status species are, however, included in this assessment of the potential for sublethal effects.

The sublethal effects evaluated in this risk analysis for special status aquatic species are those that are relevant to biological requirements of the animal: in this case, rearing and migratory effects, and reproductive endpoints (NOAA 2002). Survival is also included in this analysis.

The assessment endpoints used to characterize potential effects reflect measures of the animal's health that can be functionally related to survival, rearing and migratory behavior, or reproductive success (NOAA 2002). Since relatively few scientific studies have examined sublethal effects of

pesticides on fish physiology or behavior, the selection of assessment endpoints is limited. In the absence of data specific to the identified species of concern, data from biologically and genetically similar surrogate species were used. Comparative toxicology has demonstrated that various species of scaled fish generally have equivalent sensitivity (within an order of magnitude) to other species tested under the same conditions. Dwyer et al. (1995) and Beyers et al. (1994), among others, have shown that endangered and threatened fish tested to date are similarly sensitive to a variety of pesticides and other chemicals as their non-endangered counterparts. Very few studies have investigated the effects of pesticides specific to the lamprey, so comparative toxicity with fish species from available literature is made cautiously. In some cases, in the absence of sublethal effects data on a specific chemical for appropriate fish species, information was evaluated for pesticides which are chemically similar and share a common mechanism of toxicity.

For the purpose of broadening and strengthening the best available science for this evaluation, the proposed-use chemicals were analyzed by chemical groups. The insecticides and acaricides are divided by chemical classes (biologicals, organophosphates, organosulfites, and pyrethroids), reflecting a common mechanism of toxicity for each class. The herbicides, fungicides and fumigant, other ("inert") ingredients, fertilizers, and "other pesticides" (not inclusive within any other group classification) were evaluated wholly by their respective groups. In each case, the lowest toxicity result (indicating greatest toxicity) was used in the analysis of risks, so that this categorization approach would not sacrifice a protective analysis.

Appendix D provides details of the sublethal effects literature and analysis of risk values. Table 4.7-1 summarizes the lowest (most sensitive) toxicity values identified during this process. These data points are not intended to be definitive of all possible adverse effects at all life-stages related to survival, migration, or reproduction, but are intended to be conservative, representative estimates.

Risks to special status species were determined by comparing the stream concentrations estimated in the risk assessment and the toxicity data endpoints summarized in Table 4.7-1. A concentration-effects ratio was determined, defined as the estimated chemical concentration in surface waters over the effect concentration. Risks to survival, migratory, and reproductive endpoints were predicted to be low if the concentration-effects ratio was 0.1 or below, moderate if 0.1 to 1.0, and high if 1.0 or greater.

Table 4.7-1. Summary of Special Status Species Toxicity Data

Chemical	Effect Concentration (mg/L)		
	Survival	Migration	Reproduction
Bacillus thuringiensis	75	NA	NA
Organophosphates	0.001	0.01	0.0003
Organosulfites	0.008	NA	0.028
Pyrethroids	0.000025	0.0001	0.000004
Herbicides	0.033	0.046	2.0
Fungicides/fumigants	0.0049	NA	0.0065
Other pesticides	100	NA	NA
Other ingredients	0.32	0.1	8.0
Fertilizers:			
ammonia (as NH_3)	0.0074	NA	NA
nitrate (as NO_3)	2.0	NA	NA
phosphate	49	NA	NA
calcium nitrate	480	NA	NA

NA = No data available.

4.7.2 Potential Impacts of Alternative A—Maximum Production IPM

4.7.2.1 Vegetation

Biological, cultural, and prescribed fire methods of pest control are not expected to present any adverse impacts to non-target vegetation.

Although the proposed herbicides are variously toxic to plants with which they come into contact, there should be no undesired impacts if properly applied. No special status plant species have been identified on-site at the seed orchard. Broadcast applications of herbicides are only proposed for intensively managed or disturbed areas such as along roads and fences, within orchard units, or around facilities, while spot applications would be used to control weed species in less disturbed areas. Only spot hand applications would be conducted within the riparian buffer areas. Insecticides, fungicides, and fertilizers are only proposed for use in cultivated areas (seed orchard blocks and native species beds), so no direct contact with plant species in other areas is expected.

Aquatic plants may be present in streams and ponds that receive runoff from treated areas. A literature review was conducted to identify the levels at which any of the proposed chemicals may pose a hazard to aquatic plants (see Section 9.2.4 in the risk assessment report). For many chemicals, tests in algae were the only available data, and are expected to provide a sensitive endpoint for hazards to aquatic plants. For each chemical, the estimated water concentrations were compared to the levels of concern. None of the predicted concentrations in onsite streams, Swagger Creek, or Nate Creek exceed the effects criteria equivalent to 50% of the values reported in the literature summarized in the preceding paragraphs. Therefore, no adverse effects to aquatic plants are expected under typical or maximum conditions of pesticide or fertilizer application at Horning.

4.7.2.2 Terrestrial Species

Risks to General Terrestrial Species

No risks to terrestrial wildlife are predicted for biological or cultural controls. Risks to wildlife from prescribed fire were evaluated in detail in BLM (1991); this evaluation is summarized below:

> Many different wildlife (vertebrate) responses to fire have been reported. Fire effects on wildlife vary with (1) animal species complex, (2) mosaic of habitat types, (3) size and shape of fire-created mosaic, (4) fire intensity, (5) fire duration, (6) fire frequency, (7) fire location, (8) fire shape, (9) fire extent, (10) season of burn, (11) rate of vegetation recovery, (12) species that recover, (13) change in vegetation structure, (14) fuels, (15) sites, and (16) soils....
>
> In general, fire affects wildlife by direct killing, alteration of immediate postfire environments, and postfire successional influences on habitat.... Direct killing of vertebrates by prescribed burning is rare.... For those species that cannot flee a burn, the most exposed habitat sites are dry exposed slopes, hollow logs with a lot of exposed wood, burrows less than five inches deep, lower branches of trees and shrubs, and poorly insulated underground/ground nesting areas.... Effects of prescribed burning on ground cover depends on fire severity: low severity fire on wet sites would remove less cover than high severity fires on dry sites. Escaped prescribed burns may accidentally destroy riparian habitats and impact aquatic resources, causing losses of wildlife through exposure, total loss of habitat, and increased sedimentation of the aquatic habitat caused by unchecked overland flow and destabilized stream channels.
>
> Fire mainly affects wildlife through habitat alteration.... Fire may have a positive effect on wildlife habitats by creating habitat diversity, by re-creating lost or degraded habitats for indigenous species, and by allowing for the re-introduction of extirpated species when habitat degradation was significant to their [local] extinction. Immediate postfire conditions raise light penetration and temperatures on and immediately above and below soil surfaces and can reduce soil moisture.... Burning of cover and destruction of trees, shrubs, and forage modify habitat structure.... The loss of small ground cover and charring of larger branches and logs (with diameters greater than 3 inches) can negatively affect small animals and birds. Early,

vigorous vegetation growth immediately after a fire alters feeding and nesting behaviors.... Postfire plant and animal succession effects creating seral and climax mosaics in habitat cannot be generalized in their effects on wildlife.... Negative impacts can be lessened if the period of treatment avoids the bird nesting season and other critical seasons when loss of cover would be critical to wildlife; for example, during critical reproductive periods and prior to severe winter weather conditions.

Because the seed orchard is an intensively managed site, and only limited areas would potentially be treated with prescribed burning, negligible impacts to wildlife are expected from vegetation control using prescribed fire.

Risks to terrestrial wildlife from pesticide and fertilizer use under Alternative A are summarized in Table 4.7-2.

Table 4.7-2. Summary of Scenarios with Predicted Non-Target Species Risks Under Alternative A

Chemical	Scenario	Species	Risk*
Risks to General Terrestrial Wildlife			
Chlorpyrifos	Airblast	Black-capped chickadee	Q = 1.84 (typical) and 7.59 (maximum)
		Song sparrow	Q = 0.657 (maximum)
Diazinon	High-pressure hydraulic sprayer	Black-capped chickadee	Q = 6.05 (typical) and 63.4 (maximum)
		California quail	Q = 0.845 (typical) and 9.31 (maximum)
		Mallard duck	Q = 1.69 (maximum)
		Red-tailed hawk	Q = 0.634 (maximum)
		Song sparrow	Q = 5.59 (maximum)
Dimethoate	High-pressure hydraulic sprayer	Black-capped chickadee	Q = 20.7 (typical) and 138 (maximum)
		California quail	Q = 3.80 (typical) and 31.1 (maximum)
		Song sparrow	Q = 3.66 (typical) and 43.2 (maximum)
		Pacific tree frog	Q = 23.9 (typical) and 135 (maximum)
		Cow	Q = 1.22 (maximum)
		Sheep	Q = 2.45 (maximum)
		Long-eared myotis	Q = 1.27 (maximum)
		Mallard duck	Q = 0.857 (maximum)
		Red-tailed hawk	Q = 6.26 (maximum)
Risks to Special Status Terrestrial Species			
Chlorpyrifos	Airblast	All	Q = 0.125 to 0.604 (typical) and 0.600 to 2.53 (maximum)
Diazinon	High-pressure hydraulic sprayer	All	Q = 0.416 to 1.98 (typical) and 5.11 to 21.4 (maximum)
Dimethoate	High-pressure hydraulic sprayer	All	Q = 3.34 to 6.77 (typical) and 33.5 to 53.5 (maximum)
Calcium nitrate	Cone stimulation	Western pond turtle	Q = 0.116 (typical) and 0.233 (maximum)
		Common nighthawk	Q = 0.114 (maximum)
		Oregon vesper sparrow	Q = 0.107 (maximum)
Risks to General Aquatic Wildlife			
None	None	None	None
Risks to Special Status Aquatic Species			
None	None.	None.	None.

*Risks are predicted for general terrestrial species if Q > 0.5; for special status terrestrial species if Q > 0.1; for general aquatic species if Q > 0.5, and for special status aquatic species if Q > 0.05.

Risks are predicted from chlorpyrifos for the black-capped chickadee in the typical and maximum scenarios, and for the song sparrow in the maximum scenario.

Risks are predicted from diazinon for the black-capped chickadee and California quail in the typical and maximum scenarios, and for the mallard duck, red-tailed hawk, and song sparrow in the maximum scenario.

Dimethoate was estimated to present risks to the black-capped chickadee, California quail, song sparrow, and Pacific tree frog in the typical scenario, and to all general terrestrial species except the coyote and jackrabbit in the maximum scenario.

In most cases, little or no adverse impact to terrestrial wildlife populations is expected from the pesticides and fertilizers proposed for use at Horning under typical conditions of use, with the possible exception of impacts to bird and amphibian species from applications of three of the insecticides (chlorpyrifos, diazinon, and dimethoate). Most of the estimated doses are extremely low, with risk quotients several orders of magnitude below the levels of concern. A margin for error is provided by the methodology applied, which uses reasonable assumptions that tend toward overstating potential exposures to wildlife, in the absence of site-specific data on potential exposure patterns. In addition, the chemicals have relatively short half-lives and are not expected to remain in the environment for significant periods of time: two herbicides (hexazinone and picloram) have soil half-lives in the five to six month range, while the rest of the pesticides' soil and foliar half-lives are less than three months.

Although some terrestrial insects onsite may be affected by the insecticide applications, and may constitute a portion of the dose to insectivorous species, populations of beneficial insects as a whole are not expected to suffer adverse impacts because the proposed seed orchard applications are localized. Although honeybees and other pollinators are generally susceptible to insecticides, the protection measures that are part of all the alternatives include practices to minimize potential exposures; see Section 2.3.1.

It appears that insecticide applications may have adverse impacts on local earthworm populations (see discussion in Section 9.2.1 of the risk assessment report). However, any possible impacts are expected to be reversible, given that these chemicals are not persistent in the soil and that limited areas would be treated only on an as-needed basis in any growing season, allowing for re-population from adjacent untreated areas.

Risks to Special Status Terrestrial Species

Risks are predicted from chlorpyrifos, diazinon, and dimethoate for all special status terrestrial species in both the typical and maximum scenarios.

Calcium nitrate application was estimated to pose a risk to the western pond turtle in both typical and maximum scenarios, and to the common nighthawk and Oregon vesper sparrow in the maximum scenario.

Risks from Accidents

Risks are predicted for all terrestrial species except the cow, sheep, and coyote in the scenario in which an animal ingests an acephate implant capsule.

General terrestrial species were predicted to be at risk from a concentrate spill of diazinon, esfenvalerate, or dazomet at the mixing area.

4.7.2.3 Aquatic Species

Since biological, cultural, and prescribed fire methods are expected to have no significant impacts to surface water (as discussed in Section 4.4.2.2), no impacts to aquatic species would occur from the use of those methods.

Any chemical concentrations in Milk Creek are likely to be less than those predicted in the risk assessment. The risk assessment assumed that any chemical entering Stream 8, in the southwest portion of Section 23, could enter Milk Creek (see Figure 3.4-2 for location of Stream 8). Stream 8 is ephemeral north of Unger Road (see Figure 2.1-1 for location of Unger Road); however, this flow goes underground before reaching the road. Flow resurfaces near the BLM property line. There is no direct surface connection between Streams 8d and 8e and Milk Creek.

Risks to General Aquatic Species

No risks of lethal effects to general coldwater fish species, aquatic invertebrates, or aquatic stages of amphibians were predicted in onsite streams in the typical or maximum scenarios in the risk assessment (summarized in Appendix C).

Drift from permethrin airblast applications was predicted to exceed the 21-day MATC for aquatic invertebrates in onsite streams. However, this permethrin concentration would persist for less than 24 hours, compared to the three-week exposures used to calculate this criteria. Therefore, this comparison is not expected to indicate a potential risk.

Risks to Special Status Aquatic Species

Risks of Lethal Effects

In the lethality effects evaluation contained in the risk assessment (summarized in Appendix C), ammonia in runoff from general orchard fertilization was predicted to pose a risk to resident cutthroat trout in Section 13 onsite streams in the maximum scenario only. However, since cutthroat is no longer considered a special status species at Horning, the more restrictive criteria that resulted in this conclusion in the risk assessment do not apply. No lethality risks to special status species in any other streams were identified in the risk assessment. Therefore, no lethality risks are expected for special status aquatic species.

Risks of Sublethal Effects

For all of the proposed insecticides, including the biological insecticide *B.t.*, it is conceivable there could be a localized loss of part of the insect food source for fish species due to drift or runoff to streams. However, any chemical presence and associated decrease in non-target aquatic insect populations would be temporary and localized; insects would be expected to quickly re-populate from upstream areas. Therefore, no indirect effects to fish from loss of insect food sources are expected. Additionally, no adverse effects are expected for aquatic invertebrates in the general aquatic species analysis, so no impacts to food sources for special status fish are expected.

Typical applications of *B.t.*, organophosphates, organosulfites, and pyrethroid insecticides are expected to pose low risk to special status species in all surface waters for the sublethal effects evaluated.

Maximum applications of *B.t.* and organosulfites are expected to present low risk in all surface waters for all biological endpoints. Maximum scenario risks from the organophosphates and pyrethroids are low in Swagger Creek, Milk Creek, and Clear Creek; but there are moderate risks for reproductive effects from these two types of insecticides in Nate Creek. However, no special status aquatic species are known to occur in Nate Creek in the vicinity of the orchard where these concentrations were estimated. Therefore, no insecticide exposures resulting in maximum scenario risks of sublethal effects to special status species are predicted to occur. In addition,

monitoring and gauge records at Horning indicate that precipitation occurring during the spring and summer months does not usually induce surface runoff, resulting in the conclusion that contamination reaching surface water via runoff is unlikely during the time of year during which there is more potential for use of chemical pesticides.

Typical and maximum applications of all herbicides, fungicides and fumigant, other pesticides, and other ingredients are associated with low risk to special status species in all streams for all sublethal effects evaluated.

Typical applications of fertilizers are expected to present low risk in all streams for the biological endpoints evaluated. Under the maximum scenario, fertilizer applications were estimated to present moderate risks of ammonium toxicity to special status species in Swagger Creek, Milk Creek, and Clear Creek. Although high risks for ammonium toxicity to special status species would be predicted for Nate Creek, no special status aquatic species are known to occur in Nate Creek in the vicinity of the orchard.

Risks from Accidental Spills

Most categories of aquatic species (fish, invertebrates, amphibians, both general and special status) are at risk of lethal effects from spills of tank mixtures of chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, dicamba, glyphosate (Roundup®), hexazinone, horticultural oil, picloram, and triclopyr butoxyethyl ester into the irrigation pond, or into onsite tributaries to Swagger Creek and Nate Creek. No risks were predicted in any spill scenarios from acephate, propiconazole, glyphosate (Rodeo®), or triclopyr triethylamine salt. Risks would be lower for species not found nearer to the seed orchard than Clear Creek or Milk Creek, due to greater dilution. The details of the modeled accidental spills are presented in Section 3.2.5 of the risk assessment report.

4.7.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Alternative B was designed in response to the results of the quantitative risk assessment, by incorporating limitations to specifically address any risks from applications under Alternative A (which are summarized in Table 4.7-2). The risks from Alternative A (from Table 4.7-2) and the corresponding limitations that address the risks (from Section 2.3.3) are correlated in Table 4.7-3. With these risk-responsive limitations as an integral part of Alternative B, no adverse effects to terrestrial wildlife or to aquatic species, including special status fish species, are expected from the use of chemical pesticides under this alternative.

Should an accidental spill to surface water occur, the risks from that accident would be the same as those identified under Alternative A. However, the probability of an accident is decreased by limitations on transport of pesticide concentrate over certain tributaries (see Section 2.3.3).

Risks from biological, prescribed fire, cultural, and other methods of pest control are the same as under Alternative A.

4.7.4 Potential Impacts of Alternative C—Ground-Based IPM

Since no risks are predicted for terrestrial or aquatic wildlife species from aerial esfenvalerate application under Alternative B, the omission of that method from the alternative does not change the risks. The risks from Alternative C would be the same as from Alternative B: no risks to terrestrial or aquatic wildlife, including special status species, from chemical pesticides or fertilizers except in the case of accidents. Risks from biological, prescribed fire, and cultural methods of pest control are the same as under Alternative A.

Table 4.7-3. Risk-Responsive Limitations to Protect Ecological Resources Under Alternative B

Identified Risk from Alternative A			Alternative B Limitation that Addresses Risk
Chemical	**Scenario**	**Species**	
Chlorpyrifos	Airblast	Conifer-seed-eating birds, all special status terrestrial species	Would not be applied within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than three acres in any 12-acre area within a 14-day period, at a rate no greater than 1 lb a.i. per acre.
Diazinon	High-pressure hydraulic sprayer	Seed-eating birds, game birds, insect-eating birds, water fowl, raptors, all special status terrestrial species	Would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than 150 trees at a rate of 0.015 lb a.i. per tree (nor any combination of number of trees and application rate more than 2.25 lb a.i. applied) in any 12-acre area within an 11-day period.
Dimethoate	High-pressure hydraulic sprayer	Seed-eating birds, game birds, insect-eating birds, water fowl, raptors, reptiles/amphibians, domestic and wild mammals, all special status terrestrial species	Would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than five trees at a rate of 0.13 lb a.i. per tree (nor any combination of number of trees and application rate more than 0.65 lb a.i. applied) in any three-acre area within a seven-day period.
Calcium nitrate	Cone stimulation	Western pond turtle, Oregon vesper sparrow, common nighthawk	If calcium nitrate is applied to trees that are within 500 feet of streams after April 30, the fertilizer in these areas would be "watered in" if there is no rainfall within a week. During calcium nitrate applications, orchard employees would be vigilant for nests of ground-nesting bird species.

4.7.5 Potential Impacts of Alternative D—Non-Chemical Pest Management

Under Alternative D, there would be no risks from chemical pesticides since they would not be used. As discussed under Alternative A, no risks to non-target species from biological, cultural, prescribed fire, or other control methods would be expected from their use in an IPM program at Horning, except for fertilizers, which would pose the same risks as under Alternative A.

4.7.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

If BLM continued its current management approach, risks from pesticides would be intermediate between Alternative A and Alternative D. Chemical pesticides would likely be used less frequently, due to the need to conduct individual NEPA analyses for each project. Therefore, the potential for risks from chemical pesticides, including accidents, would be lower. Impacts from biological, prescribed fire, and cultural methods of pest control would be higher than under Alternatives A, B, or C, due to their increased use compared to those alternatives. Impacts from fertilizers would be the same as under Alternative A.

4.8 Noise

The proposed action or an alternative could produce occasional short-term impacts on the noise environment, but the impacts would not be significant. Alternatives A and B would include occasional helicopter noise from aerial applications; however, the impacts would not be significant since these applications would occur for only a few hours once or twice a year. Ground equipment noise associated with any pest management alternative would not significantly influence the noise environment, because the noise generated would be intermittent and would occur during daytime hours, would be attenuated by the equipment's distance from noise receptors, and would be indistinguishable from the use of the same or similar equipment for non-pest management activities. Under the no action alternative, noise levels would be unchanged.

4.8.1 Analysis Approach and Assumptions

The analysis of noise impacts involved assessing the estimated noise levels from the proposed action and alternatives, comparing them with ambient noise levels, and identifying the presence of any sensitive receptors near the seed orchard. Maps of the Horning vicinity were used to determine the locations of sensitive receptors.

Noise perception and annoyance to the public depend on the intensity of the sound (measured in dB), the frequency of the sound (high or low pitch), and the duration of the noise (steady, intermittent, or impulsive (sudden)). For single noise events, an increase of 3 dB is perceived by most people as barely louder. An increase of 6 dB is perceived as noticeably louder, and an increase of 10 dB is perceived as twice as loud (Cavanaugh 1998).

Aircraft noise is usually perceived as louder because of its frequency. Sudden impulsive sounds are also perceived as louder (FAA 1985). Helicopters generate a distinct noise which is a mixture of noise from many sources: engine, aerodynamics, main rotor, tail rotor and interaction of the vortices created by the two rotors. Blade slap is typically annoying, but it is not present in some maneuvers, speeds, and rotor configurations (HDOT 1994). A helicopter flying overhead at an altitude of 30 feet produces 85 dB at a distance of 600 feet.

There are two basic considerations for protecting the community from increased noise from short-term sources. To protect human health, noise levels must not exceed limits identified with potential loss of hearing. An L_{eq} of 73 dB sustained over 8 hours for 250 days or more per year can cause hearing loss to a general population over a prolonged time period (about 40 years) (EPA 1974). The other consideration for protecting the public is noise interference with activity, or annoyance. This depends upon the setting in which the increased noise takes place, for both indoor and outdoor activities. Thresholds for various uses vary from 45 L_{eq} (averaged over 24 hours) within residences and other locations based on a quiet use, to 70 L_{eq} (averaged over 24 hours) for outdoor exposure in recreational areas (EPA 1974). Communities that typically experience higher noise levels tolerate higher increases in noise (typically 5 dB more without complaints).

The impact on the noise environment is related to the magnitude of the noise levels and the proximity of noise-sensitive receptors to the noise source. Increasing the L_{eq} (averaged over 24 hours) to 73 dB or above for one year or more could be a significant impact, as this could potentially cause hearing loss in a portion of the general public. If noise levels increased, but affected noise-sensitive receptors to a level below 73 L_{eq}, the impact would not be significant. A decrease in noise levels would be a beneficial impact.

4.8.2 Potential Impacts of Alternative A—Maximum Production IPM

Normal background noise levels average about 45 to 50 dBA at Horning and in the surrounding area. The ground-based IPM activities associated with Alternative A (tractors and other

equipment) would negligibly increase noise levels at Horning for short periods, and the type of noise impact would be similar to the current noise environment at Horning. As noted in Table 3.8-2, at 1,600 feet away from the noise source, composite noise would attenuate to the area's ambient noise level.

Alternative A also includes aerial insecticide applications by helicopter. Horning would use helicopter applications at most two times per year during normal weekday working hours, and the duration of each application would not exceed a few hours. The occasional helicopter use, which would be similar to that at adjacent privately-owned timber farms, would increase noise levels on and around the orchard during the operations and could produce short-term annoyance among nearby residents, but impacts would be insignificant. Livestock on neighboring lands could experience minor startle effects during helicopter operations, but impacts to livestock would also be insignificant because of the infrequency and short duration of helicopter events.

There are no sensitive receptors within 1,000 feet of the seed orchard. There would be no significant noise impacts.

4.8.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under Alternative B, which includes both ground-based and aerial applications, impacts would be essentially the same type as under Alternative A, but could be slightly less if equipment use were reduced. Noise impacts would be insignificant.

4.8.4 Potential Impacts of Alternative C—Ground-Based IPM

Under Alternative C, only ground-based applications would be used. Noise impacts for ground equipment would be the same as under Alternative B, but there would be no helicopter noise. Noise impacts would be insignificant.

4.8.5 Potential Impacts of Alternative D—Non-Chemical Pest Management

Under Alternative D, no chemical pesticides would be used, and noise impacts could be similar to or less than the impacts under Alternative C, depending on the types of mechanical control used. There would also be no helicopter noise. Noise impacts would be insignificant.

4.8.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

Under Alternative E, the current insignificant noise impacts would continue. Before BLM applied any pesticides, including by helicopter, an EA would be prepared to determine potential impacts of that application, and would include an assessment of potential noise impacts to the area, if appropriate.

4.9 Cultural Resources

Cultural resources are limited, nonrenewable resources whose values may easily be diminished by physical disturbances. There are no important cultural resources at Horning, and the grounds have been disturbed over the years of the orchard's operations. The proposed action and alternatives include no construction or excavation activities that could disturb any undiscovered cultural resources either on or adjacent to the orchard. There would be no impacts to cultural resources from any alternative.

4.9.1 Analysis Approach and Assumptions

To determine potential impacts, the analysis focused on the types of activities that would occur, the location where they would occur, and the significance of the resource in that location. NEPA documents and past archaeological and historic resources surveys were reviewed. BLM and the State Historic Preservation Office (SHPO) were consulted for the latest information concerning cultural resources on the seed orchard.

The criteria used to determine the significance of impacts on cultural resources includes the effects on NRHP eligibility, future research potential, or suitability for religious or traditional uses. An impact could be significant if it resulted in the physical alteration, destruction, or loss of a resource listed or eligible for listing in the NRHP. An adverse impact could not be significant if only slight portions of the resource were affected or if the value of the resource was not important. The impact of the action could be beneficial if it protected or reconstructed the resource.

4.9.2 Potential Impacts of All Actions

As noted in Section 3.9, no important cultural resources have been identified at Horning, and the grounds have all been disturbed during the years of the orchard's operations. There are no nearby Native American religious sites. Neither the proposed action nor any alternative includes construction or excavation activities that could disturb any undiscovered cultural resources either on or adjacent to the orchard. There would be no impacts to cultural resources from any alternative.

In the unlikely event that archaeological materials were encountered during project activities, work in that location would cease until the artifacts were evaluated by a qualified archaeologist, and the BLM had consulted with the Oregon SHPO if applicable.

4.10 Socioeconomics And Environmental Justice

Socioeconomic impacts are generally related to changes in an area's population, number of jobs, employment structure, or income. No population or employment impacts are projected for the proposed action or any alternative at Horning. However, income in the ROI could be affected by changes in the land's productivity or value, or in the marketability of its products. There are three possible factors that would lead to economic impacts: offsite pesticide transport to a neighboring land parcel used for organic farming; decreased production on and adjacent to the seed orchard if pest control methods are not successful; and pest infestation on and adjacent to the seed orchard if pest control methods are not successful. The potential for impacts to the organic farm is negligible, with the probability for impact slightly higher under Alternative A. Decreased production is least likely under Alternative A, and increases successively with Alternatives B and C having a similar effect, and Alternative D having the greatest potential for this impact. Economic loss from uncontrolled pest infestation is most likely under Alternative D, and is unlikely under Alternatives A, B, or C. Overall, socioeconomic and environmental justice impacts would be insignificant under Alternatives A, B, C, or D. Similarly, under Alternative E (no action), the current insignificant impacts would be unchanged.

4.10.1 Analysis Approach and Assumptions

Measures used for impact analysis include population, employment, and income. The analysis used population data from the USBC, and employment and income data from the U.S. Bureau of Economic Analysis and the Oregon Employment Department. To predict impacts to socioeconomic resources in a given ROI, significance criteria were determined by analyzing long-term fluctuation in elements such as population, employment, and income within that ROI. This approach allows an ROI-specific determination of the appropriate levels, or thresholds, beyond

which changes in an element would noticeably affect individuals and communities. The analysis compares each element's actual yearly change to the predicted amount of change, which, in turn, is based on the average annual change that has occurred over the long-term period used as a basis for the analysis (1980-2000). The annual deviations between actual change and predicted (average) change are the basis for determining a threshold of significance for each element. Regions are assumed to have a greater capacity for positive change—growth—than for negative change; therefore, the negative income threshold is decreased by one-third to avoid understating impacts from actions that may result in a decline in income. Based on this methodology, a significant adverse impact for this ROI (Clackamas County) would be a decline of more than 7% in projected income as a result of an action assessed in this EIS. An increase in income would be considered beneficial. Since no employment or population changes are anticipated, no significance criteria were defined for those measures.

There are no disproportionate populations of low-income or minority persons, or children, in the areas surrounding Horning. Therefore, no environmental justice impacts would occur under any alternative considered in this EIS.

4.10.2 Potential Impacts of Alternative A—Maximum Production IPM

Under Alternative A, the risk assessment predicted negligible contamination to neighboring land parcels, one of which is a certified organic farm growing herbs and mushrooms. (This farm is located northeast of the seed orchard; see Figure 3.5-1.) While the probability of pesticide drift contaminating this farm is extremely low, unforeseen weather conditions coupled with a failure to quickly respond to adverse conditions by ceasing the application could increase the possibility of such an impact. The individual impact to the organic farm would be significant if pesticide residues were sufficient to cause the farm to lose its organic certification and, consequently, its ability to certify and market its produce as organic. The overall economic impacts of inadvertent contamination would be insignificant to the landowners surrounding Horning and to the ROI.

Economic losses due to increases in insects or disease, or to pest infestation, are very unlikely. Impacts would be insignificant.

4.10.3 Potential Impacts of Alternative B—IPM with Environmental Protection Emphasis (Proposed Action)

Under the proposed action, the more controlled application procedures (see Section 2.3.3) would further reduce the risk of offsite pesticide transport to neighboring land parcels, including the organic farm. The potential economic impacts to neighboring landowners from pesticide drift would be as described under Alternative A, but the likelihood for such impacts would be reduced. Production losses due to increases in insects or disease, or to pest infestation, are very unlikely. Impacts to income would be insignificant.

4.10.4 Potential Impacts of Alternative C—Ground-Based IPM

Under Alternative C, socioeconomic impacts would be similar to those predicted for Alternative B. Although it is a common perception that aerial spraying has the greatest potential for off-site drift, the risk assessment modeling concluded that a ground-based method (airblast sprayer) had more potential for drift deposition at the distance to the organic farm, given the specific wind direction. The potential risk of economic loss from contaminating nearby land parcels, such as the nearby organic farm, would be negligible. The likelihood of production losses due to increases in insects or disease, or to pest infestation, is similar to Alternative B. Impacts to income would be insignificant.

4.10.5 Potential Impacts of Alternative D—Non-Chemical Pest Management

Under Alternative D, no chemical pesticides would be used, so there would be no possibility of pesticide transport to nearby land parcels. However, reduced production and/or pest infestation could result if non-chemical pest control methods were not successful, resulting in economic losses. If the pest infestation were to spread from the seed orchard to neighboring land parcels whose crops were susceptible to those pests, those landowners would also suffer an economic loss. Although there could be localized economic losses, the overall impact to the ROI would be insignificant.

4.10.6 Potential Impacts of Alternative E—No Action: Continue Current Management Approach

Under Alternative E, the current insignificant economic impacts would continue. Before BLM undertook a pesticide application, an EA would be prepared to determine potential impacts of that application. The EA would include an assessment of the potential to contaminate neighboring land parcels and the consequent economic impacts.

4.11 CUMULATIVE IMPACTS

According to CEQ regulations at 40 CFR 1508.7, "cumulative impact" is the impact on the environment that 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 actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

In terms of pesticide or fertilizer application, other agencies or private individuals in the vicinity of the orchard may be using other treatments with many of the same chemicals as BLM proposes to use. Also, applications may be used in agriculture, forestry, or industrial operations that might create an overall chemical burden in the orchard area. While the chemicals used in the proposed IPM program are not expected to have an impact on water quality, streams that may receive some pesticide or fertilizer drift or runoff from the orchard also may be receiving drift or runoff of chemicals from other locations, and this cumulative burden may place the aquatic ecosystems at risk. The 1985 Clackamas County Soil Survey (SCS 1985) found 8% of the county's land area to be urban, 50% in timber, and 35% in crops, hay, or pasture. Horning's total orchard acreage accounts for 0.2% of the county's farm acreage and 0.1% of county timber acreage. Therefore, Horning's proposed IPM program is not expected to be present a significant contribution to the cumulative impacts to the environment from pest management in Clackamas County.

The human health risk assessment addressed cumulative risk to members of the public and workers from all of the pesticides and fertilizers as proposed for use under Alternative A, and from the subset of pesticides that are more likely than others to be used in a given year. Since no data exist indicating synergistic toxicity among the pesticides proposed for use at Horning, cumulative human health risks were estimated assuming additive toxicity. No risks to members of the public were predicted from these aggregated exposures. For workers, the highest cumulative exposure could occur if one employee was involved in all pesticide applications, with the exception of aerial applications, which are always conducted by a contractor. In this case, a risk of health effects is predicted, as the cumulative dose exceeds the acceptable level by a factor of 39.5 for noncarcinogenic effects, and the cumulative cancer risk is 7.15 in one million, which is slightly greater than the generally accepted level of one in one million. It is important to note that this cumulative risk scenario includes the unlikely case in which all pesticides that target every pest problem are called for during the season. The highest contributor to the cumulative hazard index is dimethoate, and the main contributor to the cancer risk is propargite. For the subset of

pesticides more likely to be used, no risks to workers were predicted. Actual cumulative risk values are likely to be less than the results estimated in this conservative analysis for the following reasons:

- It is highly unlikely that one individual would be exposed to every chemical in all of the scenarios evaluated in the risk assessment;
- Several pesticides are proposed for use as alternatives for certain groups of target pests or weeds, and if one were selected for use in a given season, the alternatives would not also be used;
- To avoid underestimating risk, where multiple application methods are possible for a proposed pesticide treatment scenario, the method with the highest associated risk was included in the cumulative assessment; and
- The temporal spacing of the potential chemical applications would correspond to a timeline in which some exposure routes were no longer active due to dissipation and degradation, prior to application of other chemicals.

4.12 Mitigation Measures

Alternative A. Based on the results of the quantitative risk assessment, the selection of Alternative A, Maximum Production IPM, could result in environmental impacts to human health and biological resources. Therefore, CEQ's regulations for implementing NEPA require that potential mitigation measures for these consequences be identified in this EIS. The following measures have been identified to mitigate the risks predicted for Alternative A:

- Diazinon would be applied to no more than 250 trees in one day at a maximum rate of 0.015 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of diazinon applied more than 3.75 lb a.i.) by any individual worker who is conducting both the mixing/loading and application activities.
- Dimethoate would be applied to no more than 22 trees in one day at a maximum rate of 0.13 lb a.i. per tree (nor any combination of number of trees treated and application rate with a total amount of dimethoate applied more than 2.86 lb a.i.) by an individual using the high-pressure hydraulic sprayer, and an individual other than the applicator would conduct the mixing/loading activities. If more than one applicator sprays trees during a single day, different mixer/loaders would prepare each pesticide mixture.
- An individual conducting hand pollination activities would not work on trees that had been treated with diazinon until at least 11 days post-application.
- An individual applying dicamba using a backpack sprayer would apply no more than 0.61 lb a.i. during any given day.
- An individual applying hexazinone using a backpack sprayer would apply no more than 6.5 lb a.i. during any given day.
- Greenhouse weighing/monitoring personnel would not handle seedlings treated with mancozeb for 14 days after application.
- Chlorpyrifos would not be applied within 25 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than three acres in any twelve-acre area within a 14-day period, at a rate no greater than 1 lb a.i. per acre .

- Diazinon would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than 150 trees at a rate of 0.015 lb a.i. per tree (nor any combination of number of trees and application rate more than 2.25 lb a.i. applied) in any twelve-acre area within an 11-day period.

- Dimethoate would not be applied within 40 feet of a bird box (unless the bird box is empty and covered with a plastic bag during spraying) or the edge of a managed orchard unit (the distance associated with no drift from the proposed application methods). It would not be applied to more than five trees at a rate of 0.13 lb a.i. per tree (nor any combination of number of trees and application rate more than 0.65 lb a.i. applied) in any three-acre area within a seven-day period.

- Fertilizer application rates would be limited to those identified in the typical scenarios (see Table 2.2-1).

- If calcium nitrate is applied to trees that are within 500 feet of streams after April 30, the fertilizer in these areas would be "watered in" if there is no rainfall within a week. During calcium nitrate application, orchard employees would be vigilant for nests of ground-nesting bird species, particularly the Oregon vesper sparrow and common nighthawk, to avoid applying fertilizer to any nests.

Alternatives B and C. A requirement for additional mitigation measures has not been identified for BLM's proposed action: Alternative B, IPM with Environmental Protection Emphasis. The design of this alternative, which includes the limitations specified in Section 2.3.3, is expected to address all identified potential risks. Similarly, Alternative C, Ground-Based IPM, incorporates all of these limitations, so no additional mitigation measures were identified.

Alternative D. No significant impacts would be associated with Alternative D, Non-Chemical Pest Management, so identification of mitigation measures is not required.

Alternative E. Mitigation measures for use of chemical pesticides under Alternative E, No Action, would be identified on a project-by-project basis during the specific NEPA assessments.

The ROD that will be published at the conclusion of the EIS process will specify the mitigation measures that will be implemented with the selected alternative.

4.13 Unavoidable Adverse Impacts

Any alternative would result in adverse environmental effects that cannot be avoided. Protection measures, limitations, and mitigation measures developed in this Draft EIS are intended to reduce the extent and duration of these effects. However, adverse effects cannot be completely avoided. There are two areas under Alternative A where potential risk was identified from the use of some pesticides and fertilizers in certain situations: human health (workers) and ecological resources (wildlife/aquatics). Specifically, the human health risk assessment predicted some worker risk from the use of diazinon, dimethoate, propiconazole, dicamba, hexazinone and mancozeb in certain situations. In response to these identified risks, however, Alternative B was developed to limit chemical pesticide use such that these estimated worker and ecological risks would be reduced to negligible levels.

The ecological assessment predicted that the use of *B.t.* as a biological insecticide could impact populations of non-target beneficial insects in areas immediately adjacent to any treated orchard units. In addition, the use of pesticides could adversely impact bird and amphibian species from application of chlorpyrifos, diazinon, and dimethoate, although most of the wildlife exposures are very low. An analysis of the potential for sublethal effects on special status fish species

identified potential risks to reproductive endpoints from typical applications of pyrethroids, and from maximum applications of organophosphates and pyrethroids. Potential risks to migratory endpoints were also identified for pyrethroid applications under maximum scenario conditions. As mentioned previously, Alternative B was designed in response to the risks identified for Alternative A, to limit chemical use and thereby reduce the estimated ecological risks to negligible levels.

There is also potential for additional adverse effects beyond those identified above. However, these also are expected to be negligible given the implementation of protection measures and limitations identified in this Draft EIS. These include:

- Short-term reduction in air quality from dust and engine emissions resulting from IPM activities (power tools and mechanical equipment that burn fossil fuels, prescribed burning, and volatile and drift fraction of pesticides used in chemical methods);
- Temporary increase in fire hazard from waste material (dry vegetation) left on ground after treatment;
- Localized changes in terrestrial wildlife habitat;
- Localized lethal impacts to non-target insects from insecticide use, and to non-target plants from herbicide use; and
- Temporary health effects from prescribed burning (eye, throat, lung irritation).

The potential for adverse effects varies with each alternative and is discussed in greater detail in earlier sections of this chapter. Adherence to protection measures (and, under Alternatives B and C, limitations) would minimize the potential for any adverse environmental effects.

4.14 Relationship Between Short-term Uses Versus Long-term Productivity

Short-term uses are generally those that determine the present quality of life for the public, including BLM orchard employees. The short-term use of the orchard is to produce improved seed for conifer seedling production, preserve individual valuable conifer trees, produce native species plants and plant species seed, and produce containerized seedlings in a greenhouse nursery. This high-quality seed is supplied to BLM and other cooperators for reforestation and restoration projects. Long-term productivity refers to the capacity of the soils to support sound ecosystems that produce resources such as forage, wildlife, water, and timber. Long-term productivity for a seed orchard refers to the capabilities of the seed orchard to support production that will continue to sustain adequate quantities of high quality seed. The proposed pest management program is designed to protect and enhance the long-term productivity of the orchard, as well as contribute to the short-term uses.

The cultural and biological pest control methods associated with short-term uses have no known long-term adverse effects on productivity. The pesticides examined in this Draft EIS also should have no adverse effect on long-term productivity because most dissipate in the environment relatively quickly and would not change the productivity of the natural environment.

4.15 Irreversible And Irretrievable Commitment Of Resources

Implementation of the proposed IPM program at Horning would result in the commitments of various natural resources and man-made resources. Some of these commitments of resources are irretrievable by virtue of duration of commitment or cost. In other cases, commitments of resources are irreversible since the resource is consumed during IPM implementation.

4.15.1 Irretrievable Effects

Orchard Seed Production

An irretrievable effect on resources is the loss of seed production opportunities. Seed production would vary between alternatives, as would the costs associated with accomplishing environmentally sound pest management. The commitment of time and dollars are irretrievable when production is lost. However, they are not irreversible, since production levels can be reversed by changing orchard pest management strategies in the future.

Seed loss, primarily to insects and disease, would occur under all alternatives, but would have the potential to be highest under Alternative D (Non-Chemical Pest Management).

Cost Efficiency

Lost efficiencies associated with not using an optimum mix of pest control methods would be irretrievable. Since Alternative A has the most flexibility for using all pest management methods, it should be the most cost-efficient.

4.15.2 Irreversible Effects

The principal irreversible commitment of resources associated with the proposed IPM methods is the use of fossil fuels from the operation of heavy equipment or power tools associated with mechanical methods or the equipment used in application of chemical pesticides and fertilizers. Pest management approaches selected, the mix of which can vary widely even within a single alternative, would determine the level of fossil fuel consumption. For example, hand applications of pesticides and manual vegetation control methods would consume no fossil fuel during the treatment, while mowers or a tractor-mounted sprayer would.

5.0 Consultation And Coordination

Public involvement and interagency/intergovernmental coordination and consultation are recognized as an essential element in the development of an EIS. Public participation has been encouraged and solicited since the original "Notice of Intent to Prepare an EIS" was published in March 1999, and will continue through completion of the Final EIS. A scoping plan was developed in June 2002 when BLM initiated contractor support to complete the IPM EIS (BLM 2002). Agencies and interest groups with special expertise or concerns related to pest management have been notified of the project and advised of the need to coordinate information and provide input. Technical and scientific information available from a variety of sources has been reviewed and considered during the scoping process.

5.1 Scoping Process

Table 5.1-1 outlines a chronology of BLM's public outreach for the EIS scoping – starting March 26, 1999, when the first Notice of Intent was published in the *Federal Register*, through July 26, 2002, the official end of the public scoping period for the Draft EIS.

Table 5.1-1. Chronology of Scoping Activities

Date	Action
3/26/99	Notice of Intent published in *Federal Register* (one EIS for all four BLM western Oregon seed orchards)
3/31/99	Media news releases in the *Clackamas County News*, *Molalla Pioneer*, *Silverton Associated Press*, *The Oregonian*, *Statesman Journal* (Salem), *Capitol Press*, *Sandy Post*, and *Sandy Profile*
3/31/99	Congressional news release – Darlene Hooley's Salem Office; state legislative representatives; Clackamas County Commissioners
4/7/99	Request for comments published in *Illinois Valley News* in Cave Junction, OR
4/22/99	Open house announcement and fact sheet mailed
4/99	Community outreach – Area bulletin boards (flyer announcing open house): Colton Market; Colton Post Office; Colton Grade, Middle and High Schools; Springwater Store; Gerber Farm Supply; Estacada Public Library; Estacada Ranger District Office; Meadowbrook; Clarkes Grade School; Clarkes Grange 261; Clarkes Store
5/11/99	Open house at Horning Seed Orchard (5 attended)
3/29/01	Revised Notice of Intent in *Federal Register* (indicating decision to prepare three district-specific EISs)
7/1/02	Mailing to interested public advising of additional scoping period and revised EIS schedule (approximately 150 on mailing list)
7/1/02	Mailing to interested agencies advising of additional scoping period and revised EIS schedule (approximately 30 on mailing list for both orchards)
7/5/02	Second public scoping period begins
7/10/02	Public notice in local newspaper, *Molalla Pioneer*
7/10/02	Public notice in local newspaper, *Clackamas County News*
7/11/02	Public notice in Clackamas County edition of Portland newspaper, *The Oregonian*
7/26/02	Second public scoping period ends

5.2 Persons, Groups, And Agencies Consulted

BLM actively solicited scoping comments from the interested members of the general public, including adjacent and nearby landowners and other public citizens, public interest groups, industry and business, members of the media, libraries, and schools; and requested input from state and Federal officials (including tribal representatives), and Federal, state, and local environmental resource agencies. These persons and groups are identified in more detail in Section 5.3.

Numerous members of the public, representing nearby landowners, orchard cooperators, and public interest groups, as well as two agencies have responded to date. OWRD (Bill Fujii) commented during scoping regarding the need to coordinate with the State Watermaster if IPM activities would require additional water for agricultural, irrigation, or domestic use; and NOAA Fisheries (Dan Tonnes), at the invitation of BLM, conducted a site visit of the orchard on October 31, 2002, to meet with BLM orchard staff, and identify and discuss potential areas of concern for special status aquatic species. BLM consulted with ODFW in November 2002 regarding the presence of special status aquatic species within orchard boundaries. Finally, BLM contractors consulted with the EPA Office of Pesticide Programs and with manufacturers of pesticide products during performance of the risk assessment to request relevant information. Specifically, EPA provided agency-prepared documents that summarize technical studies relevant to the FIFRA registration of the pesticides and the current status of "other" ("inert") ingredients. Pesticide manufacturers provided material safety data sheets and product labels, as well as information on "other" ingredients.

5.3 List Of Agencies, Organizations, And Persons To Whom Copies Of The Statement Are Sent

The current mailing list includes 187 names, 158 of which are members of the general public, including adjacent and nearby landowners and other public citizens, public interest groups, industry and business, members of the media, libraries, schools, and state and Federal officials (including tribal representatives); and 29 of which represent Federal, state, and local environmental resource agencies. A breakdown of the state, Federal, and local environmental resource agencies, tribal contacts, and public interest groups is provided below.

Agency List (29)

City of Estacada
City of Oregon City
City of Oregon City, Parks Department
Colton Water District
South Fork Water Board

Clackamas County Forester
Clackamas County Board of Commissioners
Clackamas County Extension Service

Oregon Department of Agriculture
Oregon Department of Environmental Quality
Oregon Department of Fish and Wildlife – Clackamas Fish Hatchery
Oregon Department of Fish and Wildlife, Planning and Coordination (NW Region)
Oregon Department of Fish and Wildlife (2)
Oregon Department of Forestry (2)
Oregon Department of Forestry, Clackamas-Marion District
Oregon Department of Land Conservation
Oregon Department of Water Resources

Deputy State Historic Preservation Officer
National Marine Fisheries Service
U.S. Department of Agriculture, APHIS Wildlife Services
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Fish and Wildlife Service, Eagle Cr. Nat. Fish Hatchery
U.S. Forest Service, Willamette National Forest
U.S. Forest Service, Regional Forester
U.S. Forest Service, Mt. Hood National Forest HQ
U.S. Forest Service, Clackamas River Ranger District

Public Interest Groups (46)

1000 Friends of Oregon
Associated Oregon Loggers, Inc.
Canaries Who Sing
Canby Utility Board
Cascadia Forest Alliance
Coast Range Guardians
Estacada Chamber of Commerce
Clackamas River Basin Council
Clackamas River Water
Defenders of Wildlife
Department of Veterans Affairs (Canada)
Friends of Clackamas
Izaak Walton League of America
Molalla Area Chamber of Commerce
Molalla River Watch
Molalla Timber Action Committee
Molalla Saddle Club
M-TAC
Native Plant Society of Oregon
Northwest Christmas Tree Growers Association
Northwest Coalition for Alternatives to Pesticides
Northwest Forestry Association
Northwest Steelheaders
NW Environmental Defense Center
NW Ecology Center
Oregon Environmental Council
Oregon Equestrian Trails
Oregon Farm Bureau Federation
Oregon Forest Industries Council
Oregon Forest Resources Institute
Oregon Natural Resources Council
Oregon Public Broadcasting
Oregon Trout
Oregon Water Trust
Oregon Wildlife Federation
Oregonians for Food and Shelter
OSPIRG
Pacific Rivers Council
Portland Audubon Society
Rivers Network
Sierra Club
Society of American Foresters
The Harness and Pleasure Driving Association
The Nature Conservancy

Western Wildlife Sports, Association
Western Wood Products Association

Government Officials (12)

Confederated Tribes of Warm Springs (2)
Governor's Federal Forest & Resource Policy Team
Governor's Forest Planning Team
Honorable Darlene Hooley, U.S. House of Representatives
Rep. Earl Blumenauer
Rep. Jan Lee
Sen. Roger Beyer
Sen. Gordon Smith
Sen. Marylin Shannon, District 15
Sen. Ron Wyden
Sen. Rick Metsger

6.0 List Of Preparers

BLM Staff (Horning Seed Orchard, Salem District Office, Oregon State Office)

Name	Primary Responsibility	Discipline	Related Professional Experience
Jeannette Griese	Contracting officer's representative State coordinator	Forestry	14 years BLM forester/ silviculturist
Greg Tyler	Horning Seed Orchard manager	Forestry	15 years forestry-related roles (BLM and Forest Service)
Arlene Roux	Alternate contracting officer's representative	Seed orchard and botany	11 years BLM
Bob Ruediger	Fisheries Alternate contracting officer's representative ESA Section 7 consultation (fish)	Fisheries	16 years BLM 5 years Forest Service
Chester Novak	Water resources Water quality monitoring Soils	Hydrology and soils	13 years BLM hydrologist 10 years BLM soil scientist
Roy Price	Terrestrial wildlife and habitat	Wildlife management	27 years BLM wildlife biologist
Terry R. Garren	Horticulturalist Contributor	Horticulture	25 years BLM horticulturalist 5 years Weyerhaeuser tree breeding supervisor 1 year commercial pesticide applicator 5 years laboratory analysis and biological technician (Oregon State University)
Paul Jeske	Salem District NEPA, Planning	NEPA and planning	20+ years BLM multi-resource staff and supervisory roles
Claire Hibler	Botany	Botany and weeds	14 years BLM botanist/ forester
Fran Philipek	Cultural resources	Archaeology	25 years BLM and Forest Service
Leslie Frewing-Runyon	Oregon State Office NEPA	Planning and economics	14 years BLM regional economist/planner

Contract Staff (LABAT-ANDERSON INCORPORATED and Subcontractors)

Name	Primary Responsibility	Discipline	Related Professional Experience
Christine Modovsky	Project manager Alternatives Human health Ecological impacts Risk assessment	Environmental chemistry and risk assessment	15 years risk assessment and NEPA analysis/ compliance (LABAT, EPA, Dept. of Interior)
Kristin Sutherlin	Deputy project manager Socioeconomics and environmental justice Land use Noise Public involvement	Planning and economics	16 years socioeconomics and NEPA analysis/ compliance (LABAT, USDA APHIS, University of Maryland)
Susan Smillie	NEPA compliance Public involvement Water resources	Environmental engineering and biology	22 years NEPA analysis/compliance and impact assessment (LABAT, Morrison-Knudsen, Battelle)
Randy McCart	Soils GIS mapping Air quality	Geography	14 years NEPA compliance and impact assessment (LABAT)
John Weeks	Environmental fate modeling Risk assessment	Forestry, biostatistics, biology, and toxicology	23 years fate and transport modeling, risk assessment (SC Johnson, LABAT, Ketron, Environmental Research Associates, Forest Service)
Jason Sandahl	Aquatic species impacts	Aquatic toxicology	12 years pesticide management and impacts, science research and education, forestry (Oregon State University, Forest Service, Peace Corps)
Dr. William Liss	Aquatic species impacts	Salmonid ecology	26 years science research and education (Oregon State University)
Dr. Jesse Ford	Impact assessment	Ecology	23 years science research and education (Oregon State University, University of Alaska, NCASI, Cornell University, North Shore Consultants, University of Minnesota, Minnesota DNR)
Jody Nelson	Vegetation impacts IPM methods	Botany	12 years ecological impact assessment, science education (LABAT, Denver Botanic Gardens, University of Northern Colorado)
Karin Keifer	Terrestrial wildlife	Biology and animal behavior	4 years ecological impact assessment, research, animal husbandry (LABAT, Sevilleta National Wildlife Refuge, Dallas Zoo, Tantra National Park -Slovakia, Franklin and Marshall College)
Quinn Damgaard	General research and support Cultural resources Aquatic species	Biology	2 years technical writing, lab analysis, vegetation management, public outreach (LABAT, Midwest Laboratories, Pottawattamie County Conservation Board)
Dean Converse	General research and support Air quality	Geography and environmental studies	3 years air quality, environmental analysis (LABAT, Nebraska DEQ)

7.0 References

Certain information cited below was obtained from Internet sites maintained by government agencies or other reliable sources. The Internet citations (uniform resource locators, or URLs) were accurate at the time the data were collected. However, websites change frequently due to changes in data availability or reorganization of information, and the cited URLs may not work in the future. If this occurs, "backing up" to a less specific web address may allow retrieval of the information. For further assistance in locating references cited in this document, please contact the seed orchard manager at the Bureau of Land Management.

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NRC. See National Research Council.

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Acronyms And Abbreviations

°F	degrees Fahrenheit
μg/L	micrograms per liter
μg/m3	micrograms per cubic meter
μm	micron, micrometer
a.i.	active ingredient
AQCR	air quality control region
BLM	Bureau of Land Management
BMP	best management practice
B.t.	Bacillus thuringiensis
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
CX	categorical exclusion (under NEPA)
dB	decibel
dBA	"A-weighted" decibel
EA	environmental assessment
EFH	essential fish habitat
EIS	environmental impact statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	evolutionarily significant unit
EXAMS	Exposure Analysis Modeling System
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLPMA	Federal Land Management and Policy Act
FONSI	finding of no significant impact
ft	foot or feet
ft^2	square feet
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
GA 4/7	gibberellic acid
gal	gallon
GLEAMS	Groundwater Loading Effects of Agricultural Management Systems
in	inch or inches
IPM	integrated pest management
kg	kilogram
lb	pound(s)
LC_{50}	median lethal concentration
LD_{50}	median lethal dose
Leq	equivalent sound level
MATC	maximum acceptable toxicant concentration
mg	milligram

mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
min	minute
MSA	metropolitan statistical area
Mt.	Mount
NA	not applicable / not available
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWSOMA	Northwest Seed Orchard Managers Association
O3	ozone
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OWRD	Oregon Water Resources Department
oz.	ounce
PAH	polynuclear aromatic hydrocarbon
Pb	lead
PCI	per capita income
PM	particulate matter
PM2.5	particulate matter less than 2.5 microns in diameter
PM10	particulate matter less than 10 microns in diameter
ppm	parts per million
Q	quotient
RfD	reference dose
RMP	resource management plan
ROD	record of decision
ROI	region of influence
SDWA	Safe Drinking Water Act
SEIS	supplemental environmental impact statement
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SWAP	source water assessment program
TMDL	total maximum daily load
TPI	total personal income
UIC	underground injection control
URL	uniform resource locator (web site address)
USBC	U.S. Bureau of the Census
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

Glossary

Note: All definitions are specific to their use in this environmental impact statement. Additional terms specific to the recently conducted risk assessment are found in Section 10 of the risk assessment report.

Acaricide. An insecticide that specifically targets mites and ticks.

Active ingredient. The pesticidally active chemical contained in a pesticide product.

Acute. Single-dose toxicity study. May also refer to adverse effects that exhibit a short and relatively severe course.

Adsorption. Adhesion of substances to the surfaces of solids or liquids; technically, the attraction of ions of compounds to the surfaces of solids or liquids.

Anadromous. Fish that are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn.

Analysis. The second step of an ecological risk assessment, which examines the two primary components of risk–exposure and effects–and the relationships between each other and ecosystem characteristics.

Biological control. The use of natural enemies to attack a target plant, insect, or animal pest.

Boom. A tubular metal device that conducts a pesticide or fertilizer mixture from a tank to a series of spray nozzles. A boom may be mounted beneath an aircraft or behind a vehicle.

Broadcast application. The applying of pesticide or fertilizer over an entire area or field rather than only to rows, beds, or individual plants.

Buffer (strip or zone). A zone left untreated with pesticide or fertilizer (at the outer edge of a treated area or along streams) as protection against the effects of treatment.

Cancer slope factor. Represents the probability that a 1-mg/kg/day chronic dose of a chemical will result in formation of a tumor. Expressed as a probability, in units of "per mg/kg/day" or $(mg/kg/day)^{-1}$.

Canopy. The uppermost level of a forest community, usually formed by the tallest trees.

Carcinogen. A substance producing or inciting cancer.

Categorical exclusion. A category of actions that do not individually or cumulatively have significant effects on the human environment and for which neither an environmental assessment nor an environmental impact statement is required.

Cation exchange capacity. The capacity of a soil to adsorb cations (positively charged ions), expressed in milliequivalents per 100 grams of soil.

Chemical degradation. The breakdown of a chemical substance into simpler components through chemical reactions.

Chemigation. The injection of pesticides and fertilizers through irrigation systems.

Chronic. Long-term, usually lifetime or near lifetime in duration.

Clonal orchard. A production unit consisting of plants that are genetically identical to the parent plant; they are produced asexually, e.g., from cuttings or suckers.

Control. Reduction of a pest problem to a point where it is below an acceptable threshold.

Critical habitat. (1) Specific areas within the habitat occupied by a species at the time it is listed under the *Endangered Species Act* where there are physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection, and (2) specific areas outside the habitat occupied by the species at the time it is listed upon the determination by the Secretary of the Interior that such areas are essential for the conservation of the species.

Cultural resources. Remains of human activity, occupation, or endeavor, reflected in districts, sites, structures, building, objects, artifacts, ruins, works of art, architecture, and natural features that were of importance in past human events. Cultural resources consist of (1) physical remains, (2) areas where significant human events occurred, even though evidence of the events no longer remains, and (3) the environment immediately surrounding the actual resource.

Cumulative impact. 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

Dose. The amount of chemical entering the body.

Drift. The movement of airborne particles by air motion (wind) away from an intended target area.

Endangered species. Plant or animal species that are in danger of extinction throughout all or a significant part of their range.

Environmental assessment. A systematic environmental analysis of site-specific activities used to determine whether such activities would significantly affect the human environment, and whether an environmental impact statement is required.

Environmental impact statement. An analytical document developed for use by decisionmakers to weigh the environmental consequences of a potential action.

Ephemeral stream. A stream that flows only in direct response to precipitation and whose channel is at all times above the water table.

Exotic plants. Plants that are not native to the region in which they occur.

Exposure assessment. The second step in human health risk assessment, involving estimation of doses from various scenarios and routes of exposure.

Fertilizer. Any of a large number of natural or synthetic materials, including manure and nitrogen, phosphorus, and potassium compounds, spread on or worked into the soil to increase its fertility. General fertilization refers to application of fertilizer to entire orchard units, in contrast to calcium nitrate application to specific trees for cone stimulation.

Forb. A low-growing herbaceous plant that is not a grass, sedge, or rush.

Formulation. A specific composition of pesticide active ingredient(s) and other ingredients, comprising a pesticide product.

Girdling. A physical cutting or disruption of the cambial sap flow within a tree.

GLEAMS. Groundwater Loading Effects of Agricultural Management Systems, a computer-based model for predicting the fate and transport of agricultural pesticides and fertilizers.

Ground cover. Grasses or other plants that keep soil from being blown or washed away.

Habitat. The environment in which an organism occurs.

Half-life. The time required for a chemical to degrade to 50% of its original concentration.

Hazard assessment. The first step in human health risk assessment, in which each chemical's toxic properties and dose-response relationship are identified.

Hazard index. An indicator of risk to human health, representing the ratio of the estimated dose to the reference dose. A hazard index of 1 or less usually indicates negligible risk to human health.

Infiltration. The downward or lateral entry of water into the soil.

Integrated pest management. Use of several techniques (for example, burning, grazing and mechanical, manual, or chemical methods) as one system to control pests where they are unwanted. IPM means responding to pest problems with the most effective, least-risk option. Under IPM, actions are taken to control pests only when their numbers are likely to exceed acceptable levels and to limit the impact on other organisms and the environment.

Intermittent stream. A stream that flows only at certain times of the year when it receives water from winter rain or melting snow.

LC_{50}. The concentration of a chemical in water at which 50 percent of test animals were killed. It is usually used in testing of fish or other aquatic animals.

LD_{50}. The dosage of toxicant (expressed in milligrams of toxicant per kilogram of animal body weight) required to kill 50 percent of the animals in a test population.

Leaching. The movement of chemicals through soil by water.

Lowest-observed-effect concentration. The lowest chemical concentration in water at which adverse effects are observed in an aquatic toxicity study.

Maximum acceptable toxicant concentration. The geometric mean of a no-observable-effect concentration and a lowest-observed-effect concentration.

Mean. The average of a set of values.

Median. The middle value in a ranked distribution.

mg/kg. Milligrams per kilogram, usually indicating a dose level in terms of milligrams intake of a substance per kilogram of body weight.

mg/kg/day. Milligrams per kilogram per day, usually indicating a daily dose level in terms of milligrams intake of a substance per kilogram of body weight per day.

mg/L. Milligrams per liter, usually indicating a concentration of a substance in water.

No-observed-effect concentration. The highest water concentration at which no adverse effects are observed in an aquatic toxicity study.

Noxious weed. According to the *Federal Noxious Weed Act* (FL 93-629), a weed that causes disease or has other adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the United States and to the public health.

Perennial stream. A stream that flows continuously year round.

Pesticide. Any substance or mixture of substances intended for controlling insects, rodents, fungi, weeds, or other plants and animals that are considered pests.

Phytophagous. An organism that feeds on plants, particularly an insect that feeds on shrubs or trees.

Prescribed burning (prescribed fire). The scientific, intentional burning of wildland fuels in either their natural or modified states under conditions to allow the fire to continue to a predetermined area and to produce the intensity of heat and rate of spread needed to meet certain objectives.

Problem formulation. The first step in an ecological risk assessment, in which the purpose of the assessment is provided, the problem is defined, and a plan for analyzing and characterizing risk is determined.

Raptors. Birds of prey, such as owls, hawks, or eagles.

Receptor. An ecological entity that is exposed to a stressor.

Reference dose. An estimate of the highest possible daily dose of a chemical that will pose no appreciable risk of deleterious effects to a human during his or her lifetime.

Riparian. Pertaining to or located along a stream bank or other water bodies, such as ponds, lakes, reservoirs, or marshes.

Risk characterization. The third step in both human health and ecological risk assessment, in which estimated doses are compared to a chemical's toxic properties to predict the potential for adverse effects under the given conditions of exposure.

Risk. The probability that a substance will produce harm under specified conditions.

Rogue. To systematically cut and remove individual trees and/or families considered no longer desirable within the seed orchard population. Roguing is used to increase genetic gain potential in an orchard. Theoretically, the more intensive the roguing, the greater the genetic improvement.

Runoff. The part of the precipitation in a drainage area that is discharged from the area in stream channels, including surface runoff, ground water runoff, and seepage.

Scoping. The process by which significant issues relating to a proposal are identified for environmental analysis. Scoping includes eliciting public comment on the proposal, evaluating concerns, and developing alternatives for consideration.

Soil compaction. The compression of the soil profile from surface pressure, resulting in reduced air space, lower water-holding capacity, and decreased plant root penetrability.

Sorption. The process of taking up or holding by either absorption or adsorption.

Special status species. Species which are proposed for listing, officially listed as threatened or endangered, or are candidates for listing as threatened or endangered under the provisions of the

Endangered Species Act; those listed by a state in a category such as threatened or endangered implying potential endangerment or extinction; and those designated by each BLM State Director as sensitive.

Spot treatment. Applying pesticide to a selected individual area (as opposed to broadcast application).

Stressor. Any physical, chemical, or biological entity that can induce an adverse response.

Threatened species. A plant or animal species that is not in danger of extinction but is likely to become so within the foreseeable future throughout all or a significant portion of its range.

Trade name. The commercial name of a pesticide product.

Water table. The upper limit of the part of the soil or underlying rock material that is wholly saturated with water.

Weed. A plant out of place or growing where not desired.

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Appendix A: Seed Orchard Pests

This appendix provides detailed information on the more common and damaging insects and diseases at the Horning Seed Orchard; information on weeds and animal pests is provided in Chapter 1. It is not intended to be a complete guide to orchard insects and diseases in the Pacific Northwest Region.

Insects

Cone gall midge (*Contarinia oregonensis*)
Adults are flies 3-4 mm in length, which emerge in early spring. The females lay eggs near the base of the cone scale in newly opened flowers. When the egg hatches, the larva tunnels into the young cone scale and forms a gall. When the mature cones become wet in the fall, the larvae drop to the litter and pupate. Cocoons are spun in the litter, and overwintering occurs in prepupal and pupal stages. Seeds may be fused to the scale when only a few larvae are present or completely destroyed when numbers are large. This insect can be a major destroyer of Douglas-fir seeds; severe infestations can destroy all seeds in the cone.

Fir coneworm (*Dioryctria abietivorella*)
As a group, coneworms are one of the most important North American lepidopterous cone pests. Life cycles and preferred hosts vary between species of coneworms. White fir, Douglas-fir, ponderosa pine, and sugar pine cones may be attacked. The adults are moderate-sized, drab-colored moths with mouth parts that are somewhat snout-like. Larvae can bore into the cambium of the trunk, branches, and shoots or into fresh green cones. The larva feeds voraciously, tunneling indiscriminately through the scales and seeds. One larva can destroy an entire cone. A heavy infestation can destroy 100% of a Douglas-fir cone (and seed) crop.

Cone moth (*Barbara colfaxiana*)
Adult cone moths are grayish brown in color with forewings transversely banded with gray, silver, and brown. The moth emerges in spring and the female lays eggs on the cone bract. The larva feeds first in scale tissue, but soon moves to the central seed-producing portion of the cone, where it mainly feeds on seeds. By the end of July, they pupate in a tough pitch-coated cocoon in the center of the cone. Feeding tunnels around the cone axis sharply reduce seed production. External evidence of damage differs depending on cone size. This insect is one of the major pests of Douglas-fir cones. One larva may destroy up to 60% of the seeds in a cone. Pupae may remain in diapause for one to three years in the old cones after they have fallen from the trees.

Western conifer seed bug (*Leptoglossus occidentalis*)
The broad flat tibia of the hind legs characterizes the western conifer seed bug, also called the leaf-footed bug. It feeds upon and damages the seed of Douglas-fir, sugar pine, and ponderosa pine. The adults are 15 to 18 mm long, and are reddish brown to dark gray with dense whitish pubescence. The seed bug overwinters in the adult stage and emerges in May or June; there is one generation per year. The eggs are deposited in rows on the needles from June until mid-August. Seed bug nymphs feed in the ovules and can cause conelet abortion. Later nymphal instars and adults feed on seeds. No external damage is visible on the cones. Both adult and nymph stages insert their long proboscises into cones to suck juices from the seeds, while the bug remains on outside of cone. Feeding by this insect lowers the quality of the seed crop, and heavy feeding can cause up to 40% loss in Douglas-fir seed crop.

Seed chalcid (*Megastigmus* spp.)
The species of this genus include pests of a wide range of conifers. All species are highly specialized in their method of attack and feeding habits. Several species are found attacking Douglas-fir and true fir; however, only one species is known to attack pine (*M. albifrons*). The adults are small antlike wasps, which may be black to brown, or yellowish in color. The females are larger (about 4.0 mm long) with a long curved ovipositor. Eggs are deposited into immature

seeds. Larvae feed only on seed contents, each one destroying a single seed. After devouring the contents, it remains within the seed coat. There is no external evidence of damage on the seeds until the adult emerges, after which a clearly defined emergence hole is evident. Larvae remain over winter in the seeds, either in the cone or in the litter under the trees in the orchard. It pupates in the spring.

Bark beetles and wood borers
A variety of small, dark-colored, winged beetles bore into standing green trees or downed slash material, or lay eggs on the bark surface of standing green trees or dead and downed trees. These damaging forest insects are ubiquitous throughout the forest, are specific to host trees, and maintain fairly consistent populations during normal conditions, but increase significantly during stressful events or conditions. Under normal circumstances, vigorous, healthy trees have unique capabilities to resist beetle attack. However, under adverse conditions such as disease infection, heat and drought damage, mechanical damage, high water tables, nutrient deficiencies, or a variety of other stress-related tree conditions, the insect populations increase and infest weak trees, as well as healthy nearby trees.

An adult insect generally emerges in spring from a tree infested the previous year and flies to a susceptible green tree, where it excavates an egg gallery in the fresh phloem tissue. When the eggs hatch, the larvae bore away from the egg gallery and construct a mine that gradually increases in length and width. The pattern of adult and larval mines is distinctive for each insect species. The larvae pupate in the wood and overwinter as pupae or adults. Some species produce more than one generation in a year.

The trees are killed by fungi introduced into the tree by beetles feeding and boring in the phloem tissue, and the fungi expanding into the xylem tissue, obstructing the transport of water to the tree crown. The beetle galleries themselves also can become so numerous that the tree is girdled by insect activity.

Disease

Armillaria* root rot (*Armillaria* spp.*)
Armillaria root disease is the most common and most widely distributed forest root disease in Oregon and Washington. It is often found affecting trees that have been weakened by other agents, particularly drought or poorly drained soils. Symptoms of *Armillaria* root disease include thin and/or chlorotic foliage; distress cone crops; abundant resin flow, or leaching of brown liquid at tree bases; a yellow-stringy root and butt rot; and tree mortality. Crown and root collar symptoms occur on only 15-20% of the living infected trees with disease centers; infection in the remaining trees is virtually undetectable. Virtually all trees and other woody species in Oregon and Washington can be damaged by *Armillaria* root disease. It can locally be very severe in southwestern Oregon. In general, white fir is the most susceptible. Mortality caused by the disease is most common in Douglas-fir plantations between the ages of 10 and 25. Tree death after age 25 is uncommon unless the trees are stressed. The disease in Douglas-fir is often associated with poor planting technique, use of planting stock that is not adapted to a particular site, wounding, inadequate drainage, or soil compaction. Affected trees can be windthrown but tend to die standing. Tree death by the disease will often increase one to two years after severe droughts or nearly complete defoliation by insects. Spread of the disease from infected stumps or trees to adjacent healthy trees occurs mainly by mycelia growing across root contacts and, to a lesser extent, by rhyzomorphs that form after a stump or large root system has been colonized. Once a root is infected, the fungus can spread distally and proximally within it.

Annosus root rot (*Fomes annosus*)
Annosus root rot is caused by the fungus *Fomes annosus* and occurs throughout the Pacific Northwest. Estimates of losses caused by this disease have not been made for Oregon and Washington, but it is believed to be the third most damaging root disease in the two states after

laminated root rot and *Armillaria* root disease. Losses due to annosus root disease are known to be increasing. All conifers can be affected, but there are differences among species in degree of susceptibility and damage. In the Pacific Northwest, western hemlock, mountain hemlock, grand fir, white fir, and Pacific silver fir are highly susceptible and can be severely damaged. Douglas-fir, western redcedar, incense cedar, Port-Orford-cedar, western larch, western white pine, sugar pine, Engelmann spruce, and Sitka spruce are slightly susceptible and rarely damaged. Pines in southwestern Oregon are rarely affected.

This disease is more difficult to identify than are other common root diseases. It causes variable symptoms. Some hosts, especially true firs, frequently die without showing crown symptoms. Other hosts, particularly pines, exhibit decreased terminal growth, needle yellowing, and crown decline prior to death. The disease infects its hosts in two ways: by windblown spores depositing and germinating on freshly exposed wood, and by mycelial growth from diseased roots to healthy roots via contacts. The disease causes two kinds of damage: tree mortality and wood loss through decay. Tree death is the usual result of infection in resinous hosts. Trees killed by the disease tend to die standing rather than be windthrown. Mountain pine beetles and western pine beetles often attack infected pines, and attacks by fir engraver are common on infected true firs.

Laminated root rot (*Phellinus weirii*)

Laminated root rot is caused by the fungus *Phellinus weirii*. It is the most damaging root disease in the Pacific Northwest, estimated to cause annual losses of 32 million cubic feet of wood in western Oregon and Washington. Douglas-fir, mountain hemlock, white fir, and grand fir are especially susceptible; pines and cedars are considered to be tolerant or resistant and are seldom infected and killed. Crown symptoms of affected trees include retarded leader growth; short, sparse, and chlorotic faded foliage; and distress cone crops. Crown symptoms are usually not seen until at least half of the host root system is affected. Only about half the infected trees in a disease center will have crown symptoms. Laminated root rot extensively decays roots of highly susceptible host trees and either causes windthrow or kills the trees by destroying their ability to take up water and nutrients. Infected saplings and small poles usually die standing; larger trees are more likely to be windthrown. Infected trees may suffer growth loss for several years prior to death. Laminated root rot often predisposes highly susceptible hosts to bark beetle. Spreading of the disease is all by mycelia on or within the roots. The fungus can persist from tree generation to generation in infested areas and can be considered a disease of the site. It can survive up to 50 years in large roots and stumps of dead or cut trees, and can infect trees that become established nearby by growing across root contacts. This disease is found mostly in forested areas with a site history of occurrence, and likely not to be found in non-forest conditions.

***Phytophthora* root rot (*Phytophthora* spp.)**

Hosts include a range of conifer species, primarily Douglas-fir and true fir. Infection by *Phytophthora* species results in decay and loss of roots. Depending on the degree of infection, seedlings may be killed, stunted, or show no above-ground symptoms. Because the fungus needs high soil moisture to sporulate and infect, the disease is most common in low, poorly drained areas. In these wet areas, 100 percent of seedlings may be killed or culled, although usually less than 1% of a crop is lost to *Phytophthora*.

Black stain root rot (*Leptographium wageneri*)

This disease can be found in most parts of Oregon and Washington, but is far more common west of the Cascade Range. It tends to be most widely distributed and most damaging in southwest Oregon. Black stain is a vascular wilt-type disease rather than a true root rot, colonizing the water-conducting tissues of the roots, root collars, and lower stems, ultimately blocking the movement of water to the foliage. Infected trees experience severe moisture stress, decline rapidly and die. Often, disease-weakened trees are infested by bark beetles and woodborers at the root crown area. Black stain causes crown symptoms similar to those of other conifer root diseases, including sudden reduction of terminal growth, partial loss of older needles, foliage chlorosis, and production of distress cone crops. Douglas-fir is the most common host of black stain in the Pacific Northwest, where centers of black stain root disease usually are found in 15-25 year old plantations or in heavily stocked patches of natural regeneration. It is believed that

Douglas-fir over 30 years old develop substantial resistance to the disease. With other hosts, the disease affects trees of all ages in relatively pure stands. Long-distance spread of the fungus involves insect vectors, predominantly root-feeding bark beetles (*Hylastes nigrinus*) and weevils (*Steremnius carinatus* and *Pissodes fasciatus*).

***Phomopsis* canker (*Phomopsis lokoyae*)** Infection of two-year-old stem tissue occurs early in the second growing season, resulting in a canker at the base of the new growth, which girdles the stem. The part of the shoot above the canker is killed. The disease appears periodically in the Pacific Northwest, typically 1 or 2 years after droughts. It is associated with prolonged periods of warm weather during budburst. Douglas-fir is most susceptible to this pest.

***Rhabdocline* needlecast (*Rhabdocline pseudotsugae*)**
Rhabdocline needlecast is occasionally common, but seldom damaging in Douglas-fir stands. Yellow and purple blotches appear on infected needles in the fall and following spring. Needles drop one year after infection. Purplish-pink fruit bodies break through the undersides of one-year-old needles in May to June, exposing orange-brown spores. Spores released from them are windborne and require considerable moisture to germinate. Only the current season's needles are susceptible. There is considerable variation in the susceptibility of Douglas-fir to this disease. In general, coastal Douglas-fir is less susceptible than the inter-mountain variety, and local seed source stock is less susceptible than offsite stock. However, trees within any stand show different levels of infection (many are immune). Disease is most common on trees 5-30 years old.

Swiss needlecast (*Phaeocryptopus gaumanni*).
This disease is very common in western Oregon and Washington. Damage is seldom serious in forest stands, but is probably the most important disease in Christmas tree plantations. Only Douglas-fir is attacked. Infected needles are killed and shed. Growth loss may result on severely infected trees. It has become an increasingly important concern as a threat to Douglas-fir in the Oregon Coast Range and western Cascades. For the past several years, Swiss needlecast has been especially damaging in stands within 30 miles of the Oregon coast north from Coos Bay. Affected trees exhibit yellowing and browning of infected previous year's needles in spring shortly after current needles emerge. One-and two-year-old needles are lost in summer, with needle loss beginning in the bottom of the crown and progressing upward. Severely infected trees may have only current season's needles in the fall. The disease cycle begins in spring when spores are released from fruiting bodies on older diseased needles. Spores are carried on air currents to newly emerged needles. When adequate moisture is present, the spores germinate and the fungus penetrates the needle. Needles are only susceptible for a few weeks after emergence. The fungus ramifies through the needles and, eventually, the fruiting bodies form in the stomata in the fall and winter and mature in the spring.

Douglas-fir rust (*Melampsora occidentalis*)
Native *Melampsora* rusts attack a wide variety of conifer hosts that belong to a number of different genera, including Douglas-fir (one of the primary hosts). *Melampsora* rusts attack the foliage of young primary hosts, most severely in the regeneration and sapling stages. The infected needles are killed and, in years of severe infections, all current year's foliage may be eliminated, resulting in growth reduction. Occasionally, cone scales are attacked, but no damage to seed occurs as happens with cone rusts. All foliage rusts cause yellow to orange discoloration or spots on the foliage of their hosts. For *M. medusae* and *M. occidentalis*, host alternation appears to be obligatory; that is, the presence and proximity of both poplars and conifers is necessary for the rust's survival. Basidiospores from secondary hosts infect the new foliage of the primary hosts in spring, and aecia begin to appear on the primary hosts approximately two weeks after infection. The aeciospores infect the secondary hosts during the summer, and uredinia begin to appear on them approximately two weeks after infection. Uredeniospores spread and intensify the rust on its secondary hosts. Toward fall, telia, instead of uredinia develop on the secondary hosts. They overwinter in a state of dormancy in dead leaves on the ground and germinate the following spring, at a time when young shoots of the primary hosts begin to break forth from their buds.

Storage molds (including *Botrytis cinerea*, *Pythium* spp. and *Phytophthora* spp.)
Storage molds in greenhouse seedlings are caused by a wide variety of soil and fungi which enter the storage bag via the soil or on the roots or foliage of the packed seedlings. Under favorable conditions, before, during, or after storage, these fungi move from the soil or organic debris in the bag, into healthy seedling tissue, and cause destruction of part or all of the seedling. Fungi such as *Pythium* and *Phytophthora* can infect the lower stem and roots, and cause root death. *Botrytis cinerea*, cause of gray mold in the field, can also infect foliage and stem tissue in storage, causing needle or branch death. Storage molds occur sporadically; their occurrence depends upon environmental conditions before, during, and after storage, the physiological condition of the seedlings, and the abundance of inoculum on the seedling or in the soil adhering to the rots.

Gray mold (*Botrytis cinerea*)
Many conifer species, Douglas-fir, and redwoods are very susceptible to this pest. Gray mold infects and kills needles, branches, or stems. Gray mold occurs at varying levels, primarily in Douglas-fir crops during the second year. Gray mold occurs both in the field and in storage. In the field, the disease is most prevalent after the canopies of the seedlings have closed, usually in the second or third year, and during cool, wet seasons. Beneath the canopy, an ideal environment exists for the development of gray mold – abundant moisture and the presence of dead or senescing plant material, which the fungus grows on. The fungus is also a problem in greenhouses where high humidity and favorable temperatures increase the potential for outbreaks.

Damping-off (*Pythium* and *Fusarium* spp.)
Pythium and *Fusarium* are found in the soil, or can be present on the seeds themselves. They can affect a wide variety of plants, including most conifers. Damage includes poor germination or death of seedlings shortly after emergence. Damping-off is common and usually results in losses up of 5 to 10% in some seedlots which may, on occasion, be much higher.

***Lophodermium* needle cast (*Lophodermium seditiosum* and others)**
Needles of infected pines develop brown to black spots on the needles in the late summer and fall of the first year of infection. These needles turn completely brown and are cast the following spring. Heavily infected seedlings can be killed by the fungus.

***Fusarium* root disease (*Fusarium* spp.)**
Fusarium root disease (hypocotyls rot) infects the roots; this may or may not result in death of the seedling, depending on the extent of decay in the root system. *Fusarium* hypocotyls rot involves the infection and decay of the hypocotyls tissue at the ground line, so that the seedling is girdled and killed. Losses in various seedlots range from 0 to 30%. *Fusarium* root rot is less common in nurseries which routinely fumigate their soil prior to sowing. Common hosts include Douglas-fir, ponderosa pine, and true firs.

Leaf spots and blights (various fungal species)
Infected leaves show spots and blotches, function poorly, and die early. Heavy infections cause stunting. Hardwoods serve as hosts and conditions favoring pests include high seedling densities, high humidity, and wet foliage.

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Appendix B: Monitoring Plan

Note: This monitoring plan would be modified as necessary to address the differences between the various pesticides and application methods, and to respond to the results of on-going monitoring.

B.1 Water Quality Monitoring

B.1.1 Goal

The goal of the water quality monitoring plan is to ensure water quality is protected during and after integrated pest management (IPM) activities.

B.1.2 Background

Agencies and the public are concerned that pesticide application in the Horning Seed Orchard may enter streams and groundwater, contributing to concentrations which exceed those known to have impacts to human and aquatic life. Special status salmonid species occur in direct proximity to actively managed orchard units and the seasonal groundwater table is a concern in terms of greenhouse effluent management.

The Human Health and Non-Target Species Risk Assessment for Pest Management at Horning Seed Orchard indicates the use of pesticides and fertilizers poses minimal threat to water quality with two possible exceptions: (1) accidental spill of pesticides directly into tributaries to both Nate and Swagger Creeks; and (2) runoff of ammonia due to potential fertilization rates.

Water quality monitoring of an aerial esfenvalerate application during the spring of 2001 documented that introduction of drift is possible despite implementation of standard best management practices (BMPs). Monitoring of a similar spray project in 2002 documented control of drift through implementation of additional stream-specific BMPs. During both periods of monitoring, surface runoff from the orchard units in Section 13 was found to be an insignificant pathway for esfenvalerate transport, as almost all actual and potential rainfall infiltrates the soil surface. No concentrations of esfenvalerate were recorded in stream flow samples during peak storm flow periods. This monitoring indicated that risk assessment estimates in surface runoff from Section 13 are very conservative and significantly over-estimate the potential for runoff and concentrations of exposure. The predicted model values have inherent uncertainty in terms of pesticide movement through subsurface pathways of preferential flow. Through previous monitoring and observation, it is evident that tile drain flow is a significant component of water movement from the orchard units to the stream systems.

BMPs utilized in the 2002 spray project, design features included in the Orchard Water Management Plan, and design features in the EIS proposed action are expected to minimize the potential water quality impacts from drift, runoff, irrigation, and spills. Monitoring the BMPs (listed as “protective measures” in this EIS) and limitations, documenting impacts, and adjusting practices based on this knowledge are part of the EIS design features.

This plan provides general direction for water quality monitoring whenever a pesticide or fertilizer covered under the EIS is proposed for use. The plan covers four types of monitoring: implementation monitoring, effectiveness monitoring, validation monitoring, and compliance monitoring. Implementation monitoring is intended to document the design features and mitigation measures that are actually implemented. The effectiveness component documents how well these measures performed in avoiding introduction of pesticides to the aquatic and groundwater system. The effectiveness data would also be used to further validate that water quality modeling conducted for the Human Health and Non-Target Species Risk Assessment was conservative for orchard units in Section 23. Compliance monitoring would be used to document domestic water quality and pesticide fate in terms of irrigation effluent.

B.1.3 Overall Objective

The overall objective of the water quality monitoring program at Horning is to document the impacts of IPM actions on water quality and to use this information to continue or modify the protective measures needed to meet the requirements for a healthy aquatic ecosystem. This documentation would include impact assessment for application of pesticides, spills, and irrigation of greenhouse effluent. A full assessment of protective measures used in the orchard requires monitoring both groundwater and surface water. Documentation would focus on the following monitoring questions, which were formulated based on public concerns and prior monitoring results.

B.1.4 Specific Monitoring Questions

1. Does drift of aerial or ground-based application occur?

Method: Monitor all aerial applications and high-risk ground-based applications to ensure compliance with protective measures and to document application rates, environmental conditions, and the actual occurrence of drift.

2. Does aerial or ground-based application of insecticides, herbicides, and fungicides result in measurable concentrations in the streams associated with the applied fields?

Method: Conduct effectiveness monitoring for "high risk" pesticides depending on application to ensure that the implemented protective measures were effective in preventing drift, surface runoff, and subsurface runoff from entering surface water.

3. What are the measured pesticide concentrations in tile drains (subsurface flow) from application orchard units?

Method: Conduct flow and pesticide sampling at tile drain outlets to document the significance of tile flow in total runoff, and document pesticide concentrations in the tile flow.

4. If a spill occurs, what is the potential for surface water and groundwater contamination and what are the resulting concentrations in the associated stream and groundwater area?

Method: Depending on the type and amount of chemical, conduct surface water, ground water, air, and soil monitoring in order to comply with the ODEQ Hazardous Substance Remedial Action Rules (OAR 340-122). At a minimum, sample "at risk" streams and the immediate groundwater table, if present. Conduct sampling of orchard domestic well if in proximity to spill.

5. Are detectible concentrations of greenhouse pesticides present in the local groundwater associated with the greenhouse effluent irrigation field?

Method: Conduct periodic sampling of shallow groundwater wells located in the effluent field.

6. What are the cumulative effects of the most toxic pesticides included in the IPM program?

Method: Conduct fall / winter monitoring of select streams for analysis of a "high risk" pesticide applied during the previous season.

The overall strategies to address these questions and apply these methods are provided in the following section.

B.1.5 Monitoring Strategies

B1.5.1 Implementation Monitoring

All outdoor pesticide applications would be documented by the seed orchard manager or designated representative. Items to be documented include type of pesticide or fertilizer applied, date of application, method of application, area treated, amount applied, precipitation for the three days preceding and following application, location used for mixing and loading, wind direction and speed for aerial or airblast applications, relative humidity, air temperature, and notes regarding whether any leakage or spills occurred. A list of all implemented design features for each unit applied would be provided in the Annual HSO Monitoring Report with a summary included in the Salem District Annual Implementation Monitoring Summary.

Implementing protective measures and analyzing monitoring data of all types depends heavily on quality climate information. Informed decisions involving pesticide application rely on access to on-site weather data. Maintenance of the existing seed orchard climate station would continue providing real-time climate data including air temperature, precipitation, wind speed, wind direction, and relative humidity. These data would provide documentation of compliance and information to predict runoff patterns for effectiveness and validation monitoring.

All greenhouse pesticide applications would be documented by the greenhouse manager or designated representative. During the irrigation season, the type of pesticide and fertilizer applied, date of application, and greenhouse area treated would be recorded. Greenhouse personnel would monitor and record the monthly irrigation supply to the greenhouse and the daily volume exiting the storage tank for effluent irrigation.

B.1.5.2 Effectiveness Monitoring

Drift

Drift Card Monitoring

All orchard units planned for aerial spray and “high risk” ground-based applications would have spray cards placed such that drift from the application can be captured and characterized. Where the application unit is in direct proximity to a flowing stream, cards would be placed at a maximum of 50-foot intervals along the edge of the unit prior to the application. Immediately after the application, the cards would be collected and reviewed to determine if any “signature” of drift has occurred, the extent of the drift, and the potential for contamination of the adjacent stream or wetland. A copy of all the cards would be kept on file at Horning, along with a record of their location and all the compliance monitoring documentation. Where open canopy occurs in the stream buffer, drift cards would be placed to characterize potential intrusion of drift toward channels.

Surface Water Monitoring

Water samples would be taken in streams before and after spray application as per ODF (1994) protocols and site-specific “time of concentration” measurements. Selection of sampling stations for surface water sampling would be based on the proximity to application areas. (See Figures B-1 and B-2 for location of designated sampling sites.) The selection of a specific pesticide for analysis would depend on the chemical characteristics, amount applied, and application method. Samples would be collected above and below the helicopter corridor when aerial spray is used in the north portion of Section 13.

Samples would be taken within 24 hours prior to application and at 15 minutes, 2 hours, 4 hours, 8 hours, and 24 hours after the first swath has been sprayed parallel to the stream of concern. The time of collection would be based on the time of concentration measurements in the flowing channels associated with the treatment areas. These measurements would be taken during the 24

Figure B-1: Section 13 Water Quality Sites

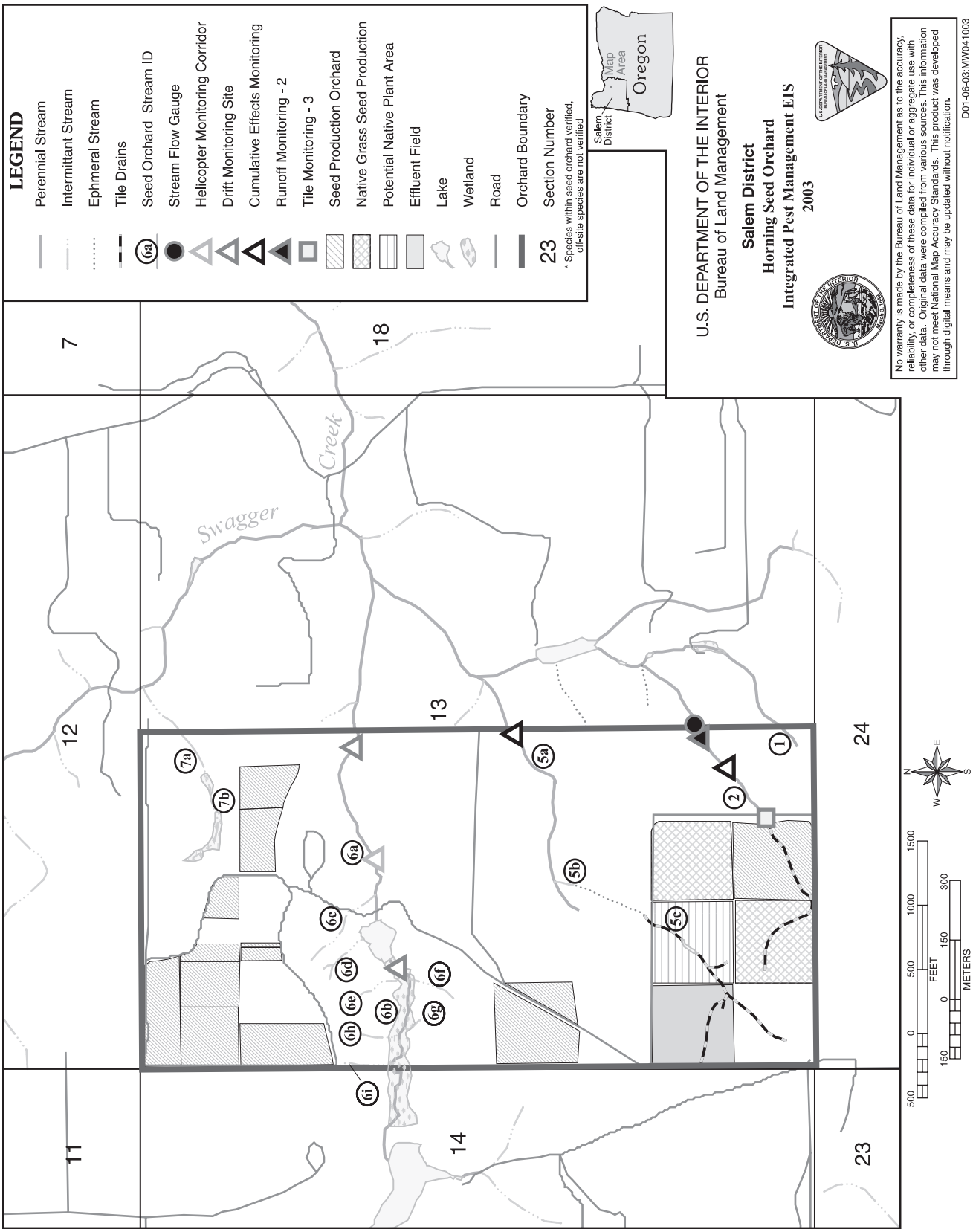
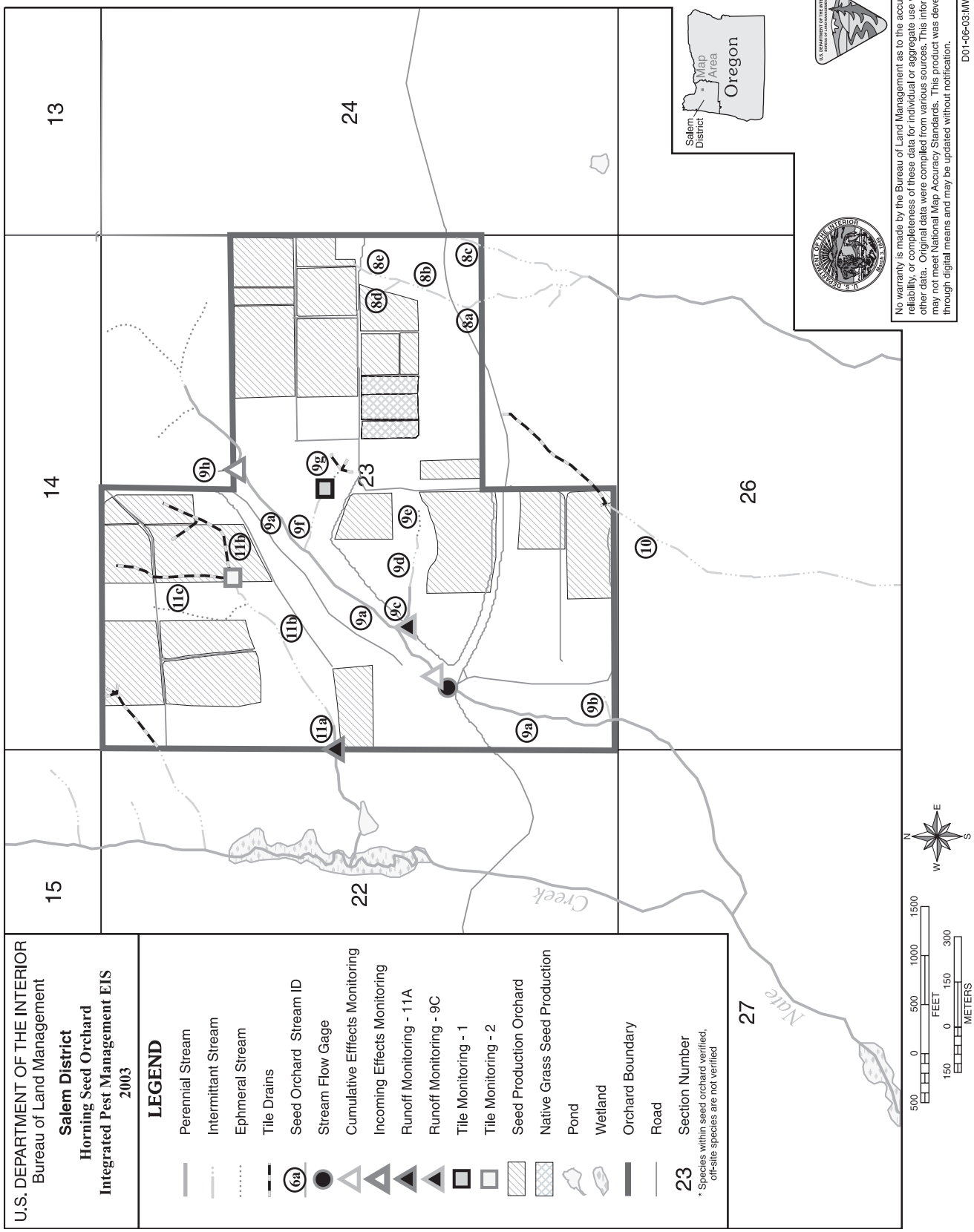


Figure B-2: Section 23 Water Quality Sites



hours prior to application. During the 24 hours after application, a series of composite samples would also be taken through the use of a continuous pumping sampler. These data would provide a 24-hour concentration to compare with the ODF calculation, water quality criteria, and literature studies.

All data would be used in conjunction with the spray cards to determine the effectiveness of the full "suite" of protective measures implemented to avoid drift. Samples would be analyzed at a state-certified laboratory that has detection limits of 0.02 parts per billion (ppb) for most of the potential pesticides. Samples would be collected in accordance with laboratory instructions. When sites are sampled, additional interpretive data would be collected for pH, specific conductance, turbidity, and temperature.

Runoff

Surface Runoff

Pesticide fate modeling from the risk assessment indicates that field runoff events within the first six months after spray application have the highest probability for carrying detectible concentrations of pesticides. One study (TFW 1993) determined that runoff events within the first 72 hours of application were the most important in terms of increases in detectible pesticide concentrations. Effectiveness monitoring of design features in the proposed action would target those periods of precipitation that could result in field surface runoff and increased stream flow. These periods are most likely to carry the greatest detectible concentrations of pesticides.

Previous rates of surface runoff and predicted concentrations from Section 13 have been shown to be significantly lower than the literature and model predictions for the soils and climate at the orchard (BLM 2002). Under this plan, similar investigations would be conducted in Section 23, where most future applications are planned. Perennial flowing Streams 9c and 11a would have continuous flow recording stations that would collect water and sediment samples on a flow weighted basis with the intension of providing individual storm concentrations for multiple runoff events. These stations would account for most of the "highest risk" applications in the seed production orchards of Section 23. The data from these stations would represent water quality conditions as a result of the effectiveness of implemented protective measures and limitations in the higher risk seed production orchards.

Stream flow and concentration sampling would continue in the downstream station at Stream 2 to document the fate of esfenvalerate application as per BMPs implemented in 2002. This site would also be used to determine the long-term downstream passage of any concentration found to flow from the upstream tile drains in the native seedbeds. This station would collect continuous flow along with water and sediment samples on a flow-weighted basis, in conjunction with upstream tile flow. Comparison would be made with the tile drain results and semi-permeable membrane device monitoring (see descriptions of sub-surface and cumulative monitoring, below). The selection of a specific pesticide to analyze would depend on the chemical characteristics of the pesticides use in the native seedbeds. This monitoring would provide information in determining wetland and channel effectiveness in attenuation of potential pesticides from the native seed operations.

All data would be used in conjunction with continuous recorded climate data to illustrate the effectiveness of design features in minimizing introduction of pesticides to the aquatic system. Samples would be analyzed at a state-certified laboratory that has detection limits of 0.02 ppb for most of the potential pesticides. Samples would be collected in accordance with laboratory instructions.

Subsurface Runoff

The orchard contains approximately 1,500 feet of "perforated drain pipe" located in orchard units identified for potential broadcast pesticide use. This is a concern, since water that would

naturally percolate through the full soil profile (thus having significant opportunity for absorption of compounds) is allowed to move more rapidly off-site through the tile system. This is termed preferential flow, which has no proven predictive model for determining the fate of pesticides. Currently, there are no data documenting the amount of runoff moving through the tile systems nor the contribution of pesticides from these conduits.

Previous monitoring (BLM 2001, BLM 2002) indicates that subsurface flow could be a significant pathway for water to reach the stream system via the orchard units. Since much of the drain system was installed in the 1970s and 1980s, information such as the depth and full extent of the system is unknown. As a conservative measure, management buffers are planned along tile drain "corridors". These management buffers preclude broadcast spray of pesticides until more is understood about the drain flow rates, linkage to surface flow and the associated pesticide concentrations. Monitoring the drain pipes would provide an indication of the effectiveness of the drain buffers and over time would provide justification for future application within the corridors.

Drain pipe flow and pesticide concentration sampling are planned for three sites in the orchard (see map A). Tile site 1 is a control with no previous application of pesticide and no planned application in the future, except for herbicide spot spray. Tile site 2 is in the tile drains located in the northern portion of Section 23 draining an actively managed seed production orchard. Tile site 3 is in the tile drain located in the native seedbeds in Section 13. Continuous flow measurement would also be recorded at all three tile sites. Sampling would target flushing periods, such as during significant spring and fall storm events. These events would be most likely to mobilize compounds in solution and sediment. Focus would be on pipe flow periods immediately after "select" applications and the first pipe flow after the summer application period. The selection of a specific pesticide to analyze would depend on chemical characteristics, amount applied, application method, and proximity of the treatment to the tile area.

Cumulative Effects Runoff

Previous monitoring for the 2001 and 2002 environmental assessments did not address the potential for non-detectible pesticide concentrations, which over a cumulative period could reach sub-lethal levels affecting beneficial uses. There is also concern over the transitory nature of concentrations in the stormflow period and uncertainty whether sampling is accounting for concentration which may be present. Manpower, budget, and logistics all demand that only flow with the highest potential for pesticide presence be sampled. During these flow events, samples are often composite according to the rise and fall of the hydrograph, which in turn can inadvertently diminish concentrations.

In an effort to deal with these issues and answer the cumulative effects question, semi-permeable membrane devices (SPMDs) would be deployed in Streams 9a, 2, and 5a to monitor the accumulation of "high risk" pesticides in reaches containing aquatic species. The SPMD is an in-stream "accumulator" which allows calculation of an average pesticide concentration during the period of deployment. For this reason, the SPMDs would only be deployed during the initial winter storms and spring storms periods after pesticide application. Chlorpyrifos, dimethoate, esfenvalerate, permethrin, propiconazole, and chlorothalonil are compounds that could be sequestered (accumulated) in an SPMD.

Stream flow gauges (USGS and BLM) would be maintained in both Streams 2 and 9a to provide flow data for derivation of concentrations (pesticide loading) over the period of time the SPMD is deployed. Data from the SPMD concentrations would be used to compare and validate the storm flow concentration monitored during the deployment period. Since previous monitoring has document no detection of esfenvalerate at 0.02 ppb for all storm flow monitoring, the SPMD would serve as a better indicator of a "low concentration" presence of the pesticide and provide documentation of beneficial use exposure over time.

B.1.5.3 Validation Monitoring

Validation monitoring is intended to verify the water quality modeling predictions presented in the EIS. Concentrations well below those that would cause sub-lethal effects to fish were predicted for Stream 9a and the combination of Streams 2 and 5. Both of these stream systems would be monitored for effectiveness of protective measures. The data are intended to help validate the conservative estimates in the risk assessment.

As a partial continuation of past EA sampling, runoff samples of both water and sediment would be captured at the edge of field P-11 (flowing to Stream 5), which is the only field observed to have had overland flow since the initiation of water quality monitoring at the orchard. This unit has a collection chamber installed. During significant rainfall events, this site would be visited and a water sample taken from the collection chamber. Once the first surface runoff event is captured and results become available, further sampling would be determined based on concentrations detected. In the short term, these data would be used to assess the mobility of esfenvalerate since unit application was conducted in 2002. Concentrations would be compared with modeled results utilizing field- and climate-specific data to validate risk assessment estimates. In the future, this site would receive only herbicide application and would be used to determine their associated mobility.

Stream concentrations gathered at site 9c in Section 23 would also be compared to model results using actual application information, field specific data, and continuous climate record. These data would provide a relationship between previous monitoring results and the Section 23 management that is planned for the future. Once the yearly application period is complete, the climate record collected during that period would be used to model a predicted concentration using the GLEAMS and MOC models. These concentrations would be "diluted" using the continuous flow data from the station. The resulting concentrations would be compared with the actual measured concentrations for each storm event sampled.

B.1.5.4 Compliance Monitoring

Spill Monitoring

In the event of a pesticide spill, the volume of spill, proximity to water, and pesticide characteristics such as toxicity and mobility would be evaluated to determine if water sampling is desirable and necessary. If so, water samples may be collected in a sufficient number and at surface water and groundwater locations that would allow characterization of impacts and effective remediation methods. Depending on ODEQ Hazardous Substance Remedial Action Rules (OAR 340-122), monitoring could include surface water, ground water, air, and soil. At a minimum, sampling would be conducted in the "at risk" streams draining the spill area and the immediate groundwater table if present. Sampling would also be conducted of the orchard domestic well if it is in proximity to the spill.

Groundwater Monitoring

The domestic well would be monitored according to the parameters outlined by the Oregon Department of Health. A pesticide would also be sampled from the well on a yearly basis during maximum well usage. The pesticide chosen would vary according to the rates, persistence, and mobility of the pesticides applied during the period since the last sampling. These samples would be collected in late summer and handled according to state-certified laboratory instructions.

On select distribution lines in the greenhouse effluent field and the storage tank overflow site, groundwater monitoring wells would be installed to monitor groundwater quality. Monitoring would be conducted during the winter period when risks are highest for irrigation water to potentially reach the local ground water table. When and if the local groundwater table is less than six feet from the surface (soils are at high moisture content), water samples would be taken and analyzed for a select pesticide that has been applied during the period. If these "point in time"

samples are found to have detectible levels of the pesticides, SPMDs would also be deployed in selected wells. These devices would allow a more quantitative determination of long-term concentration in the local groundwater.

The depth to the water table would also be monitored on a periodic basis to determine sampling potential and information for irrigation timing. If a tank overflow event occurs, the distance of travel and estimated quantity would be recorded.

B.1.6 Annual Reporting

All monitoring information associated with IPM during a calendar year would be compiled and reviewed on an annual basis. This information, along with analysis results and protective measures recommendations, would be contained in an Annual Horning Seed Orchard Monitoring Report. This report would be available to the public and regulatory agencies at the end of January. This schedule should provide necessary information for formulating the plan for the coming year and the future monitoring needs. Results would also be included in the Salem District Annual Program Summary and would be on file at the Horning Seed Orchard.

B.1.7 Responsibility

Specific aspects of implementing this plan would be determined by the Salem District hydrologist in coordination with the seed orchard manager, tailoring the site-specific monitoring needs to the pesticides actually applied and the level of use. The district hydrologist would be responsible for formalizing annual monitoring plans with the orchard manager, selecting sample locations, determining where and when to sample, analyzing sample results, reporting annual monitoring results, presenting results to regulatory agencies, and submitting an annual budget.

The district hydrologic technician would be responsible for maintenance of all sampling sites, collecting all water samples, QA/QC, transferring samples to the laboratory as appropriate, coordination with the analysis lab, and providing data for analysis.

B.2 Pest Monitoring

Monitoring of pests (insects, diseases, vegetation, unwanted animals) is an integral and ongoing component of the orchard IPM program. A wide variety of monitoring tools are used to detect and report the incidence and severity of pest activity and damage to orchard resources and facilities.

Knowledge of potential pests, recognition of damage symptoms, past damage in the orchard or surrounding lands, analysis of the damage in relation to objectives, and other factors help to determine the best way to manage pests as part of an IPM program. Field observations and pest identification methods, along with specific pest and damage survey techniques, are used to detect the presence of pests and the severity of damage. Annual assessments of cone and seed insect populations and damage are used to predict potential crop damage and the need for pest control. Other insect, disease, vegetation (noxious weeds and competing vegetation), and animal pests are routinely surveyed throughout the orchard during normal orchard activities and projects and during periodic orchard tree inventories.

Pest and damage survey data are collected, summarized, and evaluated to determine if control measures are needed and the most effective methods of control. The primary focus of pest management in the orchard is the protection of cone and seed crops. A variety of methods are currently used to determine the presence of cone damaging insects at Horning.

Monitoring for the seed chalcid has taken place at Horning since 1998 using a sampling technique developed by U.S. Forest Service entomologists. Sticky traps are monitored for chalcid in the spring between the time when the first cones turn pendant until ten days after all cones are pendant.

Results from this monitoring give an approximate estimate of seed chalcid populations and anticipated chalcid damage.

Monitoring for the cone gall midge has been done using two techniques: pheromone traps and ground traps. Pheromones lure the males to a sticky trap, from which information is gathered on emergence and potential damage. The procedure is still under development by entomologists at the University of British Columbia, with their goal being to develop strong correlations between trap counts and insect damage. Ground traps have also been used to determine the timing of cone gall midge emergence from the duff and litter layer, but this method does not predict potential damage.

Cone dissection research, under the direction of Beth Wilhite, a U.S. Forest Service entomologist, is ongoing each fall following cone collection. Cones are manually dissected and seed is examined under a microscope and through x-rays to determine the degree of damage caused by each of the cone insects. The results of this process are compared with those from the spring monitoring traps, field observations, and actual seed yields.

In the future, pest monitoring plans would be modified and expanded to incorporate new research and include new pests. To help with this effort, forest health (insect and disease) specialists are contacted as necessary to assist in pest identification and assessment and to obtain IPM recommendations. For other IPM work, noxious weed specialists, botanists, wildlife biologists, fish biologists, and silviculturists may be contacted for expertise in identification of pests or control methods. Also, seed orchard staff members receive periodic training to build a knowledge base for recognition of orchard pests and damage symptoms.

B.3 Human Health Monitoring

All BLM employees involved in pesticide application programs at Horning would be required to participate in a monitoring program. Monitoring would ensure that all of the worker protection measures and limitations to protect worker health are implemented.

Documentation would include such things as names and application duties of involved individuals, chemical(s) used, dates of application, acreage and location of treatment areas, use of protective clothing and equipment, duration of exposure, and method of application.

Baseline and annual (unless no applications are made in a year) medical evaluations would be conducted on BLM employees for the use of cholinesterase-inhibiting pesticides. The Government would not conduct medical or personal monitoring of contractors involved with pesticide application.

B.4 References

BLM. See U.S. Bureau of Land Management.

ODF. See Oregon Department of Forestry.

Oregon Department of Forestry. 1997. Forest chemical monitoring program. November 1997. Salem, OR.

Rashin, E., and C. Graber. 1993. Effectiveness of best management practices for aerial application of forest pesticides. TFW-WQ1-93-001. State of Washington Timber, Fish and Wildlife. Olympia, WA.

U.S. Bureau of Land Management. 2001. Horning Seed Orchard Esfenvalerate Spray 2001, Water Quality Monitoring Report for Salem District. C.A. Novak and K.A. Appleman. Salem, OR.

U.S. Bureau of Land Management. 2002. Horning Seed Orchard Esfenvalerate Spray 2002, Water Quality Monitoring Report for Salem District. C.A. Novak and K.A. Appleman. Salem, OR.

Appendix C: Risk Assessment Summary

C.1 Risks To Human Health

A quantitative risk assessment was conducted to estimate the risks to members of the public and workers as a result of using the proposed pesticides and fertilizers at Horning Seed Orchard, as described under Alternative A, Maximum Seed Production. The application details are listed in Table 2.2-1 in Chapter 2 of this EIS, and the proposed application methods are described in an attachment to this appendix. The supporting record for this EIS contains the full risk assessment report. The methodology and results of the human health risk assessment are summarized in the following paragraphs. Detailed information on inputs, methodology, assumptions, and outputs can be found in Sections 4.0, 5.0, and 6.0 of the risk assessment report.

Computerized fate and transport modeling was conducted to estimate concentrations of pesticides in environmental media at the point of exposure. The Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model was used to characterize the leaching and runoff behavior of the pesticides. Published studies and the Method of Characteristics model were used to represent attenuation in runoff due to buffer zones, and to estimate concentrations in groundwater, on-site streams, Swagger Creek, Nate Creek, Milk Creek, and Clear Creek. AgDRIFT was used to estimate off-target pesticide drift from aerial applications, airblast applications, and applications using a tractor-pulled rig with a boom. Field studies reported in the published literature provided the basis for estimates of drift from other ground-based pesticide application methods. The Exposure Analysis Modeling System model was used to predict downstream concentrations following accidental spills of pesticide concentrate or tank mixes. Section 3.0 of the risk assessment report provides an overview of the models, their inputs, and the results obtained. The estimated surface water and groundwater concentrations due to runoff or leaching are presented in Tables C-1 and C-2, respectively, and the estimated drift deposition results are presented in Table C-3.

To assess the risk of human health effects from using pesticides and fertilizers at Horning, it was necessary to estimate the human exposures that could occur as a result of the proposed applications and associated activities, and to estimate the probability and extent of adverse health effects that could occur as a result of those exposures. This risk assessment employs the three principal analytical elements that the National Research Council (1983) described and EPA (1989, 2000a) affirmed as necessary for characterizing the potential adverse health effects of human exposures to existing or introduced hazards in the environment: hazard assessment, exposure assessment, and risk characterization.

The risk assessment addresses risks from fertilizers and the 19 pesticide active ingredients, as well as “other” ingredients in the pesticide formulations, formerly termed “inert” ingredients. EPA (2000b) has classified these other ingredients into four categories, based on the degree of toxicity posed by the chemical, as follows:

- List 1: Inerts of toxicological concern.
- List 2: Potentially toxic inerts, with high priority for testing
- List 3: Inerts of unknown toxicity
- List 4: Inerts of minimal concern

Table C-1. Estimated Surface Water Concentrations from Runoff and Erosion (mg/L)

		Section 13 Streams		Section 23 Streams		Swagger Creek	
Chemical	**App Method**	**Typ**	**Max**	**Typ**	**Max**	**Typ**	**Max**
Acephate	HPHS & HHW	-0-	-0-	-0-	-0-	-0-	-0-
Chlorpyrifos	Airblast	1.03E-006	1.58E-006	2.17E-006	3.33E-006	2.63E-007	4.11E-007
Diazinon	HPHS	1.37E-009	6.40E-005	9.96E-010	4.64E-005	3.19E-010	1.54E-005
Dimethoate	HPHS	-0-	6.91E-005	-0-	1.80E-005	-0-	1.43E-005
Cyclohexanone		-0-	3.28E-006	-0-	8.54E-007	-0-	6.80E-007
Petroleum distillate		2.84E-007	1.99E-005	7.41E-008	5.18E-006	5.57E-008	4.12E-006
Esfenvalerate	Aerial	1.75E-007	4.90E-007	4.56E-007	1.29E-006	5.06E-008	1.23E-007
Ethylbenzene		-0-	3.26E-007	-0-	8.59E-007	-0-	1.06E-007
Xylene		-0-	3.13E-008	-0-	8.23E-008	-0-	1.01E-008
Esfenvalerate	Airblast	5.81E-008	2.20E-007	1.51E-007	5.79E-007	1.68E-008	5.68E-008
Ethylbenzene		-0-	1.51E-007	-0-	3.97E-007	-0-	4.89E-008
Xylene		-0-	1.45E-008	-0-	3.81E-008	-0-	4.69E-009
Esfenvalerate	HPHS, HHW, & BP*	4.60E-008	1.82E-007	1.17E-007	4.63E-007	8.36E-009	3.01E-008
Ethylbenzene		-0-	1.21E-007	-0-	3.07E-007	-0-	2.50E-008
Xylene		-0-	1.15E-008	-0-	2.94E-008	-0-	2.39E-009
Horticultural Oil	HPHS	4.75E-007	4.83E-005	-0-	-0-	8.56E-008	1.00E-005
Permethrin	Airblast & HPHS	-0-	-0-	2.02E-009	3.31E-009	-0-	-0-
Ethylbenzene		-0-	-0-	-0-	5.14E-009	-0-	-0-
Light aromatic solvent naphtha		-0-	-0-	8.84E-008	4.83E-007	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-
Propargite	HPHS	2.81E-007	1.00E-006	7.74E-007	2.75E-006	5.20E-008	1.66E-007
Chlorothalonil	HPHS	3.00E-008	4.05E-006	6.47E-008	8.72E-006	5.45E-009	8.39E-007
Propiconazole	Boom & BP	2.16E-008	3.58E-007	-0-	-0-	3.99E-009	5.92E-008
Dicamba	Aerial	-0-	-0-	-0-	-0-	-0-	-0-
Dicamba	Boom, HHW, & BP	-0-	-0-	-0-	-0-	-0-	-0-
Glyphosate-Roundup	Circles around trees	-0-	-0-	2.32E-007	7.06E-007	-0-	-0-
Glyphosate-Roundup	Strips along rows	3.41E-007	1.00E-006	2.64E-007	7.79E-007	6.31E-008	1.66E-007
Hexazinone	Circles around trees	-0-	-0-	-0-	6.76E-007	-0-	-0-
Hexazinone	Strips along rows	-0-	9.55E-007	-0-	6.10E-007	-0-	1.98E-007
Picloram	HHW & BP	-0-	3.14E-010	-0-	2.34E-010	-0-	6.15E-011
Hexachlorobenzene		-0-	3.14E-014	-0-	2.34E-014	-0-	6.15E-015
Triclopyr triethylamine salt	Backpack	-0-	5.14E-010	-0-	3.83E-010	-0-	1.01E-010
Triclopyr butoxyethyl ester	Backpack	2.29E-008	1.02E-006	1.71E-008	7.62E-007	3.84E-009	1.76E-007
Dazomet	Spreader	-0-	-0-	-0-	-0-	-0-	-0-
Greenhouse effluent	Irrigation						
Acephate		-0-	-0-	-0-	-0-	-0-	-0-
Chlorothalonil		-0-	-0-	-0-	-0-	-0-	-0-
Mancozeb		-0-	-0-	-0-	-0-	-0-	-0-
Thiophanate-methyl		2.30E-009	1.44E-008	-0-	-0-	3.96E-010	2.82E-009
General Fertilization	Spreader						
NO3 (as N)		2.79E-003	4.66E-003	8.24E-003	1.38E-002	8.83E-004	1.36E-003
NH4 (as N)		-0-	1.24E-002	-0-	3.66E-002	-0-	4.56E-003
PO4 (as P2O5)		7.54E-006	3.14E-003	2.23E-005	9.28E-003	2.39E-006	9.52E-004
Calcium nitrate	Spreader						
NO3 (as N)		2.45E-003	4.10E-003	4.63E-005	1.10E-003	6.76E-004	1.23E-003

*HPHS = high-pressure hydraulic sprayer; HHW = hydraulic sprayer with hand-held wand, BP = backpack sprayer

Note: 1 mg/L = 1 part per million (ppm) = 0.001 parts per billion (ppb)

Table C-1. Estimated Surface Water Concentrations from Runoff and Erosion (mg/L) (continued)

		Nate Creek		Milk Creek		Clear Creek	
Chemical	App Method	Typ	Max	Typ	Max	Typ	Max
Acephate	HPHS & HHW	-0-	-0-	-0-	-0-	-0-	-0-
Chlorpyrifos	Airblast	1.03E-006	1.58E-006	1.66E-008	2.89E-007	1.77E-007	2.86E-007
Diazinon	HPHS	1.37E-009	6.40E-005	-0-	-0-	2.09E-010	9.95E-006
Dimethoate	HPHS	-0-	6.91E-005	-0-	5.35E-006	-0-	9.25E-006
Cyclohexanone		-0-	3.28E-006	-0-	2.54E-007	-0-	4.39E-007
Petroleum distillate		2.84E-007	1.99E-005	2.20E-008	1.54E-006	-0-	2.66E-006
Esfenvalerate	Aerial	1.75E-007	4.90E-007	1.72E-008	1.62E-007	3.40E-008	8.56E-008
Ethylbenzene		-0-	3.26E-007	-0-	1.08E-007	-0-	6.82E-008
Xylene		-0-	3.13E-008	-0-	1.04E-008	-0-	6.53E-009
Esfenvalerate	Airblast	5.81E-008	2.20E-007	1.16E-009	5.74E-008	1.13E-008	3.95E-008
Ethylbenzene		-0-	1.51E-007	-0-	3.95E-008	-0-	3.16E-008
Xylene		-0-	1.45E-008	-0-	3.79E-009	-0-	3.03E-009
Esfenvalerate	HPHS, HHW, & BP	4.60E-008	1.82E-007	-0-	-0-	5.65E-009	2.09E-008
Ethylbenzene		-0-	1.21E-007	-0-	-0-	-0-	1.61E-008
Xylene		-0-	1.15E-008	-0-	-0-	-0-	1.54E-009
Horticultural Oil	HPHS	4.75E-007	4.83E-005	-0-	-0-	5.80E-008	6.47E-006
Permethrin	Airblast & HPHS	-0-	-0-	5.62E-010	9.22E-010	-0-	-0-
Ethylbenzene		-0-	-0-	-0-	1.43E-009	-0-	-0-
Light aromatic solvent naphtha		-0-	-0-	2.47E-008	1.35E-007	-0-	-0-
Xylene		-0-	-0-	-0-	-0-	-0-	-0-
Propargite	HPHS	2.81E-007	1.00E-006	-0-	-0-	3.49E-008	1.15E-007
Chlorothalonil	HPHS	3.00E-008	4.05E-006	-0-	-0-	3.68E-009	5.42E-007
Propiconazole	Boom & BP	2.16E-008	3.58E-007	-0-	-0-	2.68E-009	4.12E-008
Dicamba	Aerial	-0-	-0-	-0-	-0-	-0-	-0-
Dicamba	Boom, HHW, & BP	-0-	-0-	-0-	-0-	-0-	-0-
Glyphosate-Roundup	Circles around trees	-0-	-0-	-0-	-0-	-0-	-0-
Glyphosate-Roundup	Strips along rows	3.41E-007	1.00E-006	-0-	-0-	4.24E-008	1.16E-007
Hexazinone	Circles around trees	-0-	-0-	-0-	-0-	-0-	-0-
Hexazinone	Strips along rows	-0-	9.55E-007	-0-	-0-	-0-	1.28E-007
Picloram	HHW & BP	-0-	3.14E-010	-0-	-0-	-0-	4.05E-011
Hexachlorobenzene		-0-	3.14E-014	-0-	-0-	-0-	4.05E-015
Triclopyr triethylamine salt	Backpack	-0-	5.14E-010	-0-	-0-	-0-	6.63E-011
Triclopyr butoxyethyl ester	Backpack	2.29E-008	1.02E-006	-0-	-0-	2.66E-009	1.21E-007
Dazomet	Spreader	-0-	-0-	-0-	-0-	-0-	-0-
Greenhouse effluent	Irrigation						
Acephate		-0-	-0-	-0-	-0-	-0-	-0-
Chlorothalonil		-0-	-0-	-0-	-0-	-0-	-0-
Mancozeb		-0-	-0-	-0-	-0-	-0-	-0-
Thiophanate-methyl		2.30E-009	1.44E-008	-0-	-0-	2.72E-010	1.86E-009
General Fertilization	Spreader						
NO3 (as N)		2.79E-003	4.66E-003	9.57E-004	1.60E-003	5.96E-004	9.42E-004
NH4 (as N)		-0-	1.24E-002	-0-	4.25E-003	-0-	2.95E-003
PO4 (as P2O5)		7.54E-006	3.14E-003	2.59E-006	1.08E-003	1.61E-006	6.54E-004
Calcium nitrate	Spreader						
NO3 (as N)		2.45E-003	4.10E-003	3.72E-004	9.90E-004	4.56E-004	8.53E-004

*HPHS = high-pressure hydraulic sprayer; HHW = hydraulic sprayer with hand-held wand, BP = backpack sprayer

Note: 1 mg/L = 1 part per million (ppm) = 0.001 parts per billion (ppb)

Table C-2. Estimated Groundwater Concentrations (mg/L)

Chemical	Method	Estimated Groundwater Concentration (mg/L) Typ	Max
Acephate	HPHS & HHW	6.13E-006	6.13E-006
Chlorpyrifos	Airblast	-0-	-0-
Diazinon	HPHS	1.64E-009	9.01E-007
Dimethoate	HPHS	1.08E-004	3.57E-004
Cyclohexanone		1.28E-005	3.72E-005
Petroleum distillate		-0-	-0-
Esfenvalerate	Aerial	-0-	-0-
Ethylbenzene		-0-	-0-
Xylene		-0-	-0-
Esfenvalerate	Airblast	-0-	-0-
Ethylbenzene		-0-	-0-
Xylene		-0-	-0-
Esfenvalerate	HPHS, HHW, & BP	-0-	-0-
Ethylbenzene		-0-	-0-
Xylene		-0-	-0-
Horticultural Oil	HPHS	-0-	-0-
Permethrin	Airblast & HPHS	-0-	-0-
Ethylbenzene		-0-	1.64E-009
Light aromatic solvent naphtha		-0-	-0-
Xylene		-0-	-0-
Propargite	HPHS	-0-	-0-
Chlorothalonil	HPHS	-0-	-0-
Propiconazole	Boom & BP	-0-	-0-
Dicamba	Aerial	-0-	-0-
Dicamba	Boom, HHW, & BP	-0-	-0-
Glyphosate-Roundup	Circles around trees	-0-	-0-
Glyphosate-Roundup	Strips along rows	-0-	-0-
Hexazinone	Circles around trees	1.70E-004	2.75E-004
Hexazinone	Strips along rows	1.06E-003	1.59E-003
Picloram	HHW & BP	2.70E-004	2.78E-003
Hexachlorobenzene		2.70E-008	2.78E-007
Triclopyr triethylamine salt	Backpack	5.47E-004	3.30E-003
Triclopyr butoxyethyl ester	Backpack	-0-	-0-
Dazomet	Spreader	-0-	-0-
Greenhouse effluent	Irrigation		
Acephate		-0-	2.30E-008
Chlorothalonil		-0-	-0-
Mancozeb		-0-	-0-
Thiophanate-methyl		-0-	-0-
General Fertilization	Spreader	-0-	-0-
NO3 (as N)		8.23E-001	8.23E-001
NH4 (as N)		-0-	-0-
PO4 (as P2O5)		1.08E-002	1.08E-002
Calcium nitrate	Spreader	-0-	-0-
NO3 (as N)		1.38E+000	1.38E+000

*HPHS = high-pressure hydraulic sprayer; HHW = hydraulic sprayer with hand-held wand, BP = backpack sprayer

Table C-3. Estimated Drift Deposition from Aerial, Airblast Sprayer, and Boom Applications

Pesticide	Section 13 Stream Concentration (mg/L)[a]		Section 23 Stream Concentration (mg/L)[a]		Deposition at 25 Feet (lb/acre)		Deposition at Organic Farm (lb/acre)	
	Typ	Max	Typ	Max	Typ	Max	Typ	Max
Aerial (helicopter)								
Esfenvalerate	2.33×10^{-8}	1.95×10^{-6}	2.33×10^{-8}	1.95×10^{-6}	9.00×10^{-5}	0.0004	1.83×10^{-8}	4.70×10^{-8}
Ethylbenzene	2.77×10^{-9}	2.32×10^{-7}	2.77×10^{-9}	2.32×10^{-7}	1.7×10^{-5}	4.76×10^{-5}	2.18×10^{-9}	5.59×10^{-9}
Xylene	8.32×10^{-9}	6.96×10^{-7}	8.32×10^{-9}	6.96×10^{-7}	3.21×10^{-5}	1.43×10^{-4}	6.53×10^{-9}	1.68×10^{-8}
Airblast sprayer								
Chlorpyrifos	2.28×10^{-5}	8.18×10^{-5}	2.30×10^{-5}	8.18×10^{-5}	4.50×10^{-3}	8.99×10^{-3}	6.70×10^{-4}	1.35×10^{-3}
Esfenvalerate	1.15×10^{-6}	3.60×10^{-6}	1.15×10^{-6}	3.60×10^{-6}	2.20×10^{-4}	0.0004	3.00×10^{-5}	6.00×10^{-5}
Ethylbenzene	1.37×10^{-7}	4.28×10^{-7}	1.37×10^{-7}	4.28×10^{-7}	2.62×10^{-5}	4.76×10^{-5}	3.57×10^{-6}	7.14×10^{-6}
Xylene	4.11×10^{-7}	1.29×10^{-6}	4.11×10^{-7}	1.29×10^{-6}	7.85×10^{-5}	1.43×10^{-4}	1.07×10^{-5}	2.14×10^{-5}
Permethrin			2.33×10^{-5}	4.23×10^{-5}	4.72×10^{-3}	4.72×10^{-3}		
Ethylbenzene			1.21×10^{-6}	2.20×10^{-6}	2.46×10^{-4}	2.46×10^{-4}		
Light aromatic solvent naphtha	0	0	1.95×10^{-5}	3.55×10^{-5}	3.96×10^{-3}	3.96×10^{-3}	0	0
Xylene			6.20×10^{-6}	1.15×10^{-5}	1.26×10^{-3}	1.26×10^{-3}		
Tractor-pulled spray rig with boom								
Propiconazole	4.46×10^{-7}	7.95×10^{-7}	0	0	2.00×10^{-4}	3.40×10^{-4}	0	0
Dicamba	9.23×10^{-6}	3.09×10^{-5}	9.38×10^{-6}	3.09×10^{-5}	1.87×10^{-3}	3.74×10^{-3}	2.90×10^{-4}	5.80×10^{-4}
Glyphosate-circles around individual trees	0	0	1.78×10^{-6}	3.87×10^{-6}	3.60×10^{-4}	4.70×10^{-4}	0	0
Glyphosate-strips between rows of trees	9.41×10^{-6}	1.68×10^{-5}	8.56×10^{-6}	2.08×10^{-5}	1.96×10^{-3}	2.41×10^{-3}	2.80×10^{-4}	3.60×10^{-4}
Hexazinone-circles around individual trees	0	0	1.03×10^{-6}	2.63×10^{-6}	2.10×10^{-4}	3.20×10^{-4}	0	0
Hexazinone-strips between rows of trees	5.56×10^{-6}	1.48×10^{-5}	5.06×10^{-6}	1.44×10^{-5}	1.12×10^{-3}	1.73×10^{-3}	2.50×10^{-4}	2.50×10^{-4}

[a]24-hour average concentrations.

To include consideration of potential risks from these chemicals, any "other" ingredients in the proposed pesticide formulations that appear on either List 1 or List 2 are included in this quantitative risk assessment, along with the active ingredient in the formulation. Accordingly, the following "other" ingredients are included in the human health (and non-target species) risk assessments:

- Cyclohexanone: present in Digon® 400 formulation of dimethoate.
- Ethylbenzene: present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin.
- Light aromatic solvent naphtha: present in the Pounce® 3.2 EC formulation of permethrin.
- Petroleum distillates: present in the Digon® 400 formulation of dimethoate.
- Xylene: present in the Asana® XL formulation of esfenvalerate and the Pounce® 3.2 EC formulation of permethrin.

C.1.1 Human Health Hazard Assessment

Methodology and Data Summary

Hazard assessment requires gathering information to determine the toxic properties of each chemical and its dose-response relationship. Human hazard levels are derived primarily from the results of laboratory studies on animals. The goal of the hazard assessment is to identify acceptable doses for noncarcinogens, and identify the cancer potency of potential carcinogens.

For noncarcinogenic effects, it is generally assumed that there is a threshold level, and that doses lower than this threshold can be tolerated with little potential for adverse health effects. EPA has determined threshold doses for many chemicals; these are referred to as reference doses (RfDs). The oral RfD is an estimate of the highest possible daily oral dose of a chemical that will pose no appreciable risk of deleterious effects to a human during his or her lifetime. The uncertainty of the estimate usually spans about one order of magnitude.

EPA selects the RfD using the lowest no-observed-effect level (NOEL) from the species and study most relevant to humans. (The NOEL is the dose in a toxicity study at which there is no statistically or biological significant increase in the frequency or severity of an adverse effect in individuals in an exposed group, when compared with individuals in an appropriate control group.) In the absence of data from the most clearly relevant species, a study using the most sensitive species (the species that exhibited the lowest NOEL) is selected for use in RfD determination. This NOEL is divided by an uncertainty factor (usually 100) consisting of a factor of 10 to allow for the variation of response within the human population and a factor of 10 to allow for extrapolation to humans. Additional uncertainty factors may be applied to account for extrapolation from a shorter term study, overall inadequacy of data, or failure to determine a no-effect level. RfDs are expressed in units of mg/kg/day.

In many cases, exposures to the chemicals proposed for use at Horning will not occur every day for a person's lifetime, but over a shorter duration. EPA's Risk Assessment Guidance for Superfund (EPA 1989) discusses the use of subchronic RfDs when exposures may range from two weeks to seven years in duration, instead of an individual's entire lifetime. These subchronic RfDs are *not* used in the assessment of risks from seed orchard chemicals, for the following reasons:

- The seed orchard pesticide and fertilizer use programs are anticipated to be in effect for more than seven years, exceeding the upper time limit for exposure in EPA's discussion of appropriate use of subchronic RfDs. It is safe to assume that length of employment and length of residence may make the exposure scenarios applicable to an individual worker or nearby resident for longer than a seven-year period.

- EPA (2000c) stated that subchronic RfDs should not be used to evaluate risks to children, as they may not be sufficiently protective. Children are a subset of the general public whose risks are assessed in the analysis.

Additionally, the use of chronic RfDs provides a more conservative estimate of the dose-response relationship in all cases, decreasing the likelihood of underestimating any potential risks to any worker or member of the public.

Data on carcinogenic potential were reviewed for each chemical. Acephate, permethrin, propargite, and thiophanate-methyl are considered possible human carcinogens; and chlorothalonil, mancozeb, and hexachlorobenzene (a contaminant in picloram) are considered to be probable human carcinogens. For these compounds, cancer slope factors that have been calculated by EPA or other appropriate sources are used in this risk assessment. The cancer slope factor of a chemical represents the probability that a 1-mg/kg/day chronic dose will result in formation of a tumor, and is expressed as a probability, in units of "per mg/kg/day" or $(mg/kg/day)^{-1}$.

The RfDs and cancer slope factors used in this risk assessment are summarized in Table 4.6-1 in Chapter 4 of this EIS.

Data Availability and Quality

A consistent level of information on all data points researched was not available for all of the chemicals evaluated in this risk assessment. For the endpoints evaluated in this quantitative risk assessment, there are no data gaps in the information available for acephate, chlorothalonil, chlorpyrifos, diazinon, dimethoate, esfenvalerate, glyphosate, horticultural oil, hydrogen dioxide, mancozeb, permethrin, picloram, propargite, propiconazole, and thiophanate-methyl. However, the following data gaps were identified and addressed as described:

- No dermal absorption data were available for dazomet, so a value of 10% was assumed. Inhalation exposure to dazomet's hydrolysis products is expected to be the route with the highest potential for exposure to humans from this pesticide, so this assumption is not likely to significantly affect the conclusions of the risk assessment.

- No studies of dermal absorption were available for dicamba. USDA (1984) recommended a value of 10% as a conservative assumption. This value is used in the risk assessment.

- Hexazinone's carcinogenic potential is unknown, with equivocal results from one study in mice and negative results from a study in rats. Cancer risks are not quantified for this pesticide.

- Conclusive information was not available on triclopyr's potential for carcinogenicity. Therefore, no judgment was made as to whether it is potentially carcinogenic, and no quantitative cancer risk analysis was conducted.

- No dermal absorption factor was identified for cyclohexanone. A value of 10% was selected for use in the risk assessment. Carcinogenicity findings for cyclohexanone were inconclusive. No quantitative analysis of the compound's cancer risk is conducted.

- Inhalation studies of ethylbenzene in rats and mice resulted in some tumors in the high-exposure groups, although EPA lists it as not classifiable as to human carcinogenicity. No cancer risk assessment is conducted for this chemical.

- Although naphthalene (an example of the "other" ingredient light aromatic solvent naphtha) is considered a possible human carcinogen, the available data do not allow calculation of a cancer slope factor; therefore, no quantitative estimate of cancer risk from light aromatic solvent naphtha compounds is made. No dermal absorption data were available, so a default value of 10% was selected for use in the risk assessment.

- For xylene, one negative and one equivocal carcinogenicity study were reported, and dermal studies have indicated a potential for xylene to be a promoter or co-carcinogen for skin cancer. Due to the lack of conclusive information, no judgment was made in this risk assessment as to whether xylene is potentially carcinogenic, and no quantitative cancer risk analysis was conducted for it.

- No dermal absorption data were available for the fertilizers. A value of 1% was used in the risk assessment.

C.1.2 Human Health Exposure Assessment

Exposure assessment involves estimating doses to persons potentially exposed to the pesticides or fertilizers. In the exposure assessment, dose estimates were made for typical, maximum, and accidental exposures. These exposures are defined as follows:

- *Typical:* For this risk assessment, the word "typical" refers to a level of exposure within a scenario, and does not indicate whether the scenario itself is likely to occur. Typical exposure reflects the average dose an individual may receive if all exposure conditions are met. Typical exposure assumptions include the application rate usually used at the seed orchard, usual number of applications per year, the average of the ten highest values for chemical concentrations predicted to be present in runoff over a 10-year period of annual typical applications, and other similar assumptions.

- *Maximum:* Maximum exposure defines the upper bound of credible doses that an individual may receive if all exposure conditions are met. Maximum exposure assumptions include the maximum application rate according to the label, maximum number of applications per year, the highest chemical concentration predicted to be present in runoff over a 10-year period of annual maximum applications, and other similar assumptions.

- *Accidental:* The possibility of error exists with all human activities. Therefore, it is possible that during seed orchard operations, accidents could expose individuals to unusually high levels of pesticides or fertilizers. To examine these potential health effects, several accident scenarios were evaluated for health effects to members of the public and workers.

It is important to note that these exposure scenarios estimate risks from clearly defined types of exposure. If all the assumptions in an exposure scenario are not met, the dose will differ from that estimated here, or may not occur at all.

For members of the public, the exposure scenarios analyzed in this risk assessment consist of the following:

- Ingestion of groundwater.

- Ingestion of water from Swagger Creek east of Section 13 or Nate Creek west of Section 23. (These creeks are not known sources of drinking water; therefore, drinking water from their tributaries is even less likely and this risk was not quantified).

- Ingestion of fish from Swagger Creek east of Section 13 or Nate Creek west of Section 23.

- Ingestion of grouse or quail hunted on or near grounds.

- Ingestion of mushrooms with pesticide residues.

- Dermal exposure to insecticide/fungicide drift residues on vegetation, or herbicide treatment residues on vegetation, during recreational hiking/hunting/mushroom gathering on orchard grounds.

- Dermal exposure to residues on dogs following recreational use of site.

The categories of workers evaluated in this risk assessment for occupational exposure to pesticides are as follows:

- Helicopter pilot.
- Helicopter mixer/loader.
- High-pressure hydraulic sprayer mixer/loader/applicator.
- Hydraulic sprayer with hand-held wand mixer/loader/applicator.
- Tractor-pulled spray rig with boom mixer/loader/applicator.
- Backpack sprayer mixer/loader/applicator.
- Granular spreader loader/applicator.
- Hand pollinator.
- Hand sprayer mixer/loader/applicator in greenhouse.
- Chemigation mixer/loader in greenhouse.
- Weighing and monitoring personnel in greenhouse.

Several accidental exposure scenarios were also evaluated:

- Ingestion of groundwater after a spill of concentrate.
- Ingestion of fish and water containing runoff from a spill of concentrate.
- Ingestion of fish and water downstream of a spill of tank mix directly into a stream.
- Spill of pesticide concentrate onto worker's skin.
- Spill of pesticide mixture onto worker's skin.
- Spray of worker with tank mix of pesticide.

C.1.3 Human Health Risk Characterization

Methodology

Risk characterization requires comparing the hazard information with the dose estimates to predict the potential for health effects to individuals under the conditions of exposure. The risk characterization also identifies uncertainties (such as data gaps where scientific studies are unavailable) that may affect the magnitude of the estimated risks.

In this risk assessment, the potential noncarcinogenic risks were evaluated by comparing the representative doses (estimated in the exposure assessment) with the RfDs (identified in the hazard assessment). All the RfDs used in this risk analysis take into account multiple exposures over several years and represent acceptable dose levels. The comparison of dose to RfD consists of a simple ratio, called the hazard index:

$$\textit{Hazard Index} = \textit{Estimated Dose (mg/kg/day)} \div \textit{RfD (mg/kg/day)}$$

If the estimated dose does not exceed the RfD, the hazard index will be one or less, indicating a negligible risk of noncarcinogenic human health effects.

A dose estimate that exceeds the RfD, although not necessarily leading to the conclusion that there will be toxic effects, clearly indicates a potential risk for adverse health effects. Risk is presumed to exist if the hazard index is greater than one. However, comparing one-time or once-a-year doses (such as those experienced by the public or in an accident) to RfDs derived from long-term studies with daily dosing tends to exaggerate the risk from those infrequent events.

For workers and the public, hazard indices were computed for each chemical, application, and scenario for typical, maximum, and accident situations. For pesticide formulations containing ingredients on EPA's List 1 or 2 of "other" ingredients, the hazard indices for each component of the formulation are added together, to indicate the total risk to the exposed individual from that pesticide.

If the hazard index exceeds one, the risk may require mitigation, depending on the circumstances of exposure. For workers, this may mean reducing the quantity of pesticide to which the worker is exposed or increasing the level of protective clothing. For members of the public, it may mean decreasing the application rate or using measures to reduce the potential for runoff to reach streams. In some cases, the simple mitigation procedures will not reduce exposures (and thereby decrease the hazard index) to an acceptable level. In these cases, the seed orchard manager may consider use of a different pesticide or use a non-pesticide method to meet management goals.

To estimate cancer risk, the dose is averaged over a lifetime (75 years), and multiplied by the chemical's cancer slope factor. The resulting cancer probability is compared to a benchmark value of one in one million, a value commonly accepted in the scientific community as representing a cancer risk that would result in a negligible addition to the background cancer risk of approximately one in four in the U.S.

Risk Summary

Hazard indices and cancer risks for each chemical and scenario are presented in tables in Section 6.0 of the risk assessment report. The chemicals and scenarios for which risks were identified are summarized in the following paragraphs and in Table 4.6-2 in Chapter 4 of this EIS.

Members of the Public

For members of the public, hazard indices were less than one for all typical and maximum exposure scenarios, and cancer risks were all less than 1×10^{-6} (one in one million), with non-zero cancer risks ranging up to 1.22×10^{-9} (1.22 in one billion).

Workers

For typical scenarios, worker hazard indices are less than one, with the following exceptions:

- A high-pressure hydraulic sprayer mixer/loader/applicator applying diazinon or dimethoate, and
- A backpack sprayer applying propiconazole, dicamba, or hexazinone

In the maximum scenarios, the hazard indices exceed one for the following workers:

- A high-pressure hydraulic sprayer mixer/loader/applicator applying diazinon or dimethoate;
- A backpack sprayer applying dicamba or hexazinone; and
- A hand pollinator encountering residues of diazinon.

The estimated cancer risk to greenhouse weighing/monitoring personnel encountering residues of mancozeb is 5.15 in one million, exceeding the standard point of departure of one in one million. All other cancer risks to workers were less than one in one million.

Risk Management Approaches

If applications of these pesticides were prescribed, risks to mixer/loader/applicators could be mitigated by decreasing the application rate, using water soluble bags (if available), spreading the work over a longer time period, increasing the use of personal protective equipment, and

dividing the work between two or more workers. Risks to hand pollinators could be mitigated by increasing the time period between applications and pollination activities to allow additional degradation, decreasing the application rate, increasing the use of personal protective equipment, and dividing the work between two or more workers.

Accidents

For a spill of a container of pesticide concentrate at the mixing area, no risks to the public from drinking groundwater contaminated by leached chemical were predicted. If precipitation caused runoff of spill residues to surface water from the spill site, risks were predicted from diazinon, dimethoate, permethrin, and chlorothalonil to adults and children consuming fish or surface water from Swagger Creek. All estimated cancer risks were less than one in one million.

For a spill of an application tinkled of mixed pesticide into the onsite stream east of Horning Reservoir, risks to the public from drinking water and eating fish from Swagger Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, picloram, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

For a spill of an application tinkled of mixed pesticide into the onsite stream east of orchard unit B14, risks to the public from drinking water and eating fish from Swagger Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, picloram, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

For a spill of an application tinkled of mixed pesticide into the onsite stream west of orchard unit P67, risks to the public from drinking water and eating fish from Nate Creek are predicted for acephate, chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, propiconazole, dicamba, hexazinone, and dazomet. Cancer risks from permethrin and propargite exceed one in one million.

In the scenario in which a worker spills liquid pesticide concentrate on the skin, hazard indices exceed one (ranging up to 10,100 for dimethoate) for all liquid concentrates except horticultural oil, glyphosate, picloram, and triclopyr. Estimated cancer risks were all less than one in one million.

In the scenario in which a worker spills tank-mixed diluted pesticide on the skin, hazard indices are greater than one for chlorpyrifos, diazinon, dimethoate, and dicamba. All estimated cancer risks are less than one in one million.

Hazard indices for the accident scenario in which a worker was directly sprayed exceed one for chlorpyrifos, diazinon, and dimethoate. Estimated cancer risks are all less than one in one million.

Cumulative Human Health Risks

No data indicating synergistic toxicity exists among the proposed chemicals were identified. Therefore, cumulative human health risks were estimated assuming additive toxicity.

For members of the public, risks were aggregated from all routes of exposure for each chemical, as estimated for the typical scenarios. These chemical-specific aggregated risks were then added together to provide an upper bound estimate of the cumulative risk for adults and children. Actual cumulative risk values are likely to be far less than the results estimated in this assessment, since (1) it is highly unlikely that one individual would be exposed to every chemical in all of the scenarios evaluated in the risk assessment; (2) several pesticides are proposed for use as alternatives for certain groups of target pests or weeds, and if one was selected for use in a given season, the alternatives would not also be used; (3) where multiple application methods are possible for a proposed pesticide treatment scenario, the method with the highest associated risk

was included in the cumulative assessment; and (4) the temporal spacing of the potential chemical applications would correspond to a timeline in which some exposure routes were no longer active due to dissipation and degradation, prior to application of other chemicals. The upper bound cumulative risk estimates are as follows:

- Cumulative hazard indices are 0.342 and 0.809 for adult and child members of the public, respectively. These values do not exceed the reference value of one, at which noncarcinogenic hazard indices are concluded to represent a risk.

- Cumulative cancer risks are 1.07×10^{-9} (1.07 in one billion) and 2.64×10^{-9} (2.64 in one billion) for adult and child members of the public, respectively. Neither value exceeds the cancer risk criterion of one in one million.

For workers, the highest cumulative exposure could occur if one employee was involved in all pesticide applications, with the exception of aerial applications, which are always conducted by a contractor. In this case, the cumulative hazard index for workers is 39.5, and the cumulative cancer risk is 7.15 in one million. It is important to note that this cumulative risk scenario includes the unlikely case in which all pesticides that target every pest problem are called for during the season. The highest contributor to the cumulative hazard index is dimethoate (24.7) for an individual applying the chemical using a high-pressure hydraulic sprayer and conducting hand pollinating activities. The estimated cumulative cancer risk to workers is 7.15×10^{-6}. The main contributor to this risk is mancozeb, which is associated with a 6.08×10^{-6} cancer risk for an individual conducting hand sprayer applications and weighing/monitoring activities in the greenhouse.

Uncertainties

The risks summarized in this assessment are not probabilistic estimates of risk, but are conditional estimates. That is, these risks are likely only if all exposure scenario assumptions that were described are met. In addition, the methodology applied to estimating risks is not definitive, since uncertainty in the final risk estimates is introduced in almost every step of the assessment. Some of the primary areas of uncertainty are as follows:

- The accuracy of the RfDs in approximating doses to humans that pose negligible risk of health effects, without either under- or overestimating these doses: the RfDs are derived from tests in laboratory animals. Extrapolating the results of animal tests to human health hazards has an inherent level of uncertainty associated with it.

- The use of the conservative approach, recommended by EPA, that chronic toxicity data be used in estimating risks from occasional (or, at most, subchronic) exposures to the chemicals proposed for use at the seed orchard.

- The cancer slope factors, in providing a good approximation of the chemical's carcinogenic potency in humans: updated guidelines for estimating cancer risks are in progress that may provide a different approach to estimating cancer risks for some of the chemicals evaluated in this report (see discussion in Section 6.2.2 of the risk assessment report). However, reassessment of the carcinogenic mechanism and application of an appropriate strategy for cancer risk assessment for any one chemical may be years away. This analysis uses the cancer risk approach currently used by EPA for estimating the cancer potency of each chemical.

- The equations and studies on which the dose estimations are based: Many monitoring studies have been conducted since the 1970s that measure exposures to pesticides in a range of situations. This risk assessment relies on those that (1) are most relevant to the types of applications at the seed orchard, (2) incorporated sound methodology to provide a degree of confidence in the reported results, and (3) monitored, correlated, and reported a sufficient number of parameters to allow extrapolation to other situations.

All together, it is likely that the uncertainty in the risk estimates predicted in this assessment spans at least an order of magnitude. For example, for a hazard index estimated to be 0.0035, the true value is likely to be within the range of 0.035 to 0.00035, as a result of the uncertainties described here.

C.2 Risks To Non-target Species

A quantitative non-target species risk assessment was conducted to evaluate the potential effects of the proposed chemical pesticides on terrestrial and aquatic wildlife species. The methodology and results are summarized in the following paragraphs; detailed information on inputs, methodology, assumptions, and outputs can be found in Sections 7.0, 8.0, and 9.0 of the risk assessment report.

The results of computerized fate and transport modeling were used to estimate concentrations of chemicals at points of exposure for non-target species, just as described in the summary of the human health risk assessment. Details of the methods and models can be found in Section 3.0 of the risk assessment report. Estimated surface water concentrations from runoff and drift are presented in Tables C-1 and C-3.

The non-target species risk assessment follows the steps of problem formulation, analysis, and risk characterization, as described in EPA's Guidelines for Ecological Risk Assessment (EPA 1998). This risk assessment also identifies uncertainties that are associated with the conclusions of the risk characterization. Risks to non-target species were evaluated for the fertilizers, pesticides, and List 1 or 2 "other" ingredients in the pesticide formulations.

C.2.1 Problem Formulation

In problem formulation, the purpose of the assessment is provided, the problem is defined, and a plan for analyzing and characterizing risk is determined. The potential stressors (in this case, pesticides and fertilizers), the ecological effects expected or observed, the receptors, and ecosystem(s) potentially affected are identified and characterized. Using this information, the three products of problem formulation are developed: (1) assessment endpoints that adequately reflect management goals and the ecosystem they represent, (2) conceptual models that describe key relationships between a stressor and assessment endpoint, and (3) an analysis plan that includes the design of the assessment, data needs, measures that will be use to evaluate risk hypotheses, and methods for conducting the analysis phase of the assessment.

The ecological effects that may be associated with the chemical pesticides and fertilizers are those associated with direct toxicity to non-target species that encounter the chemical. Permanent or persistent exposures through environmental pathways are not expected, since the half-lives of these chemicals are on the order of one month or less. Control of certain pests and vegetation in and of itself is not expected to affect the area's wildlife, since the seed orchard is a managed area, and has been managed for tree species preservation and seed production for 33 years.

The receptors in this non-target species risk assessment were selected to represent the range of species present at or near Horning, along with specific evaluation of special status species that may inhabit or visit the site. These receptors include mammals, birds, reptiles, amphibians, fish, and aquatic vertebrates for which quantitative risk estimates can be made.

Assessment endpoints are selected based on three criteria: ecological relevance, susceptibility to stressors, and relevance to management goals (EPA 1998). For special status species, the assessment endpoint selected is individual survival, growth, and reproduction. For general species present at the seed orchard, the assessment endpoint selected is the survival of populations.

A conceptual model was developed to illustrate the relationships between stressors, exposure routes, and receptors. The conceptual model is presented in Figure 4.7-1 in Chapter 4 of this EIS.

Based on the conceptual model, an analysis plan was developed with the following components:

- Selection of typical and maximum exposure scenarios to evaluate risks to terrestrial and aquatic wildlife species;
- Identification of representative terrestrial and aquatic species and their characteristics, illustrating the various types of exposure that wildlife species may have to chemicals used at the seed orchard;
- Estimation of environmental exposures in terms of dose (mg/kg) for terrestrial species or concentration (mg/L) for aquatic species;
- Research and summary of the toxic properties of each pesticide, "other" ingredient, and fertilizer to wildlife species, to identify endpoints, including median lethal doses (LD_{50}s), median lethal concentrations (LC_{50}s), and maximum acceptable toxicant concentrations (MATCs); and
- Comparison of the doses and concentrations identified in the exposure characterization to the toxic properties identified in the effects characterization, using the guidelines specified by EPA's Office of Pesticide Programs for interpreting risk estimates to general wildlife and to special status species.

C.2.2 Analysis

Analysis is a process that examines the two primary components of risk–exposure and effects–and the relationships between each other and ecosystem characteristics. The assessment endpoints and conceptual models developed during problem formulation provide the focus and structure for the analysis. Exposure characterization describes potential or actual contact or co-occurrence of stressors with receptors, to produce a summary exposure profile that identifies the receptor, describes the exposure pathway, and describes the intensity and extent of contact or co-occurrence. Ecological effects characterization consists of evaluating ecological effects (e.g., ecotoxicity) data on the stressor of interest, as related to the assessment endpoints and the conceptual models, and preparing a stressor-response profile.

The terrestrial species exposure scenarios postulate that a variety of terrestrial wildlife species use the Horning Seed Orchard at various times. The scenarios further postulate that these terrestrial species may be exposed to any applied pesticides or fertilizers through ingestion of contaminated food and water and, in the maximum scenario, direct dermal spray as a result of being in an area while a treatment is occurring.

The list of representative species is as follows:

Mammals
- Cow (domestic)
- Sheep (domestic)
- Coyote (carnivore)
- Jack rabbit (small herbivore)
- Long-eared myotis (insectivore)

Birds
- Black-capped chickadee (conifer seed-eater)
- California quail (game bird)
- Mallard duck (water fowl)
- Red-tailed hawk (raptor)
- Song sparrow (seed-eater)

Reptiles/Amphibians
- Pacific tree frog

These particular wildlife species were selected because they represent the majority of the species present, or the seed orchard has suitable habitat and is within their range (e.g., selection of black-capped chickadee as conifer seed-eater), and because they represent several types of coverage: a range of phylogenetic classes, body sizes, foraging habitat, and diets for which parameters are generally available. In addition, several special status terrestrial species were evaluated for potential risk:

- western pond turtle
- common nighthawk
- Oregon vesper sparrow
- western meadowlark
- streaked horned lark

For each species, characteristics were identified that were used in estimating doses of pesticides, other ingredients, and fertilizers. These characteristics include body weight, surface area, water intake, dietary intake, composition of diet, and home range/foraging area.

Risks were also estimated for aquatic species for which ecotoxicity data are available: rainbow trout as a representative coldwater fish species, the water flea *Daphnia magna* as a representative aquatic invertebrate, and tadpoles of the Pacific tree frog as a representative amphibian aquatic stage. Risks were also evaluated for steelhead trout, a Federally listed threatened species and state-listed critical species that is present in Clear Creek and Milk Creek near Horning. At the time of the risk assessment, cutthroat trout were proposed for Federal listing as threatened, so they were evaluated as if they were a special status species. However, subsequent to the risk assessment's completion, it was determined that these cutthroat trout would not be listed.

Stressor-response profiles were prepared for each pesticide, "other" ingredient, and fertilizer proposed for use at Horning. These profiles addressed ecotoxicity to both terrestrial and aquatic species, with the goal of identifying endpoints relevant to the types of exposure and methodology used in the assessment. The focus of this research was to identify LD_{50}s, LC_{50}s, and MATCs. The stressor-response profiles for all chemicals are presented in Section 8.3 of the risk assessment report.

C.2.3 Risk Characterization

Risk characterization uses the results of the analysis phase to develop an estimate of the risks to ecological entities, describes the significance and likelihood of any predicted adverse effects, and identifies uncertainties, assumptions, and qualifiers in the risk assessment.

By comparing the exposure profile data (estimated dose or water concentration) to the stressor-response profile data (LD_{50}s, LC_{50}s, MATCs), an estimate of the possibility of adverse effects can be made. The levels of concern are determined following the quotient methodology used by EPA's Office of Pesticide Programs. The quotient is the ratio of the exposure level to the hazard level. For acute exposures, the levels of concern at which a quotient is concluded to reflect risk to non-target species are as follows:

- Terrestrial species (general): 0.5, where dose equals one-half the LD_{50}.

- Terrestrial species (special status): 0.1, where dose equals one-tenth the LD_{50}.

- Aquatic species (general): 0.5, where water concentration equals one-half the LC_{50}.

- Aquatic species (special status): 0.05, where water concentration equals one-twentieth the LC_{50}.

Due to the high level of concern for protecting threatened salmonids in the watershed, the predicted water concentrations are also compared to the MATC for a chemical, if available.

Quotients for each chemical and scenario are presented in tables in Section 9.0 of the risk assessment report. The chemicals and scenarios for which risks were identified are summarized in the following paragraphs and in Table 4.7-2 in Chapter 4 of this EIS.

Risks to Terrestrial Wildlife

Risks to General Terrestrial Species

Risks are predicted from chlorpyrifos for the black-capped chickadee in the typical and maximum scenarios, and for the song sparrow in the maximum scenario.

Risks are predicted from diazinon for the black-capped chickadee and California quail in the typical and maximum scenarios, and for the mallard duck, red-tailed hawk, and song sparrow in the maximum scenario.

Dimethoate was estimated to present risks to the black-capped chickadee, California quail, song sparrow, and Pacific tree frog in the typical scenario, and to all general terrestrial species except the coyote and jackrabbit in the maximum scenario.

In most cases, little or no adverse impact to terrestrial wildlife populations is expected from the pesticides and fertilizers proposed for use at Horning under typical conditions of use, with the possible exception of impacts to bird and amphibian species from applications of three of the insecticides (chlorpyrifos, diazinon, and dimethoate). Most of the estimated doses are extremely low, with risk quotients several orders of magnitude below the levels of concern. A margin for error is provided by the methodology applied, which uses reasonable assumptions that tend toward overstating potential exposures to wildlife, in the absence of site-specific data on potential exposure patterns. In addition, all of the chemicals have relatively short half-lives and are not expected to remain in the environment for significant periods of time.

Although some terrestrial insects onsite may be affected by the insecticide applications, and may constitute a portion of the dose to insectivorous species, populations of beneficial insects as a whole are not expected to suffer adverse impacts because the proposed seed orchard applications are localized. Although honeybees and other pollinators are generally susceptible to insecticides, the standard operating procedures at Horning include practices to mitigate potential exposures.

It appears that insecticide applications may have adverse impacts on local earthworm populations (see discussion in Section 9.2.1 of the risk assessment report). However, any possible impacts are expected to be reversible, given that these chemicals are not persistent in the soil and that limited areas would be treated only on an as-needed basis in any growing season, allowing for re-population from adjacent untreated areas.

Risks to Special Status Terrestrial Species

Risks are predicted from chlorpyrifos, diazinon, and dimethoate for all special status terrestrial species in both the typical and maximum scenarios.

Calcium nitrate application was estimated to pose a risk to the western pond turtle in both typical and maximum scenarios, and to the common nighthawk and Oregon vesper sparrow in the maximum scenario.

Risks to Terrestrial Plants

The proposed herbicides will be variously toxic to any plants with which they come into contact. No special status plant species have been identified on site at the seed orchard. Broadcast

applications of herbicides are only proposed for intensively managed or disturbed areas such as along roads and fences, within orchard units, or around facilities, while spot applications will be used to control weed species in less disturbed areas. Only spot hand applications would be conducted within the riparian buffer areas. Insecticides, fungicides, and fertilizers are only proposed for use in cultivated areas (seed orchard blocks and native grass beds), so no direct contact with plant species in other areas is expected.

Risks to Aquatic Species

Risks to General Aquatic Species

No risks to general coldwater fish species, aquatic invertebrates, or aquatic stages of amphibians were predicted in onsite streams in the typical or maximum scenarios.

Drift from permethrin airblast applications was predicted to exceed the MATC for aquatic invertebrates in onsite streams. However, it is important to note that the permethrin concentration is expressed as a 24-hour average, while the MATC was based on a 21-day study period; therefore, this is a very conservative indication of any potential risk.

Risks to Special Status Aquatic Species

In the risk assessment, ammonia in runoff from general orchard fertilization was predicted to pose a risk to cutthroat trout in Section 13 onsite streams in the maximum scenario only. However, after the risk assessment was completed, it was determined that cutthroat trout would not be listed as a threatened species; therefore, the risk threshold for general species (Q = 0.5) would apply to cutthroat trout as well. No risks are predicted from ammonia based on current information.

Risks from Accidental Spills

Risks are predicted for all terrestrial species except the cow, sheep, and coyote in the scenario in which an animal ingests an acephate implant capsule.

General terrestrial species were predicted to be at risk from a concentrate spill of diazinon, esfenvalerate, or dazomet at the mixing area.

Most categories of aquatic species (fish, invertebrates, amphibians, both general and special status) are at risk from spills of tank mixtures of chlorpyrifos, diazinon, dimethoate, esfenvalerate, permethrin, propargite, chlorothalonil, dicamba, glyphosate (Roundup), hexazinone, horticultural oil, picloram, and triclopyr butoxyethyl ester into the irrigation pond, or into onsite tributaries to Swagger Creek and Nate Creek. No risks were predicted in any spill scenarios from acephate, propiconazole, glyphosate (Rodeo), or triclopyr triethylamine salt. Risks to steelhead in Clear Creek or Milk Creek would be less than those presented here (which assumed the species was present in Swagger Creek and Nate Creek), due to greater dilution.

Risks to Aquatic Plants

Aquatic plants may be present in streams and ponds that receive runoff from treated areas. A literature review was conducted to identify the levels at which any of the proposed chemicals may pose a hazard to aquatic plants (see Section 9.2.4 in the risk assessment report). For many chemicals, tests in algae were the only available data, and are expected to provide a sensitive endpoint for hazards to aquatic plants. For each chemical, the estimated water concentrations were compared to the levels of concern. None of the predicted concentrations in onsite streams, Swagger Creek, or Nate Creek exceed the effects criteria equivalent to 50% of the values reported in the literature reviewed. Therefore, no adverse effects to aquatic plants are expected under typical or maximum conditions of pesticide or fertilizer application at Horning Seed Orchard.

Risk Management Approaches

If applications of these pesticides were prescribed, risks to wildlife species could be mitigated by measures such as decreasing the application rate, decreasing the area treated, decreasing the number of applications, and increasing the distance to streams from treated areas. Field surveys could also be used to determine whether some special status species that were evaluated are actually present on the seed orchard grounds, in on-site streams, or in downstream drainages.

Uncertainties

The risks summarized in this assessment are not probabilistic estimates of risk, but are conditional estimates. That is, these risks are likely only if all exposure scenario assumptions that were described are met. In addition, the methodology applied to estimating risks is not definitive, since uncertainty in the final risk estimates is introduced in almost every step of the assessment. Some of the primary areas of uncertainty are as follows:

- The information on each terrestrial species' range, diet, and other characteristics, compared to the characteristics it exhibits at the specific time of year when any particular application may be made.

- The LD_{50}s and LC_{50}s selected for use in the risk assessment, which are often drawn from data on species related to the species of interest, and not from tests on the species of interest itself.

- The necessity of using model-defined inputs and site-characterizing assumptions to depict the seed orchard and management activities for conducting the runoff, drift, and accidental spill modeling; as well as the accuracy of the models themselves, which provide an estimate of the impacts that could occur for purposes of prospective program evaluation, mitigation design, and alternative comparison, but are not able to be as accurate as data obtained from actual monitoring.

C.2.4 References Cited

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Attachment
Proposed Application Methods

Pesticides may be applied using several methods. For some pesticides, different combinations of pesticide and application method are being proposed, to give the seed orchard flexibility in addressing the specific management needs that may occur, including:

- aerial, using helicopter
- airblast sprayer
- high-pressure hydraulic sprayer
- hydraulic sprayer with hand-held wand
- tractor-pulled spray rig with boom
- backpack sprayer
- capsule implantation
- granular spreaders
- hand sprayer
- chemigation
- total-release canister
- greenhouse effluent irrigation

Each method is described briefly in the following paragraphs.

Aerial Application

A helicopter is equipped with a pesticide tank for aerial application of liquid mixtures. The size and type of helicopter may vary; however, a standard representation of its application equipment is used in the risk assessment, based on the local contractor's current equipment. Aerial application may be used to apply the insecticide esfenvalerate to active orchard units.

Airblast Sprayer

Airblast sprayers are pulled behind a tractor or a truck. Airblast sprayers use fans or blowers to propel spray mixtures into dense foliage or the tops of trees. The nozzles of airblast sprayers are positioned in the air stream to break up spray droplets and propel them into the tree tops. At Horning, an airblast sprayer may be used to apply the insecticides chlorpyrifos, esfenvalerate, or permethrin to orchard units.

High-Pressure Hydraulic Sprayer

High-pressure hydraulic sprayers consist of a powered pump and tank carried by truck or tractor, and hand-held nozzles for dispersing the solution upward into the tree. These sprayers could be used to treat individual mature trees with the insecticides acephate, diazinon, dimethoate, esfenvalerate, permethrin, horticultural oil, or propargite; or with the fungicide chlorothalonil.

Hydraulic Sprayer with Hand-Held Wand

A spray tank is mounted on a truck, tractor, or all-terrain vehicle, and may be used to treat young trees; and to apply herbicides around trees in orchard units, along fencelines, and as a spot treatment in fallow fields, orchard units, and administrative areas. The sprayer may be operated by one worker, who drives and stops to spray; or by two workers, with one driving and the other spraying. This method may be used to apply the insecticides acephate or esfenvalerate, the fungicide propiconazole, or the herbicides glyphosate, triclopyr, hexazinone, picloram, or dicamba.

Tractor-Pulled Spray Rig with Boom

This method may be used to apply herbicides for control of weeds in orchard units, in roadways, or in fallow areas. Equipment consists of a hydraulic spray tank pulled by a tractor or heavy-duty pickup truck, with a spray boom attached to the tank to release the herbicide. At Horning, this method may be used to apply the herbicides glyphosate, hexazinone, or dicamba; or the fungicide propiconazole.

Backpack Sprayer

A backpack sprayer consists of a plastic tank that is strapped to the applicator's back. A hand-operated hydraulic pump forces the liquid from the tank through a nozzle in a hand-held wand. At Horning, a backpack sprayer could be used to apply the insecticide esfenvalerate; or the herbicides glyphosate, picloram, or triclopyr for spot treatment of unwanted vegetation in orchard units and along fencelines.

Capsule Implantation

The insecticide acephate may be implanted into individual trees for long-term control of insect pests in the form of a capsule. One small hole is drilled into a tree for every 4 inches of its circumference, and a capsule is inserted.

Granular Spreaders

Granular fertilizers or the granular fumigant dazomet may be distributed over the ground using a spreader pulled by a truck or tractor, or mounted on an all-terrain vehicle. Broadcast or sidecast spreaders would be used for general fertilizer (nitrogen/phosphorus/sulfate) applications. Sidecast or drop spreaders would be used to apply calcium nitrate to the dripline of trees for stimulating flower production. A broadcast spreader would be used to apply the fumigant dazomet, after which the granules would be incorporated to a depth of four to eight inches, depending on targets to be controlled (e.g., annual weeds, specific soil-borne pathogens). Fertilizer application needs and rates for each orchard unit are determined based on the results of annual foliar analyses.

Hand Sprayer

A hand sprayer consists of a one- to two-gallon plastic container with a hand-operated trigger and wand. A hand sprayer may be used to apply the insecticide acephate or the fungicides chlorothalonil, mancozeb, and thiophanate-methyl in the greenhouse

Chemigation

Chemigation is the process of injecting pesticide into the irrigation system, so that it is applied with the irrigation water. At Horning, chemigation is only used in the greenhouse. This method may be used to apply the fungicides chlorothalonil, hydrogen dioxide, mancozeb, or thiophanate-methyl to greenhouse plants. For foliar applications such as these, the pesticide is added to the irrigation water at the end of the irrigation cycle, to minimize washoff and maximize efficacy.

Total-Release Canister

One formulation of the insecticide acephate may be used in the greenhouse in the form of total release canisters, or "foggers." The cans are placed evenly throughout the greenhouse, and a tab release is pressed. The greenhouse is evacuated. The entire contents of each can are released automatically.

Greenhouse Effluent Irrigation

The effluent from greenhouse operations will be collected in a holding tank. This effluent will consist of excess irrigation water, including washoff containing greatly diluted residues of the fertilizers and pesticides used in the greenhouses. Greenhouse pesticides are acephate, chlorothalonil, hydrogen dioxide, mancozeb, and thiophanate-methyl. A typical effluent irrigation amount is estimated to be 4,800 gallons over 3 hours. The maximum volume is estimated to be 9,600 gallons in two 3-hour increments. Typical irrigation frequency is estimated to be every 2 to 3 days in summer and every 5 to 6 days in spring, fall, and early winter. The effluent will be irrigated over field B11.

Appendix D: Risk Analysis For Special Status Aquatic Species

D.1 Methodology

In the non-target species risk assessment (summarized in Appendix C), it was postulated that species of fish may be exposed to pesticides or fertilizers through contaminated surface runoff or from drift during application. For each chemical, if data were not available for each species, acute toxicity to the most sensitive coldwater fish was determined for which acute toxicity data were available. Based on this information, mortality risks were also evaluated for one special status species known to be present in the Clear Creek and Milk Creek watersheds: the steelhead trout. Three additional special status aquatic species (chinook and coho salmon, Pacific lamprey) are located in the watershed; however, acute risks were not quantified for these species in the risk assessment, due to lack of information on populations of coho salmon and Pacific lamprey, and to the distance from the seed orchard of chinook salmon (more than 10 miles downstream), which is associated with a negligible potential for measurable mortality impacts. These additional special status species are, however, included in this assessment of the potential for sublethal effects.

In the quantitative aquatic species risk assessment, if data were available for sublethal or long-term effects, the MATC (maximum acceptable toxicant concentration) was determined. The MATC is the geometric mean of a no-observable-effect concentration (NOEC) and a lowest-observed-effect concentration (LOEC). This further analysis of risks to special status aquatic species expands upon the MATC approach by estimating the risk of effects that may be relevant to the biological requirements of the animal: in this case, survival, rearing and migration, and reproductive endpoints.

The assessment endpoints used to characterize potential effects reflect measures of the animal's health that can be functionally related to survival, migratory, or reproductive success (NOAA 2002). Since relatively few scientific studies have examined sublethal effects of pesticides on fish physiology or behavior, the selection of assessment endpoints is limited by available scientific and commercial literature. In the absence of data specific to the identified species of concern, data from biologically and genetically similar surrogate species are used. Comparative toxicology has demonstrated that various species of scaled fish generally have equivalent sensitivity (within an order of magnitude) to other species tested under the same conditions. Dwyer et al. (1995) and Beyers et al. (1994), among others, have shown that endangered and threatened fish tested to date are similarly sensitive to a variety of pesticides and other chemicals as their non-endangered counterparts. Very few studies have investigated the effects of pesticides specific to the lamprey, so comparative toxicity with fish species from available literature is made cautiously. In some cases, in the absence of sublethal effects data on a specific chemical to appropriate fish species, information was evaluated for pesticides which are chemically similar and share a common mechanism of toxicity.

For the purpose of broadening and strengthening the best available science for this evaluation, and simplifying the presentation of information, the proposed-use chemicals are analyzed by chemical groups. The insecticides and acaricides are divided by chemical classes (biologicals, organophosphates, organosulfates, and pyrethroids), reflecting the common mechanism of action for each class. The herbicides and fungicides/fumigants are evaluated as groups, based on the most sensitive toxicity findings. Pesticides that do not fit in specific categories are grouped as "other pesticides". The other pesticides, "other" (formerly "inert") ingredients, and fertilizers are evaluated within their respective groups. In each case, the lowest toxicity result (indicating greatest toxicity) was used in the analysis of risks, so that this categorization approach would not sacrifice a protective analysis.

D.2 Literature Review Of Toxicity Data

D.2.1 Insecticides and Acaricides

Biological

This group includes the insecticide *Bacillus thuringiensis* (*B.t.*).

The mode of action for *B.t.* is a disruption of the digestive tract. After an insect ingests a crystal of *B.t.*, the biopesticide dissolves in the alkaline gut. The toxin that is released binds to the lining of the midgut membrane, creating pores and upsetting ion balance. A similar mechanism of toxicity is assumed for fish.

Table D-1 lists relevant assessment endpoints and effect concentrations of *B.t.* to fish species as identified from the literature.

B.t. is practically nontoxic to aquatic vertebrate species, and only one identified study has investigated sublethal effects relevant to the assessment endpoints and measures for the essential biological requirements of special status fish species. Field observations of populations of brook trout, common white suckers, and smallmouth bass did not reveal adverse effects one month after aerial application of the *B.t.* HD-1 formulation.

B.t. israelensis was tested for possible impacts on non-target invertebrates. Its use over a three-year period did not disturb the prey base of fish. No negative impacts were observed on invertebrate predators (Plecoptera, Odonata, Megaloptera, Trichoptera, Diptera) or grazers (Trichoptera, Ephemeroptera). Predators often consumed more *B.t.*-contaminated (dead) black fly larvae than live larvae with no adverse effects. Detritivores (mainly mayflies) consumed large amounts of *B.t.*-contaminated black fly larvae, resulting in increased body mass and shorter developmental times. Some Diptera species were sensitive to high doses of *B.t.* israelensis (>100 times the normal field dose) (Merritt 1999).

Table D-1. Effects of *Bacillus thuringiensis* on Fish Species

Assessment Endpoints	Assessment Measures	Species	Formulation	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	HD-1	> 112	Abbott Laboratories 1982
mortality	1/20 LC_{50}[b]	bluegill	HD-1	> 200	Abbott Laboratories 1982
mortality	1/20 LC_{50}[b]	European eel	HD-1	200-400 times field rates	Abbott Laboratories 1982
mortality	1/20 LC_{50}[b]	trout	israelensis	75 - 100	Merritt 1999
Migration					
NA[c]					
Reproduction					
Success	population (number)	brook trout	HD-1	typical aerial application	Abbott Laboratories 1982

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation
[b] Adjusted 24-hour value.
[c] NA = Not available.

B.t. is moderately persistent in soils, with a half-life of about 4 months (Extoxnet 1996). In soils with a pH below 5.1, *B.t.* is rapidly inactivated. It does not tend to move, or leach, with groundwater. After 48 hrs, *B.t.* begins to inactivate in water, gradually settling out or adhering to suspended organic matter.

Organophosphates

This group includes the insecticides acephate, chlorpyrifos, diazinon, and dimethoate.

Organophosphate insecticides are highly toxic to fish. The primary mechanism of this toxicity is generally well understood, with inhibition of acetylcholinesterase (AChE) being the critical target. The function of AChE is to hydrolyze the neurotransmitter acetylcholine at synaptic junctions, terminating nervous stimulation. Inhibition of AChE is followed by an accumulation of acetylcholine, resulting in a continuous stimulation at cholinergic and muscarinic receptors. Relationships between AChE inhibition and biological function for fish have been investigated and include alterations in growth, reproduction, maturation, swimming, hyperactivity, and feeding. Organophosphate insecticides can target AChE located in the central and peripheral nervous system, and in the neuro-muscular junctions. Inhibition of AChE at these regions can affect behavioral processes, sensory systems, and swimming ability in fish.

Table D-2 lists relevant assessment endpoints and effect concentrations of acephate, chlorpyrifos, diazinon and dimethoate and other relevant organophosphates to salmonid species and the European eel.

Table D-2. Effects of Organophosphates on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout cutthroat trout brook trout	acephate	44.8 > 20.0 > 20.0	EPA 1984
mortality	1/20 LC_{50}[b]	rainbow trout cutthroat trout lake trout	chlorpyrifos	0.006 0.003 0.020	EPA 2000a
mortality	1/20 LC_{50}[b]	rainbow trout cutthroat trout lake trout	diazinon	0.018 0.34 0.12	Johnson and Finley 1980
mortality	1/20 LC_{50}[b]	brook trout	diazinon	0.15	Allison and Hermanutz 1977
mortality	1/20 LC_{50}[b]	European eel	diazinon	0.008	Sancho et al. 1992
mortality	1/20 LC_{50}[b]	European eel	chlorpyrifos	0.065	Ferrando et al. 1991
mortality	1/20 LC_{50}[b]	rainbow trout	dimethoate	1.24	EPA 1999a
predation	olfactory anti-predatory response (food strikes, activity)	chinook salmon	diazinon	0.001	Scholz et al. 2000
predation	swimming (distance, speed, turning rate, tortuosity of path)	rainbow trout	diazinon	0.250	Brewer et al. 2001
predation	survival (predation by Large mouth bass)	rainbow trout	methyl parathion[c]	0.01	Little et al. 1990
predation	swimming (erratic pattern)	European eel	diazinon	0.16	Ferrando et al. 1991
predation	swimming (erratic pattern)	European eel	chlorpyrifos	1.29	Ferrando et al. 1991
growth	foraging (prey ingestion)	Atlantic salmon	fenitrothion[c]	0.006	Morgan and Kiceniuk 1991

Table D-2. Effects of Organophosphates on Fish Species (continued)

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Migration					
upstream return	homing (number returning to hatchery)	chinook salmon	diazinon	0.010	Scholz et al. 2000
rearing	Territory defense (location)	Atlantic salmon	fenitrothion[c]	0.1	Symons 1973
rearing	territory defense (agonistic behaviors)	coho salmon	fenitrothion[c]	0.1	Bull and McInerney 1974
Reproduction					
mating	detection of mate (electrophysiology)	Atlantic salmon	diazinon	0.001	Moore and Waring 1996
physiology	biological stimulation (hormone production, expressible milt)	Atlantic salmon	diazinon	0.0003	Moore and Waring 1996

[a] Lowest-observed-effect-concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] Not proposed for use in seed orchard by BLM; data used for assessment purposes only.

Scholz et al. (2000) exposed juvenile chinook salmon to concentrations of diazinon ranging from 0.0001 to 0.010 mg/L for two hours and then allowed them to recover for one hour. After exposures, anti-predator behaviors were observed when skin extracts from juvenile salmon were added to the trial tanks. At concentrations of 0.001 and 0.010 mg/L, the fish failed to respond to the olfactory cue. Rainbow trout showed altered swimming patterns when exposed to diazinon for 24 to 96 hours, at concentrations ranging from 0.25 to 1.0 mg/L (Brewer et al. 2001).

The European eel, when exposed to diazinon and chlorpyrifos, exhibited signs of restlessness, erratic swimming, convulsions and difficulty in respiration at acutely toxic concentrations of 0.16 and 1.29 mg/L, respectively, after 24 hours (Ferrando et al. 1991). When rainbow trout were exposed to 0.01 mg/L methyl parathion for 96 hours, swimming activity decreased and the fish were more vulnerable to predation by bass. Of control fish, 84% survived predation, as opposed to 57% of the exposed fish (Little et al. 1990).

Foraging behaviors were tested in Atlantic salmon exposed to fenitrothion for two 24-hour periods separated by seven days. At concentrations of 0.006 and 0.21 mg/L, the reaction distance of the salmon to respond to prey decreased significantly (Morgan and Kiceniuk 1991).

Exposure of juvenile Atlantic salmon to 0.1 mg/L fenitrothion for 15 to 16 hours caused a 20% decrease in the number of fish that were able to maintain and hold territories six days following treatments (Symons 1973). The territories were not reclaimed for approximately two to three weeks. Some severely affected fish swam stiffly and ceased feeding, but recovery to these effects was evident within 48 hours after returning to clean water. Coho salmon showed very similar behavioral changes over the same concentration range (Bull and McInerney 1974). When adult chinook salmon were treated with 0.010 mg/L diazinon and re-released downstream of their native hatchery, the number of returns was significantly lower than unexposed control fish.

Following a direct perfusion-exposure of diazinon directly over the olfactory epithelium, adult male Atlantic salmon showed inhibited olfactory stimulation to a female reproductive pheromone (Moore and Waring 1996). Concentrations of diazinon ranged from 0.001 to 0.02 mg/L. The same study found that exposures of 0.0003 to 0.045 mg/L reduced biochemical responses to the pheromone and a reduction of viable sperm produced.

Environmental factors may also influence organophosphate toxicity to aquatic species, altering effect estimates to the fish (Table D-3). A number of studies tested environmental effects on the toxicity of chlorpyrifos and azinphos-methyl to salmonids. Parameters included temperature, pH, water hardness, fish size, and static versus flow-through exposures. In general, acute toxicity

of chlorpyrifos and azinphos-methyl were found to increase with temperature, pH, and body size of the fish. Increasing hardness tended to reduce the toxicity of chlorpyrifos, and static exposure tests produced lower lethality values than those from flow-through tests.

Organosulfites

This group includes the acaricide propargite.

EPA lists propargite as a probable human carcinogen, meaning there is a possibility of causing cancer in animals as well. Propargite is highly toxic to fish.

Table D-4 lists relevant assessment endpoints and effect concentrations of propargite to fish species as identified from the literature.

Table D-3. Environmental Factors Influencing Organophosphate Toxicity to Fish

Environmental Factor	Assessment Measures	Species	Chemical	Reference
temperature	24-hr LC_{50} (2, 7, 13°C)	rainbow trout	chlorpyrifos	Macek et al. 1969
temperature	96-hr LC_{50} (2, 7, 13°C)	rainbow trout	chlorpyrifos	Macek et al. 1969
temperature	24-hr LC_{50} (2, 7, 13°C)	rainbow trout	azinphos-methyl[a]	Macek et al. 1969
temperature	96-hr LC_{50} (2, 7, 13°C)	rainbow trout	azinphos-methyl[a]	Macek et al. 1969
temperature	96-hr LC_{50} (2, 7, 13, 18°C)	rainbow trout	chlorpyrifos	EPA 2000a
pH	96-hr LC_{50} (7.5, 9.0)	cutthroat trout	chlorpyrifos	EPA 2000a
hardness	96-hr LC_{50} (44, 162 mg/L $CaCO_3$)	lake trout	chlorpyrifos	EPA 2000a
exposure system	96-hr LC_{50} (static, flow through)	lake trout	chlorpyrifos	EPA 2000a
body weight	96-hr LC_{50} (0.3 2.9 g)	lake trout	chlorpyrifos	EPA 2000a

[a]Not proposed for seed orchard use by BLM; data used for assessment purposes only.

Table D-4. Effects of Organosulfites on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	rainbow trout	propargite	0.024	EPA 2000b
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	bluegill	propargite	0.034	Uniroyal 1998
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	minnow	propargite	0.012	Uniroyal 1998
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	catfish	propargite	0. 008	Uniroyal 1998
growth	size (length, weight)	fathead minnow	propargite	0.028	EPA 2000b
Migration					
NA[c]					
Reproduction					
success	day to hatch (mean number)	fathead minnow	propargite	0.028	EPA 2000b

[a] Lowest-observed-effect-concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] NA = Not available.

A chronic test in fathead minnows showed that propargite affected growth and survival at a concentration of 0.028 mg/L; the NOEC was 0.016 mg/L (EPA 2000b). Acute mortality data for the catfish are used in the risk evaluation for the survival endpoint, since this was the most sensitive endpoint identified.

For reproductive parameters, a chronic test in fathead minnows showed that propargite affected growth, survival, and day to hatch at a concentration of 0.028 mg/L; the NOEC was 0.016 mg/L (EPA 2000b).

No data are currently available for migratory effects endpoints or environmental influences on toxicity.

Pyrethroids

The pyrethroid insecticide group includes esfenvalerate and permethrin.

Pyrethroids are highly toxic to fish, generally with acute LC_{50} values for salmonids near or below 0.001 mg/L. The mode of action for pyrethroids is the blocking of neural voltage-activated sodium/calcium channels, producing common symptoms of toxicity for the various synthetic compounds. The sensitivity of fish to pyrethroids, compared to other vertebrates, has been explained, in part, by the fishes' inability to metabolize and excrete the toxins (Haya 1989). A comparative study between steelhead trout and coho salmon showed that both species were similarly sensitive across the five pyrethroids tested (Mauck and Olson 1976). Thus, incorporating data from pyrethroids of similar toxicity across similar fish species should provide adequate estimates where salmonid data gaps are present.

Table D-5 lists relevant assessment endpoints and effect concentrations of esfenvalerate, permethrin, and other pyrethroids to fish species as identified from the literature. Note that the active isomer of fenvalerate is esfenvalerate.

Pyrethroids have been documented to affect behavior and physiology in fish important for survival. Sublethal effects observed in fish include alterations in growth, metabolic processes, swimming, a reduced startle response, loss of equilibrium, body tremors, and depressed olfactory sensitivity.

Juvenile Atlantic salmon exposed to 0.008 mg/L fenvalerate were unable to survive the stress of hunger over a 70-hour period, with mortality resulting in over half of the test animals (Haya 1989). Growth was reduced in sheepshead minnow fry exposed to fenvalerate concentrations $\geq$ 0.002 mg/L over a period of 28 days (Hansen et al. 1983).

Primary toxicity involves disruption to the neuromuscular system, affecting swimming and other coordinated muscular movement. Gross body tremors of juvenile bluegill continually or pulse-exposed to esfenvalerate were sensitive indicators of toxicity at concentrations as low as 0.000025 mg/L (Little et al. 1993). Rainbow trout exposed to 0.00075 mg/L permethrin showed a substantial decrease in swimming performance that was related to exposure duration, from one to 43 days (Kumaraguru and Beamish 1986). This effect was attributed to an increased metabolic rate and a higher demand in oxygen consumption. After a 24-hour exposure to >0.009 mg/L permethrin, Japanese medaka were hypoactive and underreactive to startle stimuli (Rice et al. 1997). Rainbow trout exposed for 48 hours to permethrin at 0.0013 mg/L caused rapid gill movements and a pattern of swimming at the water surface (Holcombe et al. 1982).

Juvenile selection of rearing habitat, smolt outward migration, and adult homing are behaviors related to successful migration. Aggression of bluegill, a response of the fish to defend rearing territory, was significantly lower among fish exposed to pulsed 11-hour concentrations of 0.0001 mg/L esfenvalerate (Little et al. 1993). Schooling behavior of fathead minnows was affected at 0.0072 mg/L permethrin (Holcombe et al. 1982).

Following a five-day exposure to 0.00001 mg/L cypermethrin (nominal concentration), male Atlantic salmon showed inhibited olfactory stimulation to a female reproductive pheromone

Table D-5. Effects of Pyrethroids on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	rainbow trout	esfenvalerate	0.001	Du Pont 1999
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	steelhead trout	fenvalerate	0.00035	Curtis et al. 1985
mortality	1/20 LC_{50} (adjusted 24-hr)[b]	rainbow trout	permethrin	0.0043	Mayer and Ellersieck 1986
growth	feeding (mortality from stress)	Atlantic salmon	fenvalerate	0.008	Haya 1989
growth	size (length, weight)	sheepshead minnow	fenvalerate	0.002	Hansen et al. 1983
predation	swimming (tremors)	bluegill	esfenvalerate	0.000025	Little et al. 1993
predation	swimming (critical speed)	rainbow trout	permethrin	0.00075	Kumaraguru et al. 1982
predation	avoidance behavior (startle response)	Japanese medaka	permethrin	0.009	Rice et al. 1997
predation	behavior (equilibrium, coughing)	rainbow trout	permethrin	0.0013	Holcombe et al. 1982
Migration					
behavior	schooling (location, grouping pattern)	fathead minnow	permethrin	0.007	Holcombe et al. 1982
rearing	territory defense (aggression)	bluegill	esfenvalerate	0.0001	Little et al. 1993
Reproduction					
mating	detection of mate (electrophysiology)	Atlantic salmon	cypermethrin[c]	0.00001	Moore and Waring 2001
physiology	biological stimulation (hormone production, expressible milt)	Atlantic salmon	cypermethrin[c]	0.000004	Moore and Waring 2001
success	recruits (number per female)	bluegill	esfenvalerate	0.00067	Fairchild et al. 1992
success	egg hatch (number) larvae survive (number) larvae abnormality (deformities)	Australian crimson-spotted rainbowfish	esfenvalerate	0.001 0.032 0.032	Barry et al. 1995

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] Not proposed for seed orchard use by BLM; data used for assessment purposes only.

(Moore and Waring 2001). The same study found that exposures < 0.000004 mg/L reduced biochemical responses to the pheromone and caused a reduction of viable sperm produced.

Barry et al. (1995) studied the effects of esfenvalerate exposure to the Australian crimson-spotted rainbowfish over a period of six days. At 0.001 mg/L, there was a significant decrease in the number of larvae hatching per spawning day. Hatchability of eggs was affected and there was an increase in abnormalities in larvae at a concentration of 0.032 mg/L. In an aquatic mesocosm study of esfenvalerate on bluegill, reproductive success, as defined by the number of offspring per female, was decreased at a concentration of 0.00067 mg/L (Fairchild et al. 1992).

Environmental factors may also influence pyrethroid toxicity to aquatic species, altering effect estimates to fish (Table D-6). Pyrethroid insecticides readily bind to organic matter in the soil, have little mobility, and are practically insoluble in water. When caged rainbow trout were exposed to cypermethrin in a pond containing 14 to 22 mg/L suspended solids, the amount of

Table D-6. Environmental Factors Influencing Pyrethroid Toxicity to Fish

Environmental Factor	Assessment Measures	Species	Chemical	Reference
turbidity	96-hr LC_{50} (suspended solids)	rainbow trout	cypermethrin[b]	Shires 1983
temperature	96-hr LC_{50} (5 - 25°C)	rainbow trout	permethrin	Kumaraguru et al. 1982
hardness[a] pH	96-hr LC_{50} (10 - 300) 96-hr LC_{50} (6.5 - 9.5)	coho salmon steelhead trout	dimethrin[b] d-trans allethrin[b] RU-11679[b] s-bioallethrin[b]	Mauck and Olson 1976

[a] As mg/L $CaCO_3$.

[b] Not proposed for seed orchard use by BLM; data used for assessment purposes only.

pesticide necessary to result in mortality increased by nearly five times (from 0.001 to 0.005 mg/L) (Shires 1983). Rainbow trout became more sensitive to permethrin with increasing water temperature (Kumaraguru and Beamish 1986). The 96-hour LC_{50} values decreased by nearly an order of magnitude (0.0064 to 0.00069 mg/L) between 10 and 20 °C, respectively. Toxicity of four pyrethroids to coho salmon and steelhead trout was not influenced by pH in the range of 6.5 to 9.5, or by water hardness ranging from 10 to 300 mg/L $CaCO_3$ (Mauck and Olson 1976).

D.2.2 Herbicides

The herbicides evaluated are dicamba, glyphosate, hexazinone, picloram, and triclopyr.

Classification of herbicides by chemical structure for evaluating toxic effects in fish is not practical because the mechanism by which herbicides elicit toxicity in animals is non-specific, with a broad overlapping of biological effects. Another method is to classify herbicides by their acute toxicity to fish as presented below. One proposed-use herbicides is classified as very highly or highly toxic to fish. Two herbicides are considered moderately or slightly toxic to fish. Three herbicides are considered practically non-toxic to fish.

- Very highly (<0.1 mg/L) and highly toxic (0.1 to 1.0 mg/L) to fish: triclopyr butoxyethyl ester.
- Moderately (1.0 to 10 mg/L) and slightly toxic (10 to 100 mg/L) to fish: picloram and dicamba.
- Practically non-toxic (>100 mg/L) to fish: glyphosate, hexazinone, triclopyr-triethylamine salt.

Herbicides do not typically elicit a specific mechanism of toxicity to fish. Toxicity is often associated with skin and eye irritations, nausea, hemorrhages, and kidney and liver inflammation in mammals which can eventually lead to mortality. The gill, liver, and kidneys are often the target organs for herbicides in fish.

Table D-7 lists relevant assessment endpoints and effect concentrations of dicamba, glyphosate, hexazinone, picloram, and triclopyr to fish species as identified from the literature.

Based on available information, chronic picloram toxicity to fish is not cumulative in terms of lethality (Woodward 1976). However, long-term exposures have been shown to affect fish development and growth. It was observed that the NOEC of technical grade picloram for lake trout was apparently <0.035 mg/L, as this level of herbicide reduced fry survival and growth. Most abnormalities occurred during yolk absorption, which took four to five days longer in picloram-treated fish. Morgan and Kiceniuk (1992) observed no effects of glyphosate exposure on growth and weight, or foraging activities at concentrations up to 0.1 mg/L for 12 hours. In an early lifestage test for hexazinone using the fathead minnow, a NOEC of 17 mg/L was determined, with fish length affected at the LOEC of 35.5 mg/L (EPA 1994).

Table D-7. Effects of Herbicides on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
mortality	1/20 LC_{50}[b]	rainbow trout	dicamba	1.8	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	cutthroat trout	dicamba	10	Caux et al. 1993
mortality	1/20 LC_{50}[b]	coho salmon	dicamba	5.5 (6-day)	Caux et al. 1993
mortality	1/20 LC_{50}[b]	cutthroat trout	dicamba/ picloram mixture	10	Woodward 1982
mortality	1/20 LC_{50}[b]	rainbow trout	glyphosate	1.6	EPA 1993a
mortality	1/20 LC_{50}[b]	chinook salmon	glyphosate	1.9	Mitchell et al. 1987
mortality	1/20 LC_{50}[b]	coho salmon	glyphosate	2.2	Mitchell et al. 1987
mortality	1/20 LC_{50}[b]	sockeye salmon	glyphosate	5.3	Servizi et al. 1987
mortality	1/20 LC_{50}[b]	rainbow trout	hexazinone	16	Wan et al. 1988
mortality	1/20 LC_{50}[b]	coho salmon	hexazinone	14.5	Wan et al. 1988
mortality	1/20 LC_{50}[b]	chum salmon	hexazinone	16.1	Wan et al. 1988
mortality	1/20 LC_{50}[b]	chinook salmon	hexazinone	19.7	Wan et al. 1988
mortality	1/20 LC_{50}[b]	pink salmon	hexazinone	15.5	Wan et al. 1988
mortality	1/20 LC_{50}[b]	sockeye salmon	hexazinone	18.2	Wan et al. 1988
mortality	1/20 LC_{50}[b]	rainbow trout	picloram	0.16	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	cutthroat trout	picloram	0.17	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	lake trout	picloram	0.09	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	cutthroat trout	picloram/ dicamba mixture	0.8	Woodward 1982
mortality	1/20 LC_{50}[b]	rainbow trout	triclopyr (triethylamine salt)	47.4	EPA 1998a
mortality	1/20 LC_{50}[b]	rainbow trout	triclopyr (BEE)[c]	0.033	EPA 1998a
mortality	1/20 LC_{50}[b]	chinook salmon	triclopyr (BEE)[c]	0.088	Kreutzweiser et al. 1994
mortality	1/20 LC_{50}[b]	coho salmon	triclopyr (BEE)[c]	0.052	Mayes et al. 1986

Table D-7. Effects of Herbicides on Fish Species (continued)

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
growth	size (length, weight)	cutthroat trout	picloram	0.61	Woodward 1979
growth	size (length, weight)	lake trout	picloram	0.035	Woodward 1976
growth	size (length, weight)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
growth	foraging (rearing distance, attacks, captures, ingestion)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
growth	size (length)	fathead minnow	hexazinone	35.5	EPA 1994
fitness	hypersensitivity to stimuli	coho salmon	triclopyr (BEE)[c]	0.10	Johansen and Geen 1990
fitness	lethargic (spontaneous activity)	coho salmon	triclopyr (BEE)[c]	0.32	Johansen and Geen 1990
Migration					
rearing	territory defense (agonistic behaviors)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
adaptation	osmoregulation (gill lesions)	rainbow trout	glyphosate	0.046 (NOEC)	Morgan and Kiceniuk 1992
adaptation	sea water challenge (mortality)	coho salmon	dicamba	0.25	Lorz et al. 1979
adaptation	sea water challenge (mortality)	coho salmon	picloram	0.25	Lorz et al. 1979
adaptation	sea water challenge (mortality)	coho salmon	glyphosate	2.8 (NOEC)	Mitchell et al. 1987
Reproduction					
success	fecundity (egg number) gonadosomatic index (gonad/body)	rainbow trout	glyphosate	2.0 (NOEC)	Folmar et al. 1979
success	larval survival (number)	rainbow trout	picloram	2.0	Mayes et al. 1987

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] BEE - butoxyethyl ester

The toxicity of triclopyr (butoxyethyl ester) at a concentration lower than 0.56 mg/L reduced spontaneous swimming activity in coho salmon after 96-hour exposures (Johansen and Geen 1990). At concentrations lower than 0.10 mg/L, fish were very sensitive to stimuli. At slightly higher concentrations, they were initially sensitive prior to reaching a pronounced state of lethargy. It was suggested that the formulation affected the nervous system of the fish.

There was no effect of dicamba on gill ATPase activity of coho salmon exposed up to 100 mg/L for 144 hours (Lorz et al. 1979). (ATPase is an enzyme that is needed for energy-requiring cellular activities to take place.) Histological examination of gill, liver, and kidney tissue indicated no apparent effects. When challenged with seawater, fish previously exposed to the lowest level of 0.25 mg/L showed a 32% mortality during the 11 days of the test. When coho salmon were

treated with picloram at 0.25 mg/L for 144 hours, 25% mortality occurred. Inexplicably, no deaths occurred at the higher exposure concentrations for both herbicides. There was no apparent effect of picloram on the ATPase activity of the gills. Histological examination of fish exposed to 5.0 mg/L revealed abnormal liver and gill tissues. Mitchell et al. (1987) exposed coho salmon to glyphosate for 10 days at concentrations up to 2.8 mg/L, with no effect on successful seawater adaptation.

Rainbow trout exposed for two months to glyphosate had no significant increase in gill lesions, and fish did not show any change in agonistic activity that would be important for territorial defense (Morgan and Kiceniuk 1992).

Rainbow trout exposed up to 2.0 mg/L glyphosate for 12 hr showed no effect on fecundity (eggs per female) and gonadosomatic index (gonad weight/total body weight) (Folmar et al. 1979). Tests with the early lifestages of rainbow trout showed that picloram concentrations of 2 mg/L reduced survival of the larvae (Mayes et al. 1987).

Environmental factors may influence herbicide toxicity to aquatic species, altering the effect estimates to fish (Table D-8). Glyphosate toxicity to rainbow trout increased with higher test temperatures (Folmar et al. 1979). Toxicity increased from pH 6.5 to 7.5, but did not change up to pH 9.5. Increasing temperature and pH with exposures to picloram resulted in greater toxicities to cutthroat trout and lake trout (Woodward 1976). The specific content of $CaCO_3$ in the tested "soft", "hard", and "very hard" waters was not specified, but were reported not to alter toxicity. Eyed eggs were the least sensitive lifestage, with toxicity increasing markedly as the fish entered the sac fry and early swim-up stages.

D.2.3 Fungicides and Fumigants

The fungicides and fumigants group include dazomet, chlorothalonil, mancozeb, propiconazole, and thiophanate-methyl.

Classification of fungicides and fumigants by chemical structure for evaluating toxic effects in fish is not practical because the mechanism by which they elicit toxicity in animals is non-specific, with a broad overlapping of biological effects. Unlike the herbicides, fumigants and fungicides

Table D-8. Environmental Factors Influencing Herbicide Toxicity to Fish

Environmental Factor	Assessment Measure	Species	Chemical	Reference
temperature	96-hr LC_{50} (7 - 17°C)	rainbow trout	glyphosate	Folmar et al. 1979
temperature	96-hr LC_{50} (5 - 15°C)	cutthroat trout	picloram	Woodward 1976
temperature	96-hr LC_{50} (5 - 15°C)	lake trout	picloram	Woodward 1976
pH	96-hr LC_{50} (6.5 - 9.5)	rainbow trout	glyphosate	Folmar et al. 1979
pH	96-hr LC_{50} (6.5 - 8.5)	cutthroat trout	picloram	Woodward 1976
pH	96-hr LC_{50} (6.5 - 8.5)	lake trout	picloram	Woodward 1976
hardness [a]	96-hr LC_{50} ("soft", "hard", very hard")	cutthroat trout	picloram	Woodward 1976
hardness [a]	96-hr LC_{50} ("soft", "hard", very hard")	lake trout	picloram	Woodward 1976
lifestage	96-hr LC_{50} (eyed eggs, sac fry, swim up fry, fingerling 1.0g, fingerling 2.0g)	rainbow trout	glyphosate	Folmar et al. 1979

[a] Content of $CaCO_3$ not specified.

can be highly toxic to animals. The same classification method used for the herbicides can be applied to fungicides and fumigants based on the acute toxicity to fish. Three of the proposed-use fungicides and fumigants are classified as very highly or highly toxic to fish. Two are considered moderately or slightly toxic to fish.

- Very highly (<0.1 mg/L) and highly toxic (0.1 to 1.0 mg/L) to fish: dazomet, chlorothalonil, mancozeb.
- Moderately (1.0 to 10 mg/L) and slightly toxic (10 to 100 mg/L) to fish: propiconazole, thiophanate-methyl.
- Practically non-toxic (>100 mg/L) to fish: none.

All fungicides and most fumigants produce positive results in the usual microbial mutagenicity test systems (Ecobichon 1996). The microorganisms (salmonella, coliforms, yeasts, and fungi) used in these test systems are similar to those cell systems that fungicides were designed to target. It is possible that the fungicides and fumigants are mutagenic to higher animals as well.

Table D-9 lists relevant assessment endpoints and effect concentrations of dazomet, chlorothalonil, mancozeb, propiconazole, and thiophanate-methyl to fish species as identified from the literature.

Table D-9. Effects of Fungicides and Fumigants on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	chlorothalonil	0.0085	EPA 1999b
mortality	1/20 LC_{50}[b]	rainbow trout	dazomet	0.032	BASF 1999
mortality	1/20 LC_{50}[b]	rainbow trout	dazomet	0.48	USDA 1998
mortality	1/20 LC_{50}[b]	brook trout	dazomet	2.0	USDA 1998
mortality	1/20 LC_{50}[b]	rainbow trout	mancozeb	0.092	EPA 1987
mortality	1/20 LC_{50}[b]	rainbow trout	propiconazole	1.0	Novartis 2000
mortality	1/20 LC_{50}[b]	brown trout	propiconazole	0.24	Grande et al. 1994
mortality	1/20 LC_{50}[b]	rainbow trout	thiophanate-methyl	1.7	EPA 1986
survival	21-day mortality (1/20 LC_{50})	rainbow trout	chlorothalonil	0.0049	Caux et al. 1996
Migration					
NA[c]					
Reproduction					
success	hatching (number, survivability)	fathead minnow	chlorothalonil	0.0065	EPA 1999b
success	hatching (number) hatching (survivability)	brown trout	propiconazole	3.0 1.0	Grande et al. 1994

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] NA = No data available.

Caux et al. (1996) reported a chronic 21-day LOEC for chlorothalonil of 0.0049 mg/L for rainbow trout with mortality as the endpoint.

A full life-cycle aquatic toxicity test with chlorothalonil resulted in a NOEC of 0.003 mg/L in fathead minnows, with hatching success and survivability affected at the LOEC of 0.0065 mg/L (EPA 1999b).

In a brown trout early lifestage test with propiconazole, a LOEC of 1.0 and 3.0 mg/L were determined for survival and hatching, respectively (Grande et al. 1994).

No data are currently available relevant to migratory effects or environmental influences on toxicity.

D.2.4 Other Pesticides

The pesticides hydrogen dioxide and horticultural oil do not fit within the previously assessed categories.

No mortality or indications of toxicity were observed in 96-hour studies in which rainbow trout, bluegill sunfish, and juvenile rainbow trout were exposed to horticultural oil at a concentration of 100 mg/L (Valent USA 1983, Wildlife International 1991). Although no LC_{50} values were determined, the value of 100 mg/L was used as the toxicity data point for fish species in the risk assessment, due to the lack of additional exposure-response information.

Hydrogen dioxide is a synonym for hydrogen peroxide. Peroxy compounds such as hydrogen peroxide are unstable and short-lived in the environment, quickly breaking down to water and oxygen (EPA 1993b). Hydrogen peroxide was evaluated for use in controlling external pathogenic bacteria and parasites in fish hatcheries (Gaikowski et al. 1999). The NOEC for 90% survival of Atlantic salmon, lake trout, and rainbow trout over eight days following a one- to three-hour exposure ranged from 112 to 429 mg/L. Another study reported increased hatch (attributed to fungicidal properties) compared to controls in eggs of cool-water fish treated five days per week for 15 minutes with hydrogen peroxide at a concentration of 1 mL/L (1.44 mg/L); higher concentrations were associated with progressive decreases in hatching success. Species tested were northern pike, walleye, yellow perch, white sucker, lake sturgeon, paddle fish, common carp, and channel catfish (Rach et al. 1998).

No data are currently available on migratory or reproductive endpoint, or environmental influences on toxicity.

D.2.5 “Other” Ingredients

In addition to active ingredients, pesticide products contain a certain percentage of “other” ingredients (previously termed “inert” ingredients), which enhance the action of the active ingredient. Other ingredients can include surfactants, carriers, or preservatives. Some of the formulations proposed for use contain one or more of the following other ingredients: cyclohexanone, ethylbenzene, light aromatic solvent naphtha, and xylene.

Cyclohexanone, ethylbenzene, naphthalene (as an example of a light aromatic solvent naphtha), and xylene are hydrocarbons with solvent properties, having broad toxicological effects in fish. However, the primary target for acute exposure appears to be the gills.

Xylene occurs in three isomers which vary in the site of attachment on the benzene ring of the two methyl groups. Technical xylene typically contains mixed proportions of *o*-, *m*-, and *p*- isomers, with varying toxicity to fish. For the purposes of this assessment, all xylene isomers will be regarded as xylene.

Table D-10 lists relevant assessment endpoints and effect concentrations of cyclohexanone, ethylbenzene, light aromatic solvent naphtha, and xylene to fish species as identified from the literature.

Morrow et al. (1975) found that 100 mg/L xylene killed 100% of young coho salmon, and that 1 to 10 mg/L caused no significant mortality. Toxic symptoms before death included rapid, violent and erratic swimming, "coughing", and loss of equilibrium. Rainbow trout exposed to 3.2 and 6.2 mg/L xylene for 2 hours showed symptoms similar to anesthesia (Walsh et al. 1977).

Rainbow trout significantly avoided xylene at a nominal concentration of 0.1 mg/L during a one-hour test (Folmar 1976). Fish exposed to 0.001 mg/L did not show significant avoidance and those exposed to 0.01 mg/L were significantly attracted to the xylene. Maynard and Weber (1981) found that juvenile coho salmon avoided *o*-xylene at concentrations greater than 0.2 mg/L.

Kjorsvic et al. (1982) exposed cod eggs to xylene isomers in covered glass dished and monitored the effects both during fertilization and during early cleavage of fertilized eggs. Both *m*-xylene and *p*-xylene induced significant decreases in the fertilization rate at concentrations above 10 mg/

Table D-10. Effects of Other Ingredients on Fish Species

Assessment Endpoints	Assessment Measures	Species	Chemical	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	fathead minnow	cyclohexanone	96.2	HSDB 2001
mortality	1/20 LC_{50}[b]	rainbow trout	cyclohexanone	30.3 - 75.7	EPA 2001
mortality	1/20 LC_{50}[b]	rainbow trout	ethylbenzene	14	Mayer and Ellersieck 1986
mortality	1/20 LC_{50}[b]	rainbow trout	naphtha (as naphthalene)	0.32 - 1.1	EPA 2001
mortality	1/20 LC_{50}[b]	coho salmon	naphtha (as naphthalene)	0.64	Eisler 1987
mortality	1/20 LC_{50}[b]	rainbow trout	xylene	0.42 - 0.68	Mayer and Ellersieck 1986
survival	predation (erratic swimming, equilibrium, breathing)	coho salmon	xylene	100	Morrow et al. 1975
survival	predation (equilibrium)	rainbow trout	xylene	3.2	Walsh et al. 1977
Migration					
rearing	olfaction (avoidance behavior)	rainbow trout	xylene	0.1	Folmar 1976
rearing	olfaction (avoidance behavior)	coho salmon	xylene	0.2	Maynard and Weber 1981
Reproduction					
success	fertilization (rate, cell cleavage)	cod	xylene	8.0 - 35	Kjorsvic et al. 1982

[a]Lowest-observed-effect-concentration. Shaded values are used in the final risk evaluation.
[b]Adjusted 24-hour value.

L. Effects on the early cleavage pattern were significant for xylene concentrations between 2 and 7 mg/L. Observed effects included inhibition of formulation of the cleavage furrow. Small cells or a total absence of cleavage occurred on exposure to all isomers at concentrations of 16 to 35 mg/L, while incomplete or uneven cleavage was found at exposures of 8 to 15 mg/L.

Because of rapid volatilization from water and soil to the atmosphere, chronic exposure to fish is unlikely. In the atmosphere, these compounds are readily degraded, primarily by photochemical processes (WHO 1996, WHO 1997).

D.2.6 Fertilizers

Fertilizers include ammonium nitrate, ammonium sulfate, monoammonium and diammonium phosphate, calcium nitrate, potassium nitrate, potassium chloride, potassium sulfate, and urea. The following paragraphs provide information of the toxicity of these fertilizers to fish species.

Table D-11 lists relevant assessment endpoints and effect concentrations of the proposed fertilizers to fish species, as identified from the literature.

In water, ammonium nitrate degrades to form ammonium and nitrate ions. In addition, ammonia is oxidized to nitrate by algae and bacteria. In water, the ammonium ion can exist in its ionized form (NH_4^+), and in its un-ionized form as ammonia (NH_3). The equilibrium between these two forms depends largely on pH and temperature. Ammonia demonstrates greater toxicity to aquatic species than does the ammonium ion, and this toxicity increases with decreases in pH and temperature.

Table D-11. Effects of Fertilizers on Fish Species

Assessment Endpoints	Assessment Measures	Species	Fertilizer Component	LOEC[a] (mg/L)	Reference
Survival					
mortality	1/20 LC_{50}[b]	rainbow trout	ammonia (as NH_3)	0.11	Arthur et al. 1987
mortality	1/20 LC_{50}[b]	Atlantic salmon	ammonia (as NH_3)	0.0074 - 0.036	Knoph 1992
mortality	1/20 LC_{50}[b]	rainbow trout	nitrate (as NO_3)	2.0 (LC_{48})	Rouse et al. 1999
mortality	1/20 LC_{50}[b]	cutthroat trout	nitrate (as NO_3)	4.0 (LC_{41})	Rouse et al. 1999
mortality	1/20 LC_{50}[b]	rainbow trout	diammonium phosphate	93	Blahm and Snyder 1973
mortality	1/20 LC_{50}[b]	coho salmon	diammonium phosphate	49 - 64	HSDB 2001
mortality	1/20 LC_{50}[b]	bluegill	calcium nitrate	480	HSDB 2001
mortality	1/20 LC_{50}[b]	bluegill	potassium nitrate	38 - 105	EPA 2001
mortality	1/20 LC_{50}[b]	fathead minnow	potassium sulfate	49.5	EPA 2001
Migration					
NA[c]					
Reproduction					
NA					

[a] Lowest-observed-effect concentration. Shaded values are used in the final risk evaluation.
[b] Adjusted 24-hour value.
[c] NA = No data available.

Schuytema and Nebeker (1999a) identified a 10-day NOEC and LOEC for ammonium nitrate in Pacific tree frog tadpoles of 141 and 280 mg/L, respectively, based on decreased length and weight; corresponding values for the clawed toad were 280 and 569 mg/L. In a follow-on study of toxicity to the embryos of the same species, Schuytema and Nebeker (1999b) identified a 10-day NOEC and LOEC in Pacific tree frog embryos of 19 and 39 mg/L, and a 5-day NOEC and LOEC in clawed toad embryos of 19 and 39 mg/L. In an additional study, Schuytema and Nebeker (1999c) identified a 16-day ammonium nitrate NOEC and LOEC for embryos of the red-legged frog of 36.6 and 75.4 mg/L, respectively.

Schuytema and Nebeker (1999a) identified a 10-day NOEC and LOEC for ammonium sulfate in Pacific treefrog tadpoles of 116 and 232 mg/L, respectively, based on decreased length; no adverse effects on length or weight were observed in the clawed toad at the highest concentration tested of 939 mg/L. In a follow-up study, the same investigators (Schuytema and Nebeker 1999b) identified a 10-day NOEC and LOEC in Pacific treefrog embryos of 58 and 110 mg/L, and a 5-day NOEC and LOEC in clawed toad embryos of 24 and 58 mg/L.

D.3 Effects Analysis

Based on the stream concentrations estimated by the risk assessment runoff and drift modeling, and the most sensitive assessment endpoints determined from the literature reviewed (as summarized in Section D.2 above), a sublethal effects risk evaluation was made. Data from the literature were evaluated to determine potential effects on some aspects of survival, migration, and reproduction, with the LOECs listed. From the listed data, the lowest LOEC from each of these three assessment endpoints was selected for the risk evaluation. The selected LOECs are not intended to be definitive of all possible adverse effects at all life-stages related to survival, migration, or reproduction, but are intended to be the most conservative, representative estimates available.

For each stream containing special status species at Horning, the highest typical and maximum pesticide concentrations modeled are identified, and are compared to the selected assessment endpoint LOECs. An effects ratio was determined, defined as the estimated pesticide concentration over the sublethal effect level. Risks to some aspects of survival, migratory, and reproductive endpoints were determined to be low if the effects ratio was 0.1 or below, moderate if 0.1 to 1.0, and high if 1.0 or greater.

D.3.1 Insecticides and Acaricides

Biological

The risk assessment did not include fate and transport modeling for *B.t.*; therefore, expected concentrations in streams were not quantified. EPA has determined that risks from *B.t.* are minimal to non-existent for non-target aquatic organisms, including endangered species (EPA 1998b). The potential risks to the survival, migratory, and reproductive endpoints evaluated for special status species in all surface waters associated with Horning are therefore expected to be low for typical and maximum application scenarios.

Organophosphates

The potential risks to the evaluated sublethal endpoints are expected to be low for typical applications of acephate, chlorpyrifos, diazinon and dimethoate. For maximum applications of organophosphates, the potential risks to survival and migration in all streams are low, and reproductive risk is low in Swagger Creek, Milk Creek, and Clear Creek. However, in Nate Creek, the risk is moderate. This risk comparison is presented in Table D-12.

Table D-12. Risks[a] of Organophosphates to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
Highest estimated concentrations[b]	*typ:* *max:*	*0.000000263* *0.0000154*	*0.00000103* *0.0000691*	*0.00000000166* *0.00000535*	*0.000000177* *0.0000099*
Survival (0.001 mg/L)[c]	typ: max:	0.00026 0.015	0.0010 0.069	0.000017 0.0054	0.00018 0.010
Migration (0.01 mg/L)[c]	typ: max:	0.000026 0.0015	0.00010 0.0069	0.0000017 0.00054	0.000018 0.00010
Reproduction (0.0003 mg/L)[c]	typ: max:	0.00088 0.051	0.0034 0.23	0.000055 0.018	0.00059 0.033

[a]The effects ratio was defined as the estimated pesticide concentration over the sublethal effect level.
[b]Estimated stream concentrations expressed in mg/L.
[c]LOEC from most sensitive related assessment endpoint determined from literature.

These estimates of risk may be influenced by environmental factors as previously discussed and presented in Section D.2.1, such as temperature, pH, hardness, and fish size. Organophosphate residues in surface runoff will likely be associated with the organic matter, reducing bioavailability of the pesticide. The only risks determined to be moderate were to reproductive endpoints.

Organosulfites

Potential risks from the organosulfite propargite to the survival and reproductive endpoints evaluated are expected to be extremely low. No information on migratory endpoints are currently available. The estimated effects ratios are summarized in Table D-13. Propargite is proposed for infrequent use at Horning, with one application to individual trees between April and October, if needed at all. There is a very low risk to aquatic species under these conditions.

Pyrethroids

For typical applications of the insecticides esfenvalerate and permethrin, potential risks to the survival, migratory, and reproductive endpoints evaluated are low in all streams.

Table D-13. Risks[a] of Organosulfites to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
Highest estimated concentrations[b]	typ: max:	*0.000000052* *0.00000017*	*0.00000028* *0.0000010*	*0* *0*	*0.000000035* *0.00000012*
Survival (0.008 mg/L)[c]	typ: max:	0.0000065 0.000021	0.000035 0.00013	0 0	0.0000044 0.000014
Migration (NA)[c,d]	typ: max:	NA	NA	NA	NA
Reproduction (0.028 mg/L)[c]	typ: max:	0.0000019 0.0000059	0.000010 0.000036	0 0	0.0000012 0.0000041

[a]The effects ratio was defined as the estimated pesticide concentration over the sublethal effect level.
[b]Estimated stream concentrations expressed in mg/L.
[c]LOEC from most sensitive related assessment endpoint determined from literature.
[d]NA = No data available.

For maximum scenario applications of pyrethroid insecticides, potential risks to the survival, migratory, and reproductive endpoints in all off-site streams are low, except for Nate Creek, where risk to reproduction is moderate. Table D-14 summarizes these risk estimates.

These risk estimates may be influenced by environmental factors, as discussed in Section D.2.1, such as turbidity and temperature. Pyrethroid residues in surface runoff will likely be associated with the organic matter, reducing bioavailability of the pesticide. Since warmer temperatures tend to reduce the toxicity of pyrethroids to salmonids, it is unlikely that toxic effects will exceed those described in the literature.

The ammocoetes of lamprey may spend up to five to seven years living and feeding in fine silt and sand on stream bottoms and so may be exposed to toxics for longer periods of time than juvenile salmonids. Also, lamprey ammocoetes may be more susceptible to uptake of chemicals that bind to sediments such as the pyrethroids.

D.3.2 Herbicides

Risks to special status aquatic species from typical and maximum applications of dicamba, glyphosate, hexazinone, picloram and triclopyr are expected to be extremely low. The concentration-effects ratios are presented in Table D-15.

Table D-14. Risks[a] of Pyrethroids to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
Highest estimated concentrations[b]	*typ:* *max:*	*0.000000051* *0.00000012*	*0.00000018* *0.00000049*	*0.000000012* *0.00000016*	*0.000000034* *0.000000086*
Survival (0.000025 mg/L)[c]	typ: max:	0.0022 0.0049	0.0070 0.020	0.00068 0.0065	0.0014 0.0034
Migration (0.0001 mg/L)[c]	typ: max:	0.000051 0.00012	0.00018 0.00049	0.000017 0.00016	0.000034 0.000086
Reproduction (0.000004 mg/L)[c]	typ: max:	0.013 0.031	0.044 0.12	0.0043 0.041	0.0085 0.021

[a]The effects ratio was defined as the estimated pesticide concentration over the sublethal effect level.
[b]Estimated concentrations expressed in mg/L.
[c]LOEC from most sensitive related assessment endpoint determined from literature.

Table D-15. Risks[a] of Herbicides to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
Highest estimated concentrations[b]	*typ:* *max:*	*0.000000063* *0.00000020*	*0.00000034* *0.0000010*	*0* *0*	*0.000000042* *0.00000013*
Survival (0.035 mg/L)[c]	typ: max:	0.0000018 0.0000057	0.0000090 0.000029	0 0	0.0000012 0.0000037
Migration (0.046 mg/L)[c]	typ: max:	0.0000014 0.0000043	0.0000068 0.000022	0 0	0.00000092 0.0000028
Reproduction (2.0 mg/L)[c]	typ: max:	0.000000032 0.00000010	0.00000016 0.00000050	0 0	0.000000021 0.000000060

[a]The effects ratio was defined as the estimated pesticide concentration over the sublethal effect level.
[b]Estimated concentrations expressed in mg/L.
[c]LOEC from most sensitive related assessment endpoint determined from literature.

The influence of environmental factors on potential risks to aquatic species appears to be negligible, as discussed in Section D.2. Increasing temperature, pH, hardness, or differences in multiple life stages of salmonids was shown to increase toxicity values up to two- to six-fold by Folmar et al. (1979) and Woodward (1976). Such increases are still not likely to result in any significant toxicity to the fish in Horning's streams or downstream water bodies.

D.3.3 Fungicides and Fumigants

Typical and maximum applications of chlorothalonil, dazomet, mancozeb, propiconazole, and thiophanate-methyl are expected to be of extremely low risk to the survival and reproductive endpoints evaluated. No information on migratory endpoints is currently available. The concentration-effects ratios are summarized in Table D-16.

D.3.4 Other Pesticides

Extremely low risks to survival endpoints for special status aquatic species are also predicted for hydrogen dioxide and horticultural oil. No information on migratory or reproductive endpoints is currently available. The concentration-effect ratios are presented in Table D-17.

Table D-16. Risks[a] of Fungicides and Fumigants to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
Highest estimated concentrations[b]	*typ:* *max:*	*0.0000000055* *0.00000084*	*0.000000030* *0.0000041*	*0* *0*	*0.0000000037* *0.00000054*
Survival (0.0049 mg/L)[c]	typ: max:	0.0000011 0.00017	0.0000061 0.00083	0 0	0.00000075 0.00011
Migration (NA)[c,d]	typ: max:	NA	NA	NA	NA
Reproduction (0.0065 mg/L)[c]	typ: max:	0.00000084 0.00013	0.0000046 0.00062	0 0	0.00000057 0.000083

[a]The effects ratio was defined as the estimated pesticide concentration over the sublethal effect level.
[b]Estimated concentrations expressed in mg/L.
[c]LOEC from most sensitive related assessment endpoint determined from literature.
[d]NA = No data available.

Table D-17. Risks[a] of Other Pesticides to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
Highest estimated concentrations[b]	*typ:* *max:*	*0.000000086* *0.000010*	*0.00000048* *0.000048*	*0.000000017* *0.00000016*	*0.000000034* *0.000000086*
Survival (100 mg/L)[c]	typ: max:	0.0000000009 0.0000001	0.000000005 0.0000005	0.0000000002 0.000000002	0.0000000003 0.0000000009
Migration (NA)[c,d]	typ: max:	NA	NA	NA	NA
Reproduction (NA)[c,d]	typ: max:	NA	NA	NA	NA

[a]The effects ratio was defined as the estimated pesticide concentration over the sublethal effect level.
[b]Concentrations expressed in mg/L.
[c]LOEC from most sensitive related assessment endpoint determined from literature.
[d]NA = No data available.

D.3.5 "Other" Ingredients

Potential risks from "other" ("inert") ingredients in the pesticide formulations for special status species in all surface waters are expected to be extremely low for both typical and maximum applications. These compounds include cyclohexanone, ethylbenzene, naphtha, and xylene. The concentration-effect ratios are summarized in Table D-18. Because these compounds volatilize quickly from water and soil to the atmosphere, actual risks to fish are expected to be lower than the above predictions.

D.3.6 Fertilizers

Potential risks to the survival endpoints evaluated from nitrate, phosphate, and calcium nitrate during typical and maximum applications are expected to be extremely low in all surface waters. The risk of ammonium toxicity to fish is low during typical application, but with maximum application the risk is moderate in Swagger Creek, Milk Creek and Clear Creek, and high in Nate Creek. Concentration-effects ratios are presented in Table D-19. No information on migratory or reproductive endpoints is currently available.

Table D-18. Risks[a] of "Other" Ingredients to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
Highest estimated concentrations[b]	*typ:* *max:*	*0.000000056* *0.0000041*	*0.00000028* *0.000020*	*0.000000022* *0.0000015*	*0* *0.0000027*
Survival (0.32 mg/L)[c]	typ: max:	0.00000017 0.000013	0.00000089 0.000062	0.000000069 0.0000048	0 0.0000083
Migration (0.1 mg/L)[c]	typ: max:	0.00000056 0.000041	0.0000028 0.00020	0.00000022 0.000015	0 0.000027
Reproduction (8.0 mg/L)[c]	typ: max:	0.0000000070 0.00000052	0.000000036 0.0000025	0.0000000028 0.00000019	0 0.00000033

[a]The effects ratio was defined as the estimated pesticide concentration over the sublethal effect level.
[b]Concentrations expressed in mg/L.
[c]LOEC from most sensitive related assessment endpoint determined from literature.

Table D-19. Risks[a] of Fertilizers to Special Status Fish

		Swagger Creek	Nate Creek	Milk Creek	Clear Creek
Highest estimated concentration					
Ammonium	*typ:* *max:*	*0* *0.0046*	*0* *0.012*	*0* *0.0043*	*0* *0.0030*
Nitrate	*typ:* *max:*	*0.00088* *0.0014*	*0.0028* *0.0047*	*0.00096* *0.0016*	*0.00060* *0.00094*
Phosphate	*typ:* *max:*	*0.0000024* *0.00095*	*0.0000075* *0.0031*	*0.0000026* *0.0011*	*0.0000016* *0.00065*
Calcium nitrate	*typ:* *max:*	*0.00068* *0.0012*	*0.0025* *0.0041*	*0.00037* *0.00099*	*0.00046* *0.00085*
Survival endpoint					
Ammonium (0.0074 mg/L)[c]	typ: max	0 0.62	0 1.6	0 0.57	0 0.40
Nitrate (2.0 mg/L)[c]	typ: max	0.00044 0.00068	0.0014 0.0023	0.00048 0.00080	0.00030 0.00047
Phosphate (49 mg/L)[c]	typ: max	0.000000049 0.000019	0.00000015 0.000064	0.000000053 0.000022	0.000000033 0.000013
Calcium nitrate (480 mg/L)[c]	typ: max:	0.0000014 0.0000026	0.0000053 0.0000085	0.00000078 0.0000021	0.00000095 0.0000018

[a]The effects ratio was defined as the estimated pesticide concentration over the sublethal effect level.
[b]Concentrations expressed in mg/L.
[c]LOEC from most sensitive related assessment endpoint determined from literature.

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BUREAU OF LAND MANAGEMENT
Salem District

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27004 Shecky Road
Colton, Oregon 97017

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PENALTY FOR PRIVATE USE, $300

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