

**Forest Service Handbook
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Forest Service Handbook 2109.14 – Pesticide-Use Management and Coordination Handbook

Chapter 10 - Planning

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Responsible Staff:

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Superseded Document(s): 2109.14,10 Contents, Amendment 2109.14-94-1, December 6, 1994; 2109.14,10, Amendment 2109.14-94-1, December 6, 1994

Digest: Following is an explanation of the changes throughout the directive by section.

10: Makes minor technical, formatting, and editorial changes throughout the chapter.

11.1: Changes caption from “Biological and Ecological Conditions” to “Biological, Ecological, and Socioeconomic Conditions.”

11.2: Removes language pertaining to public participation in NEPA planning that is described more thoroughly in FSM 1950 and FSH 1909.15.

12: Adds the concept that environmental issues might also help determine the choice of pesticide, rather than simply considering the pest. Recodes to this section direction previously set out in 15.1 referencing the requirement that all pesticides considered for use by the Forest Service be registered or otherwise approved by the Environmental Protection Agency. Identifies the need for advance coordination with EPA, or delegated authority, for requisite NPDES permits.

13.11: Clarifies direction that the Pesticide-Use Proposal (FS 2100-2) should be reviewed by the Pesticide-use Specialist, who then recommends it for approval by the appropriate Line Officer.

13.4: Clarifies direction that by signing a NEPA decision document, the Line Officer is also approving any Pesticide-Use Proposals that are a part of the decision. Clarifies direction that approval for use of household type pesticides may either be written or oral.

13.5: Clarifies direction that Pesticide-Use Proposals (FS 2100-2) do not expire annually on long-term projects, but must be reviewed annually to determine if there is a need for change. If there is a need for change, the FS 2100-2 should be rewritten and resubmitted for review and approval.

14.21: Establishes code, caption, and sets forth direction on drift reduction, so that the Project Planner can be aware of the various factors that affect drift of applied pesticides, and implement design features to minimize this drift.

14.22: Establishes code, caption, and sets forth direction on spray deposition modeling and recodes to this section reference to the Forest Service AGDISP model previously set out in 15.22.

14.3: Adds direction for the requirement of a safety plan (including a spill plan, communications plan, and security plan) to a project's work plan. This section also clarifies differences in project work plans when the work is being accomplished force account as opposed to under contract.

14.42: Adds aircraft and pesticide security to the list of possible contracted activities.

14.43: Removes code, caption, and direction for combination force account and contract.

15.2: Removes obsolete contact information for spray models.

15.21: Removes code, caption, and direction for the Forest Service Cramer, Barry, Grimm (FSCBG) Model since it references a spray model no longer used by the Forest Service.

15.22: Removes code, caption, and direction for the Agricultural Dispersion (AGDISP) Model and recodes clarified direction to 14.22.

15.23: Removes code, caption, and direction for the Computer Assisted Spray Productivity Routine (CASPR) Model since it references a spray model no longer used by the Forest Service.

16.1: The exemption for a safety plan for minor uses has been clarified to state that in addition to small amounts of pesticide, the area treated is also restrictive.

16.11: Establishes code and caption for the spill plan and refers the reader to FSH 2109.14 chapter 60 for guidelines on developing a project spill plan.

16.3: Removes code, caption, and direction for pesticide risk assessment since it duplicates direction found in FSH 2109.14 chapter 20.

17: Establishes code, caption, and sets forth direction for guidelines on security planning for aerial pesticide application projects, and refers the project planner to FSH 5709.16 for further guidance. This section is in response to the development of the Department's Homeland Security policies.

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This chapter directs the planning of all pesticide-use management and coordination activities. (Note that many issues relating to the proper analysis of methods, chemical, and other pre-project planning considerations for project use of pesticides are addressed in FSM 1950 Environmental Policy and Procedures, FSM 3400 Forest Pest Management, and FSH 1909.15 National Environmental Policy Act Handbook.) Personnel in the following positions have responsibility for compliance with this planning direction: Pesticide Specialists, Pesticide Project Coordinators, Incident Commanders, Pesticide Researchers, and Resource Managers.

11 - Determination of Pesticide-Use Need

All pesticide-use activities on National Forest System lands must be consistent with the standards and guidelines and other management direction in applicable Forest land and resource management plans (Forest plans). Forest plans generally mandate the use of Integrated Pest Management (IPM) for management of forest pests such as insects, diseases, animals, and invasive or unwanted vegetation (FSM 2150). Forest plans should also contain relevant language relating to the management of pests in areas as diverse as Wilderness, Research Natural Areas, Botanical Areas, other reserved areas such as Wild and Scenic Rivers, seed orchards, and nurseries, in addition to general forest, multiple-use areas.

The IPM process involves the collection, synthesis, and application of available knowledge on relationships between pests and hosts. Necessary information includes:

1. The ecology of systems of pests and hosts;
2. The impacts of unregulated pest populations on resource values;
3. The comparative effects of alternative pest management strategies on pests and resources of immediate concern, other pest organisms, and the forest ecosystem in general; and
4. The comparative economic and social implications of the alternative management strategies.

The objective of the IPM process is to identify and correctly implement appropriate strategies that are effective and ecologically and socially acceptable.

Land management and IPM objectives affect the entire project planning process. Objectives of pest management projects can range from avoiding a potential pest problem to suppressing an insect, disease, weed, or animal population. Objectives might determine: the appropriateness and feasibility of the action proposed; the timing of the treatment; the number of treatments needed; and, which pesticide is most appropriate.

11.1 - Biological, Ecological, and Socioeconomic Conditions

While considering public perception of the need for the specific management action, base the decision whether to use pesticides on: host and pest biology and ecological conditions in which

the host and pest system is functioning; the specific resource objectives for that given area; a broad range of viable alternatives; and pesticide efficacy.

11.2 - Public Concerns

When pesticides are being considered for pest problems on forested lands or grasslands, involve the public early in an open process to determine the issues associated with a proposed action. Neighboring residents and visitors to National Forests and Grasslands are often concerned about pest problems. Forest Managers should be in a position to respond to these concerns. Follow all relevant direction and guidelines for public involvement in FSM 1950 and FSH 1909.15.

12 - Determination of Kind of Pesticide Needed

Propose the kinds of pesticide needed for a pest management project based on the pest involved, other environmental concerns, and a careful consideration of other control methods available (biological, cultural, or mechanical). Within the guidelines for the NEPA analysis process (FSH 1909.15), analyze and determine the pesticide most appropriate for the job.

"Pesticide" (FSH 2109.14 sec. 05) is a broad term that means "pest killer." However, most pesticides are designed to control a particular group of organisms: insecticides for insects, fungicides for fungi, herbicides for vegetation, nematicides for nematodes, rodenticides for mice and rats, avicides for birds, piscicides for fish, animal damage control chemicals for vertebrate pests, and many other function-based categories.

Certain other chemicals are classified as pesticides although their mode of action might not be 'to kill' directly. For example: insect pheromones attract or repel pest insects, defoliants remove leaves, growth regulators stimulate or retard growth, desiccants dry out plants and animals, attractants lure pests, repellents deter pests, and some disinfectants might only inactivate potentially harmful microorganisms. The categories above are not necessarily exclusive of each other, and individual chemicals might be properly classed in more than one group (some chemicals may be classed as both insecticidal and fungicidal, others as fungicidal with animal repellent capacity, and so forth).

Only those pesticide products registered by the Environmental Protection Agency, appropriate State agencies, or otherwise permitted under FIFRA, must be proposed for use on Forest Service pest management projects (FSM 2151). All pesticide label directions must be followed. However, research uses of pesticides under an experimental-use permit must follow the conditions of the permit, if different from the label. Application of pesticide to/over/into jurisdictional "waters of the U.S." under the Clean Water Act must be coordinated in advance by the respective Forest Service Region/Area/Station with the Regional EPA, or delegated authority, for the determination of the need for, and requirements of, any requisite National Pollutant Discharge Elimination System (NPDES) permit.

13 - Pesticide-Use Proposals

A Pesticide-Use Proposal ([Form FS-2100-2](#)) is required to be signed by the appropriate Line Officer to approve appropriate uses of pesticides necessary to implement the preferred alternative resulting from NEPA analysis of a proposed action.

13.1 - Preparation

Instructions for preparing a Pesticide-Use Proposal (Form FS-2100-2) are included on the form (see FSH 2109.14 sec. 74 for further guidance).

13.11 - Pesticides Proposed for Use on National Forest System Lands (FSM 2152)

On National Forest System lands, District personnel commonly prepare or coordinate proposals for pesticide use on the District. ‘Uses’ include those by District personnel, contractors, licensees, permittees, grantees, States, and other Federal agencies. Pesticide Specialists review the Pesticide-use Proposal for technical accuracy and recommend further appropriate action.

District Rangers review and approve pesticide-use-proposals within their delegated authorities, and forward the remainder, not under District Ranger authority, to the Forest Supervisor. Forest Supervisors review and approve those pesticide uses that are under their approval authority and forward the remainder for Regional Forester review and approval (FSM 2151.04).

13.12 - Pesticides Proposed for Use in Cooperative Pest Management Programs

Follow guidelines for Cooperative Forest Health Protection programs in FSM 2152.2.

13.13 - Pesticides Proposed for Use in Research

Project Leaders or Research Scientists planning to use pesticides in research shall prepare a Pesticide-use Proposal (form FS-2100-2) for all projects except laboratory screening studies or the proposed use of household-type pesticides (FSH 2109.14 sec. 31.2) for project maintenance in research areas.

13.2 - Review

Designated District, Forest, Station, Area, or Regional Pesticide Coordinators, as appropriate shall review the Pesticide-Use Proposal (form FS-2100-2) for completeness and accuracy of information (FSM 2151). These personnel should also review biological evaluations or environmental assessments that include biological, human health and safety, environmental, and economic information pertinent to the proposed use. Those documents explain why the proposed action is necessary.

13.3 - Concurrence

Reviewers, such as District Rangers, Forest Supervisors, Group Leaders, Project Leaders, or Designated Pesticide Coordinators shall show concurrence by initialing the Pesticide-Use Proposal (form FS-2100-2), if their review indicates a proposed pesticide use is appropriate (FSM 2151).

13.4 - Approval

Regional Foresters, or those delegated approval authority by the Regional Forester, shall approve all proposed pesticide uses on National Forest System lands by signing the Pesticide-Use Proposal (Form FS-2100-2). Household-type pesticides (see FSM 2151) may be approved orally or in writing.

As per FSM 2151.04a and FSM 2323.04c, only the Regional Forester may approve Pesticide-Use Proposals for pesticide use in designated Wilderness Areas, wilderness study areas, or designated or candidate Research Natural Areas, and any use of sodium cyanide. This approval authority cannot be re-delegated.

13.5 - Documentation and Filing

Use a Pesticide-Use Proposal (form FS-2100-2) to show review and concurrence by District Rangers, Forest Supervisors, Project Leaders, or Designated Pesticide Coordinators and approval signature by the appropriate Line Officer or their delegated representative.

Keep Pesticide-Use Proposals on file until all projects covered by the proposal are completed and follow the records disposition instructions in FSH 6209.11, chapter 40.

For projects that extend for more than 1 year, the initially approved Pesticide-Use Proposal should be reviewed annually to determine if changes are warranted due to changes in the project. If it is determined that substantive changes are warranted, a new FS 2100-2 will be prepared, reviewed, and approved. If no changes are warranted, the original Pesticide-Use Proposal is still sufficient and does not need to be rewritten

14 - Planning for Project Implementation

Planning for pesticide project implementation involves evaluation of how the project work is to be performed and by whom. Every pesticide-use project has somewhat different needs and requirements. Thorough advance planning is necessary to ensure that all needed services and supplies are safely provided in an efficient manner consistent with project objectives.

14.1 - Choosing Application Methods

Analyze alternative application methods consistent with FSH 1909.15.

Evaluate all aspects, from management and economic constraints to mitigation measures, when

deciding upon the application method for a pesticide-use project.

Occasionally, Forest Service pesticide-use policy (FSM 2150) and/or administrative decisions dictate the method of pesticide application to be used. Be sure to coordinate with your local Pesticide Use Coordinator on pesticide application methods.

14.2 - Equipment and Personnel needs

Planning for the appropriate kinds of equipment, including personal protective equipment, and personnel needed for a particular pesticide-use project is extremely important and should be done well in advance of the intended treatment. Selection of equipment and personal protective equipment should utilize product label requirements as well as FSH 6709.11

14.21 - Drift Reduction

Application of pesticides can result in drift offsite. To mitigate drift, consider the following factors:

1. Influence of Droplet Size on Drift. Smaller droplets fall more slowly and are more prone to drift than larger droplets. As a spray droplet falls, it progressively evaporates and becomes smaller and lighter, thus reducing its rate of fall and increasing its drift potential. The greatest potential for lowering the hazard of drift results from decreasing the number of small (less than 100-micrometer diameter) droplets. The desire to reduce the number of small droplets must be balanced by the need to produce a sufficient number of small droplets to penetrate the dense canopies in many forests and the need for plant coverage in many herbicide operations. Droplet size is influenced by several factors including, but not limited to, the pressure delivered through a boom, nozzle type, distance of release above target vegetation, and for aerial operations nozzle angle relative to the forward motion of the aircraft, the speed of the aircraft, and physical properties of the tank mix including adjuvants.
 - a. Application Pressure. Generally the higher the pressure used in pesticide discharge, the finer the droplets produced.
 - b. Nozzle Type. Usually, the smaller the orifice the smaller the droplets. Other nozzle factors such as spray pattern, pathway of the discharge channel and use of whirl plates in a hollow-cone nozzle affect the droplet size of a liquid pesticide. In all cases, manufacturer specifications will include a droplet size spectrum as measured in a wind tunnel.
 - c. Nozzle Angle - aerial application. Shear (the tendency of air motion to break droplets from the discharge stream) across the nozzle orifice can be a critical component in producing small droplets. Shear is of greatest concern in aerial applications where speed magnifies the shearing action of liquids. If the nozzle axis is perpendicular to direction of flight, production of fines is maximized. If

the nozzle is oriented parallel to the direction of flight and pointed towards the rear of the aircraft, fine droplet production is minimized.

d. Nozzle Location on an Aerial Boom. Strong vortices are created during flight at the tips of rotors (helicopter) or wings (fixed-wing aircraft). Droplets released near the ends of the wings are entrained in these vortices and are initially propelled upwards in a circular pattern at high velocities. Small droplets released into vortices might drift long distances. To avoid entrainment in wing-tip vortices, it is recommended that nozzles not be positioned more than 75 percent of the wing span (rotor diameter) outward from the centerline of the fuselage. Keep in mind that these vortices can assist in deposition of fine droplets within a forest canopy so considerations of efficacy might offset those of drift in some cases, depending on label language.

The placement of nozzles along the boom is also influenced by the airstream created by the rotor of a helicopter or the propeller of a fixed wing aircraft. Adjustments will need to be made to compensate for the directional effect of the air being pushed past the spray boom. Many useful manuals are available to assist in proper positioning of nozzles on the spray boom.

e. Physical Properties of Tank Mix. Refer to paragraph 6.

2. Release Height. Release height is the second most important variable in determining drift from aerial pesticide operations. Release height is difficult to dictate in an operational setting since it is up to the pilot's discretion because of safety concerns. However, any opportunity to lower release height will reduce drift. Most forestry operations use a release height between 10 and 30 meters above the forest canopy.

3. Wind Speed and Direction. Wind controls the direction a spray will drift, and correct consideration of wind direction is the best way to prevent drift into sensitive areas. Wind speed is the primary atmospheric variable in determining the amount of drift. Maximum allowable wind speeds during application are stated on many labels; 10 mph is generally considered a generic maximum, though higher speeds are sometimes permitted in specific circumstances. Note that wind speeds below 2 mph might indicate an inversion layer.

4. Relative Humidity. Relative humidity is an important consideration in drift preplanning and management. Evaporation, which makes droplets smaller during freefall and thus more susceptible to drift, is reduced at higher relative humidity. At low relative humidity special care must be taken to minimize drift. When low relative humidity is anticipated during an application, additional mitigation measures can be taken to reduce drift potential.

5. Atmospheric Stability. Atmospheric stability characterizes the temperature change with height in the atmosphere. If temperature increases with height, an 'inversion' (stable atmosphere) is occurring. In an inversion fine droplets might hang in the air in a concentrated cloud and be available for drift. If the air temperature decreases with height

more quickly than normal, an unstable atmosphere occurs and might cause fine droplets to drift off target.

6. Adjuvants. The final mix placed in the application equipment is referred to as the tank mix. Various types of additives or adjuvants when added to the tank mix will affect droplet size and evaporation of the mix. Consult the label, a technical representative, or Forest Service specialist regarding the effects of additives or adjuvants and their selection.

7. Topography. Topography of the treatment site and surroundings must be considered in planning and scheduling spray operations. Many treatment sites are on sloping ground. Sprays aerially applied to slopes during the early morning under inversion or even stable conditions will drift downslope. Spray applied after the sun has warmed the surface (sometimes within a few minutes after sunrise) will move upslope with the wind.

14.22 - Spray Deposition Modeling

There are at least three dozen variables that will affect deposit of droplets from boom or aerial applications. The most important are summarized in section 14.2. Due to the physical complexity of these operations, the Forest Service has developed detailed computer models that are relatively easy to use to plan, set-up, and evaluate aerial spray operations. A basic model known as AGDISP (AGricultural DISPersion Model) is also used by the Environmental Protection Agency for risk assessment related to aerial application. This model is in the public domain and aerial spray managers are encouraged to use the model to evaluate scenarios and improve operational approaches. Technical assistance for planning truck-mounted boom or aerial applications and associated drift modeling can be obtained through the State and Private Forestry, Forest Health Technology Enterprise Team (FHTET).

14.3 - Project Work Plans

Prepare a project work plan to assist in determining the kinds of equipment and personnel needed for a pesticide-use project well in advance of the anticipated implementation date.

Project work plans must present the organizational and operational details of projects. Work plans are the basis for determining cost and personnel requirements. The scope of a plan depends on the project size; pesticide chosen; the rate and method of application proposed, project timing, the number and nature of sensitive or high-value areas requiring monitoring; and public concerns about the program.

As a minimum, project work plans involving pesticides that are to be implemented by Forest Service Force Account crews must consist of:

1. A precise statement of the treatment objective(s);
2. A description of equipment, materials, and supplies, including pesticide formulation, quantities, and application methods to be used;

3. A description of the organization of field crews and lines of responsibility (FSH 2109.14, ch. 30);
4. A description of any necessary interagency coordination;
5. A copy of the Pesticide-Use Proposal (form FS-2100-2) for the project;
6. A description of the process by which treatment effectiveness will be determined;
7. A description of personal protective equipment and any clothing required (refer also to FSH 6709.11, ch. 22); and
8. A safety plan which includes a spill plan, a communications plan, and security plan for the project. And, when applicable local requirements specify advance notification to sensitive individuals, provide timely notifications, as appropriate.

Where a contractor, permittee or other non-Forest Service person performs the application, paragraph 3 must be modified to read:

3. A description of the lines of responsibility for project review and monitoring of contract performance.

In addition where contractors, permittees, or other non-Forest Service persons perform the application requirement, paragraph 7 must not be required. However, contract clauses must require non-Forest Service persons to comply with all of the requirements listed on the pesticide product label.

14.4 - Planning for Completion of Work

Projects can be implemented through

1. Force account; or
2. Contract; or.
3. Interagency Agreement (for example, cooperatively with State or County Departments of Agriculture.)

Comply with the specific direction for contracting for goods and services in FSM 6320.

However, the following guidance provides additional assistance to pesticide project planners in evaluating available options.

14.41 - Force Account

Projects carried out using only Forest Service-supplied goods and services (including personnel) are called Force Account. Force Account might be considered appropriate instead of a contract based on the following factors:

1. Sufficient trained or certified applicators are available from within the Forest Service workforce; and
2. Sufficient equipment is available for the application, and adequate pesticide storage facilities are available; and
3. The area to be treated is of limited extent; and/or
4. The treatment window is very small; and/or
5. Areas of high sensitivity must be avoided.

14.42 - Contract

Contracts associated with pesticide application projects might involve a wide spectrum of contractor-furnished equipment, services, and supplies. Contracts may be awarded that include any or all of the following as obligations of the prime contractor:

1. Application services;
2. Observation aircraft services;
3. Support equipment;
4. Pesticides and adjuvants;
5. Support personnel;
6. Project management personnel;
7. Pre-application and post-application monitoring personnel;
8. Weather or spray monitoring personnel;
9. Transportation, storage, and disposal of pesticides (FSH 2109.14, ch. 40); and
10. Aircraft and pesticide security.

14.43 - Interagency Agreement

Interagency agreements should be tailored to the specific needs and constraints of the parties, subject to specific authorities (for example, “Good Neighbor Authority” under 2014 Farm Bill).

15 - Quality Control Planning

Quality control in pesticide application includes all actions taken to ensure pesticides have been applied effectively, safely, and with minimal potential for adverse effect on the environment and

unnecessary exposure to pesticide handlers, workers, and the public. Quality control planning involves:

1. The determination and establishment of procedures to ensure implementation effectiveness;
2. The use of models that can predict pesticide applications; and
3. Training of personnel who influence work quality during pesticide application.

A more complete discussion of procedures for quality control is presented in FSH 2109.14, ch. 50.

15.1 - Product Effectiveness

Testing delivered product for product acceptability might be necessary if there has been:

1. Prior failure of a pesticide to perform as well as projected;
2. Prior failure of a manufacturer or distributor to deliver a properly formulated product;
3. Prior instances of unacceptable microbial or other foreign matter contamination; or
4. Prior experience with products of varying level of potency or infectiousness.

Product failure should be reported to the manufacturer/registrant for investigation.

15.2 - Pesticide Aerial Application Models

Where appropriate, use pesticide-application computer models in planning aerial pesticide application projects. Models can be used to estimate swath widths and spray displacement (drift), compare the performance of aircraft, measure effects of terrain, compare nozzle and boom placement, and measure the effects of wind and weather on pesticide behavior, spray deposition, and canopy penetration.

16 - Safety Planning

Develop a safety plan to protect the public and employees from unsafe work conditions when pesticides are involved (FSM 2153.1). Design the safety plan to ensure pesticide handlers are fully trained in the hazards of pesticide use and hazard communication requirements (FSH 6709.11, ch. 60).

16.1 - General Safety Plan

Safety plans are required for all pesticide-use projects, except household-type uses.

When a treatment program is comprised of many similar projects such as small noxious weed treatment sites, a generic safety plan can be developed to cover all such projects.

At a minimum a safety plan should:

1. Prescribe specific communication, transportation, and emergency medical actions to be taken in the event of an emergency (for example, an accidental exposure or spill);
2. Designate one person to supervise the use, transportation, mixing, storage, and disposal of pesticides and their containers;
3. Prescribe search and rescue operations for aerial pesticide projects.
4. Include a determination of whether the pesticide label, safety data sheet (SDS) and approved pesticide-use proposal (PUP) need to be at the job site for ready reference.

16.11 - Spill Plan

Spill response plans should be prepared for all storage, transportation and application scenarios. Guidance for the preparation of a spill plan is found in FSH 2109.14, chapter 60; FSM 2160.43d; and FSM 2165.

16.2 - Safety and Health Job Hazard Analysis

Complete a Job Hazard Analysis ([FS-6700-7](#)) to determine pesticide project related hazards and identify ways to eliminate them (FSM 6700, FSH 6709.11).

“Tailgate” safety sessions must be conducted for all Force Account personnel working with pesticides. Tailgate safety sessions must be conducted for all Force Account personnel at the beginning of every project, and subsequently as deemed necessary by the Project Supervisor. Tailgate sessions will be documented in writing per FSH 6709.11.

17 - Security Planning for Aerial Application Projects

Develop a project security plan to protect the public and employees from potential tampering with aircraft or pesticides when aerial application of pesticides is planned. Refer to FSH 5709.16, chapter 60, for further guidance. Design the project security plan to:

1. Establish protocols for reacting to a threat or occurrence that places people, equipment, or facilities in harms way;
2. Document the procedures to be followed to secure the aircraft and pesticide during project implementation including non-flight times; and,
3. Guide the review and incorporation of local airport security planning into the project plan.