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Sawtooth National Forest

September 2016

Sawtooth and Boise National Forests Invasive Species Project

Draft Environmental Impact Statement

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Sawtooth and Boise National Forests Invasive Species Project

Ada, Boise, Blaine, Camas, Cassia, Custer, Gem, Elmore, Oneida, Power, Twin Falls, and Valley Counties, Idaho, and Box Elder County, Utah

Lead Agency: USDA Forest Service

Responsible Officials:

Kit T. Mullen, Forest Supervisor
Sawtooth National Forest
2647 Kimberly Road East
Twin Falls, ID 83301

Cecilia R. Seesholtz, Forest Supervisor
Boise National Forest
1249 South Vinnell Way, Suite 200
Boise, ID 83709

For Information Contact:
Carol Brown, Team Leader
Ketchum Ranger Station
206 Sun Valley Road
Sun Valley, ID 83353
(208) 622-5371

Abstract:

This Draft Environmental Impact Statement (DEIS) documents the analysis conducted for the Sawtooth and Boise National Forests Invasive Species Project, collectively referred to as 'Invasive Plants project'. The overall purpose of the proposed action is to reduce the negative effects of existing and future invasive plants on the structure and function of native plant communities and on other natural resource values that may be adversely impacted. The proposal is to treat invasive plants on infested areas within the administrative boundaries of the Boise and Sawtooth NFs including the Sawtooth, Hemingway-Boulders, and White Clouds Wilderness Areas but excluding the Frank Church – River of No Return Wilderness Area, and including Forest Administrative sites (e.g. Ranger Station sites). Proposed control methods include biological control, such as pathogens, insects, and targeted grazing; chemical control using herbicides that target invasive plant species; and manual and mechanical techniques such as cutting and pulling. Activities would be implemented with partners at the federal, state, and local level where opportunities exist. Five alternatives are considered. The No Action alternative describes the consequences of no invasive plant treatments. Four action alternatives include the Current Management Alternative which identifies the use of biological controls; ground-based herbicide treatment; and mechanical/manual treatment methods; the Proposed Action (which is also the Preferred Alternative), which would utilize biological controls; aerial, aquatic, and ground-based herbicide treatment; and mechanical/manual treatment methods; the No Aerial Herbicide Application Alternative; and the No Aquatic Herbicide Application Alternative.

It is important that reviewers provide their comments at such times and in such a way that they are useful to the Agency's preparation of the EIS. Therefore, comments should be provided prior to the close of the comment period and should clearly articulate the reviewer's concerns and contentions. The submission of timely and specific comments can affect a reviewer's ability to participate in subsequent administrative review or judicial review.

The opportunity to comment on the DEIS ends 45 days following the date of publication of the notice of availability (NOA) of the DEIS in the Federal Register (36 CFR 218.25(a)(2)). The NOA is anticipated to publish on September 30, 2016. Comments submitted by individuals or organizations must have the evidence of timely submission as defined by 36 CFR 218.25(a)(4), and meet the requirements outlined in 36 CFR 218.25(a)(3). Written comments must be submitted to: Sawtooth National Forest, Attn: Invasive Plants Project; 2647 Kimberly Road East, Twin Falls, ID 83301 (postal) or (208) 737-3236 (facsimile). For those submitting hand-delivered comments, the office business hours for the Sawtooth National Forest Supervisor's Office are 8:00 a.m. to 4:30 p.m. Monday-Friday, excluding holidays. Electronic comments must be submitted in a format such as an email message, plain text (.txt), rich text format (.rtf), and Word (.doc or .docx) to comments-intermtn-sawtooth@fs.fed.us. Please type "Invasive Plant Treatment" in the subject line for email messages and facsimiles. Additionally for facsimiles, include your mailing address and phone number. Comments received in response to this solicitation, including names and addresses of those who comment, will be part of the public record for this proposed action. Comments submitted anonymously will be accepted and considered; however, anonymous comments will not provide the respondent with standing to participate in subsequent administrative review or judicial review.

Table of Contents

1. Purpose and Need for Action 1
1.1. Introduction 1
1.2. Background 2
1.2.1. Targeted Invasive Species 6
1.3. Purpose and Need for Action 10
1.4. Proposed Action 11
1.5. Management Direction 12
1.6. Decision Framework 16
1.7. Public Involvement 16
1.8. Issues 17
1.8.1. Soil and Water 17
1.8.2. Fisheries 18
1.8.3. Wildlife 18
1.8.4. Sensitive Plants 18
1.8.5. Human Health 18
1.8.6. Wilderness 18
2. Alternatives, Including the Proposed Action 21
2.1. Introduction 21
2.2. Alternatives Considered in Detail 22
2.2.1. Alternative 1—No Action 22
2.2.2. Alternative 2—Current Management 22
2.2.3. Alternative 3—Proposed Action 28
2.2.4. Alternative 4—No Aerial Herbicide Application 47
2.2.5. Alternative 5—No Aquatic Herbicide Application 47
2.2.6. Alternatives Considered but Eliminated from Detailed Study 47
2.3. Comparison of Alternatives 48
2.3.1. Comparison of Issues by Alternative 50
3. Affected Environment and Environmental Effects 55
3.1. Introduction 55
3.1.1. Herbicide Risk Assessments 55
3.2. Soil and Water Resources 58

3.2.1. Introduction 58
3.2.2. Methodology for Analysis 58
3.2.3. Relevant Forest Plan Direction and Other Relevant Direction.....60
3.2.4. Affected Environment.....67
3.2.5. Environmental Consequences.....79
3.3. Fisheries 140
3.3.1. Introduction 140
3.3.2. Methodology for Analysis 141
3.3.3. Relevant Forest Plan Direction and Other Relevant Direction.....142
3.3.4. Affected Environment.....150
3.3.5. Environmental Consequences.....166
3.4. Wildlife..... 235
3.4.1. Introduction 235
3.4.2. Methodology for Analysis 235
3.4.3. Risk Assessments.....235
3.4.4. Compliance with Forest Plan and Other Relevant Direction 241
3.4.5. Affected Environment.....243
3.4.6. Environmental Consequences.....248
3.4.6.1.5. Mechanical Treatment 250
3.4.6.1.6. Biological Treatment 251
3.5. Sensitive Plants and Native Vegetation..... 298
3.5.1. Introduction 298
3.5.2. Methodology for Analysis 298
3.5.3. Compliance with Forest Plan and Other Relevant Direction 304
3.5.4. Affected Environment.....308
3.5.5. Environmental Consequences.....312
3.6. Human Health 375
3.6.1. Introduction 375
3.6.2. Methodology for Analysis 375
3.6.3. Compliance with Forest Plan and Other Relevant Direction 377
3.6.4. Affected Environment.....378
3.6.5. Environmental Consequences.....392
3.7. Wilderness 401

3.7.1. Introduction 401
3.7.2. Methodology for Analysis 401
3.7.3. Compliance with Forest Plan and Other Relevant Direction 403
3.7.4. Affected Environment.....405
3.7.5. Environmental Consequences.....407
3.8. Cultural Resources 412
3.8.1. Introduction 412
3.8.2. Methodology for Analysis 412
3.8.3. Compliance with Forest Plan and Other Relevant Direction 412
3.8.4. Affected Environment.....413
3.8.5. Environmental Consequences.....413
3.9. Air Quality..... 416
3.9.1. Introduction 416
3.9.2. Methodology for Analysis 416
3.9.3. Compliance with Forest Plan and Other Relevant Direction 416
3.9.4. Affected Environment.....417
3.9.5. Environmental Consequences.....423
4. Literature Cited 429

List of Table

Table 1-1. Inventoried non-native invasive plant species infestations by District on the Boise National Forest 7
Table 1-2. Inventoried non-native invasive plant species infestations by District on the Sawtooth National Forest 8
Table 2-1. Acres treated annually, by treatment method 22
Table 2-2: Herbicides and application settings currently used in the Boise and Sawtooth National Forests..... 24
Table 2-3. Riparian Conservation Areas (RCAs) herbicide use restrictions from Sawtooth Programmatic Noxious and Invasive Weed Management Program (with National Marine Fisheries Service reasonable and prudent measures) 27
Table 2-4. Maximum acres to be treated annually, per Forest by treatment method..... 29
Table 2-5. District treatment response priorities..... 30
Table 2-6: Herbicides and application settings currently used and proposed for use, Boise and Sawtooth National Forests 36
Table 2-7. Maximum acres treated annually, per Forest by treatment method..... 47

Table 2-8. Invasive plant treatment, comparison by alternative 49
Table 2-9. Comparison of alternatives by soil, water, riparian and fisheries issues 50
Table 2-10. Comparison of alternatives by wildlife issues 52
Table 2-11. Comparison of alternatives by treatment method effect on Region 4 sensitive plants[a] issues 53
Table 2-12. Comparison of alternatives by human health issues 54
Table 2-13. Comparison of alternatives by Wilderness issues 54
Table 3-1. Risk Assessments for herbicides considered for use in the Proposed Action 55
Table 3-2. National drinking water standards applicable to this project 66
Table 3-3. Cover types of the Boise and Sawtooth National Forests 68
Table 3-4. Top terrestrial noxious weed infestations in the project area 69
Table 3-5. Existing inventoried invasive plant infestations, by landtype parameter 69
Table 3-6. Comparison of soil properties, by landtype geology 70
Table 3-7. Fourth-level watersheds in the project area 73
Table 3-8. Fifth-level watersheds in the project area with the largest invasive plant infestations 75
Table 3-9. Invasive plant infestations within Riparian Conservation Areas (RCAs) in the project area 76
Table 3-10. Section 303(d)-listed impaired water bodies within the project area 78
Table 3-11. Sediment yield scenario from the spread of spotted knapweed in the Crooked River Watershed 83
Table 3-12. Input parameters and results of Disturbed Water Erosion Prediction Project (WEPP) modeling of erosion from 2 hypothetical knapweed-infested hillslopes within the Crooked River Watershed 84
Table 3-13. Land ownership percentages within 4th-level watersheds intersecting the project area 87
Table 3-14. Indicators and attributes analyzed under the Watershed Condition Framework 88
Table 3-15. Long-term cumulative effects risk matrix for 6th-level watersheds for Alternative 1 90
Table 3-16. Current and proposed herbicide characteristics in soil and water 95
Table 3-17. Summary of Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) and GLEAMS-Driver modeling results from USDA Forest Service herbicide risk assessments for herbicide application adjacent to a stream 101
Table 3-18. GLEAMS-driver modeled maximum peak concentrations of herbicide in a stream 101
Table 3-19. Summary of Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) and Gleams-driver modeling results from USDA Forest Service herbicide risk assessments for herbicide applicaton adjacent to a pond 102
Table 3-20. Gleams-driver modeled maximum peak concentrations of herbicide in a pond 102
Table 3-21. Long-term cumulative effects risk matrix for 6th-level watersheds for Alternative 2 (Current Management Alternative) 112
Table 3-22. Erosion modeling results before and after aerial herbicide treatment of a knapweed-infested hillslope near Crooked River from the Disturbed Water Erosion Prediction Project (WEPP) program 118

Table 3-23. Summary of Gleams-Driver modeling results from USDA Forest Service herbicide risk assessments for herbicide application adjacent to a stream, for additional herbicides considered in Alternative 3 (Proposed Action) 125

Table 3-24. Summary of Gleams-Driver modeling results from USDA Forest Service herbicide risk assessments for herbicide application adjacent to a pond, for additional herbicides considered in Alternative 3 (Proposed Action) 125

Table 3-25. Long-term cumulative effects risk matrix for 6th-level watersheds for the Proposed Action (Alternative 3) 129

Table 3-26. Long-term cumulative effects risk matrix for 6th-level watersheds for the No Aerial Herbicide Application Alternative (Alternative 4) 134

Table 3-27. Long-term cumulative effects risk matrix for 6th-level watersheds for the No Aquatic Herbicide Application Alternative (Alternative 5) 137

Table 3-28. Fishes identified as federally listed as endangered or threatened, regionally sensitive, and managmenet indicator species (MIS) within the project area 147

Table 3-29. Federally listed fish species of the Sawtooth and Boise National Forests 151

Table 3-30. All infested watersheds located on the Sawtooth and Boise National Forests (alphabetical order) 163

Table 3-31. Aquatic Level of Concern Assessment (Fish) for Herbicides Proposed for Use by the Sawtooth and Boise National Forests 186

Table 3-32. Standard acute aquatic species toxicity testing results (from Bakke, 2007 except where noted). 188

Table 3-33. Most Sensitive Toxicological endpoint for Algae and Aquatic Invertebrates, as reported in the Forest Service SERA or other risk assessments 194

Table 3-34. Relative risk to fish, aquatic invertebrates, algae, and aquatic plants based on hazard quotients for riparian use of herbicides at maximum project rates at upper limits 198

Table 3-35. 2012–2015 Average annual applied herbicide in riparian areas[a] 205

Table 3-36. Herbicides and application settings currently used and proposed for use, Boise and Sawtooth National Forests 208

Table 3-37. Aquatic invasive herbicide treatment options by growth form 210

Table 3-38. Most sensitive toxicological endpoint for algae, macrophytes and aquatic invertebrates, as reported in the SERA or other risk assessments 214

Table 3-39. Aquatic Level of Concern Assessment (Fish) for Herbicides Proposed for Use by the Sawtooth and Boise National Forests 215

Table 3-40. Standard acute aquatic species toxicity testing results (from Bakke, 2007 except where noted) 215

Table 3-41. Relative risk to fish, aquatic invertebrates, algae and aquatic plants based on hazard quotients for riparian use of herbicides at maximum project rates at upper limits 218

Table 3-42. Summary of Effects to Federally Listed, Sensitive and Management Indicator Fish Species and Habitat from the Boise and Sawtooth Forest Invasive Species Project 233

Table 3-43. Inventoried weed infestations within cover types occurring on the Boise and Sawtooth National Forests 241

Table 3-44. Threatened terrestrial wildlife species occurring or potentially occurring on Sawtooth (SNF) and Boise (BNF) National Forests 243

Table 3-45. Sensitive terrestrial wildlife species occurring or potentially occurring on Sawtooth (SNF) and Boise (BNF) National Forests 244

Table 3-46. Management indicator species (MIS) considered for this analysis 245

Table 3-47. Idaho Partners in Flight high priority species potentially occurring in the project area[a] 246

Table 3-48. Big game species of interest considered for this analysis 248

Table 3-49. Relationship between exposure scenarios considered to calculate hazard quotients in SERA risk assessments and species evaluated in this analysis 252

Table 3-50. Proposed herbicides which *central* Hazard Quotients exceeded 1.0 when applying median of *typical*[a] application rate (herbicides not exceeding 1.0 not listed) 254

Table 3-51. Proposed herbicides which *central* Hazard Quotients exceeded 1.0 when applying *maximum* application rates (herbicides not exceeding 1.0 not listed) 255

Table 3-52. Recommended adjuvant type by herbicide 277

Table 3-53. Standard acute aquatic species toxicity testing results 278

Table 3-54. Standard mammalian acute toxicity testing results 279

Table 3-55. Summary of determinations for Endangered Species Act and Sensitive species analyzed in the Terrestrial Wildlife and Botany Biological Assessment and Biological Evaluation 293

Table 3-56. Summary of rationale for determinations 294

Table 3-57. Idaho terrestrial and aquatic noxious weeds: Early detection/rapid response, control, and containment lists 300

Table 3-58. Utah noxious weeds: Early detection/rapid response, control, and containment lists 303

Table 3-59. Cover types of the Boise and Sawtooth National Forests 309

Table 3-60.Special status plant species and acres infested by invasive and noxious weeds 310

Table 3-61. Top terrestrial noxious weed infestations in the project area 312

Table 3-62. Depiction of leafy spurge infestation expansion in 1 decade without control 317

Table 3-63. Depiction of spotted knapweed infestation expansion in 1 decade without control 317

Table 3-64. Determination of effects to Sensitive Plant Habitat and Plants resulting from Alternative 1 322

Table 3-65. Potential doses for bees in a direct spray scenario 327

Table 3-66. Determination of effects to sensitive plant habitat and plants resulting from Alternatives 2 through 5 361

Table 3-67. New herbicides proposed for use under Alternative 3 (Proposed Action) 362

Table 3-68. Volatilization potential of herbicides considered for aerial application 366

Table 3-69. Herbicide treatment options, by growth form 369

Table 3-70. Treatment method effect on Region 4 Sensitive plants 374

Table 3-71. Environmental Protection Agency toxicity categories 379

Table 3-72. Human hazards based on acute toxicity categories 380

Table 3-73. Human hazards based on chronic toxicity categories 381

Table 3-74. Scenarios in which hazard quotients were exceeded 382

Table 3-75. Ground and aerial applications of clopyralid, 2,4-D amine, and picloram—recommended minimum buffer zones (feet) 391

Table 3-76. Project area ownership by County (acres) 400

Table 3-77. Designated wilderness areas with acres of invasive plant infestations 406

Table 3-78. Designated wilderness with acres of treated invasive plant infestations over 5 years 407

Table 3-79. Wilderness comparison of issue by alternative 408

Table 3-80. National Ambient Air Quality Standards (NAAQS) as established by the Environmental Protection Agency 418

Table 3-81. Class I and Class II wilderness areas, nonattainable areas, impact areas, cities (sensitive areas), and other interested areas, in and near the project area on the Boise National Forest (BNF) and Sawtooth National Forest (SNF) 419

Table 3-82. Forest Plan direction for air quality. Boise and Sawtooth National Forests 427

List of Figures

Figure 1-1. Cooperative Weed Management Areas on the Boise National Forest 4

Figure 1-2. Cooperative Weed Management Areas on the SawtoothNational Forest 5

Figure 2-1. Adaptive management decision tree 32

Figure 3-1. Project area map showing 4th-level watersheds, Cooperative Weed Management Areas (CWMAs), and existing, known invasive plant infestations 72

Figure 3-2. Project area with 100-kilometer radius 422

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List of Acronyms

ACS	Aquatic Conservation Strategy
ALS	Acetolactate Synthase
APHIS	Animal and Plant Health Inspection Service
ARS	Agriculture Research Station
ATV	all-terrain vehicle
BLM	Bureau of Land Management
BMP	Best Management Practices
BNF	Boise National Forest
CEQ	Council on Environmental Quality
CWA	Clean Water Act
CWMA	Cooperative Weed Management Areas
DEIS	Draft Environmental Impact Statement
DPS	Distinct Population Segment
EDRR	Early Detection and Rapid Response
EEC	Estimated Environmental Concentration
EFH	Essential Fish Habitat
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESRI	Environmental Systems Research Institute
ESU	Evolutionary Significant Unit
FC-RONR	Frank Church River of No Return
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLPMA	Federal Land Policy and Management Act
FOIA	Freedom of Information Act
FSM	Forest Service Manual
GLEAMS	Groundwater Loading Effects of Agricultural Management Systems
HQ	Hazard Quotient
IARC	International Agency for Research on Cancer
ICBEMP	Interior Columbia Basin Ecosystem Management Project
IDAPA	Idaho Administrative Procedure Act

IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDT	Interdisciplinary Team
IDWR	Idaho Department of Water Resources
ISDA	Idaho State Department of Agriculture
IWM	Integrated Weed Management
LOC	Level of Concern
MBTA	Migratory Bird Treaty Act
MIS	Management Indicator Species
MPG	Major Population Group
mph	Miles per Hour
MRDG	Minimum Requirements Decision Guide
MVUM	Motor Vehicle Use Map
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NISC	National Invasive Species Council
NMFS	National Marine Fisheries Service
NOAEC	No Observed Adverse Effect Concentration
NOAEL	No Observable Adverse Effect Level
NOEC	No Observed Effect Concentration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRA	National Recreation Area
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRIS	Natural Resource Information System
NTU	Nephelometric Turbidity Unit
OHV	off-highway vehicles
OPP	Office of Pesticide Programs

PCE	Primary Constituent Elements
PM	Particulate Matter
POEA	Polyoxyethyleneamine
R4	Region 4
RCA	Riparian Conservation Areas
RD	Ranger District
RfD	Reference Dose
RHCA	Riparian Habitat Conservation Area
RNA	Research Natural Area
ROW	right-of-way
RQ	Risk Quotient
SERA	Syracuse Environmental Research Associates, Inc.
SNF	Sawtooth National Forest
SWPA	Source Water Protection Area
SWRA	Soil, Water, Riparian, and Aquatic
TEA	Triclopyr Triethylamine Salt
TEPCS	Threatened, Endangered, Proposed, Candidate, Sensitive
TES	Threatened, Endangered, and Sensitive
TMDL	Total Maximum Daily Load
TRV	Toxicity Reference Value
UPDES	Utah Pollutant Discharge Elimination System
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildife Service
WEPP	Water Erosion Prediction Project
WOTUS	Waters of the United States
WQL	Water Quality Limited

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Chapter 1. Purpose and Need for Action

1.1. Introduction

The Forest Service has prepared this Draft Environmental Impact Statement (DEIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and State laws and regulations. This DEIS discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four chapters:

Chapter 1. Purpose and Need for Action: This chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.

Chapter 2. Alternatives, including the Proposed Action: This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose and need and proposed design criteria. The alternatives were developed based on significant issues raised by the public and other agencies. Finally, this chapter provides a summary table of the environmental consequences associated with each alternative.

Chapter 3. Affected Environment and Environmental Consequences: This chapter describes the direct and indirect effects, commitment of resources, and cumulative effects associated with the alternatives.

Chapter 4. Consultation and Coordination: This chapter provides a list of preparers and agencies consulted during the development of the DEIS.

Index: The index provides page numbers by document topic.

Appendices: The appendices provide more detailed information to support the analyses presented in the DEIS. The following appendices are included:

- Appendix A—Maps
- Appendix B—Past, Current, and Foreseeable Future Activities for the Boise and Sawtooth National Forests
- Appendix C—Range of Effective Treatment Options by Target Species
- Appendix D—Adjuvants
- Appendix E—Boise and Sawtooth Forest-wide Invasive plant Species Treatment Monitoring Plan
- Appendix F—Aquatic Invasive Plant Control Framework Strategy
- Appendix G—Herbicide Application Guidelines Near Water
- Appendix H—Aerial Herbicide Drift Monitoring
- Appendix I—Boise and Sawtooth Forest-wide Integrated Weed Management Prevention Plan

- Appendix J—Common Injuries to Non-target Species by Herbicide Active Ingredients
- Appendix K—Glossary

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Sawtooth National Forest Supervisor's Office in Twin Falls, Idaho.

1.2. Background

This DEIS has been prepared to disclose the environmental effects of a proposal to implement an adaptive management strategy, which includes early detection, control and management, restoration and rehabilitation elements, and monitoring to control or reduce the presence of non-native invasive plants on the Boise National Forest (BNF) and the Sawtooth National Forest (SNF). The effects of the No Action Alternative are also disclosed. The strategy proposed would be applied on lands administered by the BNF and SNF, including lands within the Sawtooth, Hemingway-Boulders, and White Clouds Wilderness areas, as well as Forest Administrative Sites (e.g., Ranger Stations). BNF lands within the Frank Church River of No Return (FC-RONR) Wilderness are not covered by this DEIS as treatment of invasive species within this Wilderness were covered under a separate decision issued in 2007 (USDA Forest Service 2007b).

The BNF encompasses 2,267,000 acres in southwestern Idaho within Ada, Boise, Gem, Elmore, and Valley counties, and is comprised of 5 Ranger Districts (RDs): Cascade, Lowman, Emmett, Mountain Home, and Idaho City (Figure 1-1). The SNF encompasses 2,170,000 acres within Blaine, Boise, Camas, Cassia, Custer, Elmore, Oneida, Power, Twin Falls, and Valley Counties, Idaho, and in northern Utah in Box Elder County (Figure 1-2). In addition to the Sawtooth National Recreation Area (NRA), the SNF has 3 RDs: Minidoka, Ketchum, and Fairfield. The BNF and SNF share boundaries with the Payette and Salmon-Challis National Forests; lands administered by the Bureau of Land Management (BLM), State of Idaho, and State of Utah (SNF); and private lands. For invasive plant management purposes, the BNF and SNF have been divided into Cooperative Weed Management Areas (CWMAs) (Figure 1-1 and Figure 1-2). The BNF includes 5 CWMAs: Boise Basin, Custer, Frank Church, South Fork Boise, and Upper Payette (Figure 1-1). The SNF includes 11 CWMAs: Blaine, Boise Basin, Camas, Custer, Goose Creek, Power, Raft River, Shoshone Basin, South Fork Boise, Upper Payette, and Utah and Idaho (Figure 1-2). The CWMAs help determine treatment objectives and priorities on each ranger district.

Invasive plants, which include invasive annual grasses such as cheatgrass or medusahead, are defined as "a non-native plant whose introduction does or is likely to cause economic or environmental harm or harm to human health" (Executive Order [EO] 13112). Invasive plants have been identified as a major threat to the biological diversity and ecological integrity within and outside the BNF and SNF. Invasive plants cause numerous adverse environmental effects, including displacing native plants; reducing the functionality of habitat and forage for wildlife and livestock; threatening populations of threatened, endangered, and sensitive (TES) species; altering physical and biological properties of soil, including soil productivity; changing the intensity and frequency of fires; affecting wilderness character, and reducing recreational opportunities.

A noxious weed is a subset of the broader invasive plants category. According to the Plant Protection Act of 2000 (PL 106–224), the term “noxious weed” means any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment. The term typically describes plant species that have been determined to be undesirable or injurious in some capacity. Federal noxious weeds are regulated by the United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), under the Plant Protection Act of 2000 (FSM 2900). In the state of Idaho, noxious weeds are designated by the director of the Department of Agriculture (ID Code § 22-2402). In the state of Utah, a noxious weed is any plant the commissioner determines to be especially injurious to public health, crops, livestock, land or other property (Utah Code 4-17-2).

Non-native invasive plant infestations have a high potential for expanding on lands within and adjacent to the BNF and SNF, degrading desired plant communities and the values provided by those communities. National Forest System (NFS) lands are also threatened by “potential invaders”—invasive plants that have not been found on the BNF and SNF but are known to occur in adjacent lands, counties, or states.

Infestations can be prevented, eliminated, or controlled through the use of specific management practices. A clear and comprehensive integrated invasive plant management strategy would allow for implementing timely and effective invasive plant management for projects and programs on the Forests. In the absence of an aggressive invasive plant management program, the number, density, and distribution of invasive plants on both Forests would continue to increase.

The proposal includes treating invasive plants annually with an effective combination of treatments, including biological, manual and mechanical, chemical (herbicide), and restoration methods (competitive seeding and planting).

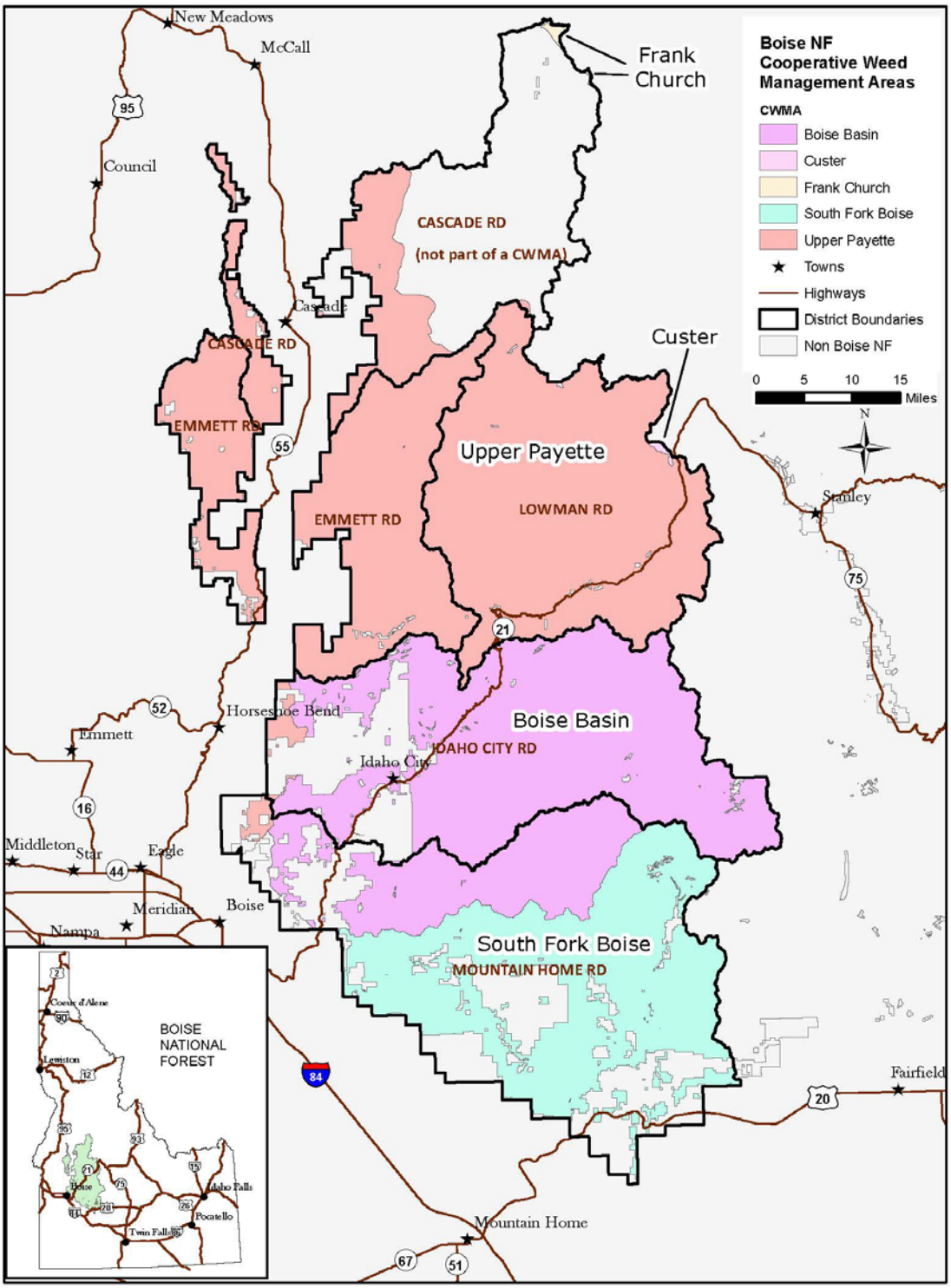

Figure 1-1. Cooperative Weed Management Areas on the Boise National Forest

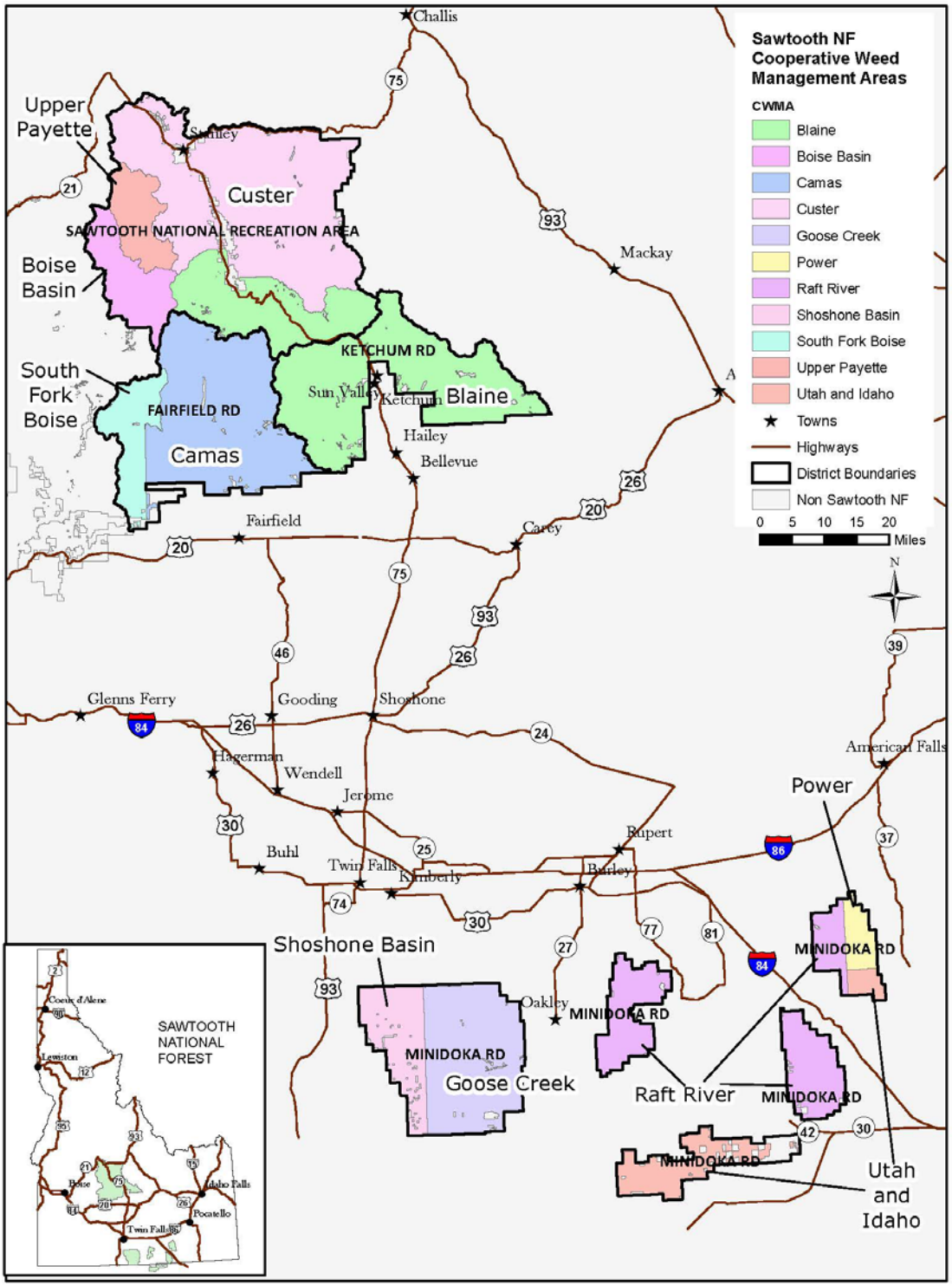

Figure 1-2. Cooperative Weed Management Areas on the SawtoothNational Forest

1.2.1. Targeted Invasive Species

Approximately 91,151 acres within the BNF (Table 1-1) and 63,598 acres within the SNF (Table 1-2) have been identified as being infested with State- and County-listed noxious weeds. Within the state of Idaho, 37 State- and County-listed noxious weed species are known to occur on or adjacent to the BNF and SNF. Within Utah, 11 State- and County-listed weed species are known to occur on the Raft River Division of the SNF. Acres of infestations by District are provided in Table 1-1, and known infestations of noxious weeds by District(s) are displayed in Maps A1 through A8 (Appendix A). Some species occur across the Forests, while others are localized (Table 1-1 and Table 1-2).

The total acreage of inventoried infestations in Table 1-1 and Table 1-2 is an over-estimate. The Forest Service Natural Resource Information System (NRIS) database protocols require that a site-identified invasive plant infestation may consist of only one species. When more than one invasive plant species occupies a site (e.g., spotted knapweed and hoary alyssum), two infestations are recorded in the NRIS database, one for each species of invasive plant present, which results in double counting the acres.

Treatment would not be limited to the species shown in Table 1-1 and Table 1-2. If new invasive plant species are discovered, they would be treated with one or more of the methods described in this document. Species that do not currently occur within the BNF and SNF, but are on the Early Detection and Rapid Response (EDRR) watch list, are identified in Chapter 3.

Thousands of acres of common, invasive plants (e.g., cheatgrass), which are not identified by the States of Idaho or Utah as being noxious, are known to occur on the BNF and SNF. While treatment activities within the scope of this program would be prioritized for noxious weed species, sites may be treated for other invasive plant species, especially if they are associated with noxious weeds. Additionally, unlisted invasive species may be included in restoration treatment plans, such as post-fire or mine reclamation. Whether the focus of treatment or not, these unlisted invasive species will not be evaluated as non-target species to protect.

Table 1-1. Inventoried non-native invasive plant species infestations by District on the Boise National Forest

Invasive Plant Scientific Name	Invasive Plant Common Name	Number of Infestations	Total Infested Acres	Mountain Home (acres)	Idaho City (acres)	Cascade (acres)	Lowman (acres)	Emmett (acres)
Hyoscyamus niger	Black Henbane	7	92.20	0	0	92.2	0	0
Linaria vulgare	Butter and eggs	96	996.17	276.26	331.64	0.37	388.27	0
Cirsium arvense	Canada thistle	553	4,279.10	8.02	1251.44	893.59	682.28	1443.77
Hypericum perforatum	Common St. John's wort	6	13.51	13.51	0	0	0	0
Echium vulgare	Common viper's bugloss	3	0.01	0	0	0	0.01	0
Linaria dalmatica	Dalmatian toadflax	535	6,038.54	167.28	4142.20	0.05	167.28	55.43
Centaurea diffusa	Diffuse knapweed	349	4,025.33	550.43	3235.36	0.59	176/01	62.84
Convolvulus arvensis	Field bindweed	10	29.25	29.14	0	0	0.11	0
Dipsacus fullonum	Fuller's teasel	10	78.76	0	0	0	0	78.76
Cynoglossum officinale	Gypsyflower	1014	5,142.12	188.28	986.18	1157.82	0	2809.83
Berteroa incana	Hoary alyssum	88	78.25	1.18	0	0	64.81	12.27
Polygonum cuspidatum	Japanese knotweed	1	0.02	0.02	0	0	0	0
Aegilops cylindrica	Jointed goatgrass	3	1.29	1.29	0	0	0	0
Euphorbia esula	Leafy spurge	315	727.27	501.38	0	0	0	225.88
Salvia aethiopis	Mediterranean sage	1	3.46	0	0	0	0	3.46
Carduus nutans	Nodding plumeless thistle	33	2.97	0	0	0	2.97	0
Hieracium aurantiacum	Orange hawkweed	7	2.48	0	0	0	2.48	0
Leucanthemum vulgare	Oxeye daisy	197	5,676.00	5.28	3986.05	0	165.91	1518.77
Lythrum salicaria	Purple loosestrife	2	3.62	0	0	0	0	3.62
Chondrilla juncea	Rush skeletonweed	3779	47,763.88	7619.25	807	2443.10	9052.11	5843.97
Onopordum acanthium	Scotch cottonthistle	52	98.31	89.02	0	0	0.26	9.03
Centaurea stoebe ssp. micranthos	Spotted knapweed	2272	15,929.60	776.83	8102.07	3299.78	1765.83	1985.10
Potentilla recta	Sulphur cinquefoil	5	5.40	0	0	5.40	0	0
Cardaria draba	whitetop	58	163.38	155.33	0	0	0	8.05
	Total	9396	91,150.91	10,382.61	44,840.02	7,892.89	13,974.61	14,060.78

Table 1-2. Inventoried non-native invasive plant species infestations by District on the Sawtooth National Forest

Invasive Plant Scientific Name	Invasive Plant Common Name	Number of Infestations	Total Infested Acres	Minidoka (acres)	Fairfield (acres)	Ketchum (acres)	Sawtooth NRA (acres)
Hyoscyamus niger	Black Henbane	16	88.23	82.93	0	0	5.30
Cirsium vulgare	Bull thistle	186	3,621.26	2881.53	0	0	739.73
Arctium	burdock	18	75.86	75.86	0	0	0
Bassia scoparia	Burning bush	2	2.15	2.15	0	0	0
Linaria vulgaris	Butter and eggs	837	10,723.32	0	351.64	0.70	10370.98
Cirsium arvense	Canada thistle	501	9,698.14	5418.10	289.72	286.22	3704.10
Bromus tectorum	Cheatgrass	7	423.49	423.49	0	0	0
Verbascum thapsus	Common mullein	83	68.49	9.20	0	0	59.29
Hypericum perforatum	Common St. John's wort	5	0.10	0	0.10	0	0
Tanacetum vulgare	Common tansey	25	12.94	0	0	0	12.94
Linaria dalmatica ssp. dalmatica	Dalmatian toadflax	222	2,141.48	0	1.94	554.88	192
Centaurea diffusa	Diffuse knapweed	217	2,145.37	1002.26	802.95	54.59	285.56
Isatis tinctoria	Dyer's woad	5	56.89	48.85	0	0	8.04
Thlaspi arvense	Field pennycress	15	3.25	0	0	0	3.25
Forb, biennial	Forb, biennial	3	0.13	0	0	0	0.13
Forb, docot	Forb, docot	5	0.26	0	0	0	0.26
Cynoglossum officinale	Gypsyflower	150	2,241.08	2212.63	20.46	0	7.99
Acroptilon repens	Hardheads	3	2.83	2.83	0	0	0
Descurainia sophia	Herb sophia	19	3.16	0	0	0	3.16
Berteroa incana	Hoary alyssum	17	57.55	0	57.18	0	0.36
Euphorbia esula	Leafy spurge	2053	14,124.90	407.79	13717	0	0.11
Cardaria chalepensis	Lendspod whitetop	3	4.45	4.45	0	0	0
Ceanothus maritimus	Maritime ceanothus	1	7.21	0	0	0	7.21
Carduus nutans	Nodding plumeless thistle	109	2,324.45	1610.47	0	0	713.98

Invasive Plant Scientific Name	Invasive Plant Common Name	Number of Infestations	Total Infested Acres	Minidoka (acres)	Fairfield (acres)	Ketchum (acres)	Sawtooth NRA (acres)
Hieracium aurantiacum	Orange hawkweed	1	2.40	0	0	0	2.4
Leucanthemum vulgare	Oxeye daisy	4	2.63	0	0	0	2.63
Lythrum salicaria	Pitseed goosefoot	65	67.16	0	0	0	67.16
Chondrilla juncea	Rush skeletonweed	616	4,916.78	0	3928.71	0.09	987.98
Tamarix ramosissima	Salt cedar	1	0.03	0.03	0	0	0
Onopordum acanthium	Scotch cottonthistle	35	292.68	292.57	0	0.11	0
Bromus inermis ssp. inermis var. inermis	Smooth brome	22	40.06	40.06	0	0	0
Centaurea stoebe ssp. micranthos	Spotted knapweed	1901	10,257.37	528.41	669.45	1383.03	7676.47
Senecio jacobaea	Stinking willie	3	2.54	0	0	0	2.54
Descurainia	Tansy mustard	1	0.00	0	0	0	0.01
Cardaria draba	Whitetop	25	188.44	188.32	0	0	0.12
Centaurea solstitialis	Yellow star-thistle	1	0.01	0	0.01	0	0
Melilotus officinalis	Yellow sweet clover	12	0.56	0	0	0	0.56
	Total	16585	63,597.66	15,231.95	19,839.17	2,286.83	26,239.71

1.3. Purpose and Need for Action

The overall purpose of the proposed action is to reduce the negative effects of existing and future invasive plants on the structure and function of native plant communities and on other natural resource values that may be adversely impacted. The proposal is in response to an underlying need to implement policy and direction provided at the national, regional, State, and Forest levels, which includes control and containment of invasive plants on the BNF and SNF (EO 13112—Invasive Species, National Strategy and Implementation Plan for Invasive Species Management [USDA Forest Service 2004], 2008–2012 National Invasive Species Management Plan [NISC2008], 2009 Invasive Species Management Strategy [USDA Forest Service 2014a], Idaho Invasive Species Strategic Plan 2012-2016 [ISDA 2012], Idaho's 10 year strategic plan for managing noxious and invasive weeds 2008–2018 [Bureau of Land Management et al. 2008], the Utah Strategic Plan for Managing Noxious Weeds and Invasive Plants [UWCA 2004], BNF Land and Resource Management Plan [USDA Forest Service 2010a], SNF Land and Resource Management Plan [USDA Forest Service 2012a], National Invasive Species Management Plan 2016-2018 [NISC 2016]).

The need of the proposed action is multifaceted as described below.

Invasive plants are diminishing natural resource values of the Forests—Forest resources are negatively impacted by existing and expanding invasive plant species populations. These species are known to out-compete native plants, which can reduce productivity and biodiversity, cause habitat loss, and have economic impacts.

Aquatic invasive species are gaining a foothold in Idaho and have the potential to cause substantial ecological and economic impacts—Although limited aquatic invasive plant species have been found on either Forest, a likely threat exists that aquatic weeds could become established on the Forests. Boat inspections conducted on the Sawtooth NRA in 2014 found 28 boats with aquatic weeds present (inspection reports available in the project record). In 2015, Eurasian watermilfoil and curleyleaf pondweed were detected on watercraft entering Redfish Lake from the middle section of the Snake River. A total of 23 watercraft were inspected and found to be contaminated with aquatic vegetation (Vuono 2014). Removing these plants is critical to keeping these invasive species out of Redfish Lake and surrounding waterbodies with critical habitats for listed species. The Idaho State Department of Agriculture (ISDA) conducted roving aquatic invasive monitoring stations on the BNF in 2015 and found 13 boats on Cascade Lake, and 1 boat on Lucky Peak Reservoir with aquatic weeds (personal communication Thomas Woolf, Idaho Department of Agriculture). Eurasian watermilfoil has been found on the Idaho City RD and is gaining a foothold in Idaho's lakes, ponds, rivers, and other waterways, with approximately 4,000 surface acres of the plant identified through State surveys[1]. Eurasian watermilfoil has been found in several counties on the BNF[2]. Once established, aquatic invasive plant species are extremely difficult to eradicate and pose a serious threat to the ecological integrity of aquatic environments. An integrated management strategy that allows for implementing timely and effective invasive plant control and eradication programs for the BNF

[1] http://www.idahoweedawareness.net/vfg/weedlist/ewmilfoil/ewmilfoil.html

[2]http://www.agri.idaho.gov/AGRI/Categories/PlantsInsects/NoxiousWeeds/Documents/mapping/County_Weed_Maps_67/EWM_2014.pdf

and SNF is critical to preventing these species from becoming established on either Forest. Establishment of these species in head waters of the Columbia River system is especially momentous as they pose a source for infesting the entire downstream aquatic ecosystem. (e.g., establishment of an infestation source in Redfish Lake could distribute propagules of these invasive plants throughout the downstream Salmon River, Snake River, and Columbia River systems.)

A timely response to new infestations, new invasive plant species, and landscape scale disturbances is necessary—Landscape-level tree mortality and insect and wildfire disturbance have increased on both Forests and are likely to continue to increase the potential for invasive plant infestations. The Forests need the flexibility to treat expanded and/or newly identified invasive plant infestations in a timely manner. Existing decisions for invasive plant management on the Forests do not address new species, nor do they provide priorities for managing new infestations. Updating these decisions would allow the Forest to satisfy the need to incorporate EDRR into the adaptive integrated management strategy.

Existing invasive plant populations on the BNF and SNF require active and adaptive management—Invasive plant infestations already exist throughout the BNF and SNF and will increase in density and distribution without management. An active and adaptive treatment strategy is necessary to contain invasive plants within existing boundaries, reduce infestation densities, and retard the establishment of new infestations. Control efforts should be focused on infestations that can realize the greatest resource benefits—those with the highest risk of spread, those that have not become broadly established, and those with the best likelihood of control success. New analysis and planning is needed to make available the most current tools and guide their best use.

Federal, State, and Forest Service laws, regulations, policies and direction relating to invasive plant management must be implemented and followed—Implementing invasive species laws and policies requires aggressive and adaptive invasive plant management. We need to develop and utilize criteria to prioritize weed species and treatment areas on both Forests. This analysis identifies the strategies that the BNF and SNF would use to comply with laws and policies pertaining to treatment of invasive plants.

1.4. Proposed Action

The BNF and SNF propose to implement adaptive invasive plant treatment on currently and potentially infested areas within the Forest boundaries including the Sawtooth, Hemingway-Boulders, and White Clouds Wilderness Areas, but outside the boundary of the Frank Church—River of No Return Wilderness. Treatment activities would include inventory and assessment designed to support Early Detection Rapid Response (EDRR), control methods, rehabilitation and restoration, and implementation and effectiveness monitoring. Activities would be implemented with partners at the federal, State, and local level where opportunities exist.

To provide for EDRR, the Forests would design a plan which allows treating invasive plant infestations located outside of currently identified infested areas. These infestations may include new sites that arise in the future or sites that currently exist but have not yet been identified in Forest inventories. The intent of EDRR is to allow timely control so that new infestations can be treated when they are small, which prevents establishment and spread while reducing treatment costs and potential side effects. Planning for EDRR includes analyzing the risk for new invasions

associated with the characteristics of the species and determining areas in the Forests where new invasions are likely to occur.

Proposed control methods would be based on integrated pest management principles and methods known to be effective for each target species. These methods include, but are not limited to, biological control, such as pathogens and insects; chemical control using herbicides that target invasive plant species; and manual and mechanical techniques, such as cutting and pulling. Appendix C displays commonly used species-specific integrated control measures that would be applied to known noxious weed species in the BNF and SNF. Control methods would be employed alone or in combination to achieve the most effective control. Treatment methods would be based on the extent, location, type, and character of an infestation and would be implemented using design criteria. For routine annual treatments, a maximum of 20,000 acres would be proposed for treatment annually on each Forest: 2,000 acres each for biocontrol and manual/mechanical treatment and 16,000 acres for herbicide treatment. Management priority would be based on risk factors such as the number and size of known infestations; vectors for spread; proximity to susceptible habitat; threat to important resources (e.g., wilderness, endangered species habitat); and ability to outcompete desirable plant species. The priority of species to be treated would vary based on these factors and could change over time. These priorities would be used to guide selection of specific management activities for particular infestations.

Following large wildfires, an additional 20,000 acres newly impacted by wildfire and at risk for infestation could be treated on each Forest. These additional acres would continue to be treated annually for an additional 3 to 5 years post wildfire as needed to reduce the risk of infestation.

Rehabilitation and restoration cultural actions would be designed and implemented based on the conditions found in and around infested areas. Both active and passive (allowing plants onsite to fill in a treated area) revegetation would be considered. Rehabilitation techniques would be assessed and implemented to promote native plant communities resistant to infestation by invasive plants.

Monitoring is necessary for implementing an adaptive treatment program. Monitoring provides the data for adaptive management. Information collected from monitoring may be used by managers to evaluate the efficacy of EDRR, treatment, and rehabilitation and restoration actions. Two basic types of monitoring exist: implementation monitoring and effectiveness monitoring. Implementation monitoring answers the question, “Did we do what we said we would do?” Effectiveness monitoring answers the questions, “Were prevention, treatment and restoration actions effective?” and “Were intended goals accomplished?”

See Chapter 2 for a detailed description of the alternatives.

1.5. Management Direction

This DEIS process and documentation has been completed according to direction contained in the National Forest Management Act (NFMA) (PL 94-588), NEPA (PL 91-190), the Federal Land Policy and Management Act (FLPMA) (PL 94-579), the Clean Water Act (CWA) (PL 92-500), the Endangered Species Act (ESA) (PL 93-205), Federal Actions to Address Environmental Justice to Minority Populations and Low-Income Populations (EO 12898), and the Council on Environmental Quality (CEQ) regulations, which provide general land management and environmental analysis direction.

The following other federal laws were also considered:

- Carlson-Foley Act of 1968 (PL 90-583)—Authorizes and directs federal agencies to permit control of noxious plants by State and local governments on a reimbursement basis in connection with similar weed control programs carried out on adjacent nonfederal land
- Plant Protection Act (PL 106-224)—Consolidates and modernizes all major statues pertaining to management and control of noxious weeds
- Noxious Weed Control and Eradication Act of 2004 (PL 108-412)—Provides financial and technical assistance to control or eradicate noxious weeds
- 36 CFR Subpart A, Section 222.8—Directs the Forest Service to cooperate with local weed control districts to develop control programs where National Forests and Grasslands exist
- EO 13112 (1999)—Directs federal agencies to
    - develop and coordinate a management program for control of undesirable plants which are noxious, harmful, injurious, poisonous, or toxic on federal lands under the agency's jurisdiction,
    - establish and adequately fund the program, to complete and implement cooperative agreements and/or memorandums, and
    - establish Integrated Weed Management (IWM) to control or contain species identified and targeted under cooperative agreements and/or memorandums.

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (1947) established the U.S. system of pesticide regulation to protect applicators, consumers, and the environment. The Environmental Protection Agency (EPA) and the appropriate environmental agencies of the respective states administer FIFRA. FIFRA requires registration for all herbicides after extensive testing to evaluate whether a pesticide has the potential to cause adverse effects on humans, wildlife, fish, and plants, including endangered species and non-target organisms, as well as possible contamination of surface water or groundwater from leaching, runoff, and spray drift. When registered, a label is created to instruct the applicator on the proper usage of the material and required personal protective equipment. The EPA also must approve the language that appears on each pesticide label, and the product can only be used legally according to the directions on the label accompanying it at the time of sale. The Forest Service is authorized by FIFRA and the Cooperative Forestry Assistance Act to use pesticides for multiple-use resource management and maintenance of the quality of the environment as long as the actions comply with NEPA and CEQ regulations. Forest Service Manual (FSM) 2150 (Pesticide Use Management and Coordination) and Forest Service Handbook (FSH) 2109.14 (Pesticide Use Management and Coordination) provide direction on safe use of pesticides, including direction on storage and transport and development of safety plans and emergency spill plans.

FSM 2900 (Invasive Species Management) directs the Forest Service to use an IWM approach to control and contain the spread of noxious weeds on NFS lands and from NFS lands to adjacent lands. FSH 2109.14 (Pesticide—Use Management and Coordination) provides additional direction related to implementing invasive plant management, and FSM 2150 (Pesticide—Use Management and Coordination) provides policy direction.

The National Strategic Framework for Invasive Species Management (USDA Forest Service 2013) provides broad strategic direction for Forest Service programs and incorporates the Invasive Species Systems Approach, which has four elements—prevention, detection, control and management, and restoration and rehabilitation.

The National Strategy and Implementation Plan for Invasive Plant Species Management (USDA Forest Service 2004) focuses on four key elements—preventing invasive species before they arrive; finding new infestations before they spread and become established; containing and reducing existing infestations; and rehabilitating and restoring native habitats and ecosystems.

The *National Invasive Species Council. Management Plan*: 2016–2018 (USDA 2016) EO 13112 established the National Invasive Species Council (NISC) to "provide national leadership regarding invasive species." The NISC Management Plan 2016–2018 identifies high priority, interdepartmental actions for the federal government and its partners to take to prevent, eradicate, and control invasive species, as well as restore ecosystems and other assets adversely impacted by invasive species.

The Forest Service Guide to Noxious Weed Prevention Practices (USDA Forest Service 2001) provides management guidance in the form of goals along with prevention practices. Forest Service policy identifies prevention of the introduction and establishment of noxious weed infestations as an agency objective. This guide provides a comprehensive directory of weed prevention practices for use in Forest Service planning and wildland resource management activities and operation.

At the regional level, the Intermountain Region of the Forest Service, headquartered in Ogden, Utah, issued an Invasive Species Management Strategy (USDA Forest Service 2009) that outlines a regional plan for complying with national direction.

The intent of the Idaho Plant Pest Act of 2002 is to prevent the introduction and spread of plant pests in the state of Idaho by regulating plant material and plant pests. The Idaho Invasive Species Act of 2008 provides policy direction, planning, and authority to combat invasive species infestations throughout the state and to prevent the introduction of new species that may be harmful by implementing strategies that requires the State of Idaho to enhance its capacity to prioritize risks, prevent new invasions, employ EDRR techniques, apply state of the art control and management strategies, coordinate multiple public and private efforts, and involve the public.

The *Idaho Invasive Species Strategic Plan 2012–2016* (ISDA 2012) is a strategic plan that outlines a framework for how Idaho can continue at the forefront of State efforts to cost-effectively prevent and manage invasive species. This strategy focuses upon three goals:

1. Prevent the introduction of new invasive species to Idaho
2. Limit the spread of existing invasive species populations in Idaho
3. Abate ecological and economic impacts that result from invasive species populations in Idaho

This DEIS complies with the BNF and SNF Land and Resource Management Plans Final Environmental Impact Statements (USDA Forest Service 2010b, 2012b) and all associated amendments. Forest-wide desired conditions, goals, objectives, and standards and guidelines for noxious weeds treatments are found under the "Non-native Plants" section in the BNF and SNF Land and Resource Management Plans (Forest Plans; USDA Forest Service 2010a, 2012a).

The desired condition for invasive plant management is stated in the BNF and SNF Forest Plans as follows (USDA Forest Service 2010a, 2012a):

- Noxious weed infestations are primarily restricted to locations along roads, trails, river corridors, and airstrips. Existing noxious weed populations are not expanding in size. Weed species cover or densities are variable across the Forest. New noxious weed outbreaks may occur temporarily or continue to exist as a small nonexpanding population in areas of high susceptibility. Noxious weed populations in low susceptibility areas are small and scattered with low to moderate densities. New invader species to the forest are not becoming established. Native plants are dominant on disturbed or recently restored sites. Some areas of historic rehabilitation or vegetative manipulation are still dominated by non-native grasses or forbs.

The BNF and SNF Forest Plans include the following Forest-wide goals (USDA Forest Service 2010a, 2012a):

- NPGO01—Manage noxious weeds with an Integrated Weed Management approach that uses prevention, education, eradication, containment, and control treatment strategies in a coordinated effort that includes potentially affected resources, users, funding sources, and activities
- NPGO02—Prevent new infestations of undesirable non-native plants or noxious weed species, with emphasis on areas of high susceptibility where those species have a strong probability for establishment and spread
- NPGO04—Re-establish vegetation that is compatible with desired long-term vegetative conditions, Forest-wide management direction, and management area priorities

The BNF and SNF Forest Plans include the following standards and guidelines (USDA Forest Service 2010a, 2012a):

- NPST03—To prevent invasion/expansion of noxious weeds, the following provisions will be included in all special use authorizations, timber sale contracts, service contracts, or operating plans where land-disturbing activities are associated with the authorized land use (additional direction may be found in timber sale and service contract provisions and in Forest Service handbooks):
    - Revegetate areas, as designated by the Forest Service, where the soil has been exposed by ground-disturbing activity. Implement other measures, as designated by the Forest Service, to supplement the influence of re-vegetation in preventing the invasion or expansion of noxious weeds. Potential areas would include: construction and development sites, underground utility corridors, skid trails, landings, firebreaks, slides, slumps, temporary roads, cut and fill slopes, and travelways of specified roads.
    - Earth-disturbing equipment used on NFS lands—such as cats, graders, and front-loaders—shall be cleaned to remove all visible plant parts, dirt, and material that may carry noxious weed seeds. Cleaning shall occur prior to entry onto the project area and again upon leaving the project area, if the project area has noxious weed infestations. This also applies to fire suppression earth-disturbing equipment contracted after a WFDSS has been completed.

- NPST10—Projects that may contribute to the spread or establishment of noxious weeds shall include measures to reduce the potential for spread and establishment of noxious weed infestations
- NPST11—Integrated Weed Management shall be used to maintain or restore habitats for sensitive plants and other native species of concern where they are threatened by noxious weeds or non-native invasive plants
- NPGU01—Noxious weeds and undesirable non-native plants should be eradicated. Where it is not practical to eradicate existing infestations, infestations should be managed to prevent seed production and spread
- NPGU03—Identify areas with extensive noxious weed infestations where precautionary actions are necessary when planning and implementing management activities. In areas of extensive weed infestations, designated wash sites should be established as part of project planning. Wash sites should be located: (1) where they are easily accessible and useable, (2) on gravelly or well-drained soils, (3) where wash water runoff will not carry seeds away from site, (4) where wash water runoff will not directly enter streams, and (5) where they may be used repeatedly for several projects or activities within the area.
- NPGU05—Noxious weed management should determine the presence, location, and amount of noxious weed infestations. Management strategies should also identify:
  a. Methods and frequency for treating infestations,
  b. Treatment procedures and restrictions,
  c. Reporting requirements, and
  d. Follow-up or monitoring requirements.

1.6. Decision Framework

The Responsible Officials are the Boise and Sawtooth Forest Supervisors, who will make the following decisions based on the results of the interdisciplinary analysis:

- Whether to select the proposed action or one of the alternatives
- What modifications, if any, to the selected alternative are needed
- Which project design features are needed

1.7. Public Involvement

The Notice of Intent (NOI) was published in the Federal Register on June 25, 2015. The NOI asked for public comment on the proposal until August 10, 2015. As part of the public involvement process, a detailed proposed action was sent to an extensive mailing list via hardcopy mail and email on June 29, 2015. In addition, on July 1, 2015, news releases were sent to local media outlets for both Forests, including newspapers and radio and television stations.

BNF and SNF personnel met with the Shoshone-Bannock tribe at Fort Hall, Idaho on December 3, 2015, to discuss the proposed project. BNF and SNF personnel met with the Nez Perce tribe in Boise, Idaho (Wings & Roots meeting) on July 9, 2015, to discuss the proposed project. The

project has been published in the Sawtooth and Boise Forest Schedule of Proposed Actions on-going since July 1, 2015.

1.8. Issues

Twenty-two organizations and individuals provided comments during scoping, all of which are located in the project record. Comments were analyzed, and public issues were identified. Many important public issues were addressed in the design of the Proposed Action. An example is human health, an issue of great public concern. All alternatives avoid herbicide use associated with harmful exposure to workers and/or the public. The issue of human health is discussed throughout this document because it is of such great importance to the public, but is not the basis for alternative comparison because all alternatives equally address this issue.

The Forest Service separated the issues into two groups: significant and non-significant. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues were identified as those 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The CEQ NEPA regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review" These issues are identified in the issue analysis form located in the project record.

The Forest Service identified the following significant issues from comments received during scoping.

1.8.1. Soil and Water

Using herbicides in riparian areas can adversely impact water quality. Herbicides could pollute water and affect source water protection areas (SWPAs). Herbicide treatment may adversely affect soils, and herbicides may leach into groundwater.

Measurement Indicators:

- Instream Sediment Loads—Estimated change in hillslope and stream bank sediment delivery to streams (based on qualitative evaluation).
- Herbicide Concentrations in Water—Estimated concentrations of herbicides in streams and other surface waters, groundwater, and drinking water source areas (based on modeling).
- Riparian Function—Estimated change in weed infested acres within Riparian Habitat Conservation Areas (RHCAs), as a measure of riparian and stream channel function.
- Effects of weed treatment type on soil condition
- Risk of impacts to soil biota
- Risk of increased soil erosion

1.8.2. Fisheries

Using herbicides in riparian areas can adversely impact water quality and aquatic species. Herbicides could contaminate water, harm fish through exposure to chemicals, and negatively affect aquatic plants and insects.

Measurement Indicators:

- Effects of herbicide to be used within riparian areas on aquatic organisms
- Adequacy of design criteria that apply to water quality and aquatic organisms

1.8.3. Wildlife

Herbicide exposure, resulting from herbicide toxicity, may harm terrestrial wildlife species. The effects of invasive plant treatment on the following species will be analyzed: wildlife species listed as threatened, endangered, proposed, or candidate under the ESA; Management Indicator Species (MIS); Forest Service Region 4 (R4) sensitive wildlife species; migratory birds and their habitat; and ungulate big game species of interest.

Measurement Indicators:

- Toxicity potential of herbicides being used
- Direct and indirect effects of invasive plant species treatment activities (disturbance)

1.8.4. Sensitive Plants

Herbicide exposure, resulting from herbicide drift, residue, or direct application, may cause harm to non-target plants and their pollinators.

Measurement Indicators:

- Effects of the following weed treatments on BNF and SNF sensitive plant species and their pollinators:
  - Biological control
  - Herbicide application
  - Mechanical control

1.8.5. Human Health

Exposure to herbicides may affect human health because of herbicide toxicity.

Measurement Indicators

- Toxicity potential of herbicides being used
- Adequacy of design criteria to protect human health

1.8.6. Wilderness

The project area includes the Sawtooth, White Clouds, and Hemingway-Boulder Wilderness areas. The Wilderness Act, Section 2(c) defines wilderness as “an area where the earth and its

community of life are untrammeled by man" "protected and managed so as to preserve its natural conditions". Furthermore, Section 4(b) of the Act mandates "…each agency administering wilderness... shall be responsible for preserving the wilderness character of the area..." While treating nonnative species may affect the natural quality of wilderness character by maintaining a naturally functioning ecosystem, the intentional control or manipulation of the components or processes or ecological systems (e.g., treatment of plant species) may also affect the untrammeled quality of wilderness character.

Measurement Indicators:

- Natural Quality Measure—Acres of nonnative species

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Chapter 2. Alternatives, Including the Proposed Action

2.1. Introduction

Chapter 2 describes and compares alternatives considered for invasive plant treatment on the non-Wilderness portion of the 2.2-million-acre BNF and on the entire 2.1 million acres of the SNF, including designated Wilderness.

Inventoried noxious weed infestations have been mapped and are displayed in Appendix A (Maps A1 through A8); these are the proposed treatment sites. Based on current treatment inventories, 37 State-listed noxious weed species exist, covering approximately 91,151acres across the BNF and 63,598 acres across the SNF.

Untreated invasive plant infestations have the potential to expand at an average rate of 1.3% to 25% each year (Duncan and Clark 2005). Increases are due to growth of existing plants and spread by a variety of vectors, such as wind, water, animals, and humans. Not all inventoried invasive plant populations receive treatment annually, due to budget and personnel constraints. Retreatment is often necessary to maintain the control level of initial treatment depending on the invasive plant species, the size and density of an infestation, seed bank viability, and site conditions. Thus, multiple treatments may be necessary over the next 15 years to achieve control objectives on known infestation sites.

This DEIS considers 5 alternatives in detail:

- No Action Alternative (Alternative 1)
- Current Management (Alternative 2)
- Proposed Action, which is also the preferred alternative (Alternative 3)
- No Aerial Herbicide Application (Alternative 4)
- No Aquatic Herbicide Application (Alternative 5)

The Forest Service developed the action alternatives in response to issues raised by the public and to meet legal requirements.

The Proposed Action includes treating invasive plant species and/or sites not present or yet undiscovered. This alternative also addresses the increased risk for new infestations over large acreages impacted by wildfire. As described in Chapter 1, detecting and treating new infestations when they are small (referred to as Early Detection/Rapid Response [EDRR]) increases the effectiveness of the invasive plant program and minimizes adverse effects. The Proposed Action includes treating newly detected infestations, utilizing the same control methods used on known sites.

2.2. Alternatives Considered in Detail

2.2.1. Alternative 1—No Action

This alternative is required by regulation (40 CFR 1502.14) and would call for no invasive plant management treatments applied to any NFS lands, except for those NFS lands under road right-of-way (ROW) agreements with the different Counties within the BNF and SNF. In those situations, the authority to undertake treatments is vested in the County agencies. Alternative 1 provides a baseline for comparison and analysis of effects.

No herbicide application (ground-based or aerial application); mechanical methods (hand or tool grubbing, mowing); revegetation; or biological control would occur. Existing biological controls would progress naturally, but no supplementation would occur. Education and awareness programs regarding invasive plants would continue. Existing Forest Plan direction, such as requiring weed-free hay, would continue.

2.2.2. Alternative 2—Current Management

The Current Management Alternative includes the following array of standard invasive plant management practices currently used on the BNF and the SNF:

- Biological control through the use of predators, parasites, and pathogens
- Herbicide control using ground-based spot and broadcast application methods
- Mechanical and manual methods such as hand-pulling, mowing, cutting, or torching

Acres treated each year can vary considerably based on funding allocation and response to events such as wildfires (Table 2-1). Neither the BNF nor the SNF have approval for aerial application of herbicides or treatment of aquatic invasive plant species.

Table 2-1. Acres treated annually, by treatment method

Treatment Method	Boise National Forest, Average Acres Treated[a]	Sawtooth National Forest, Average Acres Treated[a]
Mechanical Control	23	163
Biological Control	14	548
Herbicide Control	9,540	4,975
Total	9,577	5,686

[a]Based on 3-year average, treatment years 2012–2014.

Following is a summary of the key current management components being implemented on both Forests and being proposed under this alternative. A detailed description of Forest-specific current management components can be found in the project record.

2.2.2.1. Treatments

2.2.2.1.1. Biological Control

- Only USDA APHIS–approved biological controls would be released on the Forests.
- Biological agents would not be introduced for controlling poisonous plants.

2.2.2.1.2. Herbicide Control

- All herbicide treatments conducted for controlling invasive plants and noxious weeds would be performed in accordance with established Forest Service policy and regulations and would include EPA label restrictions. Application according to all herbicide labels would be strictly enforced. Table 2-2 displays chemicals approved for use on the Forests, along with each chemical's approved application rate and general location for use.
- Application of any herbicides to treat weeds shall be performed by, or directly supervised by, a state-licensed applicator.
- Herbicide applications would only treat the minimum area necessary to control noxious weeds.
- A Daily Pesticide Application Log would be completed for each project area detailing the chemical application, treatment area, target species distribution and density, weather conditions, and recommendations for follow-up treatments or rehabilitation.
- Care would be taken to treat only the noxious weeds targeted for treatment, in order to help prevent adverse impacts on nontarget vegetation.
- Herbicide applications would continue to be scheduled and designed to minimize potential impacts to nontarget plants and animals, while remaining consistent with the objectives of the vegetation treatment program.
- Herbicides having long-term (>1 year) residual effects would be applied only once per year.
- No chemical would be applied directly to sensitive plant species during spot treatments, and a 100-foot buffer would be maintained around known sensitive plant populations.
- Ground-based application for treating noxious weed infested areas may utilize the following:
    - Vehicle-mounted sprayers (spot-gun) (most common method)
    - Spot-spraying with hand-held spray nozzles either mounted on a vehicle (slip tank) or attached to a backpack system (very common method)
    - Hand-spreading granular formulations (least common method) and wicking, wiping, dripping, painting, or injecting target weeds (uncommon method)

Table 2-2. Herbicides and application settings currently used in the Boise and Sawtooth National Forests

Herbicide (Active Ingredient)	Commonly Used Brand Names[a]	Maximum Label Application Rate (oz or lbs AI[b] or AE[c]/acre)	Typical Application Rate (oz or lbs AI[b] or AE[c]/acre)	General Location Setting[d]	
				Vegetation Away from Water	Vegetation Near Water
Aminopyralid	Amine 4, Weedar® 64	0.11	0.078-0.11	X	
2,4-D amine	Milestone	2.0 lbs ae/acre/application 2 apps per year	1.0-2.0 lbs/ac	X	X
Chlorsulfuron	Telar	2.6 oz. product/ac/year (0.12 lbs ai/ac/year)	0.01-0.02 oz./ac	X	
Clopyralid	Transline®	0.5 lbs ae/ac/year	0.1-0.5 lb./ac	X	
Dicamba	Banvel®	2.0	0.5-2.0	X	
Diflufenzopyr	Overdrive	0.1	0.05-0.1	X	
Glyphosate	Rodeo®, Roundup®, Accord®	1.7 lbs ae/ac/app ≤ 8.0 lbs ae/ac/year	0.5-3.0 lb./ac	X	X
Imazapic	Plateau®	0.19 lbs ai/ac/year	0.09 - 0.16 lb./ac	X	
Metsulfuron-methyl	Escort®	0.15 lbs ai/ac/year	0.01-0.02 lb/ac	X	
Picloram	Tordon™	1.0 lbs ai/ac/year	0.25-1.0 lb./ac	X	
Sulfometuron methyl	Oust Weed Killer and DPX 5648	8.0 oz. product/ac/year (0.37 lbs ai/ac/year)	2.0 - 6.0 oz./ac (0.09 - 0.28 lb./ac)	X	
Triclopyr: triethylamine salt (TEA)	Element 3A®, Garlon 3A®	2.0 lb ae/ac	1-2.0	X	X

[a] List represents brands most commonly used, although brands other than those listed may also be used.
[b] AI=Active Ingredient.
[c] AE=Acid Equivalent.
[d] Some formulations are suitable for riparian vegetation application near live water while others are only suitable in upland vegetation away from live water; suitability for c application is noted on product labels.

- The following BMPs would be required during mixing, loading, and disposal of herbicides:
  - No herbicide storage, mixing, or post-application cleaning would be authorized within 100 feet of any live waters or over shallow groundwater areas. Mixing and loading operations would occur in an area where an accidental spill would not contaminate a stream or waterbody before it could be contained.
  - All hoses used to add dilution water to spray containers would be equipped with a device to prevent back-siphoning.
  - Applicators would mix only those quantities of herbicides that could be reasonably used in a day.
  - During mixing, mixers would wear hard hats, goggles or face shields, rubber gloves, rubber boots, and protective overalls.

  - All empty containers would be triple rinsed by spraying near the treatment site at rates that do not exceed those on the treatment site.
  - Any additional herbicide label requirements would be strictly followed during the mixing, loading, and disposal of herbicides

- Herbicides would be transported for daily use in their original containers and limited by container size; anticipated amounts would be used on any given day.
- Herbicides would be applied only when wind speeds are less than 8 miles per hour (mph).
- No spraying of any herbicide would occur within 50 feet of open water when wind velocity exceeds 5 mph.
- Nonhazardous dyes would be used, as necessary, to ensure uniform coverage. Signs would be posted at visible sites (campgrounds, trailheads, road intersections) to notify the public of herbicide application in the area.
- A spill contingency plan would be developed prior to all herbicide applications. Individuals involved in herbicide handling or application would be instructed on the spill contingency plan and on spill control, containment, and cleanup procedure.

2.2.2.1.3. Mechanical Control

- Workers would cut plants above ground level or pull out plant root systems to prevent subsequent sprouting and growth; competing plants would be removed around desired vegetation; or mulch would be placed around desired vegetation to limit the growth of competing vegetation.
- Workers also may use power tools such as chainsaws, power brush saws, and line trimmers (i.e., weed eaters).
- All noxious weed disposals would be in accordance with proper disposal methods—for example, plants with developed seeds would be bagged and burned.

2.2.2.1.4. 2012 Recent Noxious Weed Biological Assessment

The Sawtooth Noxious Weed Biological Assessment was completed in 2012 to address ESA consultation requirements for weed treatment for ESA listed species located on the northern portion of the SNF (Fairfield and Ketchum RDs and Sawtooth NRA). NMFS and USFWS issued biological opinions in November 2012. The following are the most commonly used BMPs on the SNF in conjunction with listed aquatic species (that are in addition to standard weed treatment practices currently employed):

- Treatment areas will be identified on maps available at the Unit offices. The herbicides used, dates of use, and name and phone number to contact for more information will also be available.
- See Table 2-3 for herbicide use restrictions relative to distance from water.
- Applicators are required to use more risk-averse application methods in sites that are close to stream channels. Key provisions include using the least toxic chemicals to aquatic resources near water, and more precise herbicide application methods in stream side areas, such as wicking, wiping, or hand spraying with a single nozzle.

- No spraying of any herbicide will occur within 50 feet of open water when wind velocity exceeds 5 mph.
- No chemical herbicides will be used within a 100-foot radius of any potable water spring development.
- A 50-foot no-spray buffer zone will apply for broadcast applications and a 15-foot buffer will apply for spot applications along all flowing water streams and ponded water bodies for those herbicides not labeled for aquatic or streamside application.
- Dyes will be used in riparian areas to provide visual evidence of treated vegetation
- Water-soluble colorants, such as Hi-Light blue dye, will be used within 100 feet of water and other situation as needed to enable applicators and inspectors to properly apply herbicides.
- No ester formulation of 2,4-D or triclopyr-Butoxyethyl Ester would be used.
- The use of power tools that dig or till the ground to remove invasive plant species should not occur within the 100 year floodplain, within 25 feet of stream banks, or flood prone areas along lakes, ponds, springs, and seeps. Treatments needed within these areas, should only be accomplished by hand or hand tools.

Table 2-3. Riparian Conservation Areas (RCAs) herbicide use restrictions from Sawtooth Programmatic Noxious and Invasive Weed Management Program (with National Marine Fisheries Service reasonable and prudent measures)

Distance from Live Water	Maximum Allowable Wind Speed	Application Activity	Herbicides
0 feet	N/A	Herbicides will not be used over live water (streams, ponds, springs, etc.), including water standing or running in ditch lines. Note: treatment of aquatic invasive plants will include review by the Level 1 team and a determination of the need for additional consultation before treatment will take place.	None
0-15 feet	5 mph and blowing away from the direction of the water	Spot applications only, such as: Spot spraying, wicking, wiping, dripping, painting, or injecting of individual plants with aquatically approved chemicals. Apply spray pointed away from the water, not towards the water.	Glyphosate (Aqua Neat, Aquamaster, Glyphos Aquatic, and Rodeo)[a] 2,4-D (Weedar 64) – Use on a limited basis only for small isolated weed populations.
15-100 feet	5 mph and blowing away from the direction of the water	Spot applications only, such as: Spot spraying, wicking, wiping, dripping, painting, or injecting of individual plants with aquatically approved chemicals. Focused spraying of target species with aquatically approved chemicals– may include treating larger patches of weeds or multiple patches in close proximity. Apply spray pointed away from the water, not towards the water.	All chemicals listed above, plus Aminopyralid (Milestone, ForeFront) Metsulfuron methyl (Escort, Cimarron X-tra) Imazapic (Plateau) 2,4-D (Weedar, Amine 4, ForeFront Curtail) Chlorsulfuron (Telar XP, Cimarron X-tra)
>50 feet	5 mph	Spot applications such as: spraying, wicking, wiping, dripping, painting, or injecting of individual plants.	All chemicals listed above, plus Picloram[b] (Tordon 22K, Grazon, Pathway, Tordon 101) 2,4-D amine (Tordon 101)
>100 feet	Less than 10 mph	Spot applications such as: spraying, wicking, wiping, dripping, painting, or injecting of individual plants. Broadcast applications only on gentle terrain accessible by truck, ATV or UTV	All chemicals listed above, plus: Glyphosate (Roundup)[c] Clopyralid (Transline, Redeem, Curtail)[c] 2,4-D/Dicamba (Weedmaster)[c] Diflufenzopyr (Overdrive)[c] 2,4-D/Clopyralid Blend (Curtail) Clopyralid (Transline) 2,4-D amine (Weedar) Dicamba (Banvel, Vanquish, Clarity, Cimarron Max)

[a]Aqua Neat, Aquamaster, Glyphos Aquatic, and Rodeo are trade name glyphosate products that do not contain surfactants and can be used within the 0-15 foot buffer of live water.
bApplication of any picloram herbicide must follow criteria under specific chemical requirements.
[c]Modified to no application closer than 100 feet from streams as stipulated in NMFS BO for anadromous waters.

2.2.3. Alternative 3—Proposed Action

The Proposed Action is to treat noxious and invasive plant species, prevent further spread of existing invasive plant species, and eradicate existing populations where possible in order to maintain native plant communities. The Proposed Action would implement an adaptive IWM strategy on the BNF and SNF to eradicate or control existing or newly discovered invasive plants over the next 10 to 15 years as budgets allow; the Proposed Action would also allow for an additional treatment emphasis on burned areas at high risk of infestation following wildfire.

The proposed adaptive IWM program would utilize a variety of tools, used alone or in combination, to treat invasive plants on the Forests. The following treatment methods are proposed:

- Biological control through the use of predators, parasites, and pathogens and through targeted grazing
- Herbicide control using ground-based spot and broadcast application methods
- Herbicide control using helicopter aerial application methods (excluding designated Wilderness and designated municipal watersheds)
- Herbicide control using aquatic application methods
- Manual and mechanical methods such as hand-pulling, mowing, cutting, or torching
- Rehabilitation and restoration methods such as site preparation and seeding

Treatments would abide by design criteria, the purpose of which is to reduce or eliminate the potential adverse impacts of the various invasive plant treatments. Implementing the design criteria is mandatory to ensure treatments are conducted according to environmental standards and adverse effects are within the scope of those predicted in this DEIS.

Invasive plant sites discovered subsequent to the current invasive plant inventory would be evaluated to determine if the eradication treatments and environmental impacts are consistent with those analyzed in this DEIS.

The Proposed Action identifies an annual program of work with treatments of up to 20,000 acres of invasive plants annually outside of areas burned by wildfire on each Forest (Table 2-4). Both Forests have experienced large, uncharacteristic wildfires over the last decade, leaving thousands of acres at very high risk for infestation by invasive plants. To address this risk, the Proposed Action also allows for treating up to 20,000 acres on each Forest newly impacted by wildfire. These additional wildfire acres would continue to be treated annually for up to 5 years[3], as needed, to reduce the risk of infestation. Any portion of the applied aerial acres not utilized could be used for applied ground acres. Combining the annual program of work plus treatment of wildfire areas, the total maximum acres that could be treated by all methods on each Forest annually would be 40,000 acres. The maximum annual treated acres using herbicide would only 36,000 acres per Forest.

[3] While Burned Area Emergency Response (BAER) does allow for post wildland fire rehabilitation and restoration treatments, it is only for up to 1 year after a wildfire has occurred. Treatments beyond 1-year are almost always needed for effective treatment of noxious and invasive plant species. Thus the Proposed Action allows up to 5 years for treatments post-fire in order to be successful. Wildfire occurs in Year 0. Following year is Year 1, and so on.

Table 2-4. Maximum acres to be treated annually, per Forest by treatment method

Treatment Method	Boise National Forest	Sawtooth National Forest
Routine Annual Program of Work		
Biological Control	2,000	2,000
Mechanical Control	2,000	2,000
Herbicide Control	16,000 total Ground Treatment—8,000 Aerial Treatment[b]—8, 000	16,000 total Ground Treatment—8,000 Aerial Treatment[b]–8,000
Aquatic Application	Known to be Present[a]	Unknown: no documented infestations at present
Post Wildfire Treatment—Up to 5 years Post-fire		
Herbicide	20,000 total Ground Treatment—5,000 Aerial Treatment—15,000	20,000 total Ground Treatment—5,000 Aerial Treatment—15,000

[a] In Boise National Forest records, Eurasian watermilfoil (*Myriophyllum spicatum*) was seen on the Idaho City Ranger District but there are no treatment records (mechanical or any other means) of this population. There are no confirmed sightings at present. Eurasian Watermilfoil has been found on the Lowman Ranger District at the Lowman Nature Ponds in 2007 and was thought to be a hybrid of Eurasian and Northern watermilfoil. The ponds are currently co-managed by the U.S. Forest Service and Idaho Department of Fish and Game (IDFG) under a MOU (FS Agreement #15-MU-11040205-019). It has been treated by Idaho Fish and Game since 2010. ISDA treated a pond on Idaho City property (which is within 1 mile from FS boundary within Idaho City RD) for milfoil in 2008. Boise County and its cooperators, which include Upper Payette Cooperative Weed Management Area (CWMA), Boise Basin CWMA, Boise National Forest, and Idaho Department of Fish and Game, treat Horseshoe Bend Millpond for Eurasian milfoil (IISC and ISDA 2007b).

[b] Any portion of the applied aerial acres not utilized could be used for applied ground acres – 3,200 acres.

Managers may use monitoring data from 1 site or from a set of sites to predict the effects of similar actions on other parts of the project area. Monitoring data would be used to promote the use of the most effective techniques for detection and treatment and to avoid the use of ineffective methods.

Following is a summary of the key components of the Proposed Action alternative for both Forests. A detailed description of the Proposed Action can be found in the project record.

2.2.3.1. Early Detection and Rapid Response

EDRR allows for discovering and treating invasive plant infestations located outside of currently identified infested areas. Infestations outside of currently identified areas may include new sites of noxious weeds known to exist on the Forest, invasive plant species previously unknown to exist on the Forest, or existing sites that have not yet been identified during Forest inventories. The intent of EDRR is to allow timely control so that new infestations can be identified and treated when they are small, preventing establishment and spread while reducing the costs, potential treatment side effects, and impacts from the invasive plant. EDRR is based on the premise that the impacts of similar treatment methods are predictable, even though the exact location or timing of the treatment may be unpredictable. EDRR has been incorporated into all action alternatives.

2.2.3.1.1. Treatment Priority and Strategy

Treatment priorities are based on factors such as the current abundance and distribution of the species, type and values of the site affected, and risk for spread or infestation into other areas. Other program management considerations may affect priorities. For example, priority may be given to sites located in areas proposed for ground-disturbing management activities. In addition, opportunities for special funding or cooperative projects with other landowners, agencies, and

organizations may be considered. Treatment priorities do not necessarily refer to the order in which an infestation is treated during a given fiscal year. They are part of an adaptive IWM strategy used by managers in determining how to allocate resources.

The BNF and SNF criteria for determining treatment priority of invasive plant infestations are disclosed in Table 2-5. Priorities are assigned at the RD level. Higher priority is generally given to those new invasive plant infestations where reduction or eradication of infestations is likely to be successful. For established infestations, suppression strategies play a much more important role. In general, the vast majority of currently inventoried infested acres are associated with human-caused disturbance such as travel routes. Because they are common to infestations at all potential priority levels, spread vectors such as trailheads, roadways, campgrounds, and parking areas are not explicitly considered when setting priorities.

Table 2-5. District treatment response priorities

Priority	Description	Treatment Objective
Highest	Infestations of species new to the project area (EDRR).	Eradication of new species
Second priority	Infestations of species that occur rarely within the project area. Infestations of species that occur rarely within a given zone. Infestations that pose substantial risk of infestation to priority areas currently free of the invasive species Infestations directly adjacent to the project area	Control by suppression to reduce existing infestations and reduce or eliminate new infestations of uncommon noxious weeds.
Third priority	Infestations in or near areas that experience disturbance due to human activity, such as designated travel routes, recreation sites, emergency staging areas, and gravel pits. Infestations in or near areas that experience disturbance due to natural forces, such as those recently affected by wildfire. Infestations with the potential to spread across ownership boundaries onto lands that are not currently infested. Infestations for which treatment has a high probability of success.	Control by direct suppression. Utilize indirect suppression where practical for achieving control.
Fourth priority	Infestations in or near areas that contain desirable plant communities, such as intact native plant communities and sensitive, threatened, or endangered plant or animal habitat. Infestations of established species occurring in an otherwise uninfested area.	Control by direct suppression
Fifth priority	Infestations in habitat susceptible to invasion by and spread of invasive plants. Infestations of established invasive plants in generally infested areas. Large infestations of established invasive plants.	Control by direct suppression when possible. Emphasis placed on indirect suppression.

2.2.3.2. Adaptive Management for Using New Treatment Methods

The Proposed Action, which incorporates EDRR, contains an adaptive management strategy to deal with constantly changing invasive plant infestations (Figure 2-1). An adaptive management strategy offers the means to describe and evaluate the consequences of changing or new invasive plant infestations and new treatment options. Provided that the results of treating new infestations and the impacts of new treatment methods remain within the effects described, the

results of this analysis remain valid. The adaptive management strategy consists of 3 principle components; 2 are described below (and the third, monitoring, is detailed in Appendix B):

- Map and inventory all new sites and apply appropriate design criteria to any invasive plant treatment.
- Consider new technology, biological controls, herbicide formulations, supplemental labels, and adjuvants when their use would be consistent with, or less than, the effects of those technologies, controls, formulations, labels, and adjuvants analyzed in this process. The adaptive management strategy allows incorporating these new treatment methods if they meet the following criteria:
    - An herbicide must have an EPA-approved herbicide label.
    - An herbicide must have a risk assessment completed by the Natural Resources Conservation Service (NRCS); USDA Agriculture Research Station (ARS); EPA; USDA Forest Service; BLM, or other federal land management agency.
    - New biological agents must be follow APHIS and the State of Idaho regulations prior to their introduction and redistribution. Restrictions by these regulating agencies provide guidance that an agent is determined to be detrimental to the target plants while at the same time being virtually harmless to native or desirable nonnative plants. A FSH 1909.15, Section 18.4, review of the BNF and SNF Invasive Plant Treatment FEIS would be conducted to determine if the effects of the new herbicide and/or biological agent are consistent with those identified in the FEIS effects analysis. If the effects are not consistent, the herbicide would not be used until a new environmental analysis is completed.
    - ESA Section 7 consultation will be completed prior to the use of new herbicides and/or biological agents. Forests will check any existing Biological Opinion terms that may be in place.

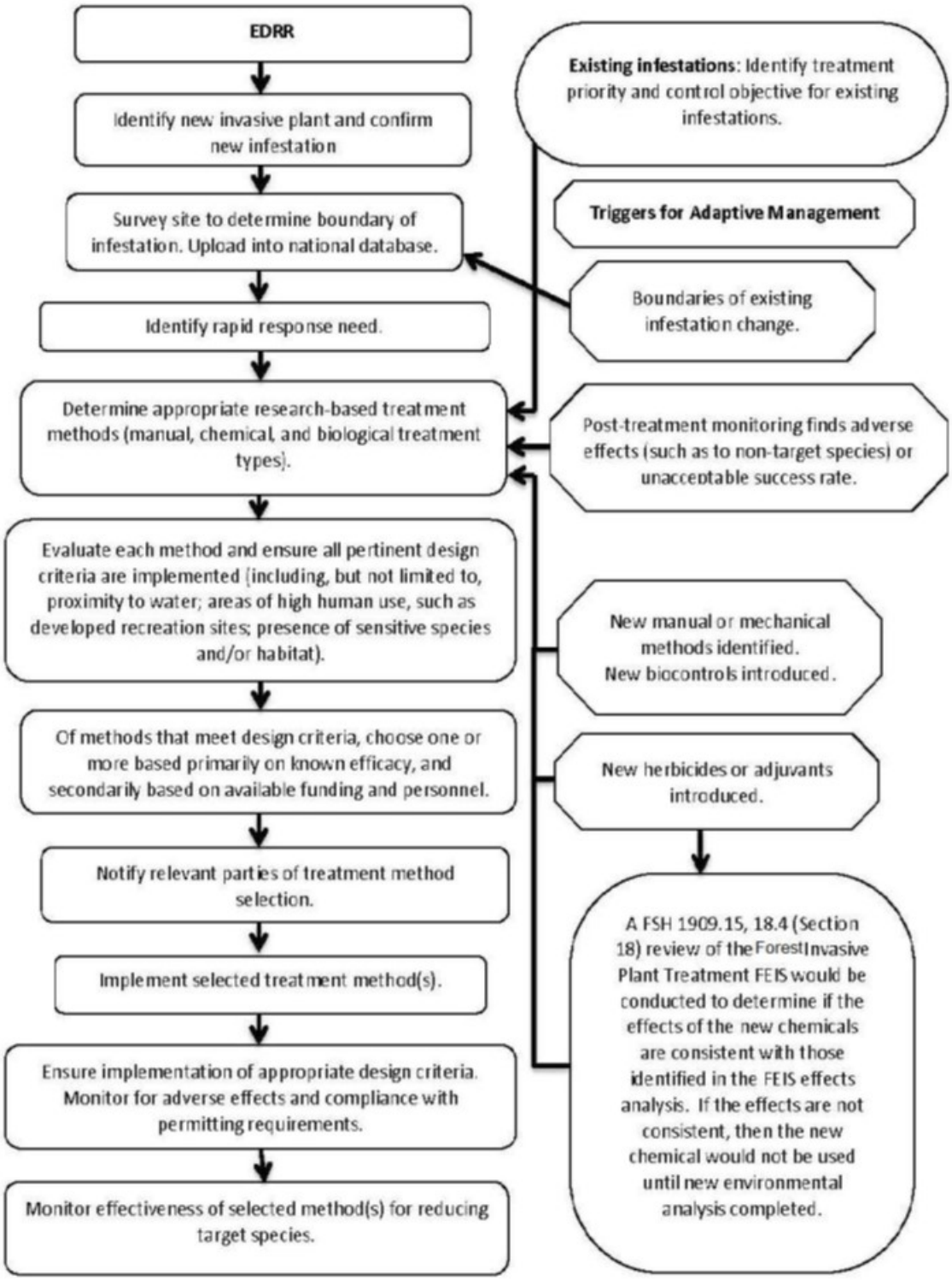

Figure 2-1. Adaptive management decision tree

2.2.3.3. Biocontrol Treatments

Biocontrol is the use of plant predators or pathogens to weaken and reduce the ability of an invasive plant species to compete and/or reproduce. Biocontrol agents typically include host-specific insects, mites, nematodes, and pathogens of a targeted plant species.

Biocontrol agents are often used in conjunction with other management actions when the target species occupies extensive portions of the landscape and other methods of control are prohibitive based on cost and location. Biocontrol is the preferred method in remote areas where access is limited, on extensive populations where other control methods may not be appropriate, on species where biocontrol agents are available and have been shown effective, and in conjunction with other control methods to reduce density of the target species. The objective is not to eradicate the target species but to reduce target plant densities to tolerable levels, allowing desired plant species to compete for space, water, and nutrients.

Invasive plants are often able to overwhelm native plant communities and establish themselves as the dominant plant species, even on undisturbed sites in excellent condition, because most invasive plant species arrived in the United States, often as seeds, without the array of natural enemies to keep their populations in check (Westbrooks 1998). Therefore, native plants are often competitively disadvantaged compared to exotic plants because native plants have to contend with their natural enemies and foraging animals. The concept of biocontrol is to reconnect the link between invasive plants and their natural enemies and reduce negative impacts of the target weed to tolerable levels.

Classical biocontrol is the introduction of relatively few host-specific plant pests and/or pathogens where they can establish and, subsequently, reduce negative impacts from invasive plants (Van Driesche et al. 2010). Two other types of biocontrol exist: augmentative and conservation. Augmentative biocontrol is the release of large numbers of natural enemies to control a pest for a short amount of time. Conservation biocontrol is the changing of environmental conditions to aid in natural enemy survival (Coombs et al. 2003). Many factors influence the establishment of biocontrol agents targeting invasive plants (Morin et al. 2009, Van Driesche et al. 2010). While some biocontrol agents are quite mobile and readily spread to other infestations, others may have to crawl from host plant to host plant, which can slow their rate of spread. Habitat conditions must also be right to establish a population, and some agents may not survive a foreign climatic regime. Some may reproduce slowly, thereby spreading more slowly and supplemental releases may be required. Biocontrol can appear cyclic over the long term as biological control agent populations wax and wane in response to invasive plant populations, site conditions, and other factors.

APHIS and the State of Idaho have the authorities and processes to approve biocontrol agents that have been tested for host specificity. Biocontrol activities include distributing approved biocontrol agents; developing nursery sites for collection, transporting and distributing biocontrol agents; supplemental stocking of biocontrol agent populations; and monitoring for biological control immigration and establishment. Biocontrol agents are transported in containers that safely enclose the agents until release, which can be ground based or aerial. Each release is recorded as treating 5 acres for reporting purposes (USDA Forest Service 2014b).

Areas with invasive plants would continue to be inventoried and monitored to determine biocontrol agent establishment and when the released biocontrol agents distribute with the target species as its range expands. Several repeat visits may be needed during a season and over a

series of years to determine if additional releases are needed or if a different or additional agents need to be released at a site.

Biological control may require 5–10 years for agent establishment and subsequent effects to targeted invasive plants. Simultaneous increases of native or desirable vegetation may eliminate the need for additional restoration inputs; however, in some instances, additional inputs may be required to reach desired vegetation conditions.

Targeted grazing is a form of biocontrol and is another tool in the kit for constructing desirable ecosystems.Targeted grazing is the application of livestock grazing at a specified season, duration, and intensity to accomplish specific vegetation management goals. The term “targeted” refers to the specific plant or landscape that is the aim of controlled grazing practices (Launchbaugh 2006). As an example, adjacent to the SNF within the Blaine County CWMA, a targeted grazing project occurred along the 20 mile bike path corridor for 2 years. Goats were herded 30 feet of both sides of the bike path eating plants, including spotted knapweed. The goats were penned in at night. Targeted sheep and goat grazing is an effective technique, comparable to chemical and mechanical control methods for the management of deleterious invasive plants including leafy spurge, spotted knapweed, yellow starthistle, cheatgrass, saltcedar, and kudzu. Removing undesirable vegetation can be accomplished by targeted grazing and is very practical along utility easements, around parking lots, and along roadsides.

The use of biological control is common to all action alternatives.

2.2.3.3.1. Biological Treatment Design Criteria

- Refer to the International Code of Best Practices for Biological Control of Weeds (Balciunas 2000) guidelines.
- Obtain an APHIS Permit to Move Live Plant Pests, Noxious Weeds, or Soil for biological agents when they are being transported across state lines
- Do not intentionally release unapproved biological control agents
- Use only APHIS and State of Idaho/Utah-approved biological control agents
- Use appropriate Forest Service protocols for documenting releases and monitoring and share release information with the ISDA
- To the extent practicable, collect biological control agents locally or from areas with similar climatic and weather conditions, land and soil types, and cover types to maximize successful establishment
- Distribute biological control agents at the optimal season and life-cycle stage for successful short-term establishment. Distribute quantities sufficient to optimize successful short-term establishment.
- For those agents that self-disperse poorly, actively assist their distribution throughout target infestations by redistribution (collecting and moving the agent to new locations)
- Prior to treatment within designated Wilderness, put into place and follow a Minimum Requirements Analysis

- Use targeted grazing practices that have shown to be effective for treating the targeted nonnative invasive plant species
- Do not use domestic sheep or goats for targeted grazing for invasive plant treatment within bighorn sheep core herd home ranges
- Targeted grazing will not occur in riparian areas.
- Ensure invasive weeds staff coordinate with Forest/District Wildlife Biologist(s) when implementing targeted grazing within big game winter range so the timing is such that targeted plant species are more palatable than nontarget plant species.

2.2.3.4. Herbicide Application

This method involves the use of herbicides and associated adjuvants. Ground-based or aerial application of herbicides would be used based on a) treatment objective and priority of the target invasive plant species, b) accessibility, topography, and the size of treatment area, c) the expected efficiency and effectiveness of the method selected, d) the risk for spread or invasion into other locations, and e) the potential to harm priority habitats and vegetation complexes such as those associated with threatened, endangered, or sensitive species.

In all, 4 types of herbicide application would be used:

- **Spot spraying—**This method targets individual plants and the immediate areas around them. Most spot spraying is done with a backpack sprayer; however, spot spraying may also be applied using a hose from a truck-mounted or OHV-mounted tank, or tanks mounted on pack animals. This is the most common herbicide application method.
- **Hand Selective**—Includes wicking, wiping, basal bark, hack & squirt, and stem injection methods to apply herbicide directly to individual plants.
- **Broadcast—**Herbicide is applied to cover an area of ground rather than individual plants. This method may employ a spray system mounted on a truck or OHV. Broadcast applications are used in areas where invasive plants occupy a large percentage of plant cover on the site, making spot spraying impractical.
- **Aquatic application—**This application method would be used in response to EDRR associated with aquatic invasive plant species. This method may employ spot or broadcast spray over the surface of or into water. Application methods may be from shore using backpacks, truck-mounted or OHV-mounted tanks, or from boats.
- **Aerial application—**This method would be used in areas (outside of designated wilderness and designated municipal watersheds) where physical features, such as topography, restricted access, size and/or rate of spread of infestation, personnel safety, or other factors (such as prohibitive unit cost of ground application) occur. Invasive plants would be treated with herbicides through the use of helicopters.

Herbicide formulations and mixtures could contain 1 or more of the active ingredients displayed in Table 2-6. The range of application rates for each chemical is derived from Human Health and Ecological Risk Assessments and from the herbicide label. Additional herbicides may be added in the future, at either the Forest Plan or project level, through appropriate risk analysis, NEPA procedures, and ESA consultation (discussed in the adaptive management section).

Table 2-6. Herbicides and application settings currently used and proposed for use, Boise and Sawtooth National Forests

Herbicide (Active Ingredient)	Commonly Used Brand Names[a]	Maximum Application Rate (active ingredient [ai] or acid equivalent [ae]/acre)	Typical Application Rate (lbs active ingredient [ai] or acid equivalent [ae]acre)	General Location			
				Vegetation—Away From water	Vegetation—Near Water	Aerial Delivery	Aquatic (In Water)
2,4-D amine	Amine 4, Weedar® 64	2.0 lb ae/acre/app 4.0 lb/ae/acre/year	1.0–2.0 lb ae/ac	X	X		
Aminopyralid	Milestone®	0.11 lb ae/acre/year	0.078–0.11 lb ae/ac	X	X	X	
Chlorsulfuron	Telar®	0.02 product/acre/year (0.12. lb ai/acre/year)	0.01–0.02 lb ai/ac	X	X	X	
Clopyralid	Transline®	0.5 lb ae/acre/year	0.1–0.5 lb ae/ac	X	X	X	
Dicamba	Banvel®	1.0 lb ai/acre/app 2.0 lb ai/acre/year	0.5–2.0 lb ai/ac	X			
Fluroxypyr	Vista® XRT®, Starane®, Spotlight®	0.5 lb ae/acre/year	0.25 lb ae/ac	X			
Glyphosate	Rodeo®, Roundup®, Accord®	1.7 lb ae/acre/app 4.0 lb ae/acre/year	0.5–3.0 lb ae/ac	X	X		X
Imazapic	Plateau®	0.1875 lb ai/acre/year	0.09–0.16 lb ai/ac	X	X	X	
Imazapyr	TVC Total Vegetation Control®, Assault®, Chopper®, Arsenal®	1.5 lb ae/acre/year	1.0 lb ae/ac	X	X		X
Imazamox	Beyond®, Raptor®, Clearcast	0.5 lb ae/acre/year	0.5 lb ae/ac		X		X
Metsulfuron-methyl	Escort®	0.15 lb ai/acre/year	0.01–0.02 lb ai/ac	X	X	X	
Picloram	Tordon™	1.0 lb ai/acre/year	0.25–1.0 lb ai/ac	X		X	
Sulfometuron methyl	Oust Weed Killer® DPX 5648	0.03 – 0.281 lb ai/acre/app 0.03 – 0.38 lb ai/acre/year	(0.09–0.38 lb ai/ac)	X	X	X	
Triclopyr TEA: triethylamine salt	Element 3A®, Garlon 3A®	2.0 lb ae/acre/year	1–2.0 lb ae/ac	X	X		X

a List represents brands most commonly used although brands other than those listed may also be used

2.2.3.4.1. Herbicide Application Design Criteria

- Comply with applicable laws (Idaho Statute Title 22, Chapter 34, Idaho Administrative Code Rule 02.03.03 and the Utah Noxious Weed Control Act R68-9), Forest Service policy and guidelines (FSH 2109 and FSM 2150), ESA Section 7 consultation requirements, National Pollutant Discharge Elimination System (NPDES) permit requirements, and product label directions (for the herbicide being used) when applying herbicides to ensure worker safety and avoid potential impacts of herbicide application.
- Read and follow label directions, including instructions for herbicide use, application rates, equipment and techniques, personal protective equipment for applicators and mixers, and container disposal.
- Have program managers ensure proper permitting is in place prior to implementation
- Make product labels, Safety Data Sheets, safety plans, spill prevention plans, and cleanup kits available to applicators and mixers, per the requirements of FSH 2109.
- Keep accurate and detailed application records, per ISDA Rules Governing Pesticide and Chemigation Use and Application; Utah Pesticides Control Act—Rule R317-8; Utah Pollutant Discharge Elimination System (UPDES); and EPA requirements identified in the NPDES.
- Perform herbicide applications by or under the direct supervision of a licensed professional herbicide applicators for forest and contract crews, as per Idaho Department of Agriculture Rules Governing Pesticide and Chemigation Use and Application, and the Utah Pesticides Control Act
- Ensure that contracts and agreements include all of these design criteria as a minimum.
- Monitor wind speed and direction and equipment and spray parameters throughout an herbicide application. Do not apply herbicide in sustained wind conditions exceeding 5 mph in riparian areas or in any wind conditions exceeding product label directions.
- Conduct equipment and personnel inspections and equipment maintenance and equipment calibration, as needed, to ensure proper herbicide application and to meet regulatory requirements. Make repairs and replace parts promptly.
- Transport only the quantity of herbicide and adjuvants needed for a project. Transport secured containers in such a way as to prevent the likelihood of spills and make periodic checks enroute to help avoid spillage. When supplies need to be transported over water by boat, raft, or other watercraft, carry herbicides and adjuvants in watertight, floatable containers.
- Use practical measures to restrict access to herbicides and adjuvants and spray equipment by unauthorized personnel when out in the field.
- Use off-highway vehicles (OHVs) used to transport or spray herbicides, which are administratively allowed to travel off designated motorized routes. Do not take these vehicles off designated routes if damage to soils could occur due to wet conditions. Take care to ensure that disturbance to desirable vegetation is minimized and no visible “trail” creation occurs.

- Follow the procedures in the BNF and SNF Spill Plan (available in the project record) in the event of a spill. The BNF and SNF Spill Plan will be compliant with NPDES.
- Use indicator dye in the herbicide mix to visually ensure uniform coverage and minimize overlapped or skipped areas and treatment of nontarget areas.
- Use treatment methods that minimize potential exposure to the public within areas of special concern, such as developed recreation, trailheads, campsites, and other high human areas.
- Use low pressure and larger droplet sizes to the extent possible, with the equipment being used, to minimize herbicide drift during broadcast operations. Use nozzles designed for herbicide application.
- Water used for mixing will be obtained prior to going into the field. Water may be transported via back-pack sprayers, saddle tanks, or portable containers to mixing site in the back country locations. Where herbicides are mixed, mixing/filling, storing of sprayers will not occur within 100 feet of live water. Mixing/filling will be limited to locations where drainage will not allow runoff or spills to move into live water, and in locations where potential contamination of ground water will not occur.
- Provide herbicide "awareness" information to forest users as opportunities arise. Sign treatment areas prior to herbicide application within areas of special concern, such as trailheads, campsites, and other high-use areas. Make information available to the public at the local RD office regarding where and when spraying and other treatments will occur. Forest Service and other web sites may also be used for public notification.
- Make grazing permittees aware of annual treatment actions at the permittee annual operating instruction meetings and/or, if requested, notify them in advance of spray dates.
- Follow label directions and other information sources when applying herbicides to the target species during phenological stages of plant development which optimize target control.
- To the extent practicable, apply herbicides to infestations containing biological control agents at times when the effects of herbicides to the host plants will not interfere with the agent’s life cycle.
- Use a spray pattern that avoids applying herbicide to nontarget species.

Fisheries/Water

- Applicators are required to use more risk-averse application methods in sites that are close to stream channels. Key provisions include using the least toxic chemicals to aquatic resources near water, and more precise herbicide application methods in stream side areas, such as wicking, wiping, or hand spraying with a single nozzle. For example;
- No broadcast application methods are used in riparian areas and broadcast application is used no closer than 100 feet to open water and a 15-foot buffer will apply for spot applications along all flowing water streams and ponded water bodies for those herbicides not labeled for aquatic or streamside application as per guidelines in Appendix G, Table 1).

- Dyes will be used in riparian areas to provide visual evidence of treated vegetation. Water-soluble colorants, such as Hi-Light blue dye, will be used within 100 feet of water and other situation as needed to enable applicators and inspectors to properly apply herbicides.
- Fuel storage and/or refueling will not occur within RCAs. Engine and hydraulic fluids will be monitored for leaks.
- All equipment used for treatments will be cleaned of external oil, grease, dirt and mud, and leaks repaired, before entering areas that drain directly to streams or wetlands. Spill packs will also be on hand for minor leaks/spills.
- No chemical herbicides will be used within a 100-foot radius of any potable water spring development
- For listed fish species, treatment areas will be identified on maps available at the Unit offices. The herbicides used, dates of use, and name and phone number to contact for more information will also be available.

Sensitive Plant Species

- Evaluate sites considered for herbicide treatment for sensitive plant habitat suitability. Survey suitable habitat, as necessary, prior to treatment. The need for field surveys in suitable habitat is based on factors such as plant phenology at the time of treatment and species' susceptibility to the herbicide(s) being used.
- Give preference to mechanical treatment, individual plant treatment (e.g., wiping), or spot herbicide application when treating invasive plant infestations associated with sensitive plant populations.
- Assign a 300-foot no-spray zone for all herbicides applied by broadcast-type spray equipment (e.g., vehicle or helicopter-mounted booms or boomless sprayers) for identified sensitive plant populations.

Sensitive Wildlife Species

- Use herbicides of low toxicity to wildlife where feasible (i.e., Hazard Quotient [HQ][4] less than 1.0; see wildlife technical report in the project record for more details).
- Arrange meetings between Invasive Weeds staff and District and/or Forest Biologists annually, prior to treatments, to discuss the upcoming season's treatment objectives and emphasis areas, share any potential resource concerns, and identify any necessary field reviews or additional site-specific mitigation. Planned treatment areas will be mapped by Invasive Weeds Staff in advance and provided to District Wildlife Biologists to identify appropriate spatial and seasonal buffers for treatments near occupied TEPCS species nests or TEPCS species den sites during breeding seasons.

[4] The Hazard Quotient is the amount of herbicide or additives to which an organism may be exposed over a specified period divided by that estimated daily exposure level at which no adverse health effects are likely to occur. An HQ less than or equal to one indicates an extremely low level of risk; therefore, an HQ less than or equal to one is presumed to indicate a level of exposure below the level of concern (LOC) for adverse health effects.

- Comply with appropriate recommendations for avoiding disturbance to nesting bald and golden eagles per the National Bald Eagle Management Guidelines (USFWS 2007):
    - Maintain a 330-foot buffer around active nests from February 1 to August 15 for nonmotorized methods of application (backpack spot spraying)
    - Maintain a 1,320-foot buffer (horizontal and vertical) around active nests from February 1 to August 15 for aerial application
    - Maintain a 660-foot buffer around active nests from February 1 to August 15 for motorized application (ATVs, UTVs, vehicles)
- Do not conduct invasive plant treatments within 330 feet of occupied yellow-billed cuckoo nest sites from June 1 to August 30 (Hughes 2015) during the breeding season.
- Do not use sheep or goats for targeted grazing for invasive plant treatment within bighorn sheep core herd home ranges.
- Ensure Invasive Weeds staff coordinate with Forest/District Wildlife Biologist(s) when implementing targeted grazing within big game winter range, to occur when targeted plant species are more palatable than nontarget plant species.
- Do not use glyphosate formulations that include the adjuvant R-11® (alkylphenol ethoxylate-based spreader).
- To reduce risk to amphibians, do not use formulations with the adjuvant polyoxyethyleneamine (POEA) in Riparian Conservation Areas (RCAs)[5].
- If any active bird nests are discovered during treatment activities, crews will move away to minimize further disturbance and avoid spraying the nest directly.
- Do not broadcast spray dicamba or triclopyr TEA in greater than 0.5 contiguous acres per application.

Northern Idaho Ground Squirrel

- Allocate a buffer for excluding the use of 2,4-D, picloram, and Triclopyr TEA near occupied northern Idaho ground squirrel habitat on a site-by-site basis. Buffer will be determined based on current and projected habitat use, including projected immigration/emigration patterns.
- Only spot treat vegetation in occupied northern Idaho ground squirrel habitat (do not aerially or broadcast spray) to avoid impacting important food sources.
- Use herbicides when northern Idaho ground squirrels are underground in the early spring, inactive during the day, or in hibernacula, when possible.

[5] RCAs referred to in this document are delineated using guidance outlined in the Sawtooth and Boise Forest Plans.

Greater Sage-grouse

- Coordinate with District/Forest Wildlife Biologist(s) and state wildlife management agencies prior to conducting aerial or surface-based herbicide treatments to identify active[6] sage-grouse leks.
- Do not apply surface-based herbicide treatments within 1.2 miles from the perimeter of an active lek during lekking (March 1–April 30). If treatments are necessary within this buffer, coordinate with the District/Forest Wildlife Biologist(s) to allow backpack applications along existing Motor Vehicle Use Map (MVUM) and designated trail routes that avoid/minimize disturbance to lekking activities.
- Do not apply aerial herbicide treatments within 3.1 miles of the perimeter of active leks during breeding and nesting (March 1–June 15). Aerial treatments may only occur at a distance closer to the active lek during the breeding and nesting period (March 1–June 15) if determined to not negatively affect or disturb sage-grouse (e.g., unsuitable or unoccupied habitat) and to also provide a conservation benefit to sage-grouse. Such an incidence would require evaluation and documentation by the Forest/District Wildlife Biologist and be placed in the project record.

Pygmy Rabbit

- Do not use the herbicides 2,4-D, picloram, or triclopyr TEA within 0.7 mile of occupied pygmy rabbit habitats (Sanchez and Rachlow 2008).
- Where feasible, spot treat vegetation in occupied pygmy rabbit habitat, rather than broadcast spraying, to avoid impacting important food sources.

Aerial Herbicide Application

- Following the Aerial Herbicide Application Coordination and Safety Implementation Plan (project record).
- Provide a minimum buffer of 300 feet for aerial herbicide application around developed campgrounds and private land (unless otherwise authorized by adjacent private landowners).
- Apply a 300-foot, no-aerial application herbicide buffer around all live water (perennial streams, flowing intermittent streams, lakes, ponds, springs, and wetlands).
- Do not apply aerial herbicide treatments in designated municipal watersheds. Idaho/Utah DEQ Source Protection Areas would not be included in aerial application project areas.
- Do not aerially apply herbicide in Research Natural Areas (RNAs) or Designated Wilderness areas. Do not aerially apply herbicides within 0.25 miles of a Designated Wild and Scenic River (includes the Recreation classification) and rivers determined to be eligible for inclusion in the Wild and Scenic River System.
- Do not aerially apply herbicide treatments over areas with >30% live tree canopy cover.

[6] Definition of “active” lek: any lek that has been attended by the male greater sage-grouse during the most recent strutting season.

- Do not aerially apply herbicide treatments over whitebark pine stands.
- Do not aerially apply herbicide treatments when sustained wind speeds exceed 5 mph or label recommendations, whichever is less.
- Do not aerially apply herbicide treatments during inversions, or below minimum relative humidity, or above maximum temperature, as stated on label.
- Obtain a weather forecast for the area prior to initiating a spraying project to ensure no extreme precipitation or wind events were predicted to occur during or immediately after spraying that could allow runoff or drift into water bodies.
- Consider the extent of the invasive plant infestation, cumulative size of the infestation (many small sites in close relative proximity of each other), and density of the invasive species when choosing sites for aerial application.
- Treat aerial treatment areas recurrently on a 2- or 3-year rotation to ensure effective control. Monitoring will show which areas would need to be re-treated or if treatment areas can be reduced based on effectiveness of previous treatment.
- Conduct public notification through press releases in local newspapers and social media and websites that identify the potential treatment windows for specific areas. Perform signing and on-site layout 1–2 weeks prior to actual aerial treatment.
- Use temporary area, trail, and road closures to ensure public safety during aerial spray operations.
- Notify grazing permittees that aerial application will be conducted and of the specific time frames in which treatment will occur to allow the option to remove grazing animals from the area.
- Identify aerial spray units (and perennial seeps, ponds, springs, and wetlands in proposed aerial units) prior to spraying to ensure only appropriate portions of the unit are aerially treated. Use a GPS system in spray helicopters and map each treatment unit before the flight to ensure that only areas marked for treatment are treated. Place drift monitoring cards out to 300 feet from and perpendicular to perennial streams to monitor herbicide presence.

Aquatic Herbicide Application

- Allow herbicide applications by or under the direct supervision of licensed Idaho professional herbicide applicators with Aquatic Pest Control certifications.
- Do not apply aquatic herbicide applications aerially.
- Use only aquatic-approved adjuvant when the product label recommends its use.
- Evaluate the infested site to determine the best control method, including a) location, number and extent of infestations; b) depth, flow, substrate, water quality and configuration of the water body involved; c) density and diversity of native flora; and d) direct and indirect effects to native flora and fauna and to people (e.g., domestic water use).

- Do not treat the entire water body at one time. Treat only one-third to one-half of any water body at any one time to prevent fish kills caused by dissolved oxygen depletion and to allow fish freedom to move to untreated areas. Apply herbicides during the spring when water temperatures are cooler and dissolved oxygen levels are higher. Apply in early spring when weeds are small and not well established, and when fewer weeds are present to decompose.
- Do not treat using aquatic herbicides within 1.0 mile upstream of an active potable water intake in flowing water, or within 1.0 mile of an active potable water intake in a standing body of water (lake or pond).
- Follow all label restrictions when treating near irrigation ditches/canals, intakes or irrigation reservoirs.
- Consider whether adequate control can be achieved by limiting applications to areas with the highest risk as vectors, such as boat ramps. If necessary to treat an entire body of water, use labeling to determine what proportion of water body may be treated at one time without causing excessive oxygen depletion from decaying plant matter. In order to protect fish and other aquatic species, treat only one-third to one-half of any waterbody at any one time to prevent fish kills caused by dissolved oxygen depletion and to allow fish to move to untreated areas.
- For submerged invasive plants, use herbicide labeled for submerged vegetation. Prefer spot-spraying techniques when applying herbicides to emergent vegetation.Notify the public of dates and type of treatment and duration of closure period.
- Follow the applicable sections of Idaho's Aquatic Nuisance Species Plan (IISC and ISDA 2007) in the event of a detection of an aquatic nuisance plant species.
- Follow steps as outlined in the *Aquatic Invasive Plan Control Framework Strategy* (Framework Strategy; Appendix F)

Wilderness

- Conduct a "Minimum Requirements Decision Guide" (MRDG) analysis annually to determine if administrative actions to treat invasive plants within Wilderness should be approved. If approved, follow the requirements outlined in the MRDG for treatment methods.

2.2.3.5. Rehabilitation and Restoration

Severely damaged treatment sites or sites at which few desirable species remain may not be able to recover without intervention. Rehabilitation and restoration are vital components of a treatment program. Rehabilitation is defined as short-term mitigation to ensure minimum site stability and functionality. Rehabilitation may include site preparation and seeding of desirable vegetation when passive restoration is not likely to be successful. Rehabilitation and restoration activities are limited to 25 acres per project.

2.2.3.5.1. Rehabilitation and Restoration Design Criteria

- Assess invasive plant-infested sites or areas of disturbance (e.g. wildfire) to determine if the area is capable of natural recovery after weed control treatments; natural revegetation is the preferred option whenever possible. Determine what mix of desirable or native grass and forb plants still occur on the site and if they are numerous and vigorous enough to be capable of spreading vegetatively or via seed production.
- Assess erosion processes that may be affecting the site and the degree of severity of any soil erosion.
- Consider the most effective, practical, and suitable means of providing rehabilitative or restorative measures, whether eliminating sources of disturbance other than invasive plants or taking actions such as seeding and/or mulching.
- Consider the need to control invasive annual grasses, such as cheatgrass, and forbs (e.g., annual mustards) that are known to compete aggressively with perennial seedlings trying to become established.
- Determine whether additional assistive measures, such as cover crops, hydraulic mulches, and mycorrhizal inoculums, may be required.
- Follow the guidance for revegetation in FSM 2070—Vegetation Ecology
- Use native plants in rehabilitation and restoration where practicable.
- If nonnative species are determined to be the best choice for interim or permanent revegetation, select species that do not behave invasively under conditions similar to those at the site to be revegetated.
- Use only certified invasive plant-seed free seed. Consider the use of site-adapted seed, if available and practicable.
- When seeding, determine the need for site preparation and protective measures that may need to be taken to allow the seeding to establish successfully.
- Plan revegetation activities for the optimal season and site conditions for successful establishment.
- Design seed mixes, whether native or desirable species, that are adapted to site conditions (e.g., soil type, precipitation patterns, plant hardiness zones).
- Protect sites where restoration and rehabilitation treatments have been applied from grazing use through temporary fencing, livestock exclusion, or other method appropriate to the sites to allow seeded plant establishment.
- Following establishment, continue to practice proper vegetation management to maintain a healthy, functioning plant community resilient to disturbance and resistant to invasive plant reinvasion.
- Use only invasive plant seed-free mulches and other products for uses such as erosion control and improved seed germination.
- Ensure that treatment tools and other equipment are free of invasive plant seed or vegetative propagules before moving to or using on the project site.

- Minimize ground-disturbing activities to the extent possible during reseeding efforts.
- Conduct rehabilitation and restoration activities only in areas with slope gradients less than 45%.
- Conduct rehabilitation and restoration activities only in areas with low or moderate landtype erosion hazard ratings.
- Consult an archaeologist prior to initiating work to determine if an archaeological survey is needed.
- When in ESA listed waters, all ground disturbing activities will be conducted outside of spawning and rearing time periods.

2.2.3.6. Mechanical and Manual Control

Mechanical and manual treatments are typically used to remove seed heads, individual plants, or small infestations. They may be used in sensitive areas to avoid impacts to nontarget species or water quality or to prevent seed production. Mechanical and manual approaches are slow and very labor intensive; they are effective only for small infestations.

The term “manual” defines treatments such as hand pulling or using hand tools (e.g., hand clippers, hoes, rakes, shovels) to remove plants or cut off seed heads. Manual treatments can be effective for annual and some tap-rooted invasive plants but are ineffective against perennial invasive plants with deep underground stems or roots or fine rhizomes that can be easily broken and left behind to resprout. This method might need to be repeated several times throughout the growing season, depending on the species. This treatment may require digging below the soil surface to remove the main root of plants.

The term “mechanical” refers to the use of equipment and power tools, including actions like mowing, torching (i.e., using a propane burner to kill invasive plants with heat), and weed whipping. Choosing the appropriate power tool depends on characteristics of the target weed species (e.g., stem size or sprouting ability); density of the target species; size of the infestation; site location and condition; and soil or topographic considerations. Mechanized treatments are typically used to remove flowering stems to prevent seed production or to reduce or remove aboveground biomass. Manual and mechanical treatment methods are common to all action alternatives.

2.2.3.6.1. Mechanical and Manual Control Design Criteria

- Obtain necessary State and federal permits, when and where required.
- Prior to burning any invasive species with a torching device, complete a prescribed burn plan that is compliant with FSM 5140 and the Interagency Prescribed Fire Planning and Implementation Procedures Guide, PMS 484.
- Consult an archaeologist prior to initiating work to determine whether an archaeological survey is needed. However, incidental weed pulling would not trigger Section 106 review, as a very low probability exists it would have an adverse effect on an archaeological site.

- Minimize soil disturbance as much as possible to minimize germination of invasive plant seeds and production of bare soil.
- Avoid non-target species damage to the extent practicable. Select mechanical methods to effectively control the target species (e.g., grubbing/hoeing is inappropriate for rhizomatous species and may increase the density of the invasive plant population as root fragments sprout and become new plants).
- Apply mechanical treatments at the proper stage of plant growth when treatment will be most effective at controlling the target invasive plant.
- Thoroughly inspect and clean all equipment and clothing to remove invasive plant seeds or vegetative propagules to prevent the movement of the invasive plant to another site.
- To the extent practicable, clip and remove seed stalks prior to seed maturity to reduce inputs to the seed bank or to prevent seeds from being easily picked up and transported by vectors such as wind, humans, or animals. A 25-foot vegetative buffer next to live water to leave ground cover intact and prevent erosion into streams or adjacent waterbodies. For ESA listed waters, a site review will be completed by the appropriate resource specialists to prescribe mitigations necessary to minimize effects on ESA-listed species/habitats to an insignificant level.
- All weeds that are mechanically or hand excavated after bud stage will be bagged and properly disposed.
- Treatments in RCAs will be accomplished by hand or with hand tools.
- A 25-foot vegetative buffer next to live water to leave ground cover intact and prevent erosion into streams or adjacent waterbodies.
- Specific to aquatic invasive plants, use hand-pulling and/or smothering when an infestation is very limited in extent and occurs close to the shoreline of a waterbody and has not yet infested deeper waters.

2.2.3.7. Monitoring

Monitoring is an integral part of any adaptive, IWM program. Monitoring addresses EDRR and treatment, informing future decision-making and strategy. Both quantitative and qualitative monitoring efforts are included in the overall monitoring program. Post-treatment reviews of monitoring data would occur on a sample basis to determine whether treatments were effective, the type and extent of damage which may have occurred to nontarget species, whether design criteria were applied correctly, and if recovery occurred as expected.

Re-treatment and active rehabilitation or restoration prescriptions would be developed as needed based on post-treatment results. Changes in treatment methods would occur based on effectiveness of treating the invasive plant infestations. For example, an invasive plant population treated with a broadcast herbicide may be re-treated with a spot spray or hand-pulled, once the size of the infestation and density of the seed bank are reduced. The detailed monitoring plan (Appendix E) is common to all action alternatives.

2.2.4. Alternative 4—No Aerial Herbicide Application

This alternative is identical to the Proposed Action alternative with the exception that no aerial application of herbicides would occur. Instead, all treatments would be ground-based. This alterantive could treat a maximum of 19,000 acres per Forest per year. All other treatment methods and acres would remain the same as in Alternative 3. All design criteria, except those specific to aerial application, would apply to this alternative.

Table 2-7. Maximum acres treated annually, per Forest by treatment method

Treatment Method	Boise National Forest	Sawtooth National Forest
Routine Annual Program of Work		
Biological Treatment	2,000	2,000
Mechanical Treatment	2,000	2,000
Herbicide Treatment (Ground Treatment Only)	16,000	16,000
Aquatic Application	Known to be Present State of Idaho currently managing the infestation	Unknown; No currently documented infestations
Post Wildfire Treatment—Up to 5 Years Post-fire		
Herbicide Treatment (Groun Treatment Only	20,000	20,000

2.2.5. Alternative 5—No Aquatic Herbicide Application

This alternative is identical to the Proposed Action alternative with the exception that no aquatic application of herbicides would occur. All design criteria, except those specific to aquatic herbicide application, would apply to this alternative.

2.2.6. Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the Purpose and Need. Some of these alternatives may have been outside the scope of invasive plant treatment, duplicative of the alternatives considered in detail, or determined to be components that would cause unnecessary environmental harm. Therefore, a number of alternatives were considered but dismissed from detailed consideration for the reasons summarized below.

2.2.6.1. Ecosystem Resilience

This alternative concentrates on preventing conditions that favor exotic and invasive vegetation problems and restoring ecological integrity. The alternative identifies site selection and treatment priorities; prevention vegetation treatments by land use activity; restoration vegetation treatments by land use activities; eliminating or reducing specific land use activities to prevent the spread of invasive plants; revegetation; monitoring and evaluation; and coordination, education, and public awareness. Many of the suggestions are included in the DEIS and analysis treatment

prioritization criteria, treatment methods and design criteria, restoration methods and design criteria, and implementation and effectiveness monitoring.

Many of the active and passive restoration actions suggested involved programs and activities beyond the treatment of invasive plants. This alternative was not analyzed in detail because making changes to land use, Forest Plan direction, travel management, and permitted activities on the BNF and SNF are outside the scope of this analysis.

2.2.6.2. No Herbicide

Some commenters believe herbicides may present risks to humans, wildlife, and native vegetation. Although herbicides proposed for invasive plant control in the Proposed Action have gone through rigorous scientific testing and government approval, some commenters perceived use of these herbicides as unsafe. The No Herbicide Alternative differs from the No Action Alternative (Alternative 1) because the No Action Alternative allows for no mechanical or biocontrol treatment of invasive plants.

For several noxious weeds found on the BNF and SNF, no effective mechanical and/or biological controls are available (Table 2-1). Other areas have extensive infestations where mechanical treatment is not physically possible. The cost of mechanical treatments, such as hand-pulling or mowing, would be prohibitively expensive, and not enough acres could be treated to address the Purpose and Need. A ‘No Herbicide’ Alternative does not comply with the Agency’s Integrated Pest Management direction and is not consistent with regulations that noxious weeds be managed on NFS lands.

2.3. Comparison of Alternatives

Table 2-8 shows the difference of treatment methods and acres treated between alternatives. Measurement indicators specific to different resources are discussed in Chapter 3.

Table 2-8. Invasive plant treatment, comparison by alternative

Treatment		Alt. 1 No Action	Alt. 2 Current Management	Alt. 3 Proposed Action	Alt. 4 No Aerial Herbicide Application	Alt. 5 No Aquatic Herbicide Application
Project area proposed for annual treated acres (%)		0	Not specified	0.5	0.2	0.5
Project area proposed for annual applied acres (%)		0	Not specified	0.4	0.1	0.4
Treatment Method [a]						
Biocontrol		No	Yes	Yes	Yes	Yes
Treated Acres per Forest		0	14 / 548[a]	2,000[b]	2,000[b]	2,000[b]
Number of Releases		0	80	400	400	400
Mechanical/Manual		No	Yes	Yes	Yes	Yes
Treated Acres per Forest		0	23 / 163[a]	2,000[b]	2,000[b]	2,000[b]
Herbicide		No	Yes	Yes	Yes	Yes
Ground Application	Per Forest	**No**	**Yes**	**Yes**	**Yes**	**Yes**
	Treated Acres	0	9540 / 4975[a]	8,000[b]	16,000[b]	8,000[b]
	Applied Acres	0	3816 / 1990[c]	3,200[c]	6,400[c]	3,200[c]
Aerial Application [e]	Per Forest	**No**	**No**	**Yes**	**No**	**Yes**
	Treated Acres	0	0	8,000[b]	0	8,000[b]
	Applied Acres	0	0	8,000[c]	0	8,000[c]
Aquatic Application	Per Forest	**No**	**No**	**Yes**	**Yes**	**No**
	Applied Acres	0	0	TBD	TBD	0
Total Herbicide Treated Acres per Forest		0	9540 / 4975[a]	16,000[b]	16,000[b]	16,000[b]
Total Herbicide Applied Acres per Forest		0	3816 / 1990[c]	12,400[c]	6,400[c]	12,400[c]
# of Herbicides		0	12	14	14	14
Total Acres Treated per Forest Annual Program of Work (all treatment types)		**0**	**9577 / 5686[a]**	**20,000[b]**	**20,000[b]**	**20,000[b]**
Total Additional Acres Potentially Treated per Forest if Impacted by Wildfire [d]		**0**	**0**	**20,000** Ground Treatment – 5,000 Aerial Treatment – 15,000	**5,000** Ground Treatment only	**20,000** Ground Treatment – 5,000 Aerial Treatment – 15,000
Total Acres Annual Program of Work plus post-Wildfire Treatments		**0**	**0**	**40,000**	**40,000**	**40,000**

[a] Boise and Sawtooth 3-year average treatment (2012-2014).
[b] Represents the maximum annual amount.
[c] How acres derived: Ground application=broadcast and spot application (assume 40% of treated area has herbicide applied). Aerial application=broadcast application; treated acres=applied acres (assume 100% of treated area has herbicide applied).
[d] The Proposed Action identifies an annual program of work with treatments of up to 20,000 acres of invasive plants annually outside of areas burned by wildfire on each Forest.
[e] Any portion of the applied aerial acres not utilized could be used for applied ground acres (3,200)

2.3.1. Comparison of Issues by Alternative

Table 2-9, Table 2-10, Table 2-11, Table 2-12, and Table 2-13 compare the alternatives by issues.

Table 2-9. Comparison of alternatives by soil, water, riparian and fisheries issues

Measurement Indicator	Alt. 1 (No Action)	Alt. 2 (Current Management)	Alt. 3 (Proposed Action)	Alt. 4 (No Aerial)	Alt. 5 (No Aquatic)
Risk of Impacts to Soil Biota	**Decreased abundance** of soil microbes	**Short term adverse** impacts to soil microbes from herbicide application to small percentage of soils on watershed scale; **Long term beneficial effects**	**Short term adverse** impacts to soil microbes from herbicide application to small percentage of soils on watershed scale; **Long term beneficial effects**	**Short term adverse** impacts to soil microbes from herbicide application to small percentage of soils on watershed scale; **Long term beneficial effects**	**Short term adverse** impacts to soil microbes from herbicide application to small percentage of soils on watershed scale; **Long term beneficial effects**
Risk of Increased Soil Erosion	**Moderate to high increase** after 5 years	**Minimal localized short term ground disturbance** to small percentage of soils on watershed scale	**Minimal localized short term ground disturbance** to small percentage of soils on watershed scale (<2000 acres across 4.3 million acres)	**Minimal localized short term ground disturbance** to small percentage of soils on watershed scale (<2000 acres across 4.3 million acres)	**Minimal localized short term ground disturbance** to small percentage of soils on watershed scale (<2000 acres across 4.3 million acres)
Instream Sediment Load	**Moderate to high increase** (29%-52%) after 5 years **High increase** (46%-153%) after 10 years	**Minimal short-term** and **slight long-term increases** in instream sediment loads	**Minimal short term increases** in instream sediment loads and localized short term impairment of soil condition as a result of invasive plant treatments. However, long term effects resulting from control of invasive plant infestations would be beneficial, with gradual **long term decreases** in instream sediment loads	**Minimal short-term increases** in instream sediment loads and localized short-term impairment of soil condition as a result of invasive plant treatments. Long-term effects resulting from control of invasive plant infestations could include possible slight **long-term increases** in instream sediment loads,	**Minimal short term increases** in instream sediment loads and localized short term impairment of soil condition as a result of invasive plant treatments. However, long term effects resulting from control of invasive plant infestations would be beneficial, with gradual **long term decreases** in instream sediment loads

Measurement Indicator	Alt. 1 (No Action)	Alt. 2 (Current Management)	Alt. 3 (Proposed Action)	Alt. 4 (No Aerial)	Alt. 5 (No Aquatic)
Herbicide Concentrations in Water	No effect	Minimal	Minimal	Minimal	Minimal
Riparian Function	**No direct effect/ Indirectly,** loss of native riparian vegetation to **impair** riparian function	Minimal Direct effect/ Indirect Gradual **long-term decline** in riparian function	Minimal Direct effect/ Indirect Gradual **long-term improvement** in riparian function	Minimal Direct effect/ Indirect **Long term improvement** in riparian function	Minimal Direct effect/ Indirect **Long-term improvement** in riparian function
Watershed Cumulative Effects Risk	Watershed risk: 58 high risk/ 98 moderate risk and 152 low risk. Most number of watersheds at high and moderate risk Aquatic risk due to aquatic invasives: **High**	Watershed risk: 35 high risk/ 25 moderate risk 248 at low risk Same number of watersheds at high and moderate risk as in alternative 4 Aquatic risk due to aquatic invasives: **High**	Watershed risk: 20 high risk/ 15 moderate risk and 273 low risk Lowest number of watersheds at high and moderate risk Aquatic risk due to aquatic invasives: **Low**	Watershed risk: 35 high risk/ 25 moderate risk and 248 at low risk Same number of watersheds at high and moderate risk as in alternative 2 Aquatic risk due to aquatic invasives: **Low**	Watershed risk: 35 high risk/ 25 moderate risk and 273 low risk Lowest number of watersheds at high and moderate risk Aquatic risk due to aquatic invasives: **High**
Effects of herbicide to be used within riparian areas on aquatic organisms	No direct or indirect effects	No direct effects. Indirect effects possible but not likely through accidental spills	No direct effects. Indirect effects possible but not likely through accidental spills.	No direct effects. Indirect effects possible but not likely through accidental spills	No direct effects. Indirect effects possible but not likely through accidental spills
Adequacy of design criteria that apply to water quality and aquatic organisms	No direct or Indirect effects possible through increased sedimentation, loss of riparian vegetation and decreased water quality with increase in aquatic invasive species	No direct or Indirect effects possible through increased sedimentation, loss of riparian vegetation and decreased water quality with increase in aquatic invasive species	All herbicides used below level of concern for fish. Project design features in place to prevent negative effects to aquatic organisms	All herbicides used below level of concern for fish. Project design features in place to prevent negative effects to aquatic organisms	All herbicides used below level of concern for fish. Project design features in place to prevent negative effects to aquatic organisms

Table 2-10. Comparison of alternatives by wildlife issues

Measurement Indicator	Alternative 1	Alternatives 2, 3, 4, 5
Toxicity Potential of Herbicides	**No effect**	**Minimal to no adverse effects** are expected from direct exposure to, or primary or secondary ingestion of, herbicide-treated vegetation or herbicide-exposed prey animals. Design criteria would further minimize potential for effects from herbicide exposure to wildlife species.
Direct and indirect effects of invasive plant species treatment activities (disturbance)	**No effect**	**Minimal to no adverse effects** are expected from temporary and localized disturbance caused by weed treatment activities. Design criteria would further minimize potential for effects from herbicides and disturbance to wildlife species
Determinations	**No effects/impacts**	Not likely to adversely affect = 3 species Not likely to jeopardize continued existence = 1 species No impact = 5 species May impact individuals = 20 species+migratory birds

Table 2-11. Comparison of alternatives by treatment method effect on Region 4 sensitive plants issues

Measurement Indicator	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Biological Control	No direct effects	NII	NII	NII	NII
Herbicide Application	**Would reduce pollinator habitat, degrade native vegetation, and potentially impact individual special status plants and their habitats** in the short and long term.	**MIIH/BIH** Would be the **most limiting** of the action alternatives, as it proposes using fewer herbicides and treating fewer acres	**MIIH/BIH** Provides the **greatest advantage** as it allows for aerial and aquatic herbicide applications. **Herbicides would pose risks** to terrestrial special status plant species under **direct spray and off-site drift scenarios**. The greatest risks to terrestrial special status plants from off-site drift would be associated with aerial applications. However, **design criteria** have been put in place to **reduce risk and protect individual special status plants and their habitats**.	**MIIH/BIH** Qould be **less beneficial than Alternative 5**, as it prohibits aerial application of herbicide, thus preventing treatment of large and remote areas	**MIIH/BIH** Would be **more beneficial than Alternative 4**, as aerial application of herbicide allows for treating large and remote areas more effectively than ground-based application; however, the risk to nontarget species also increases. Herbicides would pose risks to terrestrial special status plant species under direct spray and off-site drift scenarios. The **greatest risks** to terrestrial special status plants from **off-site drift w**ould be associated with aerial applications. However, **design criteria** have been put in place to **reduce risk and protect individual special status**
Mechanical Control	No direct effects	**MIIH**	**MIIH**	**MIIH**	**MIIH**
Cumulative Impacts	**MIIH**	**MIIH/BIH**	**MIIH/BIH**	**MIIH/BIH**	**MIIH/BIH**

Notes: NII: No impact to individuals; MII: May impact individuals; BIH: Beneficially impact habitat; MIIH: May impact individuals and habitat.

Table 2-12. Comparison of alternatives by human health issues

Measurement Indicator	Alt. 1	Alternatives 2, 3, 4, and 5 Worker Health	Alternatives 2, 3, 4, and 5 Public Health
Toxicity Potential of Herbicides being used	N/A	Of the 14 herbicides proposed for use, 9 did not have any scenarios involving workers that exceeded the level of concern. Out of the 5 herbicides with scenarios exceeding the HQ level of concern for workers at some rate of application, 4—chlorsulfuron, dicamba, sulfometuron-methyl, and triclopyr—did not exceed any level of concern at typical application rates. However, 1—2,4-D amine—exceeded the chronic exposure level of concern at typical application rates. **Design criteria minimize all worker exposure** scenarios by following safe work practices and label advisories.	Of the 14 herbicides proposed for use, 7 did not have any scenarios involving the public that exceeded the level of concern; however, 7 herbicides exhibited scenarios exceeding the HQ level of concern at some rate of application. **Design criteria would minimize public exposure** by increasing notification of the public regarding areas with herbicide applications. The general public would not be exposed to harmful levels of any herbicides used in the implementation of this project.
Adequacy of Design Criteria to Protect Human Health	N/A	**Design criteria minimize all worker exposure** scenarios by following safe work practices and label advisories. The **general public would not be exposed** to harmful levels of any herbicides used in the implementation of this project. Few plausible scenarios exist that exceed even the most conservative threshold of concern for public health and safety.	

Table 2-13. Comparison of alternatives by wilderness issues

Measurement Indicator	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Natural Quality Measure: Number of nonnative species	Alternative 1 **would affect** the natural characteristics of wilderness by unintended consequences of modern civilization on the ecological systems through the expansion and/or establishment of invasive plants. If invasive plants are left untreated, they would reduce the amount of native plants, altering the ecology. Invasive plants can displace or hybridize with native plants and may change important natural processes. Invasive plants can change the character of the landscape.	Alternative 2 would **negatively affect** the natural characteristics because controlling invasive plants on a broad landscape-scale would not be addressed.	Alternatives 3, 4, and 5 would **preserve t**he natural characteristics of the IRAs and designated wilderness areas. The variety of treatment methods available, including aerial application (outside designated wilderness areas), would allow some measure of controlling existing invasive plant populations with respect to density and spread and could eliminate new infestations if identified early enough (EDRR). Alternative 3 would best preserve the natural characteristics because of the variety of treatment methods available, including aquatic and aerial application (outside designated wilderness areas).		

Chapter 3. Affected Environment and Environmental Effects

3.1. Introduction

This chapter describes the existing conditions of the project area by resource and the environmental effects of implementing the alternatives described in Chapter 2.

3.1.1. Herbicide Risk Assessments

Each of the resource sections that follow in Chapter 3 used herbicide risk assessments to characterize the effects of the Proposed Action and other action alternatives to the particular resource. The effects of herbicide use depend on the toxicity of the herbicide, the level of exposure to that herbicide, and the duration of that exposure. Risk assessments were used to evaluate the potential effects to non-target plants, wildlife, human health, soils, and aquatic organisms from the herbicides considered for use in the BNF and SNFs. The Forest Service contracted with Syracuse Environmental Research Associates, Inc. (SERA) to evaluate human health and ecological effects of herbicides using EPA studies and other peer-reviewed articles from the open scientific literature.

Information from laboratory and field studies of herbicide toxicity, exposure, and environmental fate was used to estimate the risk of adverse effects to non-target organisms. Table 3-1 displays the risk assessments for chemical herbicides considered in the EIS. Herbicide risk assessments are also available online at http://www.fs.fed.us/foresthealth/pesticide/risk.shtml and herbicide labels are available at an EPA maintained website: https://www.epa.gov/pesticide-labels

Table 3-1. Risk Assessments for herbicides considered for use in the Proposed Action

Herbicide (Active Ingredient)	Date Final	Risk Assessment Reference
2,4-D amine	September 30, 2006	USDA Forest Service
Aminopyralid	June 8, 2007	SERA TR-052-04-04a
Chlorsulfuron	November 21, 2004a	SERA TR 04-43-18-01c
Clopyralid	December 5, 2004c	SERA TR 04-43-17-03c
Dicamba	November 24, 2004b	SERA TR 04-43-17-06d
Fluroxypyr	June 12, 2009	SERA TR-052-13-03a
Glyphosate	March 25, 2011a	SERA TR-052-22-03b
Imazamox	December 10, 2010	SERA TR-052-24-02a
Imazapic	December 23, 2004f	SERA TR 04-43-17-04b
Imazapyr	December 16, 2011d	SERA TR-052-29-03a
Metsulfuron-methyl	December 9, 2004d	SERA TR 04-43-17-01c
Picloram	September 29, 2011c	SERA TR-052-27-03a
Sulfometuron methyl	December 14, 2004e	SERA TR 03-43-17-02c
Triclopyr: triethylamine salt (TEA)	May 24, 2011b	SERA TR-052-25-03a

In addition to the analysis of potential hazards from the active ingredients in the herbicides, the SERA Risk Assessments evaluated available scientific studies of potential hazards of other substances associated with herbicide applications, including impurities, metabolites, inert ingredients, and adjuvants. Less toxicity data are usually available for these substances

(compared to the herbicide active ingredient) because they are not subject to the extensive testing that is required for the herbicide active ingredients under the FIFRA.

3.1.1.1. Risk Characterization and Approach

Toxicity indices (thresholds) were established using either measured chronic *no observable adverse effect level* (NOAELs) or 1/20th of the acute LC_{50} (lethal concentration, 50% kill), whichever was lower. NOAEL is defined as no biologically or statistically significant adverse effects attributable to treatment: effects that are attributable to treatment but do not appear to impair the organism's ability to function and clearly do not lead to such an impairment.

The estimated dose (from the scenarios) was divided by the "toxicity index," and the result is known as the HQ. When the HQ is less than 1.0, the dose is less than the toxicity index. Potential effects from doses calculated to be below the toxicity indices are discountable. When a calculated dose was greater than the toxicity index, it was assumed a potential existed for adverse effects. This very protective approach constitutes an "extreme-case" analysis for potential effects of herbicides.

3.1.1.1.1. Herbicide Toxicology Terminology

The following terminology is used throughout this document to describe relative toxicity of herbicides proposed for use in the alternatives.

3.1.1.1.2. Hazard Quotient

The HQ is the amount of herbicide or additives to which an organism may be exposed over a specified period divided by that estimated daily exposure level at which no adverse health effects are likely to occur. An HQ less than or equal to 1 indicates an extremely low level of risk; therefore, an HQ less than or equal to 1 is presumed to indicate a level of exposure below the level of concern (LOC) for adverse health effects.

3.1.1.1.3. Exposure Scenario

Exposure scenarios consider the toxicity of a given chemical and the mechanism by which an organism may encounter it. The application rate and method influence whether a person, animal, or non-target plant could be adversely affected by exposure to a particular herbicide.

3.1.1.1.4. Level of Concern

The LOC is an estimate of exposure above which there may be adverse effects; in risk assessments, the LOC is defined as a HQ of more than one.

3.1.1.1.5. Risk Quotient compared to Hazard Quotient

The approach to risk characterization used by the EPA in ecological risk assessments is similar but not identical to that used by the Forest Service (SERA 2009b). The EPA/Office of Pesticide Programs (OPP) bases risk characterizations for the ecological risk assessment on a Risk Quotient (RQ). The basic algorithm for the RQ is identical to that of the HQ—a level of exposure divided by a toxicity value. Acute RQs may be calculated based on LD_{50}, LC_{50}, or EC_{50} values rather than the NOECs preferred in Forest Service risk assessments. Thus, while these RQs are similar in structure to HQs, the equations are not identical.

The 2 risk characterization methods may often be identical and balanced by differences in how the Forest Service and the EPA define the LOC. Forest Service risk assessments always use a LOC of 1. In other words, and as in the human health risk assessment, an HQ of greater than 1 indicates the exposure is greater than the No Observed Adverse Effect Concentration (NOAEC), which raises concern that an adverse effect might be possible. The EPA/OPP uses a variable LOC. For example, if an RQ is based on an LC50 or EC_{50} value in aquatic species, the LOC is 0.5 for acute risk, 0.1 for acute restricted use, and 0.05 for endangered species.

Forest Service risk assessments may use LD_{50}, LC_{50}, and other similar values to approximate an NOAEC by multiplying the lethality value by the corresponding LOC used by the EPA/OPP for endangered species. Mathematically, this is equivalent to dividing the lethality value by an uncertainty factor (i.e., an uncertainty factors of 10 for terrestrial species and 20 for aquatic species, both of which are simply the reciprocals of the LOC values used by the EPA/OPP for these groups of organisms).

3.1.1.2. Limitations Associated with Risk Assessments

Risk assessments have a degree of uncertainty in interpretation and extrapolation of data. Uncertainty may result from a study design, questions asked, data collection, data interpretation, and extreme variability associated with aggregate effects of natural and synthesized chemicals on organisms, including humans, and with ecological relationships. Numbers used, particularly in ecological realms, are uncertain, and there are limits on our ability to understand or demonstrate causal relationships. Because of data gaps, assessments rely heavily on extrapolation from laboratory animal tests (USDA Forest Service 2005). Regardless of disadvantages and limitations of ecological and human health risk assessments, risk assessments can determine (given a particular set of assumptions) whether there is a basis for asserting that a particular adverse effect is plausible. The bottom line for all risk analyses is that absolute safety can never be proven and the absence of risk can never be guaranteed (SERA 2007c).

3.2. Soil and Water Resources

Soil and Water Resources Summary: The No Action Alternative would likely result in degradation of soil condition in the long term and potentially detectable increases in fine sediment loads in streams due to the uncontrolled expansion of noxious weeds across the landscape. The No Action Alternative is not consistent with Forest Plan standards, regulations, policy, and law.

Alternative 2 poses the least risk to soil microbes in the short term due to less acreage being exposed to herbicide. However, Alternative 2 would allow for more acres of noxious weeds to go untreated, leaving soil microbes exposed to the risks associated with noxious weeds in the long term. Because Alternatives 3 and 5 could treat large areas using aerial application of herbicide, in the short term these alternatives would pose risk of impacts to soil microbes in the short term. However, in the long term, eradication of invasive plant infestations and reestablishment of native vegetation would allow for the recovery of soil microbes. Alternative 4 would pose a similar risk as that seen under Alternative 3 and Alternative 5 because it allows just as many herbicide treatment acres. However, without the use of aerial application, it is unlikely that as many acres would be treated.

Alternatives 2, 3, 4, and 5 would include minor disturbances from manual/mechanical and rehabilitation/restoration treatments that could result in localized occurrences of soil loss in the short term during subsequent runoff events. These effects would be greater for Alternatives 3, 4, and 5 than Alternative 2 because of the larger number of acres that would be treated. Similar to Alternative 2, many of these treatments would occur in locations where soil productivity is already limited because of existing invasive plant infestations.

The action alternatives would be compatible with Forest Plans and other regulatory direction with respect to soil and water resources.

3.2.1. Introduction

This section describes how the alternatives address the purpose of the project to reduce the negative effects of existing and future invasive plants on soil and water resource values that may be adversely impacted. This section also addresses the issues and concerns identified during public scoping that herbicide invasive plant treatment could affect surface water and groundwater quality.

3.2.2. Methodology for Analysis

This analysis uses several sources of existing background information, described in the following paragraphs.

Best available science: Abundant scientific literature is available describing research on herbicide persistence in soil and water, the effects of various treatments on water quality and soils, and the effects of invasive plant infestations on runoff and erosion.

Herbicide Risk Assessments: Risk Assessments for each of the herbicides proposed for use in this project were produced for the USDA Forest Service by SERA. These risk assessments, listed in Table 3-1, provide detailed information on herbicide behavior, persistence, and potential

effects on soil and water, incorporating data from modeling of herbicides using the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model. The intent of the generic modeling in Forest Service risk assessments is to develop extreme values for exposure assessments that are likely to encompass levels of exposure potentially realizable in Forest Service programs (SERA 2007c).

Invasive plant control monitoring data: Monitoring data collected during implementation and monitoring of existing invasive plant control programs is a valuable source of information used to predict the effects of similar proposed treatments. More extensive studies have been conducted on aerial herbicide applications on the nearby Lolo and Bitterroot National Forests in Montana (USDA Forest Service 2010).

The State of Idaho has declared 67 nonnative, invasive aquatic and terrestrial plant species as noxious, and the State of Utah has declared 27 nonnative, invasive aquatic and terrestrial plant species as noxious (see "Sensitive Plants and Native Vegetation" section). Only a total of 26 of these legally designated noxious weeds are known to infest lands within the project area. The remaining species, however, are present elsewhere in Idaho, Utah, and neighboring states and have the potential to become established in the project area. The 2 Forests also track a number of nonnative invasive plant species that may not be listed as noxious in Idaho, Utah, or other western states, but that are recognized as causing economic or environmental harm. This analysis incorporates management activities for controlling all 67 plant species legally designated as noxious weeds by the State of Idaho, all 27 species legally designated as noxious weeds by the State of Utah, and other nonnative invasive plants causing economic or environmental harm.

Collective knowledge: Some of the information and assumptions used in this analysis are based on the collective knowledge provided by the Interdisciplinary Team (IDT), based on experience from decades of invasive plant treatment implementation.

Modeling: The effects of invasive plant treatments and herbicide applications on soil and water resources are estimated in this analysis through the following quantitative methods:

GLEAMS: The GLEAMS model is a field-scale, root zone model that describes the fate of chemicals in various soil types and climatic conditions (Leonard et al. 1987). The U.S. Department of Agriculture (USDA) developed GLEAMS, and the USDA Agricultural Research Service (ARS) maintains GLEAMS. This model is used extensively in many of this analysis' herbicide risk assessments completed prior to 2007 (SERA 2004a,b,c,d,e,f, 2006) to model estimates of herbicide concentrations in streams, ponds, and soil following herbicide application. Results of this modeling are summarized in the Effects of Herbicide Concentrations in Water, Effects Common to All Action Alternatives, Effects Analysis Section below.

Gleams-Driver: The Gleams-Driver model was developed by SERA for the USDA Forest Service as a pre-processor and post-processor for GLEAMS (SERA 2007b). Gleams-Driver prepares input files, runs the GLEAMS model, and reads and processes GLEAMS output. The Gleams-Driver model has been utilized in this analysis' risk assessments completed in 2007 and later (SERA 2007a, 2010, 2011a,b,c,d). The format of the Gleams-Driver inputs and outputs varies from the GLEAMS modeling. Results of this modeling are summarized below.

Disturbed WEPP: The Disturbed WEPP Model 2.0 is used in this analysis to model hillslope erosion related to invasive plant expansion and the proposed invasive plant treatment activities. The USDA ARS developed the Water Erosion Prediction Project (WEPP) model, and the Forest

Service developed the Disturbed WEPP model as an interface to the WEPP soil erosion model, to describe disturbed forest and rangeland erosion conditions (Elliot and Hall 2010). The WEPP model provides a probability of a given level of erosion occurring the years following a disturbance.

3.2.2.1. Analysis Area

The analysis area for Soil and Water resources is the project area, which includes lands administered by the BNF and SNF, including lands within the Sawtooth, Hemingway-Boulders, and White Clouds Wilderness Areas, as well as Forest Administrative Sites (e.g., Ranger Stations), but excludes BNF lands within the FC-RONR Wilderness for all alternatives. The area of analysis for cumulative effects to Soil and Water resources includes all of the BNF counties (Ada, Adams, Camas, Elmore, Gem, Valley, and Washington) and all of the SNF counties (Blaine, Box Elder [Utah], Camas, Cassia, Custer, Elmore, Oneida, Power, and Twin Falls).

3.2.2.2. Measurement Indicators

For the Soil and Water resources, the following issues were identified: Using herbicides in riparian areas can adversely impact water quality; herbicides could pollute water and affect SWPAs; herbicide treatment may adversely affect soils; and herbicides may leach into groundwater.

The following Measurement Indicators were used to analyze the effects of each alternative to the Soil and Water resources. Measurement indicators regarding the effects of weed treatment type on soil condition include the following:

- Risk of impacts to soil biota—Estimated toxicity to soil biota
- Risk of increased soil erosion—Estimated increase in soil erosion due to soil disturbing activities

Detrimental Disturbance, Total Resource Commitment, and Landslide Prone Area effects are not expected to differ significantly by alternative. Therefore, this analysis will not further address effects on these indicators.

Measurement indicators related to water include the following:

- Instream sediment loads—Estimated changes in hillslope and streambank sediment delivery to streams (based on qualitative evaluation)
- Herbicide concentrations in water—Estimated concentrations of herbicides in streams and other surface waters, groundwater, and drinking water source areas (based on modeling)
- Riparian function—Estimated changes in weed-infested acres within RCAs, as a measure of riparian and stream channel function

3.2.3. Relevant Forest Plan Direction and Other Relevant Direction

This project incorporates Forest Service (Forest-level, Regional, and National), State, and national regulatory direction pertaining to soil and water resources as part of the Proposed Action and design criteria. This regulatory direction includes a number of laws, standards, EOs, and management directives.

3.2.3.1. Forest Plans

The following Goals, Standards, and Guidelines for soil resources from the BNF Land and Resource Management Plan (Forest Plan) (USDA Forest Service 2010a) and the Sawtooth Forest Plan (USDA Forest Service 2012a) are applicable to this project:

- **NPGO01**—Manage noxious weeds with an Integrated Weed Management approach that uses prevention, education, eradication, containment, and control treatment strategies in a coordinated effort that includes potentially affected resources, users, funding sources, and activities.
- **NPGO02**—Prevent new infestations of undesirable non-native plants or noxious weed species, with emphasis on areas of high susceptibility where those species have a strong probability for establishment and spread.
- **NPGO03—**Promote and participate in establishment of Coordinated Weed Management Areas. Support the State of Idaho Weed Management Strategy.
- **NPGO04—**Re-establish vegetation that is compatible with desired long-term vegetative conditions, Forest-wide management direction, and management area priorities.
- **NPGO05—**Work to reduce the risk of establishing new noxious weed populations by minimizing weed seed transport and reducing favorable establishment conditions on disturbed sites.
- **NPOB01**—Maintain, and use current field data to update, the Forest-wide database and map library of current status of noxious weed infestations, treatment activities, and locations of newly established infestations.
- **NPOB02—**Designate Coordinated Weed Management Areas on Sawtooth National Forest System lands.
- **NPOB03—**Develop strategic noxious weed management plans for Coordinated Weed Management Areas. Cooperate on a regular basis with federal agencies, tribal governments, the State of Idaho, county weed organizations, state and local highway departments, and private individuals in establishing Coordinated Weed Management Area strategic priorities, and locating and treating noxious weed species.
- **NPOB04—**Coordinate with the Idaho Department of Transportation and county officials to assist and promote cooperative efforts to reduce introduction and spread of noxious weeds.
- **NPOB05—**Cooperatively work with holders of special use authorizations to identify and manage noxious weed infestations within areas of use to prevent further expansion or reduce existing densities.
- **NPOB06—**Emphasize prevention of noxious weed establishment through education and cooperation with recreation user groups such as all-terrain vehicle (ATV), motorcycle, and stock user groups.
- **NPOB07—**Use Burned Area Emergency Rehabilitation or other appropriate procedures to reduce the risk of noxious weed expansion in wildland fire areas, especially those

identified in the Forest-wide database and map library as being highly susceptible to invasion.

- **NPGU01—**Noxious weeds and undesirable non-native plants should be eradicated. Where it is not practical to eradicate existing infestations, infestations should be managed to prevent seed production and spread.

The following Goals, Standards, and Guidelines for soil, water, riparian, and aquatic (SWRA) resources from the BNF Forest Plan (USDA Forest Service 2010a) and the SNF Forest Plan (USDA Forest Service 2012a) are applicable to this project:

- **SWGO01**—Maintain soil productivity and ecological processes where functioning properly, and restore where currently degraded. Maintain the physical, chemical, and biological properties of soils to support desired vegetation conditions and soil-hydrologic functions and processes within watersheds.
- **SWGO02—**Provide for stream channel integrity, channel processes, and the sediment regime under which the riparian and aquatic ecosystems evolved.
- **SWGO05—**Design and implement watershed management programs and plans that will restore water quality and watershed function to support beneficial uses.
- **SWGO06**—Meet or surpass State water quality standards by planning and designing land management activities that protect water quality.
- **SWGO07**—Provide water quality for stable and productive riparian and aquatic ecosystems while fully supporting appropriate beneficial uses.
- **SWGO08**—Manage water quality to meet requirements under the CWA and Safe Drinking Water Act, with special emphasis on de-listing water quality limited [WQL] water bodies under Section 303(d) and supporting state development and implementation of TMDLs [total maximum daily loads].
- **SWOB03—**During fine-scale analysis, identify opportunities to restore degraded soil productivity and processes.
- **SWOB10**—Coordinate with municipalities to ensure that management actions are consistent with water quality requirements within municipal watersheds.

3.2.3.2. Forest Service Manual, Water Resource Management

Sections 2532.02 and 2532.03 of the FSM describe the objectives and policies relevant to protection (and, where needed, improvement) of water quality on NFS lands so that designated beneficial uses are protected (USDA Forest Service 1990). The FSM also describes guidelines for data collection activities (inventory and monitoring).

3.2.3.3. Forest Service Handbook, Soil and Water Conservation Practices Handbook

The Soil and Water Conservation Practices Handbook, part of the Forest Service Handbook (FSH 2509.22, R-1/R-4 Amendment) (USDA Forest Service 1988) presents a process to develop site-specific conservation practices for use on NFS lands to minimize the effects of management activities on soil and water resources, and to protect water-related beneficial uses. The handbook describes the application, monitoring, evaluation, and adjustment of these conservation practices.

Specific practices applicable to this project include the following:

- Practice 13.07: Pesticide Use Planning
- Practice 13.08: Apply Pesticides According to Label and EPA Registration Directions
- Practice 13.09: Pesticide Application Monitoring and Evaluation
- Practice 13.10: Pesticide Spill Contingency Planning
- Practice 13.11: Cleaning and Disposal of Pesticide Containers and Equipment
- Practice 13.12: Protection of Water, Wetlands, and Riparian Areas during Pesticide Spraying
- Practice 13.13: Controlling Pesticide Drift during Spray Application

3.2.3.4. Forest Service Best Management Practices

The Forest Service National Best Management Practices (BMP) program provides a standard set of core BMPs and a consistent means to track and document the use and effectiveness of BMPs on NFS lands across the country (USDA Forest Service 2012c). The objectives of this program include establishing:

> …uniform direction for BMP implementation to control nonpoint source pollution on all NFS lands to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources that will meet the intent of the Federal and State water quality laws and regulations, Executive orders, and USDA and Forest Service directives (USDA Forest Service 2012c).

These National Core BMPs require the following:

> …development of site-specific BMP prescriptions based on local site conditions and requirements to achieve compliance with established State, tribal, or national water quality goals. It is expected that State requirements and BMP programs, Forest Service regional guidance, and the land management plan will provide the criteria for site-specific BMP prescriptions (USDA Forest Service 2012c).

Forest Service directives implementing the National BMP program were published in the Federal Register for public review and comment (90 days) on May 6, 2014. These directives have not been finalized as of the time of this report.

The following BMPs from the National Core BMP Technical Guide (USDA Forest Service 2012c) are applicable to this project:

- Plan-2: Project Planning and Analysis
- Plan-3: Aquatic Management Zone Planning
- Chem-1: Chemical Use Planning
- Chem-2: Follow Label Directions
- Chem-3: Chemical Use Near Waterbodies
- Chem-4: Chemical Use In Waterbodies

- Chem-5: Chemical Handling and Disposal
- Chem-6: Chemical Application Monitoring and Evaluation
- Veg-2: Erosion Prevention and Control
- Veg-3: Aquatic Management Zones
- Veg-8: Mechanical Site Treatment

3.2.3.5. Clean Water Act

The Federal Water Pollution Control Act of 1972 (Public Law 92-500), as amended in 1977 (Public Law 95-217) and 1987 (Public Law 100-4), is also known as the federal CWA. The CWA provides the structure for regulating pollutant discharges to waters of the United States (WOTUS). As stated in Section 101 of the CWA, the Act's objective is "…to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Control of point and nonpoint sources of pollution are among the means to achieve the stated objective. The U.S. EPA administers the CWA, but many permitting, administrative, and enforcement functions are delegated to state governments. In Idaho, the designated agency is the Idaho Department of Environmental Quality (IDEQ).

Certain sections of the CWA special importance regarding the management of nonpoint source pollution. Sections 208 and 319 of the CWA recognize the need for control strategies for nonpoint source pollution. Section 305(b) of the CWA requires states to assess the condition of their waters and produce a biennial report summarizing the findings. In a separate list under Section 303(d) of the CWA, the IDEQ compiles a list of water bodies with water quality determined to be either impaired (not fully meeting water quality standards) or threatened (likely to violate standards in the near future).

The Section 303(d) list must be submitted to the EPA every 2 years. Water bodies on the 303(d) list—known as WQL waters—are targeted and scheduled for development of water quality improvement strategies on a priority basis. These strategies are in the form of total maximum daily loads (TMDLs), which define the quantity of pollutants that may be delivered to a water body without violating water quality standards. In practice, the TMDLs represent plans to improve water quality in a listed water body until water quality standards are met (i.e., until designated uses are fully supported).

3.2.3.6. Waters of the United States

WOTUS refers to waters over which the U.S. Army Corps of Engineers asserts jurisdiction under the CWA. One of the requirements of the permitting process for Forest herbicide application is the identification of WOTUS. Guidance defining WOTUS is provided by the Supreme Court's decision in the consolidated cases Rapanos v. United States and Carabell v. United States (referred to as "Rapanos"), and includes the following (USEPA and US Army 2008):

- Traditional navigable waters
- Wetlands adjacent to traditional navigable waters, including those with no continuous surface connection to traditional navigable waters

- Nonnavigable tributaries of traditional navigable waters that are relatively permanent, where the tributaries typically flow year-round or exhibit continuous flow at least seasonally (typically 3 months)
- Adjacent wetlands with a continuous surface connection to such tributaries (i.e., the wetlands and tributaries are not separated by uplands, berms, dikes, or similar features)
- Nonnavigable, not relatively permanent tributaries and their adjacent wetlands, where such tributaries and wetlands exhibit a significant nexus to traditional navigable water; a significant nexus analysis assesses the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine whether or not the tributary and/or wetlands significantly affect the chemical, physical, and biological integrity of downstream, traditional navigable waters

Based on this guidance, the SNF and BNF define WOTUS as

- perennial streams as identified in the National Hydrography Dataset (NHD);
- additional perennial streams field-identified by Forest personnel;
- perennial lakes and ponds identified in the Waterbodies NHD; and
- all mapped wetlands (including swamp/marsh and spring features in the NHD and any available wetland data from the National Wetland Inventory) within 300 feet of a perennial stream. (MacFarlane 2012).

3.2.3.7. Executive Order 11988, Floodplain Management

EO 11988 requires that agencies avoid, to the extent possible, adverse impacts associated with occupancy and modification of floodplains. The EO applies to all floodplain locations with a 1% or greater chance of flooding (i.e., a 100-year, or base, flood) in any given year.

3.2.3.8. Executive Order 11990, Protection of Wetlands

EO 11990 requires that agencies avoid, to the extent possible, adverse impacts associated with the destruction or modification of wetlands and avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

3.2.3.9. Idaho Water Quality Standards

Idaho State law defines the State's obligations to develop and enforce water quality standards to deal with problems related to personal health and water pollution. The State of Idaho has developed water quality standards to protect public health and welfare, enhance water quality, and comply with the requirements of the CWA. Idaho Water Quality Standards are administered under the Idaho Administrative Procedure Act (IDAPA) 58, Title 01, Chapter 2.

The Idaho State Antidegradation Policy applies to all waters subject to the jurisdiction of the CWA. This policy states that the level of water quality necessary to safeguard existing uses shall be maintained and protected; the policy includes provisions to maintain and protect the water quality of High Quality Waters and Outstanding Resource Waters.

Surface water use designations are defined for Idaho waterbodies under IDAPA 58. Waters within the project area are generally classified under the following designated uses:

- Aquatic life—Cold water, salmonid spawning, or undesignated
- Recreation—Primary contact recreation, secondary contact recreation, or undesignated
- Other—Domestic water supply

Waters with undesignated uses are presumed to support cold water aquatic life and primary or secondary contact recreation beneficial uses. For a few streams within the project area, designated use is "none" as a result of mining activity.

Idaho Water Quality Standards establish water quality criteria for aquatic life use designations. Under the following standards for water temperature and turbidity, surface waters are not to vary from the following characteristics as a result of human activities:

- Water temperatures of 22 degrees Celsius (°C) or less with a maximum daily average of no greater than 19 °C (more stringent criteria for areas used for bull trout streams and salmonid spawning in the time of spawning and incubation)
- Turbidity (below applicable mixing zone) shall not exceed background levels by more than 50 nephelometric turbidity units (NTU) instantaneously or 25 NTU for more than 10 consecutive days

Idaho Water Quality Standards also establish water quality criteria for waters designated as Small Public Water Supplies. This applies to E.F. Montezuma Creek, serving the Atlanta Water Association. Of these water quality criteria, the turbidity standard is the only standard applicable to this project, as follows:

- Turbidity measured at the public water intake should not be increased by more than 5 NTU above natural background when background turbidity is 50 NTU or less

3.2.3.10. National Drinking Water Regulations

National Primary Drinking Water Regulations regulate concentrations of a variety of contaminants in drinking water (US EPA 2009). To protect public health, these legally enforceable standards apply to public water systems. For this project, 3 contaminants referenced in these standards are applicable (Table 3-2).

Table 3-2. National drinking water standards applicable to this project

Contaminant	MCL (mg/L)[a]	Potential Health Effects from Long-term Exposure above the MCL
2,4-D	0.07	Kidney, liver, or adrenal gland problems
Glyphosate	0.7	Kidney problems, reproductive difficulties
Picloram	0.5	Liver problems

[a] MCL = Maximum Contaminant Level.

3.2.3.11. Water Rights

The Idaho Department of Water Resources (IDWR) manages water in the State of Idaho via water allocation and distribution processes. Water rights authorize the use of public water by

private individuals and organizations. The right to use water for a beneficial use must be obtained from the IDWR before a project is implemented.

3.2.4. Affected Environment

3.2.4.1. Analysis Area

The BNF and SNF cover 4.3 million acres and contain a diverse and interspersed mixture of native plant communities. These communities vary according to elevation, topography, and soil type; in general, they may be categorized by cover type. These broad groupings are defined by the predominant vegetation currently occupying a site (e.g., shrubland or conifer). Many of the cover types on the Forests provide habitat for plants identified as sensitive. Table 3-3 summarizes cover types occurring on the Forests, by acreage. Barren areas include ground that was burned or is sparsely vegetated.

The BNF and SNF are located in the temperate desert division of the Middle Rocky Mountain Ecoregion. This ecoregion, with its associated provinces, consists of mountain ranges, basins, and river canyons. The BNF occurs almost exclusively within the Idaho Batholith province of this ecoregion, with only a small portion of the Mountain Home RD falling into the Snake River Basalts province. The SNF lies within 3 separate provinces of this Ecoregion. The Fairfield RD and the western half of the Sawtooth NRA lie within the Idaho Batholith, the Ketchum RD and the eastern half of the Sawtooth NRA lie within the Challis Volcanics, and the Minidoka RD lies within the Eastern Basin and Range province.

The climatic regime is broadly similar across the ecoregion, although precipitation varies based on altitude; overall, the ecoregion is semi-arid. Lower elevations are dominated by grasslands and shrub–steppe vegetation while conifer cover increases with elevation. Ponderosa pine and Douglas-fir dominate the low-elevation coniferous forests. Lodgepole pine, Engelmann spruce, and subalpine fir occupy the mid-elevation range, while whitebark pine occupies the upper elevations (USDA Forest Service 2007a).

Table 3-3. Cover types of the Boise and Sawtooth National Forests

Vegetation Category	Acres of Vegetation	Acres of Noxious Weed Infestation
Alpine	21,806	7
Aspen	132,258	3,711
Barren	442,497	5,698
Bitterbrush	50,294	3,013
Conifer	2,118,642	92,455
Developed	1,691	697
Dwarf Sage	56,605	790
Grassland	167,359	9,124
Juniper	56,336	1,115
Mixed Shrubland	362,549	15,577
Mountain Big Sage	652,029	17,398
Mountain Mahogany	8,196	50
Riparian	58,312	5,169
Water	24,811	0
Whitebark Pine	150,362	103
Wyoming Big Sagebrush	20,614	622
Total Acres	4,324,360	155,529

Note: Totals may not add due to rounding.

On the 2 forests, approximately 155,000 acres are occupied by invasive and noxious plant species (BNF = 91,000 acres, and SNF = 64,000 acres). These species have been named by the State of Idaho or the State of Utah as official noxious weeds. These 155,000 acres do not include overlapping occurrences of weedy species; however, the actual area infested may, in fact, be underestimated by these figures due to the likely existence of un-inventoried infestations. These values represent only estimates for the purpose of characterizing existing conditions.

The most common noxious plant species in the project area are rush skeletonweed, spotted knapweed, leafy spurge, and Canada thistle (USDA Forest Service 2016). These 5 noxious plant species account for 66% of the acreage of known noxious plant infestations. Rush skeletonweed is the most prevalent noxious plant species, with nearly 53,000 acres infested (USDA Forest Service 2016) (Table 3-4). Other prevalent noxious plant species within the project area include yellow toadflax, gypsyflower (hound’s tongue), and musk thistle. Hoary alyssum, black henbane, and sulphur cinquefoil are also present.

Table 3-4. Top terrestrial noxious weed infestations in the project area

Scientific Name	Acres Infested
Chondrilla juncea (rush skeletonweed)	53,000
Centaurea stoebe ssp. *micranthos* (spotted knapweed)	26,000
Euphorbia esula (leafy spurge)	15,000
Cirsium arvense (Canada thistle)	14,000
Linaria vulgaris (yellow toadflax)	11,000
Linaria dalmatica (Dalmation toadflax)	8,000
Cynoglossum officinale (gypsyflower, a.k.a. hound's tongue)	7,000
Centaurea diffusa (diffuse knapweed)	6,000
Leucanthemum vulgare (oxeye daisy)	6,000
Cirsium vulgare	5,000
Carduus nutans (nodding plumeless thistle)	2,000

3.2.4.2. Landtypes and Soils

Landtype geology within the project area, in order of abundance from greatest to least, consists of granitics (65%), volcanics (13%), sedimentary rocks (10%), alluvial deposits (7%), quartzites (4%), mixed deposits (1%), and metamorphic rocks (0%) (Table 3-5). Landtypes are dependent on the geologic parent material. Although detailed soils data are limited, landtype geology provides a good indicator of soil characteristics, rock fragment content, soil texture, infiltration capacity, and erosion potential. Each of these characteristics can affect the mobility and persistence of herbicides.

Table 3-5. Existing inventoried invasive plant infestations, by landtype parameter

Description	Total Acres	Percent of Project Area	Invasive Plant-infested Acres	Percent of Area Infested	Percent of Total Invasive Plant Infestation
By Landtype Geology					
Alluvium	341,325	7%	19,880	6%	13%
Granitic	3,033,334	65%	115,909	4%	74%
Metamorphic	4,534	0%	4	0%	0%
Mixed	36,168	1%	1,059	3%	1%
Quartzite	167,095	4%	2,782	2%	2%
Sedimentary	479,408	10%	9,671	2%	6%
Volcanic	604,613	13%	6,290	1%	4%
TOTAL	**4,312,171**		**155,595**		
By Landtype Erosion Hazard					
Very High	332,218	8%	8,877	3%	6%
High	171,559	4%	4,641	3%	3%
Moderate	436,295	10%	11,402	3%	7%
Low	3,372,099	78%	130,675	4%	84%
TOTAL	**4,312,171**		**155,595**		

Granitics, located in the BNF and along the western portion of the SNF, tend to decompose easily, creating soils with low percentages of rock fragments but a coarse soil texture. Volcanics, located primarily in the Cassia division of the Minidoka RD and the eastern edge of the project area, may exhibit high rock fragment content, but tend also to have high clay content and very fine textured soils. Sedimentary landtypes, which are scattered throughout the project area, tend to create low percentages of rock fragments and fine soil texture. Quartzites, located primarily in the Ketchum RD and the Raft River and Albion divisions of the Minidoka RD, are more resistant to erosion, creating soils with high percentages of coarse rock fragments, moderately coarse soil textures, and high resistance to erosion.

Soil properties, particularly infiltration and organic content, influence the movement of herbicides through the soil via leaching, along with the amount of herbicide subject to transport by runoff. Infiltration rates are largely dependent on soil textures, clay content, and rock fragment content (Table 3-6). Soils on the BNF and the SNF typically have high rock fragment content. Soils with coarse textures or high rock fragment content tend to exhibit high infiltration rates. These soils include those within granitic and quartzite landtypes. Soils with fine textures, high clay content, and low rock fragment content tend to have lower infiltration rates. These soils include some of the volcanic and sedimentary landtypes.

Table 3-6. Comparison of soil properties, by landtype geology

Geology	Clay Content	Coarse Fragments	Infiltration	Runoff
Granitic	L	M	H	L
Quartzitic	L	H	H	L
Volcanic	M–H	M	L	H
Sedimentary	M–H	L	L–M	M–H

Note: L = Low, M = Moderate, H = High

Over one-half of the inventoried invasive plant infestations occur in granitics landtypes; this is due to almost the entire BNF being granitic (see Table 3-5). Although alluvium accounts for only 7% of the project area, 13% of the inventoried invasive plant infestations occur in this landtype geology, largely because of the presence of surface water and shallow aquifers promoting plant growth. Infestations occur on 6% of all alluvial landtypes in the project area. The majority of inventoried invasive plant infestations occur in areas with moderate and high landtype erosion hazard ratings. Invasive plants are most prevalent in landtypes that include moderately dissected mountain slopelands and alluvial valley bottoms.

3.2.4.3. Watersheds

The project area lies within 23 subbasins (4th-level watersheds) of the Salmon River, Upper Snake River, Middle Snake–Boise, and Great Salt Lake basins (Figure 3-1). The project area lies within ninety-five 5th-level watersheds ranging in size from about 52 to 138,192 acres, with an average size of 45,019 acres.

Elevations within the project area range from approximately 2,772 feet along the Payette River in the Emmett RD to 11,958 feet at Hyndman Peak in the Ketchum RD. Generally, NFS lands are located at higher elevations in the headwaters of the watersheds, while the broad valleys between the mountain ranges consist of private, municipal, and other federal ownership.The project area includes portions of several mountain ranges, including the Sawtooth Range,

Boulder Mountains, White Mountains, Smokey Mountains, Soldier Mountains, Boise Mountains, Sublett Range, Black Pine Mountains, and Raft River Range.

Major stream courses draining the project area in the Salmon River Basin include the Salmon River, Middle Fork Salmon River, and South Fork Salmon River. Major stream courses draining the project area in the Upper Snake River Basin include the Raft River, Goose Creek, Rock Creek, Big Wood River, and Little Wood River. Major tributaries of the Middle Snake Basin include the North, Middle, and South forks of the Boise River, and the South, Middle, and North forks of the Payette River.

Approximately 68% of the existing invasive noxious plant infestations are located in 4 subbasins within the Middle Snake River. This includes the North and Middle forks of the Boise (26.4%), along with the Boise–Mores (18%), South Fork Boise (13.3%), and South Fork Payette (10.3%) river basins. The 5th-level watersheds with the largest percentage of infested acres (greater than 10% of the watershed) include Upper Mores Creek and Lower Grimes Creek in the Boise–Mores subbasin; Lower Squaw Creek in the Payette subbasin; Lower North Fork Boise River, Crooked River, and Middle North Fork Boise River in the Middle and North forks of the Boise subbasin; Skeleton Creek in the South Fork Boise subbasin; and Alder Creek in the South Fork Payette subbasin (Table 3-8).

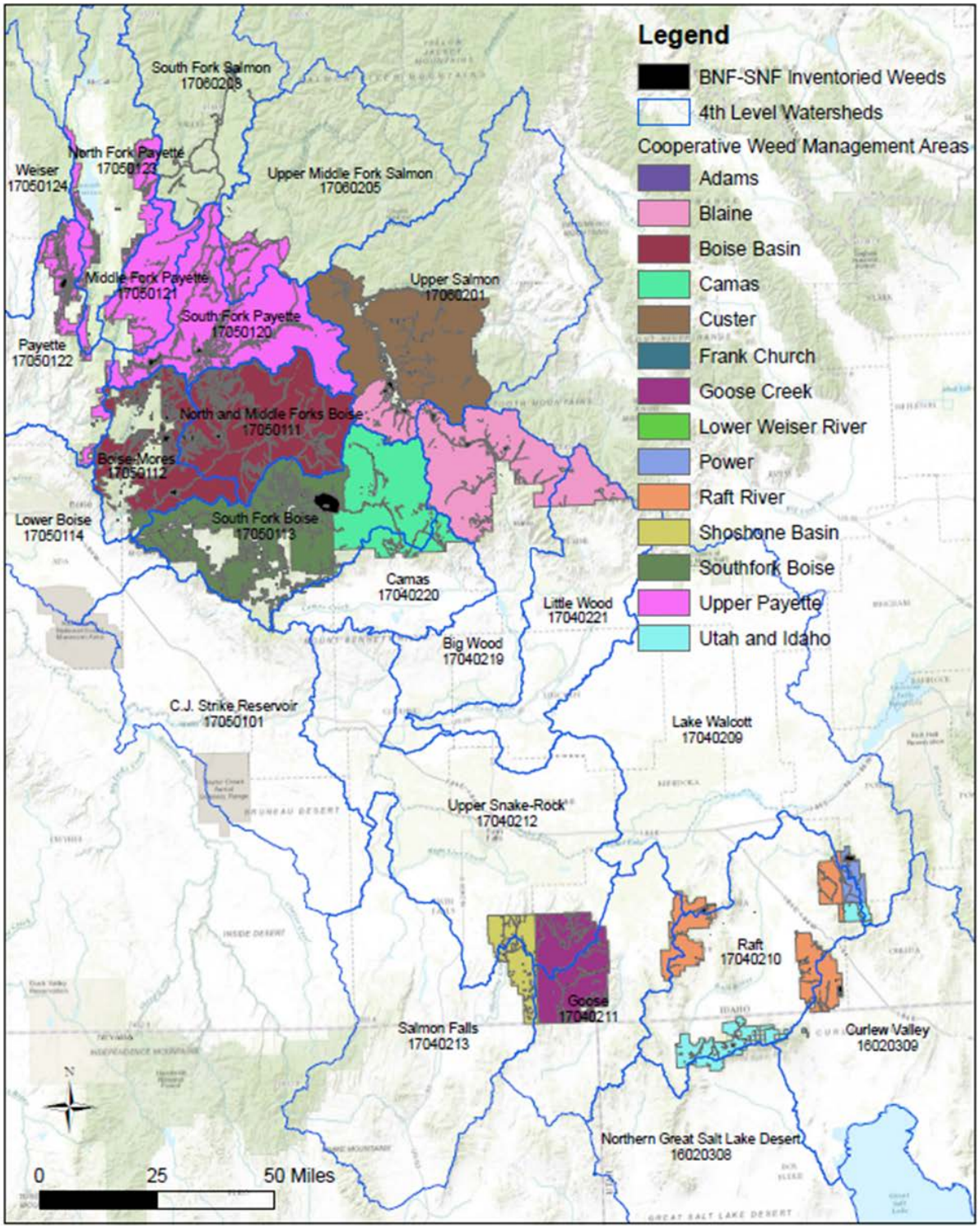

Figure 3-1. Project area map showing 4th-level watersheds, Cooperative Weed Management Areas (CWMAs), and existing, known invasive plant infestations

Table 3-7. Fourth-level watersheds in the project area

Basin Number and Name (3rd-level Watershed)	Subbasin Number and Name (4th-level Watershed)	Acres within Project Area	Percentage of Watershed within Project Area	Acres of Inventoried Infestations on Sawtooth and Boise National Forests within Subbasin	Percentage of all Inventoried Sawtooth and Boise National Forests' Invasive Plant Infestations	Cooperative Weed Management Area(s)
160203 Great Salt Lake	16020308 Northern Great Salt Lake Desert	11,308	0.4	91	0.06	Utah and Idaho
	16020309 Curlew Valley	36,627	2.5	2,092	1.3	Raft River
170402 Upper Snake	17070209 Lake Walcott	35,615	1.7	3,282	2.1	Power; Raft River; Utah and Idaho
	17040210 Raft	194,416	20.6	3,014	1.9	Power; Raft River; Utah and Idaho
	17040211 Goose	149,421	21.6	2,315	1.5	Goose Creek; Raft River; Shoshone Basin
	17040212 Upper Snake–Rock	122,395	7.5	2,708	1.7	Goose Creek; Shoshone Basin
	17040213 Salmon Falls	44,365	3.2	239	0.15	Shoshone Basin
	17040219 Big Wood	337,618	36.8	6,379	4.1	Blaine; Camas
	17040220 Camas	53,047	12.1	964	0.6	Camas; Southfork Boise
	17070221 Little Wood	69,344	8.9	73	0.05	Blaine
170501 Middle Snake-Boise	17050101 C.J. Strike Reservoir	1,814	0.1	2	0.001	Southfork Boise

Basin Number and Name (3rd-level Watershed)	Subbasin Number and Name (4th-level Watershed)	Acres within Project Area	Percentage of Watershed within Project Area	Acres of Inventoried Infestations on Sawtooth and Boise National Forests within Subbasin	Percentage of all Inventoried Sawtooth and Boise National Forests' Invasive Plant Infestations	Cooperative Weed Management Area(s)
	17050111 North and Middle Forks Boise	484,194	99.6	41,317	26.4	Boise Basin; Southfork Boise; Upper Payette
	17050112 Boise–Mores	245,762	61.8	28,245	18.0	Boise Basin; Southfork Boise; Upper Payette
	17050113 South Fork Boise	688,832	82.4	20,805	13.3	Boise Basin; Camas; Southfork Boise
	17050114 Lower Boise	2,858	0.3	7	0.004	Southfork Boise
	17050120 South Fork Payette	512,185	97.6	16,202	10.3	Boise Basin; Upper Payette
	17050121 Middle Fork Payette	190,764	88.0	2,219	1.4	Upper Payette
	17050122 Payette	106,455	13.6	6,839	4.4	Boise Basin; Upper Payette
	17050123 North Fork Payette	108,089	18.2	3,793	2.4	Upper Payette
	17050124 Weiser	68	0.006	2	0.001	Upper Payette
170602 Salmon	17060201 Upper Salmon	546,560	35.2	11,345	7.2	Blaine; Custer
	17060205 Upper Middle Fork Salmon	91,587	9.5	2,215	1.4	Frank Church; Upper Payette
	17060208 South Fork Salmon	243,451	29.0	2,629	1.7	Frank Church; Upper Payette

Table 3-8. Fifth-level watersheds in the project area with the largest invasive plant infestations

5th-level Hydrologic Unit Code (HUC)	5th-level Watershed Name	Watershed Size (Acres)	Acres of Inventoried Invasive Plant Infestations on National Forest System Lands within Watershed	Percentage of Watershed Infested on National Forest System Lands	Percentage of all Inventoried Sawtooth and Boise National Forests' Invasive Plant Infestations
1705011203	Upper Mores Creek	46,919	12,025	25.6	7.6
1705012204	Lower Squaw Creek	14,489	3,340	23.0	2.1
1705011201	Upper Grimes Creek	42,571	8,274	19.4	5.3
1705011106	Lower North Fork Boise River	53,228	10,064	18.9	6.4
1705011105	Crooked River	66,631	11,611	17.4	7.4
1705011104	Middle North Fork Boise River	69,478	8,434	12.1	5.3
1705011304	Skeleton Creek–South Fork Boise River	111,089	13,444	12.1	8.5
1705012006	Alder Creek–South Fork Payette River	64,157	7,152	11.1	4.5

3.2.4.4. Climate

For the BNF and the northern portion of the SNF, climate patterns are typically moist and cold in the winter and early spring, and warm to hot and dry during the summer and early fall. The winter climate is influenced by mountain ranges that block most arctic air. The deep Snake River and Salmon River valleys, however, can funnel dry arctic air into the basin, where it often stagnates. In the late spring and summer, moisture from the Gulf of Mexico may move north and combine with warm temperatures and steep topography to produce brief but high-intensity thunderstorms. Late spring events generally have more precipitation, with 24-hour accumulations often greater than 1 inch. Dry lightning is more common during summer and fall.

Winter temperatures average between 29 and 9 degrees Fahrenheit (°F). Snowfall ranges from about 55 to 70 inches, with greater amounts at higher elevations. Despite cold winter temperatures, occasionally warmer air off the Pacific Ocean brings rainfall, mainly at elevations below 5,000 feet. This situation increases the risk for rain-on-snow events that can trigger floods and landslides. Increased exposure to maritime air masses creates moister vegetation regimes as one moves progressively north within the Forests. Maximum summer temperatures can reach over 90 °F in the lower elevations, with higher elevations in the 80s (°F). Growing seasons vary greatly, from less than 30 days in the highest alpine areas to over 150 days in the lower valleys.

In the southern portion of the SNF, climate patterns are influenced by a variety of conditions. This area is influenced by mountain ranges that block arctic air. During the winter, however, arctic air may spill over from the Northern Rockies east of this area, and winter inversions may trap this cold air for extended time periods. As with the other portions of the Forests, in the late spring and summer, moisture from the Gulf of Mexico may move north into this area and combine with warm temperatures and steep topography to produce brief but high-intensity thunderstorms. Also, hot, unstable air from the Great Salt Lake region can increase thunderstorm

and lightning development over the upper plateaus. Dry lightning is common during summer and early fall.

This southern portion does not have the same susceptibility to marine intrusions and is very dry. Although rain-on-snow floods are rare in this region, when they occur they are more destructive and of greater magnitude than spring floods. Winter temperatures average between 31 °F and 12 °F. Seasonal snowfall typically ranges from 16 to 50 inches. Average summer temperatures generally reach the mid 90s (°F) at lower elevations and valleys, with the higher elevations in the mid 80s (°F). Growing seasons vary from less than 50 days in the high subalpine areas to over 120 days in the lower valleys and hillslopes.

3.2.4.5. Surface Water

The project area contains approximately 17,100 miles of mapped perennial streams and intermittent or ephemeral streams (7,500 miles on the SNF and 9,600 miles on the BNF), as defined by NHD mapping. Because NFS lands are generally in the headwater areas, most of these stream miles are steep headwater streams draining high-relief mountainous areas.

The project area also includes approximately 23,000 acres of lakes and reservoirs (7,600 acres on the SNF and 15,400 acres on the BNF), as defined by NHD. Although wetlands are only mapped for a small portion of the project, wetlands within the project area are generally limited to riparian environments in valley floors and small, isolated springs and seeps.

Streamflows within the project area are primarily controlled by snowmelt runoff, with peak runoff occurring in May and June. Low flows typically occur from late summer through the winter months. Many intermittent streams draining small headwater basins only carry flow during snowmelt runoff, and many streams disappear into course sediments of alluvial fans at the bases of these mountain ranges. High-intensity summer thunderstorms can produce intense rainfall capable of causing short-duration flash floods in many of the steep drainages in the project area, particularly where wildland fire has impacted soils and ground cover. Extreme flows often occur where high-intensity summer thunderstorms occur over severely burned areas.

3.2.4.6. Riparian Areas

Riparian areas vary from narrow bands along headwater streams to expansive, valley-wide floodplains in larger, low-gradient channels. Under the Boise and Sawtooth Forest Plans, riparian areas have specific management direction that limits ground-disturbing activities within RCAs. Default RCAs are delineated by 300-foot buffers on all perennial streams and 150-foot buffers on intermittent streams, ponds, lakes, and wetlands. The project area includes a total of 815,112 acres within RCAs (Table 3-9).

Table 3-9. Invasive plant infestations within Riparian Conservation Areas (RCAs) in the project area

RCAs	RCA Acres within Project Area	Acres of Inventoried Invasive Plant Infestations within RCAs	Percent of RCAs Infested
TOTAL	815,112	61,689	7.6%

Approximately 7.6% of the inventoried invasive plant-infested acres in the project area, or 61,689 acres, lie within the 150-foot and 300-foot RCAs (Table 3-9). Invasive plant infestations within riparian areas are most common in the Boise Basin, South Fork Boise, Upper Payette, and Camas CWMAs. The most prevalent invasive plants within these riparian areas are rush skeletonweed and spotted knapweed.

3.2.4.7. Water Quality

Water quality within the project area generally supports designated beneficial uses as described in the State of Idaho's 2012 Integrated Report (IDEQ 2014), including cold water, salmonid spawning, primary contact recreation, secondary contact recreation, and domestic water supply. Factors influencing water quality include natural factors such as geology, fire, and atmospheric deposition, as well as land management activities that may lead to nonpoint sources of sediment or contaminants. Streams within the highly mineralized zone of the Upper Salmon River tend to have high concentrations of metals. Fine sediments may be naturally prevalent within granitic landforms as a result of the high rate of granite decomposition.

Anthropogenic sources of water quality impairment including sediment, temperature, fecal coliform, *Escherichia coli*, and metals have resulted in the 303(d) or impaired listing of 95 Assessment Unit Water Bodies totaling 1,758 miles and 3 reservoirs totaling 5,902 acres, within the project area (IDEQ 2014) (Table 3-10). No 303(d)-listed or impaired waters occur on the Utah portion of the SNF.

TMDLs have been developed for several water bodies within the project area and are included within IDEQ subbasin assessments completed between 1999 and 2012, also identified in the State of Idaho's Final 2012 305b Integrated Report on the IDEQ web site, at https://mapcase.deq.idaho.gov/wq2012/default.html.

A total of 9,771 acres of inventoried invasive plant infestations occur within 300 feet of the 303(d)-listed and impaired water bodies within the project area. Impaired water bodies with the largest concentrations of inventoried invasive plants within 300 feet are located in the South Fork Salmon River subbasin with 237 acres. Other impaired water bodies within subbasins exhibit weed infestations ranging from 3.5 to 237acres.

Table 3-10. Section 303(d)-listed impaired water bodies within the project area

Assessment Unit Water Body	Miles	Acres	Pollutants[a]	TMDL[b]
Alturas Lake Creek—Alturas Lake to mouth	14.0		CB	
Anderson Ranch Reservoir (Boise River)		4,605	Hg	
Basin Creek—East Basin Creek to mouth	0.7		S	
Bear Valley Creek—4th order (Cache Creek to Elk Creek)	7.4		S	
Bear Valley Creek—5th order	9.7		T	
Blacks Creek and Bryans Run—1st and 2nd order	7.9		CB	
Boise River—5th order (North Fork to Arrowrock)	10.9		T	
Champion Creek—source to mouth	5.6		CB	
Clyde Creek—source to mouth	22.3		EC	
Deep Creek—Rock Creek to Idaho/Utah border	12.8		S	
Dixie and Deer Creeks—3rd order sections	6.8		CB	
East Fork Salmon River—Germania Creek to Herd Creek	19.9		CB	
East Fork of the South Fork Salmon River—5th order	4.7		S	
Fall Creek—1st and 2nd order tributaries	83.2		CB	
Indian Creek and tributaries—1st and 2nd order above reservoir	15.4		EC, S	
McMullen Creek—source to mouth	25.2		T	X
Meadow Creek—source to mouth	4.4		CB	
Montezuma Creek and Quartz Gulch	5.0		As	
North/Dry Cottonwood Creek—source to mouth	22.3		T	X
Quigley Creek—source to mouth	0.8		T	X
Salmon River—Fisher Creek to Decker Creek	8.3		S	
Salmon River—Redfish Lake Creek to Valley Creek	5.4		S, T	
Salmon River—Valley Creek to Yankee Fork Creek	12.6		S, T	
Slate Creek—source to mouth	36.5		CB	
Smith Creek—3rd order (Mule Gulch to South Fork Boise River)	9.0		EC	X
South Fork Payette River—5th order	18.5		S	
South Fork Payette River—1st and 2nd order (Lowman to Garden Valley)	110.0		CB	
South Fork Payette River—1st and 2nd order (Lowman to Grandjean)	110.2		CB	
Stewart Gulch, Cottonwood Creek, Crane Creek—1st and 2nd order	16.7		CB	
Sublett Creek—source to Sublett Reservoir	5.8		EC	
Trout Creek—source to Idaho/Nevada border	20.0		S	
Valley Creek—Trap Creek to mouth	30.0		CB	
Williams Creek—source to mouth	12.9		CB	
Willow Creek—4th order	0.9		CB	
Total	675.7	4,605		

[a] As = arsenic, CB = combined biota/habitat assessments, EC = *Escherichia coli*, Hg = mercury, S = sedimentation/siltation, T = water temperature.
[b] TMDL = total maximum daily load.

3.2.4.8. Groundwater

Limited information is available regarding groundwater resources within the project area. Large aquifers exist within the alluvial deposits of the Salmon River, Boise River, and Payette River valleys, but these areas are primarily off-Forest. Groundwater resources on NFS lands generally consist of isolated aquifers within alluvial deposits, as well as springs and seeps in basin headwaters. Groundwater is recharged directly from infiltration of rainfall, snowmelt, and surface streamflows. Many headwater streams are fed by groundwater, while some larger water courses, such as the Lost River, lose water to large aquifers in deep alluvial deposits.

3.2.4.9. Water Uses

Water uses within the project area include diversions for irrigation, small-scale stockwater developments, domestic water from wells, domestic use from municipal watersheds, and small-scale hydropower development. Numerous permitted diversions are located on NFS lands throughout the area, resulting in decreased flows downstream. Wells on NFS lands provide drinking water for campgrounds and other Forest Service facilities within the project area.

IDEQ and the Utah Department of Environmental Quality have designated "SWPAs" for waters that supply both public drinking water and wells used for public consumption. SWPAs within the project area include source waters for Oakley Valley Water, the City of Ketchum, Sun Valley Water and Sewer District, Smiley Creek Water, Featherville Townsite, the Town of Horseshoe Bend, Atlanta Water Association, Idaho City Water Department, and several homeowners associations, ski areas, private camps, and lodges, as well as NFS campgrounds and facilities. On NFS lands, 111 SWPAs exist in 16 subwatersheds (4th-level HUC). SWPAs mostly comprise wells that provide consumptive water uses. A few springs and streams are also identified. In Utah, no SWPAs are identified on NFS lands.

For the purpose of this analysis and to define the contributing watersheds affecting SWPAs, watersheds have been delineated at the 6th level for all SWPAs. SWPAs for groundwater sources have been delineated by a 1,000-foot radius around each well. The acreage of these delineated areas on NFS lands totals 248,140 acres. A total of 31,994 acres of invasive plant infestations occur within these delineated areas, comprising 12.9% of the total delineated areas. The majority of these invasive plant infestations (24,630 acres, 77%) occur along the several tributaries of Grime Creek and Mores Creek within the SWPA for the Wilderness Ranch Owners Association, Inc. Invasive plant infestations have been inventoried in the SWPAs for Sun Valley Water and Sewer (420 acres), Idaho City Water Department (924 acres), City of Ketchum (360 acres).

3.2.5. Environmental Consequences

3.2.5.1. Alternative 1—No Action

The No Action Alternative (Alternative 1) is required by 40 CFR § 1502.14, and was developed to comply with NEPA requirements. In this instance, Alternative 1 means no management of invasive plants within the project area would occur. Both forests would discontinue all invasive plant management activities including invasive plant inventory, monitoring, control, and restoration activities to meet invasive plant management objectives, except for those NFS lands under road ROW agreements with the different counties within the project area. In the latter situations, the authority to undertake treatments is vested in the county agencies. Currently, approximately 155,000 acres of invasive plant infestations have been inventoried within the 4.3-million-acre project area. Additional, unknown infestations are likely to be present.

3.2.5.1.1. Direct and Indirect Effects

Without any additional treatments, existing invasive plant infestations are expected to spread into susceptible areas along vectors such as roads, trails, livestock, wildlife, wind, and water; additional factors include various human uses and fire. The spread of invasive plants has been shown to occur at an average rate of 1.3% to 35.0% per year, based on a synthesis of data for the spread of 16 invasive plants throughout the United States (Duncan et al. 2004; Duncan and Clark 2005). This study depicts annual rates of spread of 10% to 24% for spotted knapweed,

10% to 12% for Canada thistle, 12% to 22% for musk thistle, and 12% to 16% for leafy spurge. The actual rate of spread of invasive plants within the project area has not been quantified. However, based on the existing acreage of known infestations and an implied annual rate of spread of 10% to 24%, Alternative 1 could potentially result in approximately 250,000 to 450,000 acres of infestations within the project area after 5 years of no treatment and 400,000 to 1,300,000 acres of infestations after 10 years of no treatment.

This expansion of terrestrial invasive plant infestations into areas containing native vegetation could, over time, alter vegetation composition, sediment yield, soil productivity, water availability, runoff potential, and riparian function in these areas. Relative to the established measurement indicators, these potential changes are discussed in the following sections.

Although the BNF and SNF contain a limited number of aquatic invasive plant species, a likely threat exists that aquatic weeds could become established on the Forests. Boat inspections conducted on the Sawtooth NRA in 2014 found 28 boats with aquatic weeds present (inspection reports available in the project record). In 2015, Eurasian watermilfoil and curly pondweed were detected on watercraft entering Redfish Lake from the middle section of the Snake River. A total of 23 watercraft were inspected and found to be contaminated with aquatic noxious vegetation (Vuono 2014). Removing these plants is essential to keeping them out of Redfish Lake and surrounding water bodies with critical habitats for listed species. The ISDA conducted roving monitoring stations for aquatic invasives within the BNF boundary in 2015 and found 13 boats on Cascade Lake and 1 boat on Lucky Peak Reservoir with aquatic weeds (personal communication with Thomas Wolf, Idaho State Department of Agriculture. Eurasian watermilfoil, the only listed an aquatic noxious weed listed by Idaho Department of Agriculture is gaining a foothold in Idaho's lakes, ponds, rivers, and other waterways, with approximately 4,000 surface acres of the plant identified through State surveys.[7] Eurasian watermilfoil has been found in several counties on the BNF.[8] Two locations of occurrence are known on the Boise Forest (Idaho City and Lowman RD). Watermilfoil was found on the Lowman RD at Lowman Nature Ponds in 2007 and was thought to be a hybrid of Eurasian and northern watermilfoil; it has been treated by Idaho Fish and Game since 2010. The ISDA treated a pond on Idaho City property (which is within 1 mile from the NFS boundary within the Idaho City RD) for milfoil in 2008.

Once established, aquatic invasive plant species are extremely difficult to eradicate and pose serious threats to the ecological integrity of aquatic environments. An integrated management strategy allowing for implementing timely and effective invasive plant control and eradication programs for the BNF and the SNF is critical to preventing these species from becoming established on either Forest. Without an effective control method (such as the use of aquatic herbicides), the general effects of establishment occurring could be severe, depending on the characteristics of the water body. Invasion of Eurasian watermilfoil, which can quickly outcompete native aquatic vegetation, is considered to be one of the most serious aquatic invasive plant issues in the Northwest. Under Alternative 1, impacts to water chemistry could include decreased dissolved oxygen, increased nutrient loading (nitrogen and phosphorus),

[7] Idaho Weeds Awareness Campaign http://www.idahoweedawareness.net/vfg/weedlist/ewmilfoil/ewmilfoil.html

[8] Idaho Department of Agriculture List of Noxious Weeds http://www.agri.idaho.gov/AGRI/Categories/PlantsInsects/NoxiousWeeds/Documents/mapping/County_Weed_Maps_67/EWM_2014.pdf

altered biomass turnover, changes in water temperature, and increased turbidity (Parkinson et al. 2011). These effects could have impacts on aquatic habitat.

Soil Condition

Alternative 1 (No Action Alternative) would have no direct adverse effects on soil condition because no ground-disturbing treatments would be implemented. Mechanical invasive plant treatments, road, trail, or overland access to treatment sites, and site preparation for restoration would not occur under this alternative.

The following indirect effects of Alternative 1 on soil condition are likely to occur with gradually increasing severity as native plant species are displaced by invasive species. These effects would generally occur in the long term (greater than 10 years).

Herbicide Concentrations in Soils: Under the no action there would be no use of herbicides on the forests. Any existing herbicide concentration in soils would decrease.

Soil Erosion and Sediment Yield: Under conditions with a high prevalence of invasive plant species, displacement of native species, erodible soils, limited ground cover, and steep topography, the increase in soil erosion after 5 or more years of no treatment is likely to be moderate to high. Increased soil erosion rates have been shown to decrease soil productivity (Lacey et al. 1989). Many soils within the project area are thin, particularly on moderate and steep slopes. Loss of stabilizing plant cover, such as that found with native bunchgrasses, to invasive species that have a much sparser growing pattern, such as knapweed, leads to a high risk of soil loss. In areas of high and very high erosion hazard ratings, soil lost in this manner may not be recovered. Invasive plant infestation is likely to cause limited or no increase in soil erosion rates on low-gradient slopes. Soil erosion would likely increase in infested riparian areas, as a result of increased bank erosion and channel instability.

Increased sediment yield from invasive plant-infested hillslopes in the project area could result in increased turbidity and sediment loads in stream channels. The amount of sediment reaching stream channels from these hillslopes would be limited by sediment capture within functional riparian buffers and other impoundments, but could be enough in some places to cause streams to exceed fine sediment standards in the long term after the extensive spread of invasive plants. Increased fine sediments in streams can cause sediment deposition and channel aggradation, which can result in decreased pool depths, increased channel widths, decreased channel stability, and bank erosion. These processes can degrade spawning and rearing habitat for fish.

On a watershed scale, increased runoff and peak flows caused by decreased ground cover and infiltration as a result of invasive plant infestation (Lacey et al. 1989) can result in additional stream channel instability. Invasive plant infestations in riparian areas can also result in the loss of woody riparian vegetation species, which function to maintain bank stability. This loss of woody root structure can cause increased rates of bank erosion and sediment delivery to stream channels.

These indirect effects occur to a limited extent, and the severity of these effects would increase gradually with the spread of invasive plants throughout the project area. The magnitude of these effects is likely to be the greatest where large, landscape-scale infestations occur, rather than small, scattered infestations; however, small, scattered infestations, if unmanaged, could expand to large, landscape-level infestations. It is likely that in heavily infested watersheds, increased sediment loads as a result of invasive plant infestation would be detectable at established

watershed monitoring sites in the long term (greater than 10 years). In some severely impacted watersheds, the spread of invasive plants could contribute to exceedances of Forest Plan standards for instream fine sediments.

Organic Material: Invasive plant infestations in grasslands can result in decreased organic material in the soil based on the potential for increased soil erosion, which tends to remove the organic material first, the decreased input of organic material by invasive plants, and the secretion of compounds from invasive plants that slow decomposition rates (Olson 1999). These effects vary by species, however.

Soil Mechanics: Invasive plants can affect soil mechanics in a number of ways. Sparse ground cover, decreased organic material, and soil crusting can lead to reduced infiltration rates and increased runoff and peak flows (Lacey et al. 1989; Olson 1999). Decreased ground cover, such as that seen in spotted knapweed infestations, can also result in increased evaporation rates, thereby reducing the availability of water in the soil. Different species can exploit water in various ways through root structure and timing, thereby outcompeting native plants (Olson 1999). In addition, all these factors can lead to greater fluctuations in soil temperature (Olson 1999), which can contribute to unfavorable conditions for native vegetation.

Soil Nutrients and Chemistry: Invasive plant infestations can result in depletion of soil nutrients and changes in soil chemistry. Invasive plants tend to have higher rates of nutrient uptake than native plants, as well as slower rates of root decomposition (Olson 1999). A spotted knapweed-infested site resulted in reductions of 44% in potassium, 62% in nitrogen, and 88% in phosphorus compared to adjacent soils colonized by native grasses in a study conducted by Harvey and Nowierski (1989). Nonnative plants can tolerate these soil conditions and also exploit any available nutrients, thereby outcompeting native plants (Olson 1999). Many invasive plant infestations can, in addition, increase soil pH, extractable nitrate, and net nitrogen mineralization (Weidenhamer and Callaway 2010). Additional effects may include changes to mycorrhizal fungus communities. Tyser (1992) described severe reductions in cryptogamic soil crusts as a result of a knapweed infestation.

Soil Microbes: Most invasive plant species produce secondary compounds, which can affect the diversity and abundance of soil microbial populations and mycorrhizal associations (Weidenhamer and Callaway 2010). Decreased abundance of soil microbes can result in decreased decomposition rates and slower rates of nutrient cycling (Olson 1999). Spotted knapweed is known to contain toxic secondary compounds, which negatively affect other plants and soil microbes, along with their interactions (Alford et al. 2009).

Many of the effects described above are currently taking place to some extent within the larger infestations that exist in the project area. Without aggressive intervention, soils with large infestations of knapweed are not likely to return to their “pre-infestation” conditions, conditions that would allow them to support native grasses. Under Alternative 1, the spread of smaller infestations into areas that do not currently contain invasive plant species would likely result in more widespread changes to soil condition in the long term. Because soil condition indirectly affects nearly all watershed processes, these changes to upland soils could have gradual but far-reaching impacts on streamflows, stream channel conditions, riparian areas, and habitat in the long term (greater than 10 years).

3.2.5.1.2. Watershed Condition

Effects on Instream Sediment Load

Analysis of the direct and indirect effects of Alternative 1 to the watershed condition indicator instream sediment load was simulated using watershed and hillslope scenarios to display potential effects.

Watershed Scenario

The Crooked River Watershed, a tributary of the North Fork of the Boise River, is located above Arrowrock Reservoir. It drains an area of 66,631 acres. Infestations of rush skeletonweed, spotted knapweed, and diffuse knapweed have been inventoried on 11,611 acres (17% of the watershed), and many of these infestations occur on slopes once dominated by bunchgrass. Spotted knapweed makes up 2,937 acres (4%) of the watershed. Based on the 2-fold increase in sediment yield measured by Lacey et al. (1989) on similar slopes, current conditions could represent an estimated 8% increase in basin-wide sediment production, as compared to historic conditions with no knapweed present. Given a 10% to 24% rate of annual spread of spotted knapweed (Duncan et al. 2004), total sediment production could increase 29% to 52% after 5 years of spread, and 46% to 153% after 10 years of spread (Table 3-11). Because the spread of spotted knapweed could occur on different slope gradients and cover types, some of which are less susceptible to increased sediment yields, this projected increase in sediment production is likely overestimated. However, it does provide an indication of the effects that could occur on a watershed scale.

Table 3-11. Sediment yield scenario from the spread of spotted knapweed in the Crooked River Watershed

Timeframe	Spotted Knapweed-infested Acres	Percent of Watershed Infested	Percent Increase in Basin Sediment Production[a]
Present	2,937	4	8
After 5 years of spread[b]	4,300–6,943	6–10	12–20
After 10 years of spread[b]	6,925–20,356	10–31	20–62

[a] Based on estimated 200% increase in sediment yield on slopes infested with spotted knapweed (Lacey et al. 1989).
[b] Based on estimated 10% to 24% rate of annual spread.

Hillslope Scenario

Increased sediment yield as a result of invasive plant infestation was modeled using Disturbed WEPP (Elliot and Hall 2010).

The erosion rates and sediment delivery are predicted by the model, using input values for forest conditions developed by scientists at the Rocky Mountain Research Station. Climate data used was based on the last 30 years of weather data from Arrow Rock Dam weather. Input to the model included slope angle, slope length, climate, soil type, buffer width (heavily vegetated area between disturbed area and stream), treatment, and disturbance return periods. Under this scenario, a spotted knapweed infestation spreads onto previously uninfested hillslopes within the Crooked River Watershed. Prior to infestation (Year 1), the percent ground cover was approximately 60%. By Year 5, vegetation on the slopes transitions from a native bunchgrass community to a monotypic stand of spotted knapweed. At that point, the percent ground cover is reduced to approximately 20%, with soil loss and compaction similar to the “skid trail” condition

described in Disturbed WEPP (Elliot and Hall 2010). Modeling is based on 50 years of climate data. Two scenarios are analyzed. One scenario has a vegetated buffer of 100' with a 30% slope between the disturbance and the stream channel such as a healthy riparian zone and one scenario does not have a vegetated buffer between the disturbance and the stream channel.

Assuming no change in soil type (sandy loam) or rock fragment content (20%), this modeling suggests that the change in ground cover related to invasive plant infestation could result in a considerable increase in erosion rate and sediment delivery after a period of 5 years (Table 3-12). Although a hillslope of native bunchgrass would not likely result in any measurable erosion or sediment delivery at the 10% exceedance level (i.e., from a storm with a 10-year recurrence interval), the same hillslope impacted by an expansive infestation of knapweed could experience 0.28 tons per acre of sediment delivery during the same storm for a hillslope with no buffer between the infested area and the stream channel, and 0.0043 tons per acre for a hillslope with a 100-foot riparian buffer at the base of the slope. Although the accuracy of these predicted erosion rates is plus or minus 50% at best (Elliot and Hall 2010), this modeling provides a sense of the changes that could occur.

Table 3-12. Input parameters and results of disturbed Water Erosion Prediction Project (WEPP) modeling of erosion from 2 hypothetical knapweed-infested hillslopes within the Crooked River Watershed

55% Slope, Sandy Loam, No Buffer		Year 1	Year 3	Year 5
Upper Slope	Gradient (top/mid)	55% / 55%	55% / 55%	55% / 55%
	Horizontal length	500 ft	500 ft	500 ft
	Vegetation/treatment	Good Grass	Poor Grass	Skid Trail
	% Cover	60%	40%	20%
	% Rock	20%	20%	20%
Lower Slope	Gradient (top/mid)	45% / 45%	45% / 45%	45% / 45%
	Horizontal length	100 ft	100 ft	100 ft
	Vegetation/treatment	Good Grass	Poor Grass	Skid Trail
	Percent Cover	60%	40%	20%
	Percent Rock	20%	20%	20%
Results	Probability of erosion	6%	10%	48%
	Erosion rate (tons/acre): 10-year return period	0.00	0.15	0.28
	Probability of sediment delivery	10%	18%	58%
	Sediment delivery (tons/acre): 10-year return period	0.00	0.15	0.27
55% Slope, Sandy Loam, 100-foot/30% Buffer		**Year 1**	**Year 3**	**Year 5**
Upper Slope	Gradient (top/mid)	55% / 55%	55% / 55%	55% / 55%
	Horizontal length	500 ft	500 ft	500 ft
	Vegetation/treatment	Good Grass	Poor Grass	Skid Trail
	Percent Cover	60%	40%	20%
	Percent Rock	20%	20%	20%
Lower Slope	Gradient (top/mid)	45% / 45%	45% / 45%	45% / 45%
	Horizontal length	100 ft	100 ft	100 ft
	Vegetation/treatment	Shrubs	Shrubs	Shrubs
	Percent Cover	80%	80%	80%
	Percent Rock	20%	20%	20%
Results	Probability of erosion	6%	8%	36%
	Erosion rate (tons/acre): 10-year return period	0.00	0.00	0.24
	Probability of sediment delivery	10%	12%	18%
	Sediment delivery (tons/acre): 10-year return period	0.00	0.0004	0.0232

Effects of Herbicide Concentrations in Water

Alternative 1 would have no direct or indirect adverse effects of concentrations of herbicides in streams, other surface waters, groundwater, or drinking water sources because no herbicide invasive plant treatments would be implemented. If present, concentrations of any residual herbicides currently in the environment from past treatments would decrease over time under Alternative 1.

Effects on Riparian Function

Currently, 61,689 acres of inventoried invasive plant infestations are located within RCAs, covering approximately 7.5% of the total area included within RCAs. The extent of riparian infestations ranges from small, localized occurrences to expansive occurrences throughout an RCA.

Direct Effects

Alternative 1 would have no direct adverse effects on the condition of riparian areas within the project area because no ground-disturbing treatments would be implemented. Mechanical invasive plant treatments, road, trail, or overland access to treatment sites, and site preparation for restoration would not occur under this alternative.

Indirect Effects

Alternative 1 could have a number of indirect effects on the conditions of riparian areas within the project area. Native woody riparian shrubs provide an essential function within riparian areas, particularly in lower-gradient streams, because their roots provide structure and stability to stream banks. Loss of this native riparian vegetation to invasive plant species that do not provide this woody root structure has the potential to cause decreased bank stability and increased bank erosion in some channel types, which in turn can lead to channel widening, channel instability, and increased sediment loads (Polvi et al. 2014). Additional indirect effects related to the loss of native riparian vegetation could include channel widening, filling of pools, increased fine bed sediments, decreased large woody debris recruitment, loss of aquatic habitat, decreased shading of streams, and increased stream temperatures. These effects would occur on a continual basis over the long term (greater than 10 years), with gradually increasing severity as the extent of invasive plant infestation in riparian areas increases.

Colonization of riparian areas with invasive plants has resulted in dramatic effects in many parts of the United States. The invasion of salt cedar along rivers and streams of the western United States has, in some places, resulted in almost complete loss of native willow vegetation, affecting water availability, soil properties, channel morphology, and numerous other ecological processes (Urgenson 2006). Although salt cedar is present (but not prevalent) within the project area (1 infestation covering 0.1 acres), it has the potential to spread further and displace native riparian vegetation. Japanese knotweed has invaded riparian forests in the Pacific Northwest, altering the composition of the forest and understory, which in turn affects streambank stability, channel morphology, and nutrient dynamics (Dawson and Holland 1999; Urgenson 2006). Knotweed has been shown to outcompete native juvenile trees, affecting the riparian forest succession over time, thereby decreasing root strength that provides bank stability and inputs of large woody debris to the channel (Urgenson 2006). Although knotweed has been identified in only 1 location covering 0.1 acres within the project area, it also has the potential to spread further into the area.

Riparian areas can be highly susceptible to colonization by nonnative plants as a result of regular disturbance regimes (flooding, erosion, deposition, drought, human and animal sources), availability of water and nutrients, and habitat connectivity (Planty-Tabacchi et al. 1996; Urgenson 2006). Under certain conditions, small infestations of invasive plants could spread rapidly and dramatically change the function of a riparian area in a short period of time (less than 5 years). Functional riparian areas, however, are characterized by a high diversity in not only species, but also physical processes, which allows for high species diversity and heterogeneous morphology (Schmitz and Jacobs 2007). A review of literature suggests that many invasive species infestations in riparian areas are largely the result of flow alterations, such as reduction in peak flows downstream of dams, which prevents the natural disturbance regime that allows native plant diversity to occur. For example, widespread infestations of salt cedar on regulated southwestern rivers have essentially adapted to altered flow regimes, while native willows cannot compete under those conditions. Studies have suggested that restoration of a natural flow regime is the only way to restore native plant communities in these altered riparian ecosystems (Junk et al. 1989; Poff et al. 1997; Schmitz and Jacobs 2007). Large-scale flow alterations do not generally occur within the project area; however, flow reductions related to diversions, as well as prolonged periods of drought, are likely to result in higher susceptibility to invasive plant infestations in some riparian systems.

Existing invasive species infestations are likely to expand in the project area if, under Alternative 1, no treatments occur. Duncan et al. (2004) have cited average annual rates of spread of 1.3% to 35.0% per year for a variety of invasive species. Under Alternative 1, the rate of spread in healthy, functional riparian areas is likely to be at the low end of that range. However, the rate of spread would likely be higher in riparian areas impacted by stressors such as flow reduction from upstream diversions or prolonged drought, livestock use, fire, or a variety of human uses. Because natural conditions are generally well protected within riparian areas in the project area as a result of Forest Plan direction and other BMPs, and because extreme flow alterations are limited, the annual rate of expansion in riparian areas would be relatively low. Based on the existing acreage of known infestations of Canada thistle within RCAs and an estimated annual rate of expansion of 5% to 15%, the extent of invasive plant infestation within RCAs could increase from 6,318 acres (currently) to approximately 7,680 to 8,411 acres after 5 years of no treatment, and 9,801 to 10,735 acres after 10 years of no treatment. This could result in areas of detrimental changes to riparian character and function in the long term. The most severe indirect stream channel effects would likely occur in unconfined, low-gradient, meandering stream channels with wide floodplains, where riparian vegetation provides a large influence on channel form.

3.2.5.1.3. Cumulative Effects

Cumulative effects are defined as “the incremental impacts of the proposed action and alternatives when added to effects of other actions both on NFS lands and other adjacent federal, state, or private lands” (40 CFR 1508.7). This analysis considers the effects of other ongoing and foreseeable future activities but does not consider past activities, as CEQ regulations do not require agencies to comprehensively list and analyze all individual past actions. Impacts of past activities are typically captured in the current state of the project area, as described under section 3.2.4, and do not generally provide useful information for the prediction of cumulative effects of the Proposed Action and other alternatives.

The analysis area considered for this cumulative effects analysis includes the twenty-two 4th-level watersheds covered by the project area (Table 3-13). The percentage of each 4th-level watershed covered by the project area ranges from 0.2% to 98.1%.

Table 3-13. Land ownership percentages within 4th-level watersheds intersecting the project area

4th-level Watershed	Percent within Project Area (Sawtooth and Boise National Forests)	Outside of Project Area		
		Percent Other Forest Service	Percent Bureau of Land Management	Percent State, City, Private, Other
16020308 Northern Great Salt Lake Desert	0.4	0.0	51.5	48.1
16020309 Curlew Valley	2.3	0.2	19.9	77.6
17040209 Lake Wolcott	1.7	<0.1	42.5	55.8
17040210 Raft	20.6	0.0	30.4	49.0
17040211 Goose	9.7	0.0	43.9	46.4
17040212 Upper Snake–Rock	7.9	0.0	36.1	56.0
17040219 Big Wood	3.2	5.1	70.3	21.4
17040213 Salmon Falls	36.8	<0.1	38.2	25.0
17040220 Camas	12.6	0.0	19.3	68.1
17040221 Little Wood	8.9	0.3	45.8	45.0
17050101 C.J. Strike Reservoir	0.2	0.0	61.4	38.4
17050111 North and Middle Forks, Boise	98.1	0.0	0.0	1.9
17050112 Boise–Mores	60.2	0.0	3.1	36.7
17050113 South Fork Boise	80.6	0.0	1.2	18.2
17050114 Lower Boise	1.2	0.0	17.8	81.0
17050120 South Fork Payette	94.1	<0.1	0.3	5.6
17050121 Middle Fork Payette	83.8	0.0	2.1	14.1
17050122 Payette	13.6	<0.1	19.8	66.6
17050123 North Fork Payette	19.4	22.7	0.4	57.5
17060201 Upper Salmon	35.0	34.2	24.4	6.4
17060205 Upper Middle Fork Salmon	9.5	90.0	0.0	0.5
17060208 South Fork Salmon	30.6	68.2	0.2	1.0

Under Alternative 1, no invasive plant treatments would occur on NFS lands within the project area; however, herbicide invasive plant treatments would continue on private, state, and county lands within the 4th-level watersheds of the project area. This alternative would result in no cumulative effects related to the direct or indirect effects of treating invasive plants.

The continued spread of invasive plants in the project area would make it more difficult to maintain desired conditions during the implementation of other projects such as timber sales or vegetation treatments. For example, reclamation following a vegetation improvement project would not be as effective in controlling erosion risk and sediment production if invasive plants were already present, potentially preventing adequate native vegetation re-establishment.

Uses on NFS Lands: The spread of invasive plants under Alternative 1 would make management of ongoing uses on NFS lands more difficult. For example, the ability to adequately manage grazing in riparian areas would decline with the spread of invasive plants. In this case,

invasive plants would make stream banks less resilient to the effects of hoof shear and other grazing impacts, resulting in cumulative effects if grazing were to continue.

Natural Processes: The continued spread of invasive plants within the project area would also have cumulative effects when considered in conjunction with natural sources of soil and water impairment such as wildfire. In the case of fire, recovery from fire would not occur as effectively or as quickly as it would if no invasive plants were present in the area. Following a fire, if invasive plants are already present in an area, invasive plants would be more likely to colonize burned areas, preventing re-establishment of native species and doing little to control erosion rates. In this situation, fine sediments would persist in streams longer following a fire than in a situation where native vegetation quickly became re-established.

Activities on Non-NFS Lands: The cumulative effects of Alternative 1 on soil and water resources on NFS lands resulting from activities on non-NFS lands would be relatively minor due to the small amount of land adjacent to the forests that are receiving noxious weed treatments.

Cumulative Effects of Invasive Plant Infestations on Watershed Condition

On the scale of the 6th-level watershed (subwatershed), the cumulative effects of the long-term spread of invasive plants in addition to other ongoing management activities and uses could potentially result in degradation of watershed conditions. This cumulative effects analysis utilizes the Watershed Condition Framework, a Forest Service model for classifying watershed condition (USDA Forest Service 2011). This framework identifies 12 indicators, with 1 to 4 attributes under each indicator, to assess watershed condition based on aquatic physical, aquatic biological, terrestrial physical, and terrestrial biological processes (Table 3-14).

Table 3-14. Indicators and attributes analyzed under the Watershed Condition Framework

Category	Indicator	Attribute
Aquatic Physical (30%)	Water Quality	Impaired Waters (303(d) listed)[a]
		Water Quality Problems (not listed)[a]
	Water Quantity	Flow Characteristics
	Aquatic Habitat	Habitat Fragmentation
		Large Woody Debris
		Channel Shape and Function
Aquatic Biological (30%)	Aquatic Biota	Life Form Presence
		Native Species
		Exotic and/or Invasive Species[a]
	Riparian/Wetland Vegetation	Vegetation Condition[a]
Terrestrial Physical (30%)	Roads and Trails	Open Road Density
		Road Maintenance
		Proximity to Water
		Mass Wasting
	Soils	Soil Productivity[a]
		Soil Erosion[a]
		Soil Contamination
Terrestrial Biological (10%)	Fire Regime or Wildfire	Fire Condition Class OR Wildfire Effects
	Forest Cover	Loss of Forest Cover
	Rangeland Vegetation	Vegetation Condition[a]
	Terrestrial Invasive Species	Extent and Rate of Spread[a]
	Forest Health	Insects and Disease
		Ozone

[a]Indicates attributes that may be affected by the spread of invasive plants.

Sixth-level watersheds are classified as functioning properly (Class 1), functioning at risk (Class 2), or having impaired function (Class 3). The Watershed Condition Framework considers only NFS lands within a watershed. In 2011, a total of 107 watersheds within the project area were rated as Class 1, 180 watersheds were rated as Class 2, and 21 watersheds were rated as Class 3 under the Watershed Condition Framework.

The spread of invasive plants could potentially affect ratings for 7 of these attributes, including Impaired Waters, Water Quality Problems, Riparian Vegetation Condition, Soil Productivity, Soil Erosion, Rangeland Vegetation Condition, and Extent and Rate of Spread (of terrestrial invasive species). The Watershed Condition Framework also takes into consideration a number of indicators representing disturbance or vectors that may accelerate the spread of invasive plants, such as road networks, fire susceptibility, and streamflow characteristics.

Watersheds with the highest risk of cumulative effects are those with an impaired condition class and a high percentage of the watershed covered by existing infestations. These watersheds represent areas where management activities, Forest uses, and other impacts are most likely to occur and where the widespread presence and long-term spread of invasive plants is most likely to result in cumulative effects to watershed condition in combination with these activities, uses, and impacts.

The risk of cumulative effects related to invasive plant infestations is categorized for each subwatershed under each alternative as low, moderate, or high, based on matrices for each alternative that consider watershed condition class and the percentage of the watershed covered by existing infestations. Values in the matrices were developed using professional judgment and considering the expected response of invasive plants under each alternative. The percentages of invasive plant-infested acres were broken into 5 categories used in the matrices: less than 1%, 1%–5%, 5%–10%, 10%–25%, and greater than 25%. These breaks are based on the condition rating rule set for the Terrestrial Invasive Species Condition attribute in the Watershed Condition Framework, where a “functioning properly” condition is defined by less than 10% infested acres, a “functioning at risk” condition is defined as 10%–25% infested acres, and an “impaired function” condition is defined by greater than 25% infested acres (USDA Forest Service 2011).

A matrix was developed to assess the level of risk of cumulative effects for Alternative 1 based on watershed condition class and the percentage of the watershed currently infested by invasive plants (Table 3-15). Based on the expected rates of spread as discussed in section 3.2.5.1.1, watersheds with less than 1% infested acres would generally be low risk. Watersheds with 1% to 5% infested acres would represent a moderate risk of cumulative effects in Class 2 watersheds, because it is possible that the spread of invasive plants would approach the “functioning at risk” threshold of 10% and interact negatively with other activities occurring in the watershed. Watersheds with 5% to 10% infested acres would likely exceed the 10% threshold in the long term and exhibit adverse cumulative effects. Any watershed with over 10% infested acres would likely have adverse cumulative effects in the long term as a result of the rapid spread of invasive plant infestations.

Table 3-15. Long-term cumulative effects risk matrix for 6th-level watersheds for Alternative 1

Watershed Condition Class	Level of Risk of Cumulative Effects based on Percent of Watershed Infested by Invasive Plants				
	<1%	1%–5%	5%–10%	10%–25%	>25%
1	L	L	M	H	H
2	L	M	H	H	H
3	M	H	H	H	H

Note: L = low; M = moderate; H = high

Under Alternative 1, this analysis suggests that the long-term effects of the spread of invasive plants would likely result in cumulative effects in a number of 6th-level watersheds. As invasive plants continue to spread as predicted under Alternative 1, cumulative effects would increase, leading to additional long-term watershed impairment. Fifty-eight watersheds are at high risk for cumulative effects, and 98 watersheds are at moderate risk and 152 are at low risk (see soil and hydrology technical report [project record]). Most of the high and moderate risk watersheds are located in the Boise Basin and Upper Payette CWMAs' invasive species management zones, where infestations are most concentrated. Because the spread of invasive plants affects many of the attributes in the Watershed Condition Framework, it is possible that these cumulative effects could result in degradation of watershed condition class for watersheds with moderate or high cumulative effects risk ratings in the long term (greater than 10 years).

3.2.5.1.4. Alternative 1 Summary

The No Action Alternative does not comply with current laws, regulation, and policy and would not fulfill the purpose and need. The No Action Alternative would potentially result in impairment of soil condition in the long term as a result of expansion of invasive plant infestations.

Risk of Impacts to Soil Biota: Most invasive plant species produce secondary compounds that can affect the diversity and abundance of soil microbial populations and mycorrhizal associations (Weidenhamer and Callaway 2010). Decreased abundance of soil microbes can result in decreased decomposition rates and slower rates of nutrient cycling (Olson 1999). Spotted knapweed is known to contain toxic secondary compounds, which negatively affect other plants and soil microbes, along with their interactions (Alford et al. 2009).

Under Alternative 1, the spread of smaller infestations into areas that do not currently contain invasive plant species would likely result in more widespread changes to soil conditions in the long term. Because soil condition indirectly affects nearly all watershed processes, these changes to upland soils could have gradual but far-reaching impacts on streamflows, stream channel conditions, riparian areas, and habitat in the long term (greater than 10 years).

Risk of Increased Soil Erosion: Under conditions with a high prevalence of invasive plant species, displacement of native species, erodible soils, limited ground cover, and steep topography, the increase in soil erosion after 5 or more years of no treatment is likely to be moderate to high. Increased soil erosion rates have been shown to decrease soil productivity (Lacey et al. 1989). Many soils within the project area are thin, particularly on moderate and steep slopes. Loss of stabilizing plant cover (such as that found with native bunchgrasses) to invasive species such as knapweed that have a much sparser growing pattern leads to a high risk

of soil loss. In areas of high and very high erosion hazard ratings, soil lost in this manner may not be recovered. Invasive plant infestation is likely to cause limited or no increase in soil erosion rates on low-gradient slopes. Soil erosion would likely increase in infested riparian areas as a result of increased bank erosion and channel instability.

Instream Sediment Loads, Herbicide Concentrations in Water, and Riparian Function: Alternative 1 could potentially result in long-term increases in instream sediment loads, impairment of riparian function in the long term, and impairment of soil condition in the long term as a result of expansion of invasive plant infestations. This alternative would not result in any increase in herbicide concentrations in water. This alternative would result in a high risk of cumulative effects in 58 watersheds and a moderate risk in 98 watersheds.

Alternative 1 would likely result in degradation of watershed conditions in the long term and potentially detectable increases in fine sediment loads in streams. These conditions could potentially contribute to exceedances of stream channel fine sediment standards in the Forest Plans, as well as potential exceedances of State water quality standards. Expansion of invasive plant infestations in riparian areas could also lead to exceedances of Forest Plan bank stability standards in the long term.

3.2.5.2. Effects Common to All Action Alternatives

Alternatives 2, 3, 4, and 5 have similar features and consequently, similar effects. These effects are detailed in this section. For Alternatives 2, 3, 4, and 5, invasive plant infestations within the project area are expected to continue to spread, but the percentage of annual expansion of invasive plants would be less than that found under Alternative 1.

3.2.5.2.1. Effects on Soil Condition

For Alternatives 2, 3, 4, and 5, ground disturbance may occur in the short term (less than 5 years) as a result of on-road and off-road access using OHVs to transport and spray herbicides. However, because these activities do not require repetitive travel over the same route, it is unlikely that vegetation or the duff layer would be highly disturbed such that erosion would occur.

Eradication of invasive plant infestations and reestablishment of native vegetation would allow for the recovery of soil microbes in the long term. Trevors (1998) has suggested that most effects to soil microbes occur when herbicides are applied at higher than recommended concentrations. A review of research also indicates that the effects of herbicides on soil microbes are highly variable and dependent on numerous environmental conditions. Furthermore, any potential short-term impacts would occur to a very small percentage of soils on a watershed scale because of the limited extent of treatments that would occur under this alternative.

Manual and mechanical treatments such as hand pulling can cause localized ground disturbance in the short term. These treatments would occur on relatively few acres in scattered locations throughout the project area because more cost-effective methods are often available (e.g., herbicide control), especially for larger infestations. Although minimal localized short-term effects could occur, the desired result of these activities is re-establishment of native species, which would reduce erosion in the long term.

Rehabilitation and restoration treatments using hand tools or larger equipment such as OHV-driven harrows would result in short-term ground disturbance across larger areas where extensive

infestation has occurred. This could potentially result in increased sediment delivery in the short term in an area where the soils would already have decreased ground cover, soil impacts, and increased erosion as a result of invasive plant infestation. However, harrowing would result in a very shallow depth of ground disturbance, and these treatments would typically be implemented on low-gradient slopes (less than 45%), where erosion hazards are low. Recovery of native vegetation on these types of impacted slopes is likely to be slow, requiring less than 5 years for grass and forb communities and more than 5 years for shrub/sagebrush communities. Though these methods have the greatest potential for short-term ground disturbance, the effects of these treatments on soil conditions would likely be minimal. The desired result would be the re-establishment of native vegetation, which would reduce erosion in the long term.

3.2.5.2.2. Effects on Watershed Condition

Effects of Herbicide Concentrations in Water

Direct Effects

Biological, manual/mechanical, and rehabilitation/restoration control methods would have no direct effects on the concentrations of herbicides in water because no herbicides would be applied using these methods.

Herbicide applications under Alternatives 2, 3, 4, and 5 have the potential to directly affect concentrations of herbicide in surface water and groundwater, depending on a number of factors including the type of herbicide, the amount of herbicide applied, the size of the treatment area, proximity of the application to water, the characteristics of the water body, soil characteristics such as infiltration, environmental factors such as rainfall, runoff, and wind, and chemical properties of the herbicides as they interact with soil. This section provides a discussion of herbicide properties, pathways to water, and other factors related to potential herbicide delivery to water sources common to the action alternatives.

Herbicide Properties

Forest Service Risk Assessments have been completed by SERA for all herbicides proposed under the action alternatives (SERA 2004a,b,c,d,e,f, 2006, 2011a,c,d). These risk assessments provide detailed information about the toxicity and environmental fate of each herbicide. Information from these risk assessments and from Tu et al. (2001) regarding herbicide behavior in soil and water is referenced in Table 3-16 and summarized below.

2,4-D amine—2,4-D amine is a selective systemic herbicide used to control broadleaf invasive plants. 2,4-D amine has generally lower toxicity than 2,4-D ester. This herbicide has a short half-life and is highly volatile. Water solubility and persistence in the water column is dependent on the pH of water. 2,4-D is most likely to persist in waters with low pH, allowing it to adsorb to particles in the water column. The primary mechanism of degradation in soils is from microbial activity, while degradation from ultraviolet light is limited. The environmental fate of 2,4-D in soils is dependent on the pH, microbial population, soil moisture, and temperature. Rates of degradation are highest in warm, moist, high organic soils, which favor microbial populations. 2,4-D does not readily bind to soils, and therefore has the potential to leach through soils and move offsite. However, the short half-life of 2,4-D prevents extensive leaching.

Aminopyralid—Aminopyralid is a low-toxicity, low application rate herbicide belonging to the same class of herbicides as picloram and clopyralid and used to control susceptible broadleaf

weeds, including noxious and invasive weeds. This herbicide is characterized by very high water solubility and a low sorption coefficient. It does not bind strongly with soil particles and can be mobilized by water. Degradation occurs primarily through ultraviolet light and microbial activity. Persistence is high in soils and water. Because of its high solubility, low adsorption to soils, and high persistence, aminopyralid can be highly mobile, but it has a low toxicity and environmental fate profile (SERA 2007a); aminopyralid can be used in riparian areas and close to water. The potential for leaching into groundwater is high.

Chlorsulfuron—Chlorsulfuron is used for pre-emergent and early post-emergent control of broadleaf invasive plants. This herbicide is relatively soluble, with solubility increasing with pH. Because it is weakly adsorbed by soil particles, chlorsulfuron can be highly mobile in soils and has a high leaching potential in permeable soils, leading to some potential for groundwater contamination. Degradation in soils occurs by microbial activity, which occurs more quickly under warm, moist, low pH conditions. Degradation in water occurs through hydrolysis and photolysis. The persistence of chlorsulfuron is likely to be the greatest in alkaline soils under dry conditions.

Clopyralid—Clopyralid is a selective herbicide for control of broadleaf plants. This herbicide is characterized by high water solubility, low adsorption to soil particles, and high persistence (half-life). As a result, clopyralid can be highly mobile. Degradation in soils occurs through microbial activity, with the highest degradation rates occurring in warm, moist soils that favor microbial populations. Degradation from sunlight or hydrolysis is very slow. Persistence in water can be high, as it will not generally bind with particles in the water column and is stable over a range of pH from 5 to 9. Concern for water contamination is high because it does not bind tightly with soil particles and can potentially leach into groundwater. Clopyralid is likely to move offsite via percolation on sand and loamy soils, and via runoff on clay soils.

Dicamba—Dicamba is a selective herbicide used for control of broadleaf invasive plants and woody vegetation. This herbicide is highly soluble in water, and because of its low sorption coefficient, it is highly mobile in soils. The potential for leaching in permeable soils is high, and the potential for groundwater contamination exists. Dicamba is moderately persistent in soil. Breakdown in soils occurs through microbial activity and occurs more quickly under conditions with higher temperature, higher moisture, and high organic content. Dicamba is not highly persistent in water. Breakdown in water occurs through microbial activity and photolysis.

Diflufenzopyr—Diflufenzopyr is an auxin transport inhibitor. Diflufenzopyr inhibits the polar transport of naturally occurring auxin (indoleacetic acid, or IAA) and synthetic auxin-like compounds, such as dicamba, in sensitive plants. When diflufenzopyr is applied with dicamba, as in the Distinct Herbicide formulated product, it focuses dicamba's translocation to the meristematic sinks, where it delivers effective weed control at reduced dicamba rates and across a wider range of weed species. Based on available data, diflufenzopyr has been determined to be of low toxicity to humans, birds, aquatic organisms, mammals, and bees. This herbicide is highly soluble in water, and because of its low sorption coefficient, it is highly mobile in soils. The potential for leaching in permeable soils is high, but diflufenzopyr breaks down in soils rapidly through microbial activity and in water through microbial activity and photolysis. Due to this rapid breakdown, diflufenzopyr is not expected to pose a risk of groundwater contamination.

Glyphosate—Glyphosate is a broad-spectrum, nonselective, systemic herbicide. This herbicide is characterized by high solubility in water and strong adsorption to soil particles. In water,

glyphosate dissipates rapidly because it adsorbs to soil and sediment particles. In soils, it becomes strongly adsorbed to soil particles, and the potential for leaching is very low. Glyphosate is degraded primarily through microbial activity. Ultraviolet and chemical degradation processes are slow. Glyphosate is unlikely to be transported to surface water via runoff, although it can be mobilized if the soil particles are also mobilized.

Imazapic—Imazapic is a selective herbicide used to control some grasses and some broadleaf plants. This herbicide is characterized by high solubility in water and moderate adsorption to soils, dependent on soil pH and organic content. Mobility in soils is limited, and it is unlikely to be mobilized by runoff. Persistence in soils is moderate, with microbial activity as the primary mechanism of degradation. However, persistence in water is very short, as it is rapidly degraded by sunlight in water.

Metsulfuron-methyl—Metsulfuron-methyl is a selective herbicide for pre- and post-emergence control of many invasive plants and woody plants. This herbicide is relatively soluble, with solubility increasing with pH. Metsulfuron-methyl is highly mobile, with high leachability in permeable soils. The potential for groundwater contamination exists. Half-lives are relatively long, and this herbicide can be highly persistent, particularly under aerobic and alkaline conditions. Breakdown in soil occurs through microbial activity under anaerobic conditions, with the rate of breakdown increasing with increased moisture and temperature. Breakdown also occurs through hydrolysis.

Picloram—Picloram is a selective herbicide used to control a variety of broadleaf plants. This herbicide is characterized by very high water solubility and low sorption coefficient. Picloram does not bind strongly with soil particles and can be mobilized by water. Degradation occurs primarily through microbial activity, but this occurs slowly and is dependent on soil properties. Ultraviolet light also causes degradation of picloram on surfaces. Persistence is high in soils, but short in water. Because of its high solubility, low adsorption to soils, and high persistence, picloram can be highly mobile and represents a threat to water contamination via surface or subsurface movement. The potential for leaching into groundwater is high, particluarly in sandy soils.

Sulfometuron-methyl—Sulfometuron-methyl is a nonselective herbicide used for control of broadleaf invasive plants and grasses. This herbicide is relatively insoluble in water, generally stays near the soil surface, and has low leaching potential. Because of its low solubility, it is most likely to be transported along with soil particles during runoff. The persistence of sulfometuron-methyl is short, and it degrades rapidly in soil and water by microbial activity, hydrolysis, and photolysis. The fastest degradation occurs in moist, warm, acidic soils.

Triclopyr—Triclopyr is a selective herbicide used to control broadleaf plants. The formulation of triclopyr considered in this analysis is triethylamine salt (triclopyr amine). Triethylamine salt is soluble in water, but does not generally bind to soil particles, and therefore can be mobile. Degradation occurs through microbial activity, but photolysis and hydrolysis also occur. Triethylamine salt degrades quickly in soil and water into triclopyr acid. Triclopyr acid binds moderately with soil particles, and movement in the environment is limited.

Table 3-16. Current and proposed herbicide characteristics in soil and water

Herbicide (Active Ingredient)	Half Life in Water (days)	Water Solubility (mg/L)[a]	GUS Groundwater Movement Rating[b]	Half Life in Soil (days)[c]	Sorption Coefficient (soil K_{oc})[d]	Pesticide Movement Rating (leach ability)	Toxicity to Soil Microbes	Degradation Mechanisms
2,4-D amine	45	569	0.9–3.7 Ext low to high	6.2 Non	61.7 Mobile	Moderate	Short Term	Soil microbes
Aminopyralid	447	205,000	1.8–10.1 Low to very high	32–533 Mod to persistent	10 Very mobile	High	Low	UV light Soil microbes
Chlorsulfuron	200	27,900	3.0–5.2 Mod to very high	37–168 Mod to persistent	40 Mobile	High	Low	Soil microbes
Clopyralid	261	1,000	2.0–10.5 Mod to very high	14–29 Non	0.4–12.9 Very mobile	Mod–High	Low	Soil microbes
Dicamba	39	6,500	4.8 Very high	31 Moderate	2.4–32.5 Mobile to very mobile	High	Low	Soil microbes
Diflufenzopyr	24	5,850	2.4 Moderate	26 Non	18–156 Mod mobile to very mobile	High	Low	UV light Soil microbes
Fluroxypyr	25	7,950	3.1 Moderate	23 Non	50–136 Mod mobile to mobile	Moderate	Unknown	Soil microbes
Glyphosate	21	12,000	0–6.1 Ext low to very high	5.4 Non	2,000–24,000 Nonmobile to slightly mobile	Low	Low	Soil microbes
Imazapic	30	36,000	0.1–8.2 Ext low to very high	113 Persistent	112 Mobile	Low	Unknown	Soil microbes
Imazapyr	20	11,000	5.2 Very high	210 Persistent	53 Mobile	High	Low	UV light Soil microbes
Imazamox	365	4,410	4.1 High	81 Moderate	67 Mobile	Low	Unknown	Soil microbes
Metsulfuron-methyl	1,213	2,700	2.6–8.1 Mod to very high	120 Persistent	35 Mobile	High	Short Term	Soil microbes Water
Picloram	2.6–15	200,000	2.9–6.9 Mod to very high	18–513 Non to persistent	2.2–92.9 Mod to very mobile	Mod–High	High	UV light Soil microbes

Herbicide (Active Ingredient)	Half Life in Water (days)	Water Solubility (mg/L)[a]	GUS Groundwater Movement Rating[b]	Half Life in Soil (days)[c]	Sorption Coefficient (soil K_{oc})[d]	Pesticide Movement Rating (leach ability)	Toxicity to Soil Microbes	Degradation Mechanisms
Sulfometuron-methyl	113	300	4.2 Very high	10–100 Non to persistent	78 Mod	Mod–High	Indirect>Direct	UV light Soil microbes
Triclopyr TEA (triethylamine salt)	426	440	2.6–4.5 Mod to very high	8–28.4 Non	25–134 mobile	Mod–High	Short Term	Soil microbes

Source: Data from USDA Forest Service herbicide risk assessments (SERA 2004a,b,c,d,e,f, 2006, 2011a,c,d).

[a] Pesticide values are categorized as one of the following: insoluble ≤0.1 ppm, moderately soluble = 100 to 1,000 ppm, highly soluble ≥10,000 ppm (USGS 2000). As pesticide water solubility increases, greater potential for degraded water quality through runoff and leaching exists.

[b] GUS rating = groundwater ubiquity score, after Gustafsen (1989). GUS = log (half-life) x (4 –log Koc). Based upon the GUS value, the potential to move toward groundwater would be recorded as one of the following categories: extremely low potential = <1.0, low = 1.0 to 2.0, moderate = 2.0 to 3.0, high = 3.0 to 4.0, or very high = >4.0.

[c] Soil half-life values for herbicides are from the Herbicide Handbook (Ahrens 1994). Pesticides that are considered nonpersistent are those with a half-life of less than 30 days; moderately persistent herbicides are those with a half-life of 30 to 100 days; pesticides with a half-life of more than 100 days are considered persistent.

[d] Organic adsorption rating (abbreviated as Koc) is the amount of herbicide that adsorbs to a given amount of organic carbon in the soil. <15 = Very mobile, 15–75 = Mobile, 75–500 = Moderately mobile, 500–4,000 = Slightly mobile, >4,000 = Nonmobile (PSD 2005).

Herbicide Pathways to Water

Norris et al. (1983) described 5 ways in which herbicides applied for invasive plant treatment can enter surface water or groundwater:

- Direct application
- Drift
- Mobilization in ephemeral streams and channels
- Overland flow
- Leaching

The potential for herbicides to enter water through ground-based spot and broadcast treatment operations by any of the above mechanisms is low. The following discussion applies to the ground-based spot and broadcast herbicide applications proposed in the action alternatives (Alternatives 2, 3, 4, and 5), but does not apply to aerial or aquatic application methods.

Direct Application

Direct application of herbicide to water using ground-based spot and broadcast treatment under these alternatives is very unlikely to occur during direct herbicide application. Most invasive plant treatments would occur a considerable distance from water. For treatments within riparian areas, design features require buffer widths of 15 feet from all water for herbicides identified as low risk. Some herbicides labeled for aquatic use, such as aquatic 2,4-D and aquatic glyphosate, could be applied up to the water's edge using hand selective methods (e.g., wicking, wiping on individual plants). For those herbicides identified as moderate or high risk, only focused spot applications would be permitted within 50 feet of flowing water and ponded water, allowing precise treatment of target plants only and leaving a minimal chance of herbicide being applied directly to nearby water bodies. Design criteria require that no broadcast application occur within 100 feet of water. Table 2-6 details herbicide application guidelines near water for the action alternatives, including buffer widths by application method. Label requirements would be followed, and applications would only be performed by or under the direct supervision of licensed Idaho professional herbicide applicators, providing a high level of assurance that herbicides would be applied correctly.

Drift

Drift of herbicide into water bodies during ground-based spot and broadcast herbicide application is also very unlikely to occur under the action alternatives. As discussed above, only focused spot spraying and hand selective applications would be permitted within 50 feet of water. Broadcast spraying would not be allowed within 100 feet of water. These treatments would have very low potential for drift because herbicide would be applied directly to plants near ground level. Design features would also prohibit any spraying within riparian areas when the wind speed exceeds 5 mph, virtually eliminating the possibility of any accidental drift of herbicide into water bodies. Although ground-based broadcast spraying has a higher likelihood of causing drift, no ground-based broadcast spraying would occur within 100 feet of streams or ponded water bodies, thereby minimizing the risk of drift into water bodies.

Mobilization in Ephemeral Streams and Channels

The potential for mobilization of herbicide in ephemeral streams and channels during subsequent runoff events would be minimal under the action alternatives. Ground-based spot applications could be applied in these areas, but would target specific plants. Ground-based broadcast applications would not occur within any riparian areas, but could be applied to dry ephemeral channels with no established riparian vegetation. Ephemeral channels have infrequent flow. Herbicide uptake by plants, as well as ultraviolet and microbial breakdown of herbicides applied, would in many cases limit the amount of herbicide that could be mobilized by the first runoff event following application, depending on the persistence and mobility of the herbicide. An herbicide such as picloram would have the highest potential for mobilization in ephemeral stream channels because of its high solubility and persistence. The most likely scenario in which herbicide could be mobilized in ephemeral stream channels would occur if a runoff-producing rainstorm occurred immediately after application. Design features requiring weather forecasting to ensure no extreme precipitation events are predicted immediately following application would minimize this risk.

Overland Flow

Overland flow is the most likely mechanism for herbicides to reach surface water under the action alternatives. Overland flow occurs when the rate of precipitation or snowmelt exceeds the rate of infiltration. Within the project area, this occurs occasionally during spring runoff and high-intensity summer thunderstorms. Ground-based spot applications are designed to target specific plants, with limited application directly to the ground. Ground-based broadcast applications would result in some application of herbicide directly to the ground, but the extent of coverage would be limited. Design features, BMPs, and label requirements would help ensure maximum efficiency of herbicide applications. Generally, small infestations would be treated under this alternative, and the percentage of any watershed that is treated would be very small.

Herbicides such as clopyralid and picloram, which have high water solubilities and low sorption coefficients, have the greatest potential for being mobilized by overland flow (Table 3-16), while herbicides, such as glyphosate, with high sorption coefficients are unlikely to be mobilized by overland flow. Mobilization by overland flow is also dependent on the occurrence of rainfall, which varies spatially and temporally. Rates of herbicide uptake by plants, breakdown by soil microbes or ultraviolet light, and bonding with soil particles vary by herbicide. In most cases, the levels of remaining herbicide would be very small by the time the first runoff occurs after treatment. Design features specifying that no herbicide application would occur if rain is forecast immediately after treatment decreases the potential for herbicide mobilization from runoff. However, herbicides with long persistence in soil, such as picloram, have the potential to be mobilized by overland flow occurring weeks or even months after application. It is also important to note that herbicide concentrations in runoff would be diluted in most situations because of the limited amount of herbicide that would be applied to the ground, as compared to the area contributing to runoff.

Research suggests that ground-based herbicide applications following label requirements are not likely to impair surface waters. A study conducted on the Salmon-Challis National Forest (Rose 2002) concluded that herbicide applications similar to those proposed under this alternative did not impact surface water quality. After application of 1 pound per acre of picloram on study plots adjacent to streams in Texas grasslands, Haas et al. (1971) measured

concentrations of picloram of 0.029 mg/L after the first rainfall event. This is substantially less than the 0.5 mg/L maximum contaminant level set by the EPA for drinking water (see National Drinking Water Regulations section [section 3.2.3.10]). In this study, picloram was undetectable in surface waters after subsequent rainfall events. In a study of the environmental fate of picloram used for roadside invasive plant control in Montana, Watson et al. (1989) detected no concentrations of picloram in adjacent streams and suggested that after application to a small portion of the watershed (1%), increased streamflow volume following storms would dilute any picloram mobilized to streams to low levels.

Leaching

Leaching of herbicides through the soil could potentially result in contamination of surface water or groundwater. Movement of a pesticide can be described in terms of the relationship between the sorption coefficient and the half-life (Vogue et al. 1994). Herbicides with a low sorption coefficient and a long half-life, such as chlorsulfuron, dicamba, metsulfuron-methyl, and picloram (Table 3-16), have the greatest ability to leach through soils and reach groundwater or surface water.

Once in the soil, the persistence of many herbicides can be relatively short, as they can break down quickly (as discussed in the Herbicide Properties section above). Herbicide persistence in soil depends on a number of factors including microbial decomposition, hydrolysis, photodegradation, and volatilization. A variety of organisms can contribute to decomposition, including bacteria, actinomycetes, and fungi. Herbicide decomposition occurs most quickly in conditions that favor these organisms, such as warm, moist, and nutrient-rich soils (National Council for Air and Stream Improvement Inc. 2009). In the proposed project area, herbicide decomposition likely varies with soil composition, landtype, aspect, and elevation. Arid slopes with thin soils would favor photodegradation over microbial decomposition. Riparian valley bottom soils would be more favorable to microbial decomposition.

Of the herbicides considered under the action alternatives, picloram has the highest potential for leaching into soil and contamination of groundwater and surface water due to its high leachability, long persistence, and high solubility. Picloram is broken down by ultraviolet light, and degradation by microorganisms is slow. Watson et al. (1989) conducted studies of picloram soil mobility and persistence at 2 sites in western Montana after ground-based herbicide invasive plant treatments. At the first site, they measured rapid photo decay related to high sunlight and low precipitation, and no herbicide was detected below a depth of 20 inches. At the second site, with 4 times the concentration of herbicide (1 pound/acre) applied adjacent to a stream on sandier soils with abundant shade, they measured half the rate of photo decay, and the herbicide was detected to a depth of 40 inches. The second site represents a scenario of application of picloram over a shallow water table. In both of these cases, the herbicide was not detected in groundwater or surface water, indicating that minimal leaching occurred.

Other herbicides with low sorption coefficients and moderate leachability, such as 2,4-D, have a much lower potential for leaching through soils. Radosevich and Winterlin (1977) studied the persistence of 2,4-D and 2,4,5-T in soil after ground-based application in chaparral vegetation in California. They found that although 50% of the recovered herbicide was found on the soil surface litter, only 0.1% to 0.2% of the recovered herbicide was found in the soil, and no herbicide was found below 5 centimeters soil depth. In this study, herbicide residues decreased rapidly within 30 days following treatment.

Under the action alternatives, herbicide applications would be unlikely to enter either surface water or groundwater by way of leaching through soils. Spot treatments would result in minimal contact of herbicide with soils, while some contact would occur through ground-based broadcast applications. Research suggests that with the exception of herbicides applied over shallow water tables, leaching is an unlikely mechanism for herbicides to enter water due to limited chemical mobility and relatively short persistence (Norris et al. 1983). Under the action alternatives, ground-based application of herbicides over shallow aquifers would be minimal. Shallow aquifers are limited within the project area to narrow bands below riparian areas along primarily narrow valley floors, and no ground-based broadcast application would occur within 50 feet of streams or ponded water bodies. Terms and conditions under the NMFS Biological Opinion also specify that application of picloram, clopyralid, chlorsulfuron, and metsulfuron-methyl should be avoided within annual floodplains where the water table is within 6 feet of the surface and soil permeability is high (National Marine Fisheries Service 2012).

Other Factors Related to Potential Herbicide Delivery to Water Sources

Herbicide Modeling

Forest Service risk assessments for herbicides considered under the action alternatives (SERA 2004a,b,c,d,e,f, 2006, 2011a,c,d) provide results of GLEAMS and Gleams-Driver modeling for herbicide application adjacent to streams (Table 3-17 and Table 3-18) and ponds (Table 3-19 and Table 3-20). In each risk assessment, concentrations of herbicides in water are modeled following application of herbicide in a square treatment area draining directly into a stream and a square treatment area draining directly into a pond. Table 3-17**,** Table 3-18**,** Table 3-19**,** and Table 3-20 show the GLEAMS or Gleams-Driver input parameters and the results, expressed as maximum concentration of herbicide in water. The risk assessments modeled herbicide delivery for a variety of soil types and a variety of climates, representing conditions nationwide. Clay, loam, and sand soils all exist within the project area. Results for the range of climates found within the project area are summarized, representing a generic arid lowland site (average annual precipitation of 5 inches for Gleams-Driver modeling and 10 inches for GLEAMS modeling) and a generic cooler, moister upland site (average annual precipitation of 33 inches for Gleams-Driver modeling and 25 inches for GLEAMS modeling).

Table 3-17. Summary of Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) and GLEAMS-Driver modeling results from USDA Forest Service herbicide risk assessments for herbicide application adjacent to a stream

Herbicide	Maximum Concentrations of Herbicide in a Stream (µg/L per lb/acre applied)					
	Average Annual Precipitation: 10 inches			Average Annual Precipitation: 25 inches		
	Clay	Loam	Sand	Clay	Loam	Sand
2,4-D[a]	0	0	0	236	0	0.00000997
Chlorsulfuron[b]	0	0	0	42.45427	0	1.56313
Clopyralid[b]	0	0	0	8.50807	0.42790	2.65217
Dicamba[b]	0	0	0	0.12122	0.00004	0.00820
Imazapic[b]	0	0	0	0.15831	0	0.02283
Metsulfuron-methyl[b]	0	0	0	0.46168	0.00992	0.08221
Sulfometuron-methyl[b]	0	0	0	0.27655	0	0.02907

[a] For this herbicide, the GLEAMS model assumes herbicide treatment of a 10-hectare field with a 60-inch root zone, draining directly into a 2-meter-wide stream that flows at a rate of 710,000 L/day and with a velocity of 0.08 m/sec. Additional input parameters provided in SERA (2006).
[b] For this herbicide, the GLEAMS model assumes herbicide treatment of a 10-acre-square field with a 60-inch root zone and 4 soil layers that drains directly into a 2-meter-wide, 1-foot-deep stream that flows at a rate of 4,420,000 L/day and with a velocity of 0.08 m/sec. Additional input parameters provided in SERA (2004a,b,c,d,e,f).

Table 3-18. GLEAMS-driver modeled maximum peak concentrations of herbicide in a stream

Herbicide	Maximum Peak Concentrations of Herbicide in a Stream (median value of 100 simulations; µg/L per lb/acre applied)					
	Dry/Temperate Location[a]			Average Rainfall/Cool Location[b]		
	Clay	Loam	Sand	Clay	Loam	Sand
Picloram[c]	0.7	0	0	2.49	1	19
Glyphosate[d]	0.00016	0	0	6.3	0.08	0
Triclopyr[c,e]	0.004	0	0	0.4	0	0

[a] Standard Gleams-Driver site based on climate of Bishop, CA (average annual rainfall 5.34 inches, average annual temperature 56.02 degrees F).
[b] Standard Gleams-Driver site based on climate of Sault Ste. Marie, MI (average annual rainfall 32.94 inches, average annual temperature 40.07 degrees F).
[c] For this herbicide, the Gleams-Driver model assumes herbicide treatment of 10-acre-square field with a 36-inch root zone that drains directly into a 2-meter-wide stream that flows at a rate of 710,000 L/day and with a velocity of 6,900 m/day. Additional input parameters provided in SERA (2011c,d).
[d] For this herbicide, the Gleams-Driver model assumes herbicide treatment of 10-acre-square field with a 60-inch root zone that drains directly into a 2-meter-wide stream that flows at a rate of 710,000 L/day and with a velocity of 6,900 m/day. Additional input parameters provided in SERA (2011a).
[e] Following application of Triclopyr TEA.

Table 3-19. Summary of Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) and Gleams-driver modeling results from USDA Forest Service herbicide risk assessments for herbicide applicaton adjacent to a pond

Herbicide	Maximum Concentrations of Herbicide in a Pond (µg/L per lb/acre applied)					
	Average Annual Precipitation: 10 inches			Average Annual Precipitation: 25 inches		
	Clay	Loam	Sand	Clay	Loam	Sand
2,4-D[a]	0	0	0	17.8	0	0.00000237
Chlorsulfuron[b]	0	0	0	36.77989	0	4.33955
Clopyralid[b]	0	0	0	4.94710	1.15098	6.41084
Dicamba[b]	0	0	0	0.06974	0.00002	0.00964
Imazapic[b]	0	0	0	0.14009	0	0.00970
Metsulfuron-methyl[b]	0	0	0	0.40388	0.03358	0.46725
Sulfometuron-methyl[b]	0	0	0	0.21133	0	0.04038

[a] For this herbicide, the GLEAMS model assumes herbicide treatment of a 10-hectare field with a 60-inch root zone, draining directly into a 1-hectare pond with a depth of 2 meters and a 0.01 sediment fraction. Additional input parameters provided in SERA (2006).
[b] For this herbicide, the GLEAMS model assumes herbicide treatment of a 10-acre-square field with a 60-inch root zone and 4 soil layers that drains directly into a 1-acre pond with a depth of 2 meters and a 0.01 sediment fraction. Additional input parameters provided in SERA (2004a,b,c,d,e,f).

Table 3-20. Gleams-driver modeled maximum peak concentrations of herbicide in a pond

Herbicide	Maximum Peak Concentrations of Herbicide in a Pond (median value of 100 simulations; µg/L per lb/acre applied)					
	Dry/Temperate Location[a]			Average Rainfall/Cool Location[b]		
	Clay	Loam	Sand	Clay	Loam	Sand
Picloram[c]	0.24	0	0	0.9	0.5	13.5
Glyphosate[d]	0.00006	0	0	3.5	0.03	0
Triclopyr[c,e]	0.0013	0	0	0.13	0	0

[a] Standard Gleams-Driver site based on climate of Bishop, CA (average annual rainfall 5.34 inches, average annual temperature 56.02 degrees F).
[b] Standard Gleams-Driver site based on climate of Sault Ste. Marie, MI (average annual rainfall 32.94 inches, average annual temperature 40.07 degrees F).
[c] For this herbicide, the Gleams-Driver model assumes herbicide treatment of 10-acre-square field with a 36-inch root zone that drains directly into a 1-acre pond with a depth of 2 meters and a sediment depth of 2 cm. Additional input parameters are provided in SERA (2011c,d).
[d] For this herbicide, the Gleams-Driver model assumes herbicide treatment of 10-acre-square field with a 60-inch root zone that drains directly into a 1-acre pond with a depth of 2 meters and a sediment depth of 2 cm. Additional input parameters are provided in SERA (2011a).
[e] Following application of Triclopyr TEA.

Results of GLEAMS and Gleams-Driver modeling suggest that no herbicides would be delivered to streams or ponds in arid locations (average annual precipitation of 5 to 10 inches). In locations with higher annual precipitation (25 to 33 inches), herbicides could potentially be delivered to surface waters. Aside from precipitation, soil type is the largest factor influencing herbicide delivery. Runoff is the primary delivery mechanism in clay soils, while percolation is the primary mechanism in sandy soils. GLEAMS modeling suggests that in general, runoff is associated with higher concentration of herbicide in streams and ponds than percolation. To

reduce the risk of herbicides being delivered to surface waters through precipitation, percolation, and runoff design criteria that buffer treatments around water ways and move mixing and loading herbicides out of RCAs would be adheared to.

The results presented in Table 3-17**,** Table 3-18**,** Table 3-19, and Table 3-20 are generic, applied herbicide concentrations (pound/acre). These results can be applied to scenarios within the project area, although with some limitations. For example, under Alternative 2, application of 0.75 pounds per acre of picloram across a 10-acre field adjacent to a stream with similar characteristics as the input parameters in the GLEAMS modeling would likely result in no concentrations of herbicides in water when applied on loamy or sandy soils in arid regions. This same herbicide application scenario applied in a wetter climate within the project area could potentially result in concentrations in an adjacent stream of 0.75 µg/L for application on loamy soils and 14.25 µg/L for application on sandy soils. These concentrations comprise very small fractions of the 0.5 mg/L drinking water standard established by the EPA for picloram.

GLEAMS and Gleams-Driver modeling assumes direct drainage into the water body, but in reality, established buffer zones would likely capture some portion of the herbicide delivered from the treated unit. For example, under Alternative 2, no broadcast spraying would occur within 100 feet of a water body, substantially reducing the potential for herbicides to reach surface water through runoff or percolation. Also, because treatment areas under this alternative would likely be small and isolated (i.e., it is unlikely that an entire 10-acre plot would be treated using ground-based methods), any impacts would be less severe than those shown in the modeling.

This modeling also assumes that the precipitation is evenly distributed in a uniform amount each day for the first year of simulations (SERA 2007b). It is possible that this modeling underestimates herbicide delivery from storms, as herbicide delivery from high-intensity summer thunderstorms would possibly be better modeled using a higher average annual precipitation value.

Adjuvants

Adjuvants are solution additives mixed with herbicide solution to improve performance of a spray mixture. A list of adjuvants used in the SNF and BNF may be found in Appendix D. Adjuvants can increase the effectiveness of an herbicide, sometimes by as much as 5 or 10 times, as well as the selectivity of an herbicide (Tu et al. 2001). These factors could result in less herbicide being required for a specific application, potentially decreasing the effects that an herbicide might have on water quality. Adjuvants can also decrease the potential for herbicide to wash off plant leaves after application, reducing the amount of herbicide that could potentially leach into soil or be mobilized by overland flow.

The potential exists, however, for adjuvants to mobilize and enter water bodies. Risk assessments have been completed for the adjuvants proposed in this project (see Appendix D). The toxicities of herbicides when combined with adjuvants are not generally known, and the environmental fate of many adjuvants is not always known or disclosed; however, the adjuvants proposed in this project are not listed as toxic compounds when used as intended and when label direction is followed. Label direction would always be followed, providing additional assurance that the proper adjuvant would be combined with the correct herbicide at appropriate mixing rates.

Accidental Spills of Herbicide

Under all action alternatives, the potential for normal herbicide application to adversely affect water quality is minimal. With typically small areas being treated, the amount of herbicide involved in a spill would likely be low. Accidental spills of herbicide occurring at staging areas or treatment areas have the potential to impact water quality. These concerns are addressed through numerous design features, BMPs, and label direction requiring spill prevention plans, cleanup kits, equipment inspections, secure transport of only the amount of herbicide needed, stipulations to mix and load herbicides at least 100 feet from water, and the requirement that herbicides are applied by or under the direct supervision of a licensed applicator.

Public Sources of Drinking Water

Herbicide control could potentially occur within the SWPAs established by the IDEQ (see Water Uses in section 3.2.4.9). The SWPAs with the highest infestations of invasive plants are located in the Boise–Mores Subbasin. The Wilderness Ranch Owners SWPA is very large and covers several drainages. Many of the drainages within the Wilderness Ranch Owners SWPA have infestation levels over 20% of the watershed, including Headwaters Grimes Creek, Henry Creek–Grimes Creek, Wild Goat Creek–Grimes Creek, and Granite Creek–Mores Creek. Most of the remaining SWPAs in the project area have infestation levels below 5% of the watershed. Therefore, the areas within those watersheds that would potentially be treated aresmall. For example, the Trail Creek Watershed, supplying water for the City of Ketchum, currently has 310 acres of invasive plant infestations (1.1% of the watershed). Little Cottonwood Creek, which provides water to Oakley Valley Water Cooperation, has 23 acres of invasive plants (0.3% of the watershed). James Creek, supplying water to Atlanta Water Association, has 94 acres of infestation, which is 0.6% of the watershed. Any treatments in these areas would likely be limited to ground-based spot treatments with minimal herbicide output. Furthermore, because most of these areas are undeveloped and will likely remain so, vectors such as roads and trails that could accelerate the spread of invasive plant infestations are not present, and large-scale invasive plant infestations that would require extensive herbicide control are less likely to occur than in more developed areas.

Mitigation measures under the Sawtooth Noxious Weeds Programmatic (NFMS 2012; USFWS 2012) require that no herbicides be applied within a 100-foot radius of any potable water spring development. Additional design features, BMPs, and label direction limit the application of herbicides near water and in riparian areas. Based on the analysis above and considering that only ground-based herbicide application would occur under these alternatives, the effects of herbicide application on water quality would be minimal and would not likely result in exceedances of the EPA water quality standards for drinking water.

Indirect Effects

The ground-based spot and broadcast herbicide applications proposed under the no action alternatives could potentially result in long-term increases in instream sediment loads, impairment of riparian function in the long term, and impairment of soil condition in the long term as a result of expansion of invasive plant infestations. This alternative would not result in any increase in herbicide concentrations in water.

Alternative 1 would likely result in degradation of watershed conditions in the long term and potentially detectable increases in fine sediment loads in streams. These conditions could

potentially contribute to exceedances of stream channel fine sediment standards in the Forest Plans, as well as potential exceedances of State water quality standards. Expansion of invasive plant infestations in riparian areas could also lead to exceedances of Forest Plan bank stability standards in the long term.

3.2.5.2.3. Effects on Riparian Function

Currently, 61,689 acres of inventoried invasive plant infestations are located within RCAs in the project area. The extent of riparian infestations ranges from small, localized occurrences to expansive occurrences (see Affected Environment-Riparian Areas in section 3.2.4.6).

Direct Effects

The action alternatives would have minimal direct effects on riparian function. Biological control methods would have no adverse effects on riparian function, because treatment would be target-specific, and no off-target impacts to riparian vegetation would occur. Similarly, herbicide control methods would have minimal adverse effects because only target-specific, ground-based spot applications would occur within 50 feet of streams and ponded water bodies, with no likely effects to nontarget species. Ground-based broadcast application in RCAs outside of this 50-foot buffer could result in some off-target impacts to native riparian vegetation, depending on the herbicide used.

A small amount of short-term localized disturbance to existing riparian vegetation would occur as a result of mechanical methods and rehabilitiation/restoration methods that take place within riparian areas. These short-term negative effects would be overshadowed by long-term beneficial effects, with the overall result being a decrease in invasive plant infestations at treated sites. Impacts to riparian function would be minimal because in many cases where treatments would occur, and particularly in the case of rehabilitation/restoration treatments, riparian function may already be compromised by invasive plant infestations.

Indirect Effects

The action alternatives would have a number of indirect adverse effects on riparian function related to the spread of invasive plants in RCAs. Because these alternatives limit treatment methods within riparian areas to biological control, ground-based spot herbicide application, ground-based broadcast application at locations greater than 50 feet from water, manual/mechanical control, and rehabilitation/restoration, and also limits annual herbicide control within 100 feet of water to 550 acres, it is unlikely that these treatments would keep up with the spread of invasive plants in riparian areas or result in a reduction in total invasive plant infestations within RCAs. The total acres of infestations within RCAs is likely to increase slightly over the next 10 to 15 years under the action alternatives, but at a lesser rate than under Alternative 1.

Potential indirect effects related to the continued spread of invasive plants in riparian areas under Alternative 2 would include decreased bank stability, increased bank erosion, and changes to channel morphology related to the decreased rooting strength of invasive plants compared to native woody shrubs in the long term. These impacts would be similar to those described under Alternative 1 (see section 3.2.5.1), but the rate of change would be slower and the magnitude of change would be less. Because existing large invasive plant infestations within RCAs would continue to spread, the riparian ecosystem within and around these infestations would likely

continue to decline in structure and productivity. However, current management strategies would allow for effective treatment of some small, localized infestations in riparian areas.

3.2.5.3. Alternative 2—Current Management

Alternative 2, the Current Management Alternative, continues the adaptive IWM program as it is currently implemented in the project area. In general, this alternative includes the treatment of invasive terrestrial plants utilizing biological, mechanical, and\or herbicide treatments. Herbicide application under this alternative is limited to the treatment of terrestrial invasive plants with 12 herbicides and utilizing ground-based application techniques exclusively.

3.2.5.3.1. Direct and Indirect Effects of Alternative 2

The effectiveness of methods approved under the current management strategy for treatment of invasive plant infestations is limited. Biological controls do not act quickly and may only be effective when combined with other effective treatment methods. Manual/mechanical and rehabilitation/restoration controls are the least cost-effective methods and cannot be used to treat large infested areas. Ground-based herbicide control methods are more cost effective than manual/mechanical methods, but cannot effectively treat large infested areas. The herbicides currently approved for use provide limited options for treatment in riparian areas. Even when implemented together, the use of these methods under existing budgetary constraints is not likely to be sufficient to treat the existing infestations and prevent the further spread of invasive plants.

Under Alternative 2, invasive plant infestations within the project area are expected to continue to spread, but the percentage of annual expansion of invasive plants would be less than under Alternative 1. The 3-year average (2010–2012) annual number of acres treated on both Forests is approximately 6,000 acres. This is a factor of methods available for use, as well as funding available to implement these methods. With 156,777 acres of inventoried invasive plant infestations currently, in addition to an unknown number of acres of noninventoried infestations, this level of treatment would not be able to reverse the trend even if the annual rate of expansion was only 5% (7,800 acres). The current management strategy focuses on EDRR, treating small infestations that have the potential to spread into uninfested areas and treating larger infestations along established vectors. However, the current management strategy is not likely to effectively treat large, more remote infestations using the currently approved methods.

Consultation for Section 7 of the ESA for the SNF regarding the current invasive plant treatment was completed with the regulatory agencies (NMFS and USFWS) in November 2012. The Biological Opinion received from the NMFS specified that take would occur if herbicide treatments exceed 158 acres annually within 300 feet of surface water in the Salmon River Basin portion of the Sawtooth NRA (NMFS 2012). The last 3-year average for occupied anadromous water was 23.6 acres of applied herbicide within 300 feet of water. The Biological Opinion received from USFWS authorizes a total of 173 acres of annual herbicide treatments within 100 feet of streams of identified bull trout population (USFWS 2012). The last 3-year average in occupied bull trout water was 22.2 acres of applied herbicide within 100 feet from water.

Although limited aquatic invasive plant species have been found on either Forest, a likely threat exists that aquatic weeds could become established on the Forests. As discussed in the Alternative 1 Effects Analysis (section 3.2.5.1), boat inspections have intercepted aquatic invasives weeds in several locations on both Forests in the past. A hybrid Eurasian and Northern watermilfoil was found on the Lowman RD at Lowman Nature Ponds and treated by IDFG.

Eurasian watermilfoil has also been found on other properties close to the NFS boundary. Once established, aquatic invasive plant species are extremely difficult to eradicate and pose serious threats to the ecological integrity of aquatic environments. The spread of an invasive species such as Eurasian watermilfoil could cause drastic effects on lakes over a short period of time. With limited mechanisms for controlling such an infestation under Alternative 2, the effects of such an infestation on water chemistry would be the same as described under Alternative 1 (see section 3.2.5.1).

Effects on Soil Condition

Treatment of invasive plants under Alternative 2 would have minimal direct adverse effects on soil resources, largely due to the small number of acres that would be treated within the 4.3-million-acre project area. Established design features (see section 2.2), BMPs (see section 2.2), and label direction for herbicide control would minimize the potential for herbicides to affect soil and water resources.

Herbicide Concentrations in Soils: GLEAMS and Gleams-Driver simulations in the Forest Service herbicide risk assessments (SERA 2004a,b,c,d,e,f; 2006, 2011a,c,d) were used to model concentrations of herbicides used under Alternative 2 in soil and maximum penetration into the soil. For all herbicides, the highest modeled concentrations occurred in clay soils, and the lowest concentrations occurred in sandy soils. These differences are related to losses associated with percolation, with sandy soils having higher infiltration rates and higher herbicide mobility. Modeling indicates that herbicide concentrations in the top 12 inches of soil often decrease with increasing precipitation because of losses related to percolation; however, this is not always the case, depending on herbicide properties. Differing rates of precipitation do not make as much of a difference in herbicide concentrations in soils as in streams and ponds. However, differing rates of precipitation make a large difference on the depth of soil penetration of herbicides, with deeper penetration occurring in wetter climates. For herbicides that were modeled using Gleams-Driver at 1 pound per acre, herbicide penetration occurred up to a depth of 36 inches in an average rainfall/cool climate and up to 18 inches in a dry/temperate climate. The arid conditions within most of the project area would inhibit deep penetration of herbicide into soils.

Soil Microbes: Some of the herbicides proposed for use under Alternative 2 could have short-term adverse impacts to microbial communities within soils (Table 3-16). Picloram, sulfometuron-methyl, and triclopyr have been shown to exhibit some level of toxicity to microorganisms, even at low application rates (Weidenhamer and Callaway 2010; SERA 2011c,d; 2004f). All other herbicides proposed for use under Alternative 2 have low or short-term toxicity to soil microbes. In areas heavily infested with invasive plants, microbial communities and mycorrhizal associations may already be adversely affected by secondary compounds released by certain invasive plants (Alford et al. 2009, Weidenhamer and Callaway 2010). Eradication of invasive plant infestations and reestablishment of native vegetation would allow for the recovery of soil microbes in the long term. Trevors (1998) has suggested that most effects to soil microbes occur when herbicides are applied at higher than recommended concentrations. A review of research also indicates that the effects of herbicides on soil microbes are highly variable and dependent on numerous environmental conditions. Furthermore, any potential short-term impacts would occur to a very small percentage of soils on a watershed scale because of the limited extent of treatments that would occur under this alternative.

Alternative 2 would have a number of indirect long-term effects on soil erosion, organic material, soil mechanics, soil nutrients and chemistry, and soil microbes related to the presence of invasive species. These effects would occur as a result of the expected continued spread of existing invasive plant infestations. The effects would be similar to those described under Alternative 1, but the magnitude of these effects and the rate of change would be less severe because the rate of spread of invasive plant infestations would be lower.

Soil Erosion: Direct effects of Alternative 2 on soil erosion would include minor short-term disturbances from manual/mechanical and rehabilitation/restoration treatments. These localized, short-term effects would have minimal impacts on overall soil condition, with the desired long-term result being improvement of soil condition as native species are reestablished. Furthermore, many of these treatments (particularly rehabilitation/restoration) would occur in locations where soil condition is already degraded because of existing large-scale invasive plant infestations. Any potential short-term impacts would occur to a very small percentage of soils on a watershed scale because of the limited extent of treatments that would occur under this alternative.

Effects on Watershed Condition

Effects on Instream Sediment Loads

Direct Effects

Under Alternative 2, direct effects on sediment yield caused by the implementation of invasive plant treatments would be minimal and would not likely have any measureable effect on basin sediment yields. Biological control treatments would have no direct effects on sediment, because no ground disturbance would occur during implementation. Manual/mechanical, herbicide, and rehabilitation/restoration control methods would all have minimal direct effects on sediment production and instream sediment loads as a result of minimal ground disturbance occurring during implementation. Potential sources of erosion are discussed below.

Further effects to instream sediment loads can be found in Effects Common to All Action Alternatives (section 3.2.5.2).

Indirect Effects

Alternative 2 would have a number of indirect effects related to erosion and sediment input into streams or other water bodies. Under this alternative, invasive plant infestations are expected to spread, despite efforts to eliminate them. Effects related to sediment could occur as a result of changes in ground cover composition caused by the spread of invasive plants and subsequent loss of native ground cover, as described under Alternative 1 (see section 3.2.5.1). Invasive plant management would focus on the highest-priority areas and the prevention of the spread of new infestations into uninfested areas. Large existing infestations are less likely to be treated using methods available under this alternative, and these areas would continue to be sources of erosion and sediment production. Because the rate of spread of invasive plant infestations would be less than under Alternative 1, the magnitude of these effects would be less than under Alternative 1. The current biological, herbicide, manual/mechanical, and rehabilitation/restoration methods would result in increased ground cover and improved root structure that would stabilize soils and protect soils from erosive forces such as wind, raindrop impact, and runoff, resulting in decreased sediment delivery to streams in the long term.

The use of herbicides to treat invasive plants under Alternative 2 could result in increased soil exposure and erosion potential in the short term as a result of vegetation mortality. However, because herbicide treatments under this alternative would be limited to localized ground-based spot and broadcast applications, mortality of nontarget species would be limited, and these treatments would not result in large areas of increased soil exposure. Increased soil exposure could occur in small areas, particularly in monotypic stands of invasive plants where broadcast application occurs. The buffer requirements from flowing water and ponded water bodies for broadcast application would help to minimize any effects of soil exposure causing sediment to reach water in the short term. Reestablishment of native vegetation in treated areas would result in an overall reduction in sediment yield from these slopes in the long term.

Effects of Herbicide Concentrations in Water

The herbicide treatments that would be used under Alternative 2 include only ground-based spot and broadcast applications; 12 herbicides are currently available for upland use under this alternative, and 9 of these herbicides are available for use in riparian areas.

Direct Effects

Direct effects of herbicide concentrations in water can be found in Effects Common to All Action Alternatives (section 3.2.5.2). Additional discussion under the context of Alternative 2 is presented below.

Treatment of invasive plants under Alternative 2 would have minimal direct adverse effects on soil and water resources, largely because of the small number of acres that would be treated within the 4.3-million-acre project area. Established design features (see section 2.2), BMPs (see section 2.2), and label direction for herbicide control would minimize the potential for herbicides to affect soil and water resources. Effects of individual herbicides are discussed in Effects Common to All Action Alternatives (section 3.2.5.2).

The expansion of invasive plant infestations into areas containing native vegetation could over time drastically alter vegetation composition, having indirect effects on sediment yield, soil productivity, water availability, runoff potential, and riparian function in these areas. Impacts would be concentrated where vectors allow the spread of invasive plants; however, some vectors such as wind can affect large areas. Because treatments under Alternative 2 would limit the spread of some new infestations and potentially decrease the severity of some existing infestations, the effects described above would be less severe and would occur over a longer time frame than those described under Alternative 1. These potential effects are discussed in terms of the established measurement indicators in Effects Common to All Action Alternatives (section 3.2.5.2).

<u>Herbicide Pathways to Water</u>

The potential for herbicides to enter water under each of the mechanisms described in Norris et al. (1983) was presented in Effects Common to All Action Alternatives (section 3.2.5.2). Additional discussion of these mechanisms under the context of Alternative 2 is presented below.

The potential for herbicides to enter water through ground-based spot and broadcast treatment operations by direct application, drift, mobilization in ephemeral streams and channels, overland flow, or leaching under Alternative 2 is low for those areas covered under the Sawtooth Noxious Weeds Programmatic, based on the limited acres of herbicide applied within 300 feet from

anadromous water (4-year average of 22.2 acres), and within 100 feet of streams with identified bull trout populations (4-year average of 23.6 acres).

Although the BNF and the Minidoka RD of the SNF do not have restrictions as specific as those in the Sawtooth Noxious Weeds Programmatic Biological Opinion, established design features (see section 2.2), BMPs (section 2.2), and label direction for herbicide control would help to minimize any direct impacts to soil and water resources. The potential for these treatments to affect concentrations of herbicide in water is discussed below, under the context of the mechanisms suggested by Norris et al. (1983).

Direct Application

Direct application of herbicide to water under this alternative is very unlikely to occur. Most invasive plant treatments would occur a considerable distance from water. For treatments within riparian areas within the scope of the Sawtooth Noxious Weeds Programmatic, mitigation measures requiring buffer widths of 15 feet from all water would apply for all herbicides except 2,4-D and glyphosate, which could be applied up to the water's edge using hand selective methods (e.g., wicking, wiping) on individual plants. Only spot applications would be permitted within 50 feet of flowing water and ponded water bodies, allowing precise treatment of target plants only and leaving a minimal chance of herbicide being applied directly to nearby water bodies. Design criteria require that no broadcast application occur within 100 feet of water. Although the BNF and the Minidoka RD of the SNF do not have restrictions as specific as those in the Sawtooth Noxious Weeds Programmatic, label requirements would be followed, and applications would only be performed by or under the direct supervision of licensed Idaho professional herbicide applicators, providing a high level of assurance that herbicides would be applied correctly.

Drift

Drift of herbicide into water bodies is also very unlikely to occur under Alternative 2. As discussed above, only focused spot spraying and hand selective applications would be permitted within 50 feet of water. Broadcast spraying would not be allowed within 100 feet of water. These treatments would have very low potential for drift because herbicide would be applied directly to plants near ground level. Mitigation measures under the Sawtooth Noxious Weeds Programmatic would also prohibit any broadcast spraying within riparian areas when the wind speed exceeds 5 mph, virtually eliminating the possibility of any accidental drift of herbicide into water bodies. Although ground-based broadcast spraying has a higher likelihood of causing drift, no ground-based broadcast spraying would occur within 100 feet of streams or ponded water bodies, thereby minimizing the risk of drift into water bodies. The BNF and the Minidoka RD of the SNF do not have specific restrictions regarding broadcast spraying such as those in the Sawtooth Noxious Weeds Programmatic; some potential for drift of herbicides into water bodies is possible in those locations.

Mobilization in Ephemeral Streams and Channels

The potential for mobilization of herbicide in ephemeral streams and channels during subsequent runoff events would be minimal under Alternative 2. Ground-based spot applications could be applied in these areas, but would target specific plants. Under the Sawtooth Noxious Weeds

Programmatic, ground-based broadcast applications would not occur within 50 feet of streams, but could be applied to dry ephemeral channels.

Overland Flow

Mitigation measures in the Sawtooth Noxious Weeds Programmatic specifying that no herbicide application would occur if rain is occurring or imminent decreases the potential for herbicide mobilization from runoff.

Other Factors Related to Potential Herbicide Delivery to Water Sources

Herbicide modeling, the use of adjuvants, accidental spills of herbicides, public sources of drinking water were discussed in Effects Common to All Action Alternatives (section 3.2.5.2).

3.2.5.3.2. Cumulative Effects of Alternative 2

The cumulative effects analysis area for Alternative 2 is the same as that described for Alternative 1.

Under Alternative 2, biological, mechanical, and ground-based herbicide control of invasive plant infestations would continue to occur. The direct and indirect effects of these treatments would include localized areas of ground disturbance and a low risk of herbicides entering bodies of water. Any adverse effects that would occur would likely be short term and would be followed by long-term beneficial effects related to the control of invasive plant infestations and reestablishment of native vegetation in those areas.

Alternative 2 would result in minimal cumulative effects related to the direct and indirect effects of treating invasive plants using biological, mechanical, herbicide, and rehabilitation/restoration control methods.

Biological Control Methods

Biological control methods would have no cumulative effects on water and soil condition because no ground disturbance would occur.

Mechanical and Rehabilitation/Restoration Control Methods

Mechanical and rehabilitation/restoration control methods would have minimal cumulative effects in addition to other activities occurring in the area because of the highly localized nature of the disturbance and the very small percentage of the project area that would be treated. This short-term disturbance would not exacerbate the effects of other activities in the project area, and would ultimately provide a long-term benefit.

Herbicide Control

Ground-based herbicide control would have minimal cumulative effects on soil condition because of the highly localized nature of the disturbance and the very small percentage of the project area that would be treated annually. Other potential sources of soil condition impairment within the analysis area include county herbicide application and application of herbicide on private lands. Herbicides are applied by CWMAs by county, as well as by the BLM. This report’s numbers do not include herbicide applied by private landowners. Because these treatments have little overlap with the treatments proposed in this project, label application rates per acre would not be exceeded, and the cumulative effects on soil condition would be minimal. Although herbicide use rates on private lands are unknown, the application of herbicide on NFS

lands is likely to be considerably less than that on private agricultural lands because of differing treatment objectives.

Cumulative Effects of Invasive Plant Infestations

Because methods under Alternative 2 are not sufficient to cause an overall decline in invasive plant infestations on a watershed scale, the indirect effects of this alternative include gradually increasing sediment yield and sediment loads as a result of the gradual spread of invasive plants and decreased ground cover. Cumulative effects related to these indirect effects combined with other ongoing and foreseeable future activities could occur in the long term, as discussed in Cumulative Effects for Alternative 1 (section 3.2.5.1.3), but to a lesser degree because of the expected slower rate of spread.

Analysis of cumulative effects at the subwatershed scale using the Watershed Condition Framework is described in section 3.2.5.1.3. A matrix was developed to assess the risk of cumulative effects for Alternative 2 based on these factors (Table 3-21). Continuation of existing invasive plant treatments would slow the spread of invasive plants such that watersheds currently with less than 5% infested acres would have minimal cumulative effects. However, because of the expected continued spread of invasive plant infestations, the risk of cumulative effects would be higher for Class 2 watersheds with over 5% infested acres and Class 1 watersheds with over 10% infested acres.

Table 3-21. Long-term cumulative effects risk matrix for 6th-level watersheds for Alternative 2 (Current Management Alternative)

Watershed Condition Class	Percent of Watershed Infested by Invasive Plants				
	<1%	1%–5%	5%–10%	10%–25%	>25%
1	L	L	L	M	H
2	L	L	M	H	H
3	L	M	H	H	H

Note: L = low; M = moderate; H = high

Under Alternative 2, the long-term effects of the gradual spread of invasive plants would likely result in cumulative effects in some 6th-level watersheds, based on this analysis. As invasive plants continue to spread as predicted under Alternative 2, cumulative effects would gradually increase, leading to additional watershed impairment. However, these effects would be less severe than under Alternative 1 because the rate of spread of invasive plants is expected to be less, and existing invasive plant control would target high-priority areas where cumulative effects are more likely to occur.

Under Alternative 2, 35 watersheds are at high risk for cumulative effects, 25 watersheds are at moderate risk, and 248 watersheds are at low risk. The majority of the high and moderate watersheds are located in the Boise Basin CWMA, where invasive plant infestations are most concentrated. Because the spread of invasive plants affects many of the attributes in the Watershed Condition Framework, it is possible that these cumulative effects could result in degradation of watershed condition class for watersheds with moderate or high cumulative effects risk ratings in the long term (greater than 10 years).

3.2.5.3.3. Alternative 2 Summary

Alternative 2 would potentially result in a gradual long-term decline in soil condition. Alternative 2 would be compatible with Forest Plans and other regulatory direction with respect to soil resources.

Risk of Impacts to Soil Biota: Some of the herbicides proposed for use under Alternative 2 could have short-term adverse impacts to microbial communities within soils (Table 3-16). Picloram, sulfometuron-methyl, and triclopyr have been shown to have some level of toxicity to microorganisms, even at low application rates (Weidenhamer and Callaway 2010; SERA 2011c, 2004f, 2011d). All other herbicides proposed for use under Alternative 2 have low or short-term toxicity to soil microbes. In areas heavily infested with invasive plants, microbial communities and mycorrhizal associations may already be adversely affected by secondary compounds released by certain invasive plants (Alford et al. 2009; Weidenhamer and Callaway 2010). Eradication of invasive plant infestations and reestablishment of native vegetation would allow for the recovery of soil microbes in the long term. Trevors (1998) has suggested that most effects to soil microbes occur when herbicides are applied at higher than recommended concentrations. A review of research also indicates that the effects of herbicides on soil microbes are highly variable and dependent on numerous environmental conditions. Furthermore, any potential short-term impacts would occur to a very small percentage of soils on a watershed scale because of the limited extent of treatments that would occur under this alternative.

Risk of Increased Soil Erosion: Direct effects of Alternative 2 on soil erosion would include minor short-term disturbances from manual/mechanical and rehabilitation/restoration treatments. These localized, short-term effects would have minimal impacts on overall soil condition, with the desired long-term result being improvement of soil condition as native species are reestablished. Furthermore, many of these treatments (particularly rehabilitation/restoration) would occur in locations where soil condition is already degraded because of existing large-scale invasive plant infestations. Any potential short-term impacts would occur to a very small percentage of soils on a watershed scale because of the limited extent of treatments that would occur under this alternative.

Instream Sediment Loads, Herbicide Concentrations in Water, and Riparian Function:

Under Alternative 2, direct effects on sediment loads caused by the implementation of invasive plant treatments would be minimal and would not likely have any measureable effect on basin sediment loads. Biological control treatments would have no direct effects on sediment, because no ground disturbance would occur during implementation. Manual/mechanical, herbicide, and rehabilitation/restoration control methods would all have minimal direct effects on sediment production and instream sediment loads as a result of minimal ground disturbance occurring during implementation.

The use of herbicides to treat invasive plants under Alternative 2 could result in increased soil exposure and erosion potential in the short term as a result of vegetation mortality. However, because herbicide treatments under this alternative would be limited to localized ground-based spot and broadcast applications, mortality of nontarget species would be limited, and these treatments would not result in large areas of increased soil exposure. Increased soil exposure could occur in small areas, particularly in monotypic stands of invasive plants where broadcast application occurs. The buffer requirements from flowing water and ponded water bodies for broadcast application would help to minimize any effects of soil exposure causing sediment to

reach water in the short term. Reestablishment of native vegetation in treated areas would result in an overall reduction in sediment yield from these slopes in the long term.

Overall, Alternative 2 would potentially result in minimal short-term and slight long-term increases in instream sediment loads, a gradual long-term decline in riparian function, and slight short-term impairment and gradual long-term decline in soil condition. The effects of herbicide concentrations in water from this alternative would be minimal. This alternative would result in a high risk of cumulative effects in 35 watersheds and a moderate risk in 25 watersheds.

Alternative 2 would be compatible with Forest Plans and other regulatory direction with respect to soil and water resources.

3.2.5.4. Alternative 3—Proposed Action

Alternative 3, the Proposed Action, includes a variety of methods to prevent the establishment of new invasive plant species, prevent further spread of existing invasive plant infestations, and maintain native plant communities. Alternative 3 would implement an adaptive IWM strategy to eradicate or control existing or newly discovered invasive plants over the next 10 to 15 years, as budgets allow (Appendix I). Alternative 3 identifies the treatment of up to 20,000 acres of invasive plants annually. Proposed treatment methods would include biological control on up to 2,000 acres annually, mechanical control on up to 2,000 acres annually, and herbicide control on up to 16,000 acres annually. Herbicide control would occur through ground-based, aerial, and aquatic application methods. One herbicide would be dropped from use (diflufenzopyr) and 3 new herbicides would be added for use (fluroxypyr, imazapyr, and imazamox), as compared to Alternative 2.

3.2.5.4.1. Direct and Indirect Effects of Alternative 3

Under Alternative 3, existing invasive plant infestations are expected to gradually decline as existing invasive plant infestations are treated and the spread of new infestations into susceptible areas is prevented through an EDRR approach. Alternative 3 would utilize a variety of methods to halt the spread of invasive plants and reintroduce native vegetation to existing infested areas. It is expected that vegetative cover would improve in the long term over existing conditions, resulting in beneficial effects to soil and water resources.

Treatment of invasive plants under Alternative 3 would have minimal direct adverse effects on soil and water resources. With a maximum of 20,000 acres treated annually per forest, or less than 0.5% of the 4.3-million-acre project area, any impacts would likely be minimal on a watershed scale. Design criteria, BMPs, and label direction would minimize the potential for herbicides to adversely affect soil and water resources. Potential effects are discussed in the following sections.

As opposed to Alternative 2, Alternative 3 would be able to effectively and efficiently treat a large number of acres using aerial herbicide control. This treatment method would avoid the ground-disturbing effects that could occur if ground-based mechanical and herbicide treatments were used to treat these same acres. However, aerial application of herbicide also increases the potential for nontarget application of herbicide and the potential for herbicide to be mobilized into surface water or groundwater. These potential effects are discussed in the following sections.

Aquatic herbicide control is also a component of Alternative 3 that is not proposed in Alternative 2. Potential effects of aquatic herbicide control on water quality include short-term direct adverse effects, short-term indirect adverse effects, and long-term beneficial effects. These effects are discussed in the following sections.

Indirect effects of Alternative 3 would include potential short-term adverse effects and long-term beneficial effects to soil and water resources. A reduction in the size of existing invasive plant infestations would, over time, lead to improved vegetative cover, decreased sediment yields, improved soil condition, and improved riparian function. These effects are also discussed in the following sections.

Effects on Soils Condition

Alternative 3 would have limited direct adverse effects on soil condition caused by ground disturbance and the effects of herbicides on microbial communities within soils.

Herbicide Concentrations in Soils: GLEAMS and Gleams-Driver were used in the Forest Service herbicide risk assessments to model concentrations of herbicides in soil and maximum penetration into the soil column (SERA 2004a,b,c,d,e,f; 2007a; 2010; 2011a,b,c,d). Generic soil modeling results for the 3 additional herbicides considered in Alternative 3 are presented in Table 3-23 and Table 3-24. Modeling of all herbicides considered in Alternative 3 indicates that herbicide concentrations in the top 12 inches of soil often decrease with increasing precipitation because of losses related to percolation. However, this is not always the case. For all herbicides, the highest modeled herbicide concentrations in soils were in clay soils. Concentrations in loamy and sandy soils were lower because of losses associated with percolation. Of the 3 additional herbicides considered in Alternative 3, aminopyralid has the highest mobility, with modeling suggesting that leaching can occur to 60 inches or greater in all soil types in average rainfall/cool climates. Aminopyralid is more likely to reach groundwater than all other herbicides considered.

Soil Erosion: Direct effects of Alternative 3 on soil loss would include minor disturbances from manual/mechanical and rehabilitation/restoration treatments, as well as motorized access for herbicide treatments that could result in localized occurrences of soil loss in the short term during subsequent runoff events. These effects would be greater than under Alternative 2 because of the larger number of acres that would be treated. Similar to Alternative 2, many of these treatments would occur in locations where soil productivity is already limited because of existing invasive plant infestations. On a watershed scale, however, with only 2,000 acres per forest of mechanical treatment proposed throughout the 4.3-million-acre project area, these effects would have minimal effect. Biological control methods would have no impact on soil loss.

Soil Microbes: Herbicide treatment methods would be the only mechanism under Alternative 3 that would have direct effects on microbial communities in soil. With the ability to treat nearly twice as many applied acres as the maximum allowed under Alternative 2, the effects of Alternative 3 on soil microbial communities would potentially be greater than that described under Alternative 2. Short-term effects to soil microbes would likely occur as a result of broadcast and aerial herbicide applications because of the likelihood that a portion of the herbicide would directly reach the soil using these methods. Some herbicides have been shown to be toxic to some microorganisms. The 3 new herbicides under Alternative 3 would exhibit low or unknown toxicity to soil microbes (Table 3-16). Microbial communities in many treatment

areas would likely be already compromised by the effects of the invasive plant infestations themselves. Any short-term effects caused by herbicide application would ultimately be overshadowed by the long-term beneficial effects of invasive plant eradication and reestablishment of native riparian vegetation, which would allow the recovery of biological communities within the soil.

It is expected that invasive plant infestations would decrease in size and extent under Alternative 3. Therefore, the indirect effects described under Alternative 2 on soil erosion, organic material, soil mechanics, soil nutrients and chemistry, and soil microbes related to the presence of invasive species would not occur under Alternative 3 or would occur to a lesser extent. However, Alternative 3 could result in short-term increases in soil loss as a result of target and nontarget vegetation mortality on slopes after treatment. These effects would be overshadowed by the long-term benefits of restoring native vegetation, which would improve soil condition.

Effects on Watershed Condition

Effects on Instream Sediment Loads

Direct Effects

Under Alternative 3, direct adverse effects on sediment yield caused by the implementation of invasive plant treatments would be minimal and would likely have no measurable effect on basin sediment yields. Potential sources of erosion are the same as those discussed under Alternative 2 (see section 3.2.5.3.1) related to ground disturbance caused by the treatments themselves. Alternative 2 identified the maximum number of acres that would be treated under the various methods (see Chapter 2). As compared to the last 3 years under current management, Alternative 3 would result in considerably more acres treated annually.

Biological control methods would have no direct effects on sediment loads, because ground-disturbing activities would not occur under this method.

Ground disturbance as a result of on-road and off-road access to transport and spray herbicides would be minimal. Compared to Alternative 2, this activity would cover more acres, but design criteria and BMPs would minimize any site-specific impacts. Repetitive off-road travel is not likely to occur over the same route, limiting the amount of soil disturbance and potential erosion that could occur. Design criteria restrict off-road travel if damage to soils could occur due to wet conditions, requiring that no visible “trail” creation occurs. Furthermore, the use of aerial application would allow treatment of large areas using herbicide with no ground disturbance.

Manual and mechanical treatments would occur on up to 2,000 acres on each Forest. Compared to Alternative 2, this activity would cover more acres than the annual average over the last 3 years, but design criteria and BMPs would help to minimize any disturbance. Short-term ground disturbance would occur where manual control methods such as hand pulling occur, but because this method can only be effectively used for small infestations, any impacts would be highly localized. It is not likely that soil or bare ground exposed by these isolated impacts would result in measurable increases in stream channel sediment loads, and the long-term effects of reestablishing native plants would be beneficial to water quality.

The most extensive direct ground disturbance would occur during rehabilitation/restoration activities. However, design criteria limiting treated slopes to less than 45% and landtype erosion

hazard ratings to low or moderate would prevent large-scale erosion from occurring during and after these treatments. Also, because soils in these areas would likely be already experiencing increased erosion as a result of invasive plant infestations, additional ground disturbance would likely have minimal additional effects on erosion or water quality, and the long-term effects would be beneficial. These effects would be the same as under Alternative 2.

Indirect Effects

Herbicide treatments could result in increased soil exposure and erosion potential in the short term as a result of vegetation mortality and decreased ground cover, particularly in monoculture stands of invasive plants or if nontarget species are widely affected by herbicide treatments. This would be most likely to occur with broad-spectrum herbicides during ground-based or aerial broadcast applications. However, design criteria, BMPs, and appropriate selection of herbicide would limit these effects by ensuring that methods minimize to the extent possible the application of herbicide to nontarget species. These potential effects are likely to occur in the short term (less than 1 year), prior to reestablishment of native vegetation.

Any short-term increases in sediment delivery caused by vegetation mortality after herbicide treatment would likely be overshadowed by the long-term indirect beneficial effects occurring as a result of reestablishment of native vegetation. The proposed biological, herbicide, manual/mechanical, and rehabilitation/restoration methods would result in increased ground cover and improved root structure that would stabilize soils and protect soils from erosive forces such as wind, raindrop impact, and runoff, resulting in decreased sediment delivery to streams in the long term.

Although the indirect effects of existing invasive plant infestations may currently include increased sediment loads, increased turbidities, channel aggradation, and decreased channel stability (see section 3.2.5.1.1), these effects would gradually diminish over time under this alternative as invasive plant infestations are controlled.

Hillslope Scenario

Under Alternative 3, the greatest potential for water quality impairment related to sediment would be from decreased ground cover and increased soil exposure related to aerial herbicide application. The potential magnitude of these effects has been analyzed for an example treatment scenario (Table 3-22) using the Disturbed WEPP model (Elliot and Hall 2010) to predict the probability of erosion and sediment delivery.

Table 3-22. Erosion modeling results before and after aerial herbicide treatment of a knapweed-infested hillslope near Crooked River from the Disturbed Water Erosion Prediction Project (WEPP) program

Aerial Treatment of Knapweed on 60% Slope with Sandy Loam Soils		Pre-treatment	Immediately Post-treatment	2 Years Post-treatment
Upper Slope	Gradient (top/mid)	60% / 60%	60% / 60%	60% / 60%
	Horizontal length	900 ft	900 ft	900 ft
	Vegetation condition/treatment	"Skid Trail"	"Skid Trail"	"Good Grass"
	Percent Vegetation Cover	25%	10%	50%
	Percent Rock	20%	20%	20%
Lower Slope	Gradient (top/mid)	30% / 30%	30% / 30%	30% / 30%
	Horizontal length	100 ft	100 ft	100 ft
	Vegetation condition/treatment	"Skid Trail"	"Skid Trail"	"Good Grass"
	Percent Vegetation Cover	25%	10%	50%
	Percent Rock	20%	20%	20%
Results	Probability of erosion	42%	52%	4%
	Erosion rate (tons/acre): 10-year return period	0.31	0.60	0.00
	Probability of sediment delivery	60%	60%	10%
	Sediment delivery (tons/acre): 10-year return period	0.30	0.60	0.00

Under this scenario, a 1,000-foot-long hillslope is aerially treated with herbicide near Crooked River on a 60% slope of sandy loam soils heavily infested with a monoculture stand of knapweed. The toe of the slope (lower 100 feet of slope) has a 30% gradient. Pre-treatment vegetation conditions include approximately 25% ground cover by knapweed with degraded soil conditions. The Disturbed WEPP "skid trail" condition represents these conditions with respect to ground cover and soil condition. Treatment results in 90% mortality of knapweed, causing a nearly immediate reduction in ground cover from 25% to 10%. These conditions persist for a short period of time, but ground cover improves over the following 2 growing seasons to 50% as native bunchgrasses are reestablished. This improved condition is adequately represented by the "good grass" condition in Disturbed WEPP.

Sediment delivery under this scenario modeled using Disturbed WEPP indicates an increase in the probability of erosion and sediment delivery as a result of vegetation mortality immediately after treatment (i.e., the short-term indirect adverse effects described above). However, potential rates of erosion decrease to near zero after reestablishment of native bunchgrass vegetation (i.e., the long-term indirect beneficial effects described above).

Effects of Herbicide Concentrations in Water

Under Alternative 3, up to 16,000 acres could be treated annually with herbicides, using ground and aerial applications. Aquatic applications could also be used to treat an unspecified number of acres using an EDRR approach. Depending on the proportion of these acres that would occur as aerial application versus ground application, as much as twice the maximum herbicide application could occur as compared to Alternative 2 and approximately 10 times the annual amount applied over the last 3 years. Three additional herbicides not considered in Alternative 2 would also be available for specified uses under Alternative 3: fluroxypyr, imazamox, and imazapyr.

Direct and Indirect Effects

The effects of ground application of herbicides and mechanisms of herbicides to enter water are discussed under the Effects Common to All Action Alternatives (see specifically section 3.2.5.2.2). The following discussion highlights additional effects that would occur under Alternative 3 as a result of 1) additional application methods (aerial and aquatic), 2) additional herbicides to be used, and 3) additional acres that would be treated.

As in Alternative 2, herbicide applications under Alternative 3 have the potential to affect levels of herbicide in water, depending on a number of factors. However, adherence to design criteria, BMPs, and label direction would minimize the potential for any adverse impacts to water quality from herbicide application.

Biological control, manual/mechanical methods, and rehabilitation/restoration methods would have no effects on concentrations of herbicides in water.

Herbicide Properties

Forest Service risk assessments have been completed by SERA for theherbicides proposed under this alternative (SERA 2004a,b,c,d,e,f, 2006, 2007a, 2009, 2010, 2011a,b,c,d and USDA Forest Service 2006). These include 3 additional herbicides not discussed under the Effects Common to All Action Alternatives. Information from these risk assessments for these herbicides regarding herbicide behavior in soil and water is referenced in Table 3-16 and summarized below.

Fluroxypyr—Fluroxypyr is a relatively new herbicide that is registered provisionally as a reduced risk herbicide for control of broadleaf invasive plants. This herbicide may provide similar results as other herbicides, but with reduced risk to some nontarget species. Fluroxyypyr is soluble in water and highly mobile, and is nonpersistent in soil. Therefore, it has the potential to leach into groundwater. Breakdown occurs through soil microbes.

Imazamox—Imazamox is an herbicide used for control of numerous terrestrial and aquatic invasive plants. This herbicide is very soluble in water and adheres poorly with soil. Therefore, it has a high potential to be mobilized during runoff, posing some risk to nontarget plants. Mobility in soil is moderate to high. Degradation occurs primarily through microbial activity in soil.

Imazapyr—Imazapyr is a nonselective herbicide used to control many types of invasive plants. This herbicide is very soluble in water and can be mobilized by runoff. However, imazapyr also binds strongly with organic particles in the soil and can be mobilized in runoff along with eroded soil particles. This herbicide is persistent in soil, and breakdown in soil occurs slowly via microbial activity. Persistence in water is short, and breakdown in water occurs primarily by photolysis.

Herbicide Pathways to Water

The potential for herbicides to enter water under each of the mechanisms described in Norris et al. (1983) was presented in Effects Common to All Action Alternatives (section 3.2.5.2). Additional discussion of these mechanisms under the context of Alternative 3 is presented below.

Direct Application

***Ground Applications*:** Similar to Alternative 2, the potential for direct application of herbicide to water under Alternative 3 would be minimal for ground applications. Design criteria require that no broadcast application occur within 100 feet of water (this is more restrictive than

Alternative 2 in many situations), and ground-based spot applications are highly unlikely to result in direct application to water.

***Aerial Applications*:** Because aerial application would require a 300-foot buffer on all live water (perennial streams, flowing intermittent streams, lakes, ponds, springs, and wetlands), the potential for direct application to water would be minimal. The potential for drift of herbicide to reach water is further discussed in the *Drift* section below.

***Aquatic Applications*:** Direct application to water would occur by design for aquatic herbicide treatments. Under this method, 4 herbicides would be available for use. Although label direction dictates the maximum application rates for the volume of water being treated, proposed typical application rates would generally be less than the label maximum. The Idaho Rapid Response Strategy from the Idaho Aquatic Nuisance Species Plan (Idaho Invasive Species Council Technical Committee 2007) would be followed for all aquatic applications, providing site-specific analysis that takes into consideration the dimensions of the water body, water chemistry, and other factors to minimize the potential effects and provide coordination with state and other agencies. Under these specifications, impairment of water quality as a result of herbicide concentrations would be unlikely to occur. The largest water quality concern likely to occur with aquatic herbicide treatments is the potential effects of oxygen depletion from decaying plant matter following treatment. Following of the EDRR strategy and label direction would minimize these effects as well. Also, because large quantities of herbicide would be transported and applied over water, the potential exists for a spill directly into water. This unlikely scenario is mitigated by a variety of design criteria and is further discussed in the *Accidental Spills of Herbicide* section below.

Drift

***Ground Applications*:** The potential for drift of herbicide to enter water bodies for ground applications under Alternative 3 would be minimal, the same as under Alternative 2. Design criteria restricting application during windy conditions, BMPs, label requirements for buffers, and the lack of broadcast application within riparian areas would minimize the possibility of drift.

***Aquatic Applications*:** Aquatic applications of herbicide would have no risk of drift occurring because herbicides would be applied directly to the water.

***Aerial Applications*:** The greatest potential for drift to occur under Alternative 3 is during aerial applications. However, drift from aerial applications is unlikely to enter surface water, primarily because of the 300-foot buffer widths on all live water. The primary factors influencing drift are wind direction, wind speed, presence of inversion, droplet size, and interception by vegetation. Design criteria and label direction would restrict aerial application to conditions with wind speeds of 5 mph or less. Under these conditions, it is very unlikely that drift would reach surface water. In the unlikely event that drift does occur into the 300-foot buffer, monitoring using spray cards within 300 feet of perennial streams (for monitoring requirement, see Appendix B) would detect the herbicide, allowing applicators to modify practices and prevent any additional impacts. Design criteria would also require ground checking, flagging, and marking using GPS prior to spraying, as well as GPS technology within the aircraft to ensure that only marked areas are actually treated.

A number of studies have been conducted to monitor the amount of drift that has occurred during aerial applications through drift card monitoring as well as through water quality monitoring. Gluns (1989) detected no concentrations of glyphosate in surface water draining a harvest unit in British Columbia treated with an aerial application of 1.78 kg/ha of glyphosate, with 100-meter no-spray buffers on water courses. In a study measuring drift of clopyralid during aerial treatments of starthistle in a California grassland, clopyralid was undetectable in surface water following application of 6 ounces per acre of clopyralid with a 30-meter buffer on stream courses and a slight (5 mph) breeze toward the sampled aquatic sites (DiTomaso et al. 2004). These studies suggest that drift potential is minimal and that 30-meter buffers are adequate for protection of adjacent streams.

The Oregon Department of Forestry studied the potential effects of drift to water quality on 26 stream sample sites adjacent to aerial application of herbicides to forests in western Oregon (Dent and Robben 2000). The study examined applications of glyphosate, chlorothalonil, 2,4-D ester, triclopyr, clopyralid, hexazinone, and sulfometuron, using prescribed buffers under the forest practice rules (60-foot and 300-foot buffers, depending on stream type). Post-spray results showed no detectable concentrations of herbicides at or above 1 ppb. For the 7 samples tested at a minimum detection limit of less than 1 ppb, concentrations of hexazinone and 2,4-D ester in water ranged from 0.1 to 0.9 ppb. This study concluded that the buffers prescribed under the forest practice rules effectively protect water quality during aerial herbicide applications.

The Forest Service has conducted aerial herbicide applications in nearby Montana forests. The Lolo National Forest conducted monitoring of aerial applications of picloram on the Mormon Ridge winter range in 1997 and 1999, in a steep area of rolling topography upslope of and adjacent to Mormon Creek. No picloram was detected in water samples following application, to a detection level of 0.1 ppb. The study also indicated through drift card monitoring that no drift reached Mormon Creek (USDA Forest Service 2010d). Similar results were obtained during monitoring of aerial herbicide applications on the Bitterroot National Forest in 2004 and 2005 (USDA Forest Service 2010d). In this study, no herbicides were detected in surface water or on drift cards placed within the 300-foot buffers.

Abundant research has been conducted on off-target deposition of pesticides used for aerially applied agricultural applications. Riley and Wiesner (1989) concluded that a 100-meter buffer zone “would ensure at least a 10-fold decrease” when compared to the edge of the treatment area, even when winds exceed the maximum recommended wind speed. Bird et al. (1996) showed pesticide deposition at 30 meters downwind of treatment to be 5% of the rate within the treatment area. This value was 0.5% at 150 meters downwind.

Bird et al. (1996) suggested that droplet size is the variable with the largest effect on off-target drift, even more so than wind speed. The researchers suggested that the use of a coarse spray (volume median diameter of 500 µm) could result in a 10-fold decrease in off-target drift as compared to a fine spray (volume median diameter of less than 200 µm).

Past studies show that the potential exists for herbicide drift to occur beyond the 300-foot buffers specified in Alternative 3. However, the amount of herbicide reaching these areas is likely to be very low, and as shown in numerous studies discussed above, the herbicide amounts are not likely to result in detectable concentrations of herbicide in surface water. Design criteria for Alternative 3 requiring the use of larger droplet size to the extent possible, no application when

sustained wind speeds exceed 5 mph, and no application during periods of inversions would minimize the potential for adverse effects to water quality related to drift.

Mobilization in Ephemeral Streams and Channels

***Ground Applications*:** The potential for herbicide to enter water bodies through mobilization in ephemeral channels would be minimal for ground applications under Alternative 3, the same as under Alternative 2.

***Aquatic Applications*:** Aquatic applications of herbicide would have no risk of mobilization in ephemeral channels because herbicides would not be applied to ephemeral channels.

***Aerial Applications*:** Aerial application of herbicide would not occur within riparian zones or within 300 feet of any live water. However, aerial application could occur on ephemeral or intermittent stream channels that do not have flowing water at the time and do not have defined riparian vegetation. In this situation, herbicide could potentially be mobilized during the first runoff event following application, depending on the persistence and other properties of the herbicide. This is further discussed in the "Overland Flow" section below.

Overland Flow

***Ground Applications*:** The potential for herbicide to enter water bodies through mobilization by overland flow under Alternative 3 would be the same as under Alternative 2 for ground applications. Applications under Alternative 3 are likely to cover more acres, but they would occur as scattered, targeted treatments of small infestations and would have minimal effects on water quality on a watershed scale.

***Aquatic Applications*:** Aquatic applications of herbicide would have no risk of mobilization by overland flow because herbicides would be applied directly to water bodies.

***Aerial Applications*:** Aerial herbicide applications are capable of covering large areas with a uniform cover of herbicide. This is the most likely mechanism for herbicides to reach surface water under Alternative 3. Rainfall can mobilize herbicide applied to plants or soil, depending on the herbicide properties.

A number of studies have measured concentrations of herbicides in streams adjacent to aerial herbicide treatment units. The Oregon Department of Forestry measured herbicide concentrations following aerial herbicide applications in western Oregon using buffers prescribed under the forest practice rules (60 feet or 300 feet, depending on stream type). In that study, herbicide concentrations were not detected in any of the 7 samples from 3 sites after the first runoff event following the aerial application (Dent and Robben 2000). McBroom et al. (2013) conducted herbicide runoff studies in paired watersheds in Texas after aerial and ground application of herbicides. They found that herbicides were only detected in streams during storm events, and the peak concentrations were short lived. In this study, approximately 1% to 2% of applied imazapyr and less than 1% of applied hexazinone and sulfometuron were measured in the storm runoff. Aerial broadcast application resulted in higher concentrations in runoff than ground-based banded applications. However, it was also determined that the timing and magnitude of runoff is the largest factor influencing herbicide dispersal.

Because of the variety of processes influencing overland flow discussed above, the mobility of herbicide after aerial treatment will vary greatly with the herbicide being used, the location, and

environmental factors. Therefore, it is not possible to disclose the effects of every possible treatment within the 4.3-million-acre project area. With respect to Alternative 3, the delivery of herbicides to surface water via overland flow is dependent on a number of chemical and environmental factors. The effects of these factors on the delivery of herbicides to surface water are discussed below. Prior to any aerial application of herbicide in Alternative 3, design criteria require that the *Aerial Herbicide Application Coordination and Safety Implementation Plan* (project record) is followed. This coordination would include site-specific analysis of the factors discussed below, in order to determine appropriate treatments that would minimize adverse effects.

a. *Rate of herbicide application and area treated:* Following label recommendations would minimize the potential for mobilization of abundant herbicide during runoff.

b. *Runoff characteristics:* The timing and magnitude of runoff may be the largest factor influencing delivery of herbicides to surface water via overland flow (McBroom et al. 2013). Because some herbicides degrade quickly, very little may be left by the time the first rainstorm occurs. Within the project area, rainstorms can be rare during mid-summer but frequent during late summer.

c. *Soil infiltration capacity:* Soil properties influence how runoff is generated. Soils with low infiltration capacity will have the highest potential for runoff and therefore the highest potential to result in the transport of herbicides to water bodies. Infiltration capacities of the types of soil within the project area are discussed in section 3.2.4.2.

d. *Herbicide properties:* Herbicide properties including soil half-life, sorption coefficient, solubility, and the amount of time until an herbicide is “weatherfast” on leaves and soil influence the amount of herbicide that would be mobilized by overland flow (Table 3-16). Herbicides such as aminopyralid, imazamox, chlorsulfuron, clopyralid, dicamba, metsulfuron-methyl, and picloram with low sorption coefficients and high solubility are most susceptible to transport by overland flow. Herbicide degradation occurs through microbial activity, water, and/or ultraviolet light, depending on the chemical. Herbicides such as 2,4-D and glyphosate degrade relatively quickly by microbial activity and are not likely to be mobilized during runoff unless a storm occurs immediately following application.

e. *Amount of plant uptake of herbicide*: By nature, aerial herbicide application is not target-specific. In areas where invasive plants create dense ground cover (e.g., moist riparian areas), herbicide uptake is likely to be higher than in areas with sparse ground cover (e.g., dry slope with spotted knapweed). Where uptake by plants is low, more herbicide would be residing on the soil surface and could potentially be mobilized by overland flow.

f. *Proximity of application to surface water*: A longer flow path to a water body would result in greater potential for herbicide degradation, adsorption to soil particles and organic matter, and dilution prior to entering the water body.

g. *Streamflow characteristics*: Low streamflow would result in higher concentrations of herbicide, whereas high streamflow would cause rapid dilution. A high ratio of treated area to contributing watershed drainage area would result in higher risk of water quality impacts. For example, a 100-acre treatment in a small upland watershed draining 2 square miles would have a much higher risk to water quality than the same treatment along the Salmon River, which drains 5,500 square miles.

Leaching

***Ground Applications*:** The potential for herbicide to enter water bodies through leaching as a result of ground application would be unlikely under Alternative 3, the same as under Alternative 2 (see section 3.2.5.3). Applications would likely cover more acres, but they would occur as scattered, targeted treatments of small infestations and would have minimal effects on a watershed scale.

***Aquatic Applications*:** Aquatic applications of herbicide would have no risk of leaching because herbicides would be applied directly to water bodies.

***Aerial Applications*:** The processes in which herbicides degrade in soil under Alternative 3 would be the same as discussed for Alternative 2 in section 3.2.5.3.1. However, the potential for herbicides to contaminate groundwater or surface water by way of leaching through soil would be greater than under Alternative 2 because aerial application would result in more direct contact of herbicides with soil.

Under Alternative 3, the potential to contaminate groundwater by leaching of herbicides through soils is low. As discussed in section 3.2.5.3.1, leaching is generally not a prominent mechanism for herbicide mobility because many herbicides are quickly degraded in soil by microorganisms, but the highest potential for groundwater contamination occurs when herbicide is applied over a shallow water table. Neary and Michael (1996) suggest that forest herbicide use poses little risk to groundwater because the rate, frequency, and extent of application are minimal on a watershed scale. In Alternative 3, shallow water tables are limited in the project area to narrow strips along valley floors, and the 300-foot buffers established on all live water would virtually eliminate any treatments over shallow water tables. The presence of shallow water tables would also be an avoidance factor for consideration in the *Aerial Herbicide Application Coordination and Safety Implementation Plan* (project record).

Herbicide Modeling

Modeling of herbicide delivery to a stream and a pond were conducted in the Forest Service herbicide risk assessments (SERA 2004a,b,c,d,e,f; 2006; 2007a; 2010; 2011a,b,c,d). Results of modeling for the 10 herbicides used in Alternative 2 are presented in section 3.2.5.2 (Table 3-17, Table 3-18, Table 3-19, and Table 3-20**)**. Results of modeling for the 3 additional herbicides that would also be used in Alternative 3 are presented in Table 3-23 and Table 3-24.

Table 3-23. Summary of Gleams-Driver modeling results from USDA Forest Service herbicide risk assessments for herbicide application adjacent to a stream, for additional herbicides considered in Alternative 3 (Proposed Action)

Herbicide	Maximum Peak Concentrations of Herbicide in a Stream (median value of 100 simulations; µg/L per lb/acre applied)					
	Dry/Temperate Location[a]			Average Rainfall/Cool Location[b]		
	Clay	Loam	Sand	Clay	Loam	Sand
Fluroxypyr[c]	0.45	0	0	6.33	5.61	1.8
Imazamox[c]	3.7	0	0	25.4	1.51	0.0027
Imazapyr[d]	2.14	0	0	5.2	0.31	5.3

[a] Standard Gleams-Driver site based on climate of Bishop, CA (average annual rainfall 5.34 inches, average annual temperature 56.02 degrees F).
[b] Standard Gleams-Driver site based on climate of Sault Ste. Marie, MI (average annual rainfall 32.94 inches, average annual temperature 40.07 degrees F).
[c] For this herbicide, the Gleams-Driver model assumes herbicide treatment of 10-acre-square field with a 60-inch root zone that drains directly into a 2-meter-wide stream that flows at a rate of 710,000 L/day and with a velocity of 6,900 m/day. Additional input parameters provided in SERA (2007a, 2010).
[d] For this herbicide, the Gleams-Driver model assumes herbicide treatment of 10-acre-square field with a 36-inch root zone that drains directly into a 2-meter-wide stream that flows at a rate of 710,000 L/day and with a velocity of 6,900 m/day. Additional input parameters provided in SERA (2011b).

Table 3-24. Summary of Gleams-Driver modeling results from USDA Forest Service herbicide risk assessments for herbicide application adjacent to a pond, for additional herbicides considered in Alternative 3 (Proposed Action)

Herbicide	Maximum Peak Concentrations of Herbicide in a Pond (median value of 100 simulations; µg/L per lb/acre applied)					
	Dry/Temperate Location[a]			Average Rainfall/Cool Location[b]		
	Clay	Loam	Sand	Clay	Loam	Sand
Fluroxypyr[c]	0.02	0	0	3.18	1.9	0.11
Imazamox[c]	1.63	0	0	24.2	1.16	0.005
Imazapyr[d]	0.8	0	0	2.12	0.29	9.4

[a] Standard Gleams-Driver site based on climate of Bishop, CA (average annual rainfall 5.34 inches, average annual temperature 56.02 degrees F).
[b] Standard Gleams-Driver site based on climate of Sault Ste. Marie, MI (average annual rainfall 32.94 inches, average annual temperature 40.07 degrees F).
[c] For this herbicide, the Gleams-Driver model assumes herbicide treatment of 10-acre-square field with a 60-inch root zone that drains directly into a 1-acre pond with a depth of 2 meters and a sediment depth of 2 cm. Additional input parameters provided in SERA (2007a, 2010).
[d] For this herbicide, the Gleams-Driver model assumes herbicide treatment of 10-acre-square field with a 36-inch root zone that drains directly into a 1-acre pond with a depth of 2 meters and a sediment depth of 2 cm. Additional input parameters provided in SERA (2011b).

Additional potential effects to water quality related to the 3 additional herbicides considered in Alternative 3 would be minimal. In arid climates, herbicide delivery to water bodies would be minimal. The highest delivery of herbicide to water bodies would occur in clay soils or sandy soils, depending on the herbicide. Unlike most other herbicides, concentrations of imazapyr would be highest after application on sandy soils because of high leachability and long persistence. No water quality standards exist for the 3 additional herbicides considered in Alternative 3. As previously discussed, actual concentrations of herbicide reaching water would likely be lower than suggested by modeling because no broadcast application would occur in riparian areas, and buffers would capture a portion of the herbicide.

Adjuvants

The effects of the use of adjuvants on water quality would be minimal, similar to Alternative 2. The proper use of adjuvants would likely result in an increase in efficiency in aerial herbicide applications and potentially a decrease in adverse effects.

Public Sources of Drinking Water

Similar to Alternative 2, the potential effects of herbicide concentrations on public sources of drinking water from Alternative 3 would be minimal. No aerial herbicide application would occur within the IDEQ SWPAs (see section 3.2.4.9) as well as in the 1,000-foot radius areas surrounding a number of public wells. No aquatic herbicide application would occur within SWPAs.

Accidental Spills of Herbicide

Although highly unlikely, the accidental spill of herbicide into or near a water body during herbicide application or staging could potentially affect water quality, depending on the amount spilled and the characteristics of the water body. The risk of accidental spill of herbicide into water under Alternative 3 is higher than under Alternative 2 because of the larger quantities of herbicide that would be transported and mixed. However, design criteria under Alternative 3 would minimize these risks by stipulating that mixing and loading of herbicides occur more than 100 feet from water and in places where spilled materials will not flow into groundwater, wetlands, or streams. Procedures in the SNF and BNF spill plans would be followed, and a site-specific emergency response plan would be developed for each aerial application, as specified under the *Aerial Herbicide Application Coordination and Safety Implementation Plan* (project record). Because these design criteria minimize the potential for the majority of spill scenarios, spill scenarios are not analyzed in this document.

Effects on Riparian Function

Direct Effects

Alternative 3 would have minimal direct adverse effects on riparian function in the short term. Biological control methods would have no adverse effect on riparian function because treatments would not affect nontarget vegetation. Manual/mechanical methods would have minimal effect on nontarget vegetation as a result of minor disturbance to existing riparian vegetation during treatments. Rehabilitation/restoration treatments would have minimal effect on existing riparian vegetation because these methods would only be used where invasive plant infestations have already replaced most or all native riparian vegetation. All of these treatments would have beneficial effects to riparian function in the long term by eradicating or reducing invasive plant populations and allowing native riparian vegetation to recover.

Herbicide control methods would have a slight potential to cause nontarget mortality of native vegetation within riparian zones. However, these effects would be minimal, primarily because no ground-based broadcast herbicide treatments would occur within riparian areas, and no aerial herbicide application would occur within 300 feet of any water body. The 300-foot buffers would include most riparian areas within the project area. The potential for nontarget application of aerial herbicide in riparian areas is highest where treatment units would be adjacent to riparian areas (e.g., where a riparian area extends a full 300 feet from a water body). In this situation, a small percentage of aerially applied herbicide would likely reach a portion of the riparian area

through drift. Design criteria, BMPs, and label direction, including stipulations on wind speed, atmospheric conditions, and droplet size, would minimize the amount of drift occurring in riparian areas. The amount of herbicide reaching riparian vegetation would decrease substantially with distance from the treatment area. Bird et al. (1996) showed pesticide deposition at 30 meters and 150 meters downwind of treatment to be 5% and 0.5%, respectively, of the rate within the treatment area.

Depending on the herbicide being used, herbicide drift into riparian areas could cause some short-term adverse effects to existing native riparian vegetation. However, because of the distance from the treatment area, this would have minimal or no effects to near-stream riparian vegetation, maintaining riparian function in relation to stream channel function and stability. Any short-term adverse effects to riparian vegetation would be overshadowed by the long-term benefits to riparian function gained by eradicating or reducing invasive plant infestations and reestablishing native vegetation in its place.

Indirect Effects

Because Alternative 3 would over time decrease the extent of invasive plant infestations within riparian areas, indirect effects of Alternative 3 on riparian function would primarily be beneficial improvements to riparian condition as a result of invasive plant eradication and reestablishment of native riparian vegetation in the long term. This would result in maintained or increased bank stability, channel stability, and shade, as well as a riparian structure capable of maintaining large woody debris inputs to stream channels.

3.2.5.4.2. Cumulative Effects of Alternative 3

The cumulative effects analysis approach for Alternative 3 is the same as described in section 3.2.5.1.3. A list of ongoing and reasonably foreseeable activities within the project area is presented in Appendix B.

Under Alternative 3, biological, mechanical, herbicide, and rehabilitation/restoration control of invasive plant infestations would occur. The direct effects of these treatments would include localized areas of ground disturbance and low risk of herbicides entering water bodies. Any adverse effects that would occur would likely be short term, and would be followed by long-term beneficial effects related to the control of invasive plant infestations and reestablishment of native vegetation in those areas. Indirect effects related to vegetation mortality following herbicide treatment could occur in the short term, with long-term beneficial effects following.

Alternative 3 would result in minimal cumulative effects related to the direct and indirect effects of treating invasive plants using biological, mechanical, herbicide, and rehabilitation/restoration control methods.

Biological Control Methods

Biological control methods would have no cumulative effects on soil condition because no ground disturbance or water impairment would occur.

Mechanical and Rehabilitation/Restoration Control Methods

Mechanical and rehabilitation/restoration control methods would have minimal cumulative effects in addition to other activities occurring in the area because of the highly localized nature

of the disturbance and the very small percentage of the project area that would be treated. This short-term disturbance would not exacerbate the effects of other activities in the project area, and would ultimately provide a long-term benefit.

Herbicide Control

Ground-based, aerial, and aquatic herbicide control would have minimal cumulative effects on soil condition. Although herbicide control would be more widespread than under Alternative 2, this treatment would still cover only a very small percentage of the project area. Other potential sources of water quality impairment within the analysis area include county, BLM, and private landowner application of herbicide. Because these treatments have little overlap with Forest Service treatments, label application rates per acre would not be exceeded, and the cumulative effects on water quality would be minimal. Although herbicide use rates on private lands are unknown, the application of herbicide on NFS lands is likely to be considerably less than that on private agricultural lands because of differing treatment objectives.

Invasive plant control methods under Alternative 3 would result in a gradual decline in invasive plant infestations in the project area and on a watershed scale. Therefore, Alternative 3 would result in decreasing cumulative effects related to the indirect effects caused by the presence of invasive plants.

Alternative 3 would provide the best senero for overall decline in invasive plant infestations on a watershed scale, the indirect effects of this alternative would include gradually decreasing sediment yield and sediment loads as a result of the decreased spread of invasive plants and increased ground cover. Alternative 3 would result in decreasing cumulative effects related to the indirect effects caused by the presence of invasive plants.

Analysis of cumulative effects at the subwatershed scale using the Watershed Condition Framework is described under Alternative 1. A matrix was developed to assess the risk of cumulative effects for Alternative 3 based on these factors (Table 3-25). The cumulative effects risk ratings in the matrix are the same as under Alternative 5.

Under Alternative 3, the gradual decline in invasive plant infestations would likely result in low risk of cumulative effects at the subwatershed scale. Invasive plant control would effectively target priority areas where cumulative effects would be most likely to occur, and this risk would be minimized in the long term. Because existing invasive plant infestations are widespread in some subwatersheds, the risk of cumulative effects related to indirect effects caused by invasive plants would still exist in the short term. In the most heavily infested watersheds, it is possible that effective control would not occur for many years, and cumulative effects could persist in the long term. If aquatic invasive plants were to spread into the project area, they would likely occur as isolated occurrences, and cumulative effects of these infestations on a watershed scale would be minimal.

Under Alternative 3, 20 watersheds are at high risk for cumulative effects, only 15 watersheds are at moderate risk, and 273 are at low risk. Most of the high and moderate risk watersheds are in the Boise Basin CWMA, where infestations are the most concentrated.

Table 3-25. Long-term cumulative effects risk matrix for 6th-level watersheds for the Proposed Action (Alternative 3)

Watershed Condition Class	Percent of Watershed Infested by Invasive Plants				
	<1%	1%–5%	5%–10%	10%–25%	>25%
1	L	L	L	L	M
2	L	L	L	M	H
3	L	L	M	H	H

Note: L = low; M = moderate; H = high

3.2.5.4.3. Alternative 3 Summary

Alternative 3 could potentially result in minimal short-term increases in instream sediment loads and localized short-term impairment of soil condition as a result of invasive plant treatments. However, long-term effects resulting from control of invasive plant infestations would be beneficial, with gradual long-term decreases in instream sediment loads and long-term improvement in soil condition.

Alternative 3 would be compatible with Forest Plans and other regulatory direction with respect to soil resources.

Risk of impacts to soil biota: Herbicide treatment methods would be the only mechanism under Alternative 3 that would have direct effects on microbial communities in soil. With the ability to treat nearly twice as many applied acres as the maximum allowed under Alternative 2, the effects of Alternative 3 on soil microbial communities would potentially be greater than that described under Alternative 2. Short-term effects to soil microbes would likely occur as a result of broadcast and aerial herbicide applications because of the likelihood that a portion of the herbicide would directly reach the soil using these methods. Some herbicides have been shown to be toxic to some microorganisms. The 3 new herbicides under Alternative 3 would exhibit low or unknown toxicity to soil microbes (Table 3-16). Microbial communities in many treatment areas would likely be already compromised by the effects of the invasive plant infestations themselves. Any short-term effects caused by herbicide application would ultimately be overshadowed by the long-term beneficial effects of invasive plant eradication and reestablishment of native riparian vegetation, which would allow the recovery of biological communities within the soil.

Risk of increased soil erosion: Direct effects of Alternative 3 on soil loss would include minor disturbances from manual/mechanical and rehabilitation/restoration treatments, as well as motorized access for herbicide treatments that could result in localized occurrences of soil loss in the short term during subsequent runoff events. These effects would be greater than under Alternative 2 because of the larger number of acres that would be treated. Similar to Alternative 2, many of these treatments would occur in locations where soil productivity is already limited because of existing invasive plant infestations. On a watershed scale, however, with only 2,000 acres per forest of mechanical treatment proposed throughout the 4.3-million-acre project area, these effects would have minimal effect. Biological control methods would have no impact on soil loss.

Instream sediment loads, herbicide concentrations in water, and riparian function: Alternative 3 would have minimal direct adverse effects on riparian function in the short term. Biological control methods would have no adverse effect on riparian function because treatments

would not affect nontarget vegetation. Manual/mechanical methods would have minimal effect on nontarget vegetation as a result of minor disturbance to existing riparian vegetation during treatments. Rehabilitation/restoration treatments would have minimal effect on existing riparian vegetation because these methods would only be used where invasive plant infestations have already replaced most or all native riparian vegetation. All of these treatments would have beneficial effects to riparian function in the long term by eradicating or reducing invasive plant populations and allowing native riparian vegetation to recover.

Herbicide control methods would have a slight potential to cause nontarget mortality of native vegetation within riparian zones. However, project design features (e.g., label and project design features regarding weather conditions, no broadcast or aerial treatments in riparian areas) would minimize these effects.

Increased sediment/turbidity and disturbance to riparian vegetation can occur from the proposed action. However, design criteria would help to reduce many of these impacts resulting in discountable or insignificant effects to habitat conditions.

Alternative 3 could potentially result in minimal short term increases in instream sediment loads and localized short term impairment of soil condition as a result of invasive plant treatments. However, long term effects resulting from control of invasive plant infestations would be beneficial, with gradual long term decreases in instream sediment loads, long term improvement in riparian function, and long term improvement in soil condition. The effects of this alternative on herbicide concentrations in water would be minimal. Under Alternative 3, 20 watersheds are at high risk for cumulative effects, and only 15 watersheds are at moderate risk (Appendix B). The moderate risk watershed is in the Boise Basin CWMA, where infestations are the most concentrated.

Alternative 3 would be compatible with Forest Plans and other regulatory direction with respect to soil and water resources.

3.2.5.5. Alternative 4—No Aerial Herbicide Application

The No Aerial Herbicide Application Alternative (Alternative 4) is a subset of Alternative 3. Alternative 4 excludes aerial application of herbicide for the treatment of invasive and noxious plant species.

3.2.5.5.1. Direct and Indirect Effects of Alternative 4

The direct and indirect effects as implemented by Alternative 4 would be the same as those disclosed under Alternative 3, the Proposed Action, with the exception that there would be no helicopter aerial application of herbicide.

No irreversible or irretrievable uses of resources are associated with Alternative 4. Implementation of Alternative 4 would contribute to restoration of native or desirable vegetation in areas where nonnative, invasive plant species have established. Invasive plant treatments as described in accordance with Alternative 4 would have relatively short-lived detrimental effects and long-term beneficial effects.

Alternative 4 would be slightly more effective at treating invasive plant infestations than Alternative 2. However, because it would not include the efficiency of treating large infested areas using aerial application, as in Alternative 3, this alternative would likely result in a

continued spread of invasive plant infestations in the project area. The long-term spread of invasive plant infestations under this alternative would be less severe than under Alternative 2 because the use of the additional herbicides would increase the effectiveness of ground-based treatments. Herbicide control would continue as ground-based treatments, which are much less cost-effective than aerial treatments. With time and funding concentrated on treating small infestations, new invaders, and more severe infestations along established vectors, funding would likely not be available to treat existing large, more inaccessible infestations, as would occur under Alternative 3. However, this alternative would be better suited than Alternative 2 to treating new invasive species.

Adverse effects of this alternative would be similar to those described under Alternative 2, but with some additional potential effects related to the additional herbicides and use of aquatic treatments, as discussed in the effects analysis for Alternative 3.

Effects on Soil Condition

The potential for effects on soil condition for Alternative 4 is described under Alternative 3.

To achieve similar objectives as Alternative 3, it is likely that considerably more acres of biological, ground-based herbicide, manual/mechanical, and rehabilitation/restoration treatment would have to occur under this alternative to compensate for the inability to utilize aerial herbicide treatments. These ground-based treatments would likely result in more ground disturbance than under Alternative 3. However, direct and indirect adverse effects to water quality, soils, and riparian vegetation as a result of nontarget herbicide application during aerial application would be less than would occur under Alternative 3.

Implementation of Alternative 4 would be beneficial overall since it would permit the use of new, less toxic and more selective herbicides. In the long term, Alternative 4 would prevent invasive plants from spreading into currently uninfested areas, slowing the rate of spread of existing infestations and reducing the density of invasive plants, which may prove beneficial to soil condition.

Effects on Instream Sediment Loads

Direct Effects

As in Alternative 3, biological control would have no direct effects on instream sediment loads because no ground-disturbing activities would occur. Ground-based herbicide, manual/mechanical, and rehabilitation/restoration treatments could potentially occur on more acres and hence have more ground disturbance under Alternative 4 as compared to Alternative 3. As a result, a greater potential exists for these treatments to directly cause erosion and increased sediment yield from slopes in the short term. However, these treatments would still have only minimal short-term adverse effects on a watershed scale and would not likely cause any detectable increase in sediment loads in streams.

Indirect Effects

Under Alternative 4, invasive plant infestations would not be controlled as effectively as under Alternative 3, particularly for large, inaccessible infestations that cannot be effectively treated without aerial herbicide application. As a result, sediment yield caused by decreased ground cover from invasive plant-infested slopes would remain high and potentially increase as these

infestations spread. This would result in possible small increases in sediment loads on a watershed scale in the long term. Sediment yields related to invasive plant infestations would be higher than under Alternative 3, but lower than under Alternative 2.

Because Alternative 4 would not include aerial application, the short-term effects of broadcast application on target and nontarget plant mortality, decreased ground cover, and increased sediment yield described under Alternative 3 would occur to a much lesser extent. These effects would be similar to those described under Alternative 2.

Effects of Herbicide Concentrations in Water

Direct Effects

The potential for herbicide application under Alternative 4 to affect water quality would be minimal. As in Alternative 3, design criteria, BMPs, and label direction would provide adequate protection to water bodies, minimizing any potential effects. The same number of acres could potentially be treated using herbicides as in Alternative 3, but because aerial application of herbicides would not occur, it is likely that fewer acres of broadcast treatment would actually occur, reducing the amount of herbicide that could potentially be delivered to the soil or mobilized by overland flow.

Herbicide Properties

Herbicide risk assessments have been completed for all herbicides proposed for use under Alternative 4, as discussed under the Effects Common to All Action Alternatives section. Table 3-16 provides information about these herbicides in terms of fate and mobility in soil and water.

Herbicide Pathways to Water

Potential pathways for herbicides to enter water under Alternative 4 would be similar to those described under Alternative 3. However, because aerial application would not occur, the potential for drift to deliver herbicide to water bodies would be considerably less.

Adjuvants

The potential for the use of adjuvants to result in effects to water quality under Alternative 4 would be minimal, similar to that described under Alternative 3.

Accidental Spills of Herbicide

The potential for the accidental spill of herbicide is described under Alternative 3. However, because large quantities of herbicide would not be used for aerial application as in Alternative 3, the potential for accidental spill would be less than under Alternative 3. Because design criteria minimize the potential for the majority of spill scenarios, spill scenarios are not analyzed in this document.

Public Sources of Drinking Water

The potential for herbicide treatments under Alternative 4 to affect the quality of public drinking water would be very low, similar to Alternative 2 and Alternative 3.

Indirect Effects

As in Alternative 3, Alternative 4 would have no indirect effects on concentrations of herbicides in water.

Effects on Riparian Function

Direct Effects

Under Alternative 4, the effects of biological, manual/mechanical, and rehabilitation/restoration control methods on riparian function would be the same as described under Alternative 3.

The effects of herbicide control methods on riparian function would be similar to those described under Alternative 3 because no aerial application would occur in riparian areas in either alternative. However, because Alternative 4 would eliminate the possibility of drift from aerial applications entering riparian areas (as could potentially occur under Alternative 3), the potential effects of this alternative would be less than under Alternative 3. Also, this alternative would be able to better target invasive plants in riparian areas than under Alternative 2 because of the use of the additional herbicides for riparian use, resulting in potentially less nontarget mortality, less herbicide needed, and less overall impact on riparian areas.

Indirect Effects

The indirect effects of Alternative 4 on riparian function would be the same as described under Alternative 3.

3.2.5.5.2. Cumulative Effects of Alternative 4

Cumulative effects as implemented by Alternative 4 would be the same as those disclosed under Alternative 3 (the Proposed Action).

The cumulative effects analysis approach for Alternative 4 is the same as that described in section 3.2.5.1.3. A list of ongoing and reasonably foreseeable activities within the project area is presented in Appendix B.

Cumulative Effects of Invasive Plant Treatments

As described in section 3.2.5.5.1, the direct and indirect effects of Alternative 4 would be similar to those described under Alternative 2. However, because additional herbicides would be available for use, this alternative would provide more efficient treatment options and potentially less potential for adverse effects. Despite these small differences, the cumulative effects of this alternative would be similar to those described for Alternative 2. The No Aerial Herbicide Application Alternative would result in minimal cumulative effects related to the direct and indirect effects of treating invasive plants using biological, mechanical, herbicide, and restoration/rehabilitation methods.

Cumulative Effects of Invasive Plant Infestations

Because methods proposed under Alternative 4 are not sufficient to cause an overall decline in invasive plant infestations on a watershed scale, the indirect effects of this alternative include gradually increasing sediment yield and sediment loads as a result of the gradual spread of invasive plants and decreased ground cover. Cumulative effects related to these indirect effects, combined with other ongoing and foreseeable future activities, could occur in the long term. These cumulative effects would be similar to those discussed for Alternative 1, but would occur to a lesser degree because of the expected slower rate of spread.

Analysis of cumulative effects at the subwatershed scale using the Watershed Condition Framework is described in section 3.2.5.1. A matrix was developed to assess the risk of

cumulative effects for Alternative 4 based on these factors (Table 3-26). The cumulative effects risk ratings in the matrix are the same as under Alternative 2.

Under Alternative 4, long-term effects of the gradual spread of invasive plants would likely result in cumulative effects in some 6th-level watersheds based on this analysis. As invasive plants continue to spread as predicted under this alternative, cumulative effects would gradually increase, leading to additional watershed impairment. However, these effects would be less severe than under Alternative 1 because the rate of spread of invasive plants is expected to be less, and existing invasive plant control would target high-priority areas where cumulative effects would be most likely to occur.

Table 3-26. Long-term cumulative effects risk matrix for 6th-level watersheds for the No Aerial Herbicide Application Alternative (Alternative 4)

Watershed Condition Class	Percent of Watershed Infested by Invasive Plants				
	<1%	1%–5%	5%–10%	10%–25%	>25%
1	L	L	L	M	H
2	L	L	M	H	H
3	L	M	H	H	H

Note: L = low; M = moderate; H = high

Under Alternative 4, 35 watersheds are at high risk for cumulative effects, 25 watersheds are at moderate risk, and 248 watersheds at low risk. The majority of the high and moderate risk watersheds are in the Boise Basin CWMA where infestations are the most concentrated. Because the spread of invasive plants affects many of the attributes in the Watershed Condition Framework, it is possible that these cumulative effects could result in degradation of watershed condition class for watersheds with moderate or high cumulative effects risk ratings in the long term (greater than 10 years).

3.2.5.5.3. Alternative 4 Summary

The No Aerial Herbicide Application Alternative could potentially result in minimal short-term increases in instream sediment loads and localized short-term impairment of soil condition as a result of invasive plant treatments. Long-term effects resulting from control of invasive plant infestations could include possible slight long-term increases in instream sediment loads, long-term improvement in riparian function, and gradual long-term decline in soil condition. The effects of herbicide concentrations in water from this alternative would be minimal. This alternative would result in a high risk of cumulative effects in 1 watershed and a moderate risk in 4 watersheds.

The No Aerial Herbicide Application Alternative would be compatible with Forest Plans and other regulatory direction with respect to soil and water resources.

3.2.5.6. Alternative 5—No Aquatic Herbicide Application

Alternative 5 is a subset of the Alternative 3. Alternative 5 excludes aquatic application of herbicide for the treatment of aquatic invasive noxious plants species.

3.2.5.6.1. Direct and Indirect Effects of Alternative 5

The direct and indirect effects as implemented by Alternative 5 would be the same as those disclosed under Alternative 3, the Proposed Action, with the exception that there would be no herbicide treatment of aquatic invasive plants. The primary difference in direct effects would be a decreased potential for water quality impairment as a result of aquatic herbicide applications.

Additional indirect effects could occur under this alternative because the invasive plant management program would not be equipped to manage new aquatic invasive plant infestations on the BNF and SNF. Aquatic invasive plants such as Eurasian watermilfoil do not currently exist within the project area, but do exist in the region. If aquatic invasive plant infestations are introduced into lakes and are not controlled effectively, they could result in major impacts, as described in the effects analysis under Alternative 1 (see section 3.2.5.1.1). Under the worst-case scenario, this could have drastic effects on water chemistry, nutrient loading, water temperature, and habitat.

Effects on Soil Condition

Under Alternative 5, the direct and indirect effects to soil condition caused directly by invasive plant treatments and indirectly by invasive plant infestations would be the same as under Alternative 3 for all treatment methods. There would be no difference in environmental consequences to soil condition between Alternative 3 and Alternative 5.

No irreversible or irretrievable uses of resources are associated with Alternative 5. Implementing Alternative 5 would contribute to restoration of native or desirable vegetation in areas where nonnative, invasive plant species have established. Invasive plant treatments as described in accordance with Alternative 5 would have relatively short-lived detrimental effects and long-term beneficial effects. Detrimental effects to soil condition would be minimized through the implementation of the design criteria.

Implementation of Alternative 5 would be beneficial overall since it a) would permit the use of new, less toxic, and more selective herbicides, and b) would permit the use of aerial application on invasive plant infestations that currently are uncontrolled or poorly controlled. In the long term, preventing invasive plants from spreading into uninfested areas, slowing the rate of spread of existing infestations and reducing the density of invasive plants in existing infestations, would prove beneficial to soil condition.

Effects on Instream Sediment Loads

Under Alternative 5, the direct and indirect effects to erosion and sediment loads caused directly by invasive plant treatments and indirectly by invasive plant infestations would be the same as under Alternative 3 for all treatment methods.

Effects of Herbicide Concentrations in Water

Under Alternative 5, the direct effects of herbicide concentrations in water caused by herbicide invasive plant treatments would be the same as under Alternative 3 for ground-based and aerial treatment methods. As in Alternative 3, no indirect effects would occur. Because no herbicide would be applied directly to water, this alternative would have no risk of water quality impairment via this mechanism, as compared to the minimal risk shown under Alternative 3. The effects on public sources of drinking water would be minimal, the same as under Alternative 3.

Effects on Riparian Function

Under Alternative 5, the direct and indirect effects to riparian function caused directly by invasive plant treatments and indirectly by invasive plant infestations would be the same as under Alternative 3 for all treatment methods.

3.2.5.6.2. Cumulative Effects of Alternative 5

The cumulative effects analysis approach for Alternative 5 is the same as described in section 3.2.5.1.3. A list of ongoing and reasonably foreseeable activities within the project area is presented in Appendix B.

Cumulative Effects of Invasive Plant Treatments

The direct and indirect effects of Alternative 5 would be similar to those described under Alternative 3, but without the effects related to aquatic herbicide applications. Therefore, the cumulative effects of Alternative 5 would be similar to those of Alternative 3. Alternative 5 would result in minimal cumulative effects related to the direct and indirect effects of treating invasive plants using biological, mechanical, herbicide, and rehabilitation/restoration control methods.

Cumulative Effects of Invasive Plant Infestations

Similar to Alternative 3, invasive plant control methods under Alternative 5 would result in a gradual decline in invasive plant infestations in the project area and on a watershed scale. Alternative 5 would result in decreasing cumulative effects related to the indirect effects caused by the presence of invasive plants.

Analysis of cumulative effects at the subwatershed scale using the Watershed Condition Framework is described under Alternative 1. A matrix was developed to assess the risk of cumulative effects for Alternative 5 based on these factors (Table 3-27). The cumulative effects risk ratings in the matrix are the same as under Alternative 3.

Under Alternative 5, the gradual decline in invasive plant infestations would likely result in low risk of cumulative effects at the subwatershed scale. Invasive plant control would effectively target priority areas where cumulative effects would be most likely to occur, and this risk would be minimized in the long term. Because existing invasive plant infestations are widespread in some subwatersheds, the risk of cumulative effects related to indirect effects caused by invasive plants would still exist in the short term. In the most heavily infested watersheds, it is possible that effective control would not occur for many years, and cumulative effects could persist in the long term. If aquatic invasive plants were to spread into the project area, they would likely occur as isolated occurrences, and cumulative effects of these infestations on a watershed scale would be minimal.

Table 3-27. Long-term cumulative effects risk matrix for 6th-level watersheds for the No Aquatic Herbicide Application Alternative (Alternative 5)

Watershed Condition Class	Percent of Watershed Infested by Invasive Plants				
	<1%	1%–5%	5%–10%	10%–25%	>25%
1	L	L	L	L	M
2	L	L	L	M	H
3	L	L	M	H	H

Note: L = low; M = moderate; H = high

Under Alternative 5, 20 watersheds are at high risk for cumulative effects, 15 watersheds are at moderate risk, and 273 are at low risk. The majority of the high and moderate risk watersheds are in the Boise Basin CWMA, where infestations are the most concentrated.

3.2.5.6.3. Alternative 5 Summary

Alternative 5 could potentially result in minimal short-term increases in instream sediment loads and localized short-term impairment of soil condition as a result of invasive plant treatments. However, long-term effects resulting from control of invasive plant infestations would be beneficial, with gradual long-term decreases in instream sediment loads, long-term improvement in riparian function, and long-term improvement in soil condition. The effects of herbicide concentrations in water from this alternative would be minimal. Under this alternative, no watersheds would have a high risk of cumulative effects, and only 1 watershed would have a moderate risk.

Alternative 5 would be compatible with Forest Plans and other regulatory direction with respect to soil and water resources.

3.2.5.7. Conclusions about Alternative Effects

The No Action Alternative would likely result in degradation of soil condition in the long term and potentially detectable increases in fine sediment loads in streams. The No Action Alternative is not consistent with Forest Plan standards, regulations, policy, and law. Due to a projected increase in acres occupied by nonnative species, Alternative 1 could result in an irreversible change in plant communities that could, in turn, result in a degradation of soil condition.

No irreversible or irretrievable commitment of resources associated with the implementation of any action alternatives is anticipated. In general, the implementation of invasive plant treatments would result in short-term impacts followed by long-term improvements. Design criteria would minimize the magnitude and duration of any short-term effects.

Risk of impacts to soil biota: Alternative 1 has the greatest risk of impacts to soil biota. This is due to the uncontrolled expansion of noxious weeds across the landscape. By allowing for the uncontrolled expansion of invasive species, nutrient cycling would be greatly reduced and the introduction of secondary compounds from noxious weeds would continue unchecked.

Alternatives 3 and 5 would pose the second-greatest risk of impacts to soil microbes in the short term. Due to being able to treat large areas through the use of aerial application of herbicide, more acreage is likely to be exposed to the risk of herbicides. These potential impacts would occur in the short term, as treatments could be reduced as noxious weed infestations diminish or are eradicated. Eradication of invasive plant infestations and reestablishment of native vegetation

would allow for the recovery of soil microbes in the long term and lead to decreased use of herbicide. Alternative 2 poses the least risk in the short term due to less acreage being exposed to herbicide. However, Alternative 2 would allow for more acres of noxious weeds to go untreated, leaving soil microbes exposed to the risks associated with noxious weeds. Alternative 4 would pose a similar risk as that seen under Alternative 3 and Alternative 5 because it allows just as many herbicide treatment acres. However, without the use of aerial application, it is unlikely that as many acres would be treated.

Risk of increased soil erosion: Alternative 1 poses the greatest risk of increasing erosion. Under conditions with a high prevalence of invasive plant species, displacement of native species, erodible soils, limited ground cover, and steep topography, the increase in soil erosion after 5 or more years of no treatment is likely to be moderate to high.

Alternative 2 would include minor short-term disturbances from manual/mechanical and rehabilitation/restoration treatments. These localized, short-term effects would have minimal impacts on overall soil condition, with the desired long-term result being improvement of soil condition as native species are reestablished. Furthermore, many of these treatments (particularly rehabilitation/restoration) would occur in locations where soil condition is already degraded because of existing large-scale invasive plant infestations. Any potential short-term impacts would occur to a very small percentage of soils on a watershed scale because of the limited extent of treatments that would occur under this alternative.

Alternatives 3, 4, and 5 would include minor disturbances from manual/mechanical and rehabilitation/restoration treatments, as well as motorized access for herbicide treatments that could result in localized occurrences of soil loss in the short term during subsequent runoff events. These effects would be greater than under Alternative 2 because of the larger number of acres that would be treated. Similar to Alternative 2, many of these treatments would occur in locations where soil productivity is already limited because of existing invasive plant infestations. On a watershed scale, however, with only 2,000 acres per forest of mechanical treatment proposed throughout the 4.3-million-acre project area, these actions would have minimal effect.

Instream sediment loads, herbicide concentrations in water, and riparian function: Alternative 5 could potentially result in minimal short term increases in instream sediment loads and localized short term impairment of soil condition as a result of invasive plant treatments. However, long term effects resulting from control of invasive plant infestations would be beneficial, with gradual long term decreases in instream sediment loads, long term improvement in riparian function, and long term improvement in soil condition. The effects of this alternative on herbicide concentrations in water would be minimal. Under Alternative 3, 20 watersheds are at high risk for cumulative effects, and only 15 watersheds are at moderate risk (Appendix B). The moderate risk watershed is in the Boise Basin CWMA, where infestations are the most concentrated.

Alternative 3 would be compatible with Forest Plans and other regulatory direction with respect to soil and water resources.

3.2.5.8. Forest Plan Consistency

The No Action Alternative would likely result in degradation of watershed conditions in the long term and potentially detectable increases in fine sediment loads in streams. These conditions

could potentially contribute to exceedances of stream channel fine sediment standards in the Forest Plans as well as potential exceedances of state water quality standards. Expansion of invasive plant infestations in riparian areas could also lead to exceedances of Forest Plan bank stability standards in the long term. The No Action Alternative is not consistent with Forest Plan standards, regulations, policy, and law.

With respect to soil and water resources, all action alternatives would be compatible with Forest Plan and other regulatory direction.

3.3. Fisheries

Fisheries Summary: Implementing Alternative 1 would ***not likely adversely affect*** the following federally listed species occurring within the SNF or BNF non-Wilderness project area: Snake River spring/summer Chinook salmon, Snake River sockeye salmon, Snake River basin steelhead, and Columbia River bull trout or designated critical habitat. Implementing Alternative 1 ***may impact individuals*** of the following R4 sensitive species***, but would not likely contribute to a trend towards federal listing, cause a loss of viability to the population, or be expected to result in a downward trend for the species***: Westslope cutthroat trout, Yellowstone cutthroat trout, northern leatherside chub, and Wood River sculpin. Additionally, Alternative 1 would not measureably influence the future trend of bull trout or Yellowstone cutthroat trout populations on the SNF or BNF.

For the action alternatives, implementation of manual/mechanical control, biological control, and rehabilitation/restoration components ***may affect, but are not likely to adversely affect*** Snake River spring/summer Chinook salmon, Snake River sockeye salmon, Snake River Basin steelhead trout, or Columbia River bull trout. Chemical herbicide treatment are determined ***likely to adversely affect*** Snake River spring/summer Chinook salmon, Snake River sockeye salmon, Snake River Basin steelhead trout, and Columbia River bull trout within the project action area. Implementation of the action alternatives ***may affect but are not likely to adversely affect*** Designated Critical Habitat for Snake River spring/summer Chinook salmon, Snake River sockeye salmon, Snake River Basin steelhead trout, or Columbia River bull trout within the action area.

Proposed activities ***may impact individuals or habitat but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species*** for westslope cutthroat, Yellowstone cutthroat, Northern leatherside chub and Wood River sculpin. Additionally, the action alternatives would not have a measureable influence on future short- or long- term trend of bull trout on the BNF or SNF or Yellowstone cutthroat populations on the SNF.

3.3.1. Introduction

This section describes how the alternatives address the purpose of the project to reduce the negative effects of existing and future invasive plants on fisheries resources that may be adversely impacted. This section also addresses the issues and concerns identified during internal and public scoping that using herbicides in riparian areas can adversely impact water quality and aquatic species. Herbicides could contaminate water, harm fish through exposure to chemicals, and negatively affect aquatic plants and insects.

Chemical treatment is an important and effective method when the management objective is weed eradication or control. It involves applying herbicides (chemical compounds) at certain stages of plant growth to kill weed species. However, herbicide use requires caution, as it is a chemical compound that can negatively affect aquatic species. If not used properly, herbicides can contaminate water, harm fish through exposure to chemicals, and negatively affect aquatic plants and insects. Other potential effects of herbicide use to fisheries resources include erosion from physical disturbance resulting from mechanical treatments and water quality impacts

resulting from chemical treatments. However, failure to treat invasive plants can also adversely affect aquatic resources. Loss of native vegetative cover can result in soil loss and impacts to water quality, riparian vegetation, and stream channel morphology. Treating invasive plants can help maintain native vegetative ground cover and prevent many of these impacts.

3.3.2. Methodology for Analysis

The IDT Fisheries Biologist analyzed the potential effects of chemical contaminants on fishes and macroinvertebrates using risk assessment worksheets identified at the beginning of Chapter 3 (available online at: http://www.sera-inc.com/fsworksheetmaker.html), including the SERA risk assessments, toxicity indices, and HQs.

To determine herbicide toxicity to fish and other aquatic organisms, the IDT Fisheries Biologist used three methods: the 96-hour LC_{50}, the No Observed Effect Level or No Observed Effect Concentration (NOEC), and the SERA risk assessments and associated HQs.

The first method was used to evaluate the lethal concentration (LC_{50}) of each herbicide. The 96-hour LC_{50} refers to the concentration that is lethal to 50% of the fish exposed at that level for 96 hours. The lower the LC_{50}, the more toxic the compound. The 96-hour LC_{50} for the herbicides proposed for use are provided in Table 3-31.

Although the LC_{50} is frequently used as a toxicity standard, 50% fish mortality is not acceptable. The No Observed Effect Level (NOEL) or NOEC was used in place of the LC_{50} when it was available from studies. These levels represent a conservative approach to evaluating the active ingredients of the proposed herbicides to fish. NOEL/NOEC is the highest concentration of toxicant to which organisms are exposed in a full life-cycle or partial life-cycle test that causes no observable effect on survival, growth, or reproduction of the test population. Thus, no significant difference would exist between the test solution and the control, as determined by hypothesis testing.

Analysis of the potential effects of chemical contaminants on fishes and macroinvertebrates also occurred through use of the SERA risk assessments, toxicity indices, and HQs (3.1.1 Herbicide Risk Assessments and also available at: http://www.sera-inc.com/fsworksheetmaker.html). Values were based on modeling herbicide drift using a backpack sprayer using Worksheet Maker 6.0. The derived Estimated Environmental Concentration (EEC) is an extreme level and should be viewed as a worst-case situation.

To evaluate potential risks to non-target organisms (algae, invertebrates, and fish), HQs were calculated by dividing the peak EEC available for each active ingredient by the most sensitive Toxicity Reference Values (TRV) (LC_{50}, LOEC [lowest concentration of an effluent or toxicant that results in adverse effects], EC_{50} [the median effective concentration of the toxicant in the environment that produces a designated effect in 50% of the test organisms exposed], or NOEL). HQs are based upon ecological effects data, pesticide use data, fate and transport data, and estimates of exposure to the pesticide. The TRV may be a surface water or surface soil effects concentration or a species-specific toxicity value derived from the literature.

Toxicity indices (thresholds) were established using either measured chronic NOAELs or 1/20th of the acute LC_{50}, whichever was lower. Use of these thresholds, including a chronic NOAEL for acute exposures, was intended to account for uncertainty regarding sublethal effects to fish

(USDA Forest Service 2005c). Extreme case scenarios were developed to estimate the herbicide concentration in water and, therefore, the dose received by fish and aquatic organisms.

The estimated dose (from the scenarios) was divided by the "toxicity index" and the result is known as the HQ. When the HQ is less than 1.0, the dose is less than the toxicity index. Potential effects from doses calculated to be below the toxicity indices are discountable. When a calculated dose was greater than the toxicity index, it was assumed a potential for adverse effects existsed. This very protective approach constitutes a "worst-case" analysis for potential effects of herbicides.

The techniques and methodologies used in this analysis considered pertinent available science, and the conclusions are based on a scientific analysis that shows a thorough review of relevant scientific information. Determinations were reached based upon previous monitoring of similar types of activities on NFS lands and a review of pertinent literature. The potential effect of weed treatment activities, including herbicide use, on Forest lands is well documented, and no significant scientific uncertainties or risks associated with this proposal exist.

3.3.2.1. Analysis Area

The analysis area used to examine effects on the fisheries resource includes the BNF and SNF aquatic habitats for all alternatives. The analysis area for consideration of direct and indirect effects is both the wilderness and non-wilderness portions of the SNF and non-wilderness portions of the BNF. There are 23 subbasins (4th level HUC) and 95 watersheds (5th level HUC) in the analysis area, encompassing all areas potentially directly or indirectly affected by the alternatives.

Because of the potential for downstream and cumulative effects within watersheds, the cumulative effects analysis area encompasses entire subwatersheds (6th level HUCs) where weed treatments, listed fish, and designated critical habitat occur. At least a portion of 561 subwatersheds (6th level HUCs) are within the administrative Forest unit boundary and these subwatersheds often extend outside the Forests' boundaries.

3.3.2.2. Measurement Indicators

The relevant fisheries resource indicator that will be tracked for the project is the risk of herbicide use to fish, macroinvertebrates, aquatic plants and other aquatic organisms, as measured by the following:

- Effects of herbicide to be used within riparian areas on aquatic organisms; and
- Adequacy of design criteria that apply to water quality and aquatic organisms.

3.3.3. Relevant Forest Plan Direction and Other Relevant Direction

This project incorporates Forest Service (Forest, Regional, and national levels); State; and national regulatory direction pertaining to fisheries and aquatic species as part of the Proposed Action and design criteria. This direction includes a number of laws, standards, EOs, and management directives.

Forest Service direction is to "control the establishment, spread, or invasion of non-indigenous plant species in otherwise healthy native vegetative ecosystems" (FSM 2080.1). The SNF and BNF use the IWM approach to manage weeds. The following important non-treatment practices

are the cornerstone of IWM: prevention; weed inventory and early detection; information and education programs; cooperative partnerships and coordination; and legal compliance with applicable laws, orders, policies, strategies, and forest plans pertaining to weed control.

3.3.3.1. Forest Plan

Both the SNF and the BNF Forest Plans were revised to incorporate a range of management strategies designed to maintain and improve habitat conditions for anadromous and resident fisheries resources within the Interior Columbia River basin, as identified within the Interim Strategies for Managing Anadromous Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, and portions of California (PACFISH; USDA Forest Service and USDI BLM 1995a), and the Interim Strategies for Managing Fish-Producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada (INFISH; USDA Forest Service and USDI BLM 1995b).

The revised Forest Plan replaces the 1987 Forest Plan, which was amended by Pacfish and Infish and associated Biological Opinions for Chinook salmon, steelhead, and bull trout (NMFS 1995, 1998; USDI FWS 1998).

The Sawtooth Forest Plan and the BNF Plan provide forest management goals, Forest-wide direction, and standards and guidelines regarding fisheries resources and soil, water, riparian and aquatic habitat that is relevant to invasive plant treatments:

3.3.3.1.1. Desired Conditions

The Boise and Sawtooth Forest Plans contain the following desired conditions:

- Forest, grassland, shrubland, and riparian plant communities are within a desired range of variability for composition, structure, patterns, and processes. Vegetation forms a diverse network of habitats and connective corridors for wildlife, and provides desired levels of snags, coarse woody material, and soil organic matter. Terrestrial and aquatic habitats support species diversity, with emphasis on maintaining or restoring threatened, endangered and sensitive species, rare and unique plant communities, and species of cultural, commercial, and recreational significance. Riparian areas connect upland and aquatic habitats, and promote stable and diverse stream channel conditions. *Existing noxious weed populations are not expanding, and new invader species are not becoming established.* (USDA Forest Service 2012a, p. III-7; USDA Forest Service 2010a, p. III-7).
- Habitats for threatened and endangered species are managed consistent with established and approved Recovery Plans. Management actions either contribute to, or do not prevent recovery or de-listing of these species. Habitats for proposed and candidate species are managed to help preclude listing as threatened or endangered under the ESA. Degrading effects from Forest programs are at levels that do not threaten the persistence of threatened, endangered, proposed, or candidate species populations. (USDA Forest Service 2012a, p. III-8; USDA Forest Service 2010a, p. III-8).
- Noxious weed infestations are primarily restricted to locations along roads, trails, river corridors, and airstrips. Existing noxious weed populations are not expanding in size. Weed species cover or densities are variable across the Forest. New noxious weed outbreaks may occur temporarily or continue to exist as a small nonexpanding population in areas of high susceptibility. Noxious weed populations in low susceptibility areas are

small and scattered with low to moderate densities. New invader species to the forest are not becoming established. Native plants are dominant on disturbed or recently restored sites. Some areas of historic rehabilitation or vegetative manipulation are still dominated by non-native grasses or forbs. (USDA Forest Service 2012a, p. III-38; USDA Forest Service 2010a, p. III-38).

- Distribution of native and desired non-native fish and other aquatic species is maintained or is expanding into previously occupied habitat, with inter-connectivity between and within meta-populations. The amount, distribution, and characteristics of life-stage habitats are present to maintain or reach viable populations of native and desired non-native species. Habitat conditions prevent further listing of species under the Act or adding species to the R4 Sensitive Species list. Efforts are in place to prevent new introductions of undesirable non-native fish species and to reduce degrading effects from past introductions. Habitat provides fish populations for recreational, cultural, and commercial significance. Human activities do not prevent populations from maintaining distribution and abundance during critical life stages. Restoration activities have resulted in maintaining necessary water temperatures, reducing pollutants such as sediment, and removing human-caused barriers to fish passage to restore population and habitat connectivity where genetic contamination to native fish species from exotic species is not an issue.(USDA Forest Service 2012a, p. III-18; USDA Forest Service 2010a, p. III-18).

3.3.3.1.2. Forest Plan Goals

- Threatened, Endangered, Proposed, and Candidate Species—Manage habitat within the respective ranges of species listed under ESA contributes to their survival and recovery (TEGO02 [USDA Forest Service 2010a, 2012a]).
- Non-native plants—Manage noxious weeds with an IWM approach that uses prevention, education, eradication, containment, and control treatment strategies in a coordinated effort that includes potentially affected resources, users, funding sources, and activities (NPGO01 [USDA Forest Service 2010a, 2012a]).
- Prevent new infestations of undesirable non-native plants or noxious weed species, with emphasis on areas of high susceptibility where those species have a strong probability for establishment and spread (NPGO02 [USDA Forest Service 2010a, 2012a])
- Work to reduce the risk of establishing new noxious weed populations by minimizing weed seed transport and reducing favorable establishment conditions on disturbed sites (NPGO05 [USDA Forest Service 2010a, 2012a])

3.3.3.1.3. Forest Plan Objectives

- Coordinate with the Idaho Department of Transportation and county officials to assist and promote cooperative efforts to reduce introduction and spread of noxious weeds (NPOB04)
- Develop IWM plans to maintain or restore habitats for TEPC plants and other native species of concern where they are threatened by noxious weeds or non-native invasive plants (TEOB21 [USDA Forest Service 2012a]; TEOB22 [USDA Forest Service 2010a])

3.3.3.1.4. Forest Plan Standards and Guidelines

- For management actions that include application of insecticides, herbicides, fungicides, or rodenticides, mitigation shall avoid or minimize adverse effects on TEPC species or their habitats (TEST05)
- Management actions will neither degrade nor retard attainment of properly functioning SWRA desired conditions, except (SWST04):
  - Where outweighed by demonstrable short- or long-term benefits to watershed resource conditions; or
  - Where the Forest Service has limited authority (e.g., access roads, hydropower). In these cases, the Forest Service shall work with permittee(s) to minimize the degradation of watershed resource conditions.
- Noxious weeds and undesirable non-native plants should be eradicated. Where it is not practical to eradicate existing infestations, infestations should be managed to prevent seed production and spread (NPGU01)

3.3.3.2. Forest Service Handbook, Soil and Water Conservation Practices Handbook

The Soil and Water Conservation Practices Handbook (FSH 2509.22, R-1/R-4 Amendment) (USDA Forest Service 1988) presents a process to develop site-specific conservation practices for use on NFS lands to minimize effects of management activities on soil and water resources and to protect water-related beneficial uses. It describes the application, monitoring, evaluation, and adjustment of these conservation practices.

The following specific practices apply to this project:

- Practice 13.07: Pesticide Use Planning
- Practice 13.08: Apply Pesticides According to Label and EPA Registration Directions
- Practice 13.09: Pesticide Application Monitoring and Evaluation
- Practice 13.10: Pesticide Spill Contingency Planning
- Practice 13.11: Cleaning and Disposal of Pesticide Containers and Equipment
- Practice 13.12: Protection of Water, Wetlands, and Riparian Areas during Pesticide Spraying
- Practice 13.13: Controlling Pesticide Drift during Spray Application

3.3.3.3. Forest Service Best Management Practices

The Forest Service National BMP program provides a standard set of core BMPs and a consistent means to track and document the use and effectiveness of BMPs on NFS lands across the country (USDA Forest Service 2012c). The objectives of this program include establishing "uniform direction for BMP implementation to control nonpoint source pollution on all NFS lands to avoid, minimize, or mitigate adverse effects to soil, water quality, and riparian resources that will meet the intent of the Federal and State water quality laws and regulations, EOs, and USDA and Forest Service directives." These National Core BMPs "require the development of site-specific BMP prescriptions based on local site conditions and requirements to achieve

compliance with established State, tribal, or national water quality goals. It is expected that State requirements and BMP programs, Forest Service regional guidance, and the land management plan will provide the criteria for site-specific BMP prescriptions."

Forest Service directives implementing the National BMP program were published in the Federal Register for public review and comment (90 days) on May 6, 2014. These directives were not finalized as of the writing of this report.

The following BMPs from the National Core BMP Technical Guide (USDA Forest Service 2012c) are applicable to this project:

- Plan-2: Project Planning and Analysis
- Plan-3: Aquatic Management Zone Planning
- Chem-1: Chemical Use Planning
- Chem-2: Follow Label Directions
- Chem-3: Chemical Use Near Waterbodies
- Chem-4: Chemical Use In Waterbodies
- Chem-5: Chemical Handling and Disposal
- Chem-6: Chemical Application Monitoring and Evaluation
- Veg-2: Erosion Prevention and Control
- Veg-3: Aquatic Management Zones
- Veg-8: Mechanical Site Treatment

3.3.3.4. Aquatic Conservation Strategy

The Aquatic Conservation Strategy (ACS) provides direction to maintain and restore characteristics of healthy, functioning watersheds, riparian areas, and associated fish habitats. The Boise and Sawtooth Forest Plans were developed to provide direction (goals, objectives, standards, and guidelines) for broad classes of management activities and land and water management practices that may affect SWRA resources. Embedded within the ACS, Forest Plans provide policy guidance and requirements. The ACS is a long-term strategy to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within lands administered by these National Forests. It is a refinement and furtherance of approaches outlined in the Interior Columbia Basin Ecosystem Management Project (ICBEMP) Implementation Strategy and the USFWS and NOAA Fisheries 1998 Biological Opinions (as cited in USDA Forest Service 2012c, p. B-48).

The ACS components are described within Appendix H of the Forest Plans (USDA Forest Service 2010a, 2012a). The 8 ACS components are as follows and will be applied, where appropriate, in this analysis:

1. Goals to maintain and restore SWRA resources
2. Watershed condition indicators for SWRA resources
3. Delineation of RCAs. At a minimum, default delineations, as described in USDA Forest Service (2010a, 2012a) on p. B-33, will be used within the project area; however, site-specific delineations may be developed where alterations to the default distances are needed.
4. Objectives, standards, and guidelines for management of SWRA resources, including RCAs
5. Determination of priority subwatersheds within subbasins
6. Multi-scale analyses of subbasins and subwatersheds
7. Determination of the appropriate type of subwatershed restoration and prioritization
8. Monitoring and adaptive management provisions

3.3.3.5. Endangered Species Act

The SNF and BNF are required by law, regulation, and policy to address potential impacts of federally authorized, funded, or implemented project activities, including noxious weed control measures, on fish species of special designations. Forest plans; laws and regulations (e.g., ESA of 1973, as amended); and the NFMA of 1976 (P.L. 4-588) were considered in this analysis. The effects of invasive plant treatment on the following species are analyzed (Table 3-28):

1. Species listed as threatened, endangered, or candidate fish species under the ESA
2. USDA Forest Service R4 sensitive fish species
3. SNF and BNF MIS

Table 3-28. Fishes identified as federally listed as endangered or threatened, regionally sensitive, and managmenet indicator species (MIS) within the project area

Common Name	Scientific Name	Status
Snake River Sockeye Salmon	*Oncorhynchus nerka*	Endangered
Snake River Spring/Summer Chinook Salmon	*O. tshawytscha*	Threatened[a] Essential Fish Habitat[b]
Snake River Basin Steelhead	*O. mykiss*	Threatened[a]
Columbia River Bull Trout	*Salvelinus confluentus*	Threatened[a] and MIS
Westslope Cutthroat Trout	*O. clarki lewisi*	Regionally Sensitive
Wood River Sculpin	*Cottus leiopomus*	Regionally Sensitive
Yellowstone Cutthroat Trout	*O. c. bouveri*	Regionally Sensitive and MIS
Northern Leatherside Chub	*Lepidomeda copei*	Regionally Sensitive

[a]Federally listed under the Endangered Species Act
[b]Designated critical habitat

3.3.3.6. Clean Water Act

The Federal Water Pollution Control Act of 1972 (Public Law 92-500), as amended in 1977 (Public Law 95-217) and 1987 (Public Law 100-4), is also known as the federal CWA. The CWA provides the structure for regulating pollutant discharges to WOTUS. As stated in Section 101 of the CWA, its objective is "…to restore and maintain the chemical, physical, and biological integrity of the Nation's waters". Control of point and nonpoint sources of pollution are among the means to achieve the stated objective. The U.S. EPA administers the CWA, but many permitting, administrative, and enforcement functions are delegated to State governments. In Idaho, the designated agency is the IDEQ.

Certain sections of the CWA have special importance in the management of nonpoint source pollution. Sections 208 and 319 recognize the need for control strategies for nonpoint source pollution. Section 305(b) requires States to assess the condition of their waters and produce a biennial report summarizing the findings. Water bodies with water quality determined to be either impaired (not fully meeting water quality standards) or threatened (likely to violate standards in the near future) are compiled by the IDEQ in a separate list under Section 303(d) of the CWA.

This list must be submitted to the EPA every 2 years. Water bodies on the 303(d) list, known as WQL waters, are to be targeted and scheduled for water quality improvement strategies on a priority basis. These strategies are in the form of TMDLs, which define the quantity of pollutants that may be delivered to a water body without violating water quality standards. In practice, they are plans to improve water quality in a listed water body until water quality standards are met (i.e., until designated uses are fully supported).

3.3.3.6.1. Waters of the United States

WOTUS refers to waters over which the U.S. Army Corps of Engineers asserts jurisdiction under the CWA. Defining WOTUS is a requirement of the permitting process for herbicide application on the Forests.

WOTUS are defined as follows:

- Traditional navigable waters
- Wetlands adjacent to traditional navigable waters, including those with no continuous surface connection to traditional navigable waters
- Non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months)
- Adjacent wetlands that have a continuous surface connection to such tributaries (e.g., they are not separated by uplands, a berm, dike, or similar feature)
- Non-navigable, not relatively permanent tributaries and their adjacent wetlands where such tributaries and wetlands have a significant nexus to traditional navigable water. A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of downstream traditional navigable waters.

Based on this guidance, the SNF and BNF define WOTUS as perennial streams as identified in the NHD, additional perennial streams field-identified by Forest Service personnel, perennial lakes and ponds identified in the NHD Waterbodies dataset, and all mapped wetlands (including swamp/marsh and spring features in NHD and any available wetland data from the National Wetland Inventory) within 300 feet of a perennial stream (MacFarlane 2012).

3.3.3.7. Executive Order 11988, Floodplain Management

EO 11988 requires that agencies avoid, to the extent possible, adverse impacts associated with occupancy and modification of floodplains. It applies to all floodplain locations, as a minimum to areas in the 100-year, or base, floodplain.

3.3.3.8. Executive Order 11990, Protection of Wetlands

EO 11990 requires that agencies avoid, to the extent possible, adverse impacts associated with the destruction or modification of wetlands and avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

3.3.3.9. Idaho Water Quality Standards

Idaho State law defines the State's obligations to develop and enforce water quality standards to deal with problems related to personal health and water pollution. The State of Idaho has developed water quality standards to protect public health and welfare, enhance water quality, and comply with requirements of the CWA. Idaho State Water Quality Standards are administered under IDAPA 58, Title 01, Chapter 2.

The Idaho State Antidegradation Policy applies to all waters subject to the jurisdiction of the CWA. This policy states that the level of water quality necessary to protect the existing uses shall be maintained and protected and includes provisions to maintain and protect the water quality of High Quality Waters and Outstanding Resource Waters.

Surface water use designations are defined for Idaho waterbodies under IDAPA 58. Waters within the project area are generally classified under the following designated uses:

- Aquatic Life—cold water, salmonid spawning, or undesignated
- Recreation—primary contact recreation, secondary contact recreation, or undesignated
- Other—domestic water supply

Waters with undesignated uses are presumed to support cold water aquatic life and primary or secondary contact recreation beneficial uses. Designated uses for a few streams within the project area are "none" as a result of mining activity.

Idaho Water Quality Standards establish water quality criteria for aquatic life use designations. Under the following standards for water temperature and turbidity, surface waters are not to vary from the following characteristics as a result of human activities:

- Water temperatures of 22 °C) or less with a maximum daily average no greater than 19 °C (more stringent criteria for areas used for bull trout streams and salmonid spawning in the time of spawning and incubation)

- Turbidity (below applicable mixing zone) shall not exceed background levels by more than 50 NTU instantaneously or 25 NTU for more than 10 consecutive days

3.3.4. Affected Environment

3.3.4.1. Aquatic Habitat Conditions and Threats

The SNF and BNF manage significant aquatic habitat for both anadromous and resident fish populations, including spring/summer Chinook salmon, steelhead, redband trout, westslope cutthroat trout, and bull trout. Sockeye salmon and Yellowstone cutthroat trout occur on the SNF. The Wood River sculpin is endemic only to the Wood River drainage on the SNF. The SNF has over 7,500 miles of perennial and intermittent streams, and 7,600 acres of lakes and reservoirs, supporting an estimated 29 native and non-native fish species. The BNF has over 9,600 miles of perennial and intermittent streams, and 15,400 acres of lakes and reservoirs, supporting an estimated 28 native and non-native fish species. The SNF supports 10 species and the BNF supports 11 species that have been introduced or moved to areas where they are not native. Important fish habitat is found in major portions of the Boise, Salmon, Payette, and Wood River drainages. Aquatic resource baseline conditions are discussed in the fisheries BABE (available in the project record) by subbasin that contain listed or sensitive species.

Invasive plants are displacing native plants and have the potential to destabilize streams, reducing the quality of fish and wildlife habitat in the SNF and BNF. Invasive plants found growing adjacent to or within aquatic influence areas can invade, occupy, and dominate riparian areas and indirectly impact aquatic ecosystems and fish habitat. Invasive plants can change stand structure and alter future inputs of wood and leaves that provide the basic foundation of the aquatic ecosystem food webs. Native vegetation growth may change as a result of infestation, and the type and quality of litter fall, and quality of organic matter may decline, which can alter or degrade habitat for aquatic organisms.

Noxious weeds have been shown to influence soil erosion and sedimentation (Lacey et al. 1989), which can adversely affect aquatic resources, including habitat and fish populations, of the SNF and BNF. Forest and land management practices also may affect fish and their habitat. Excessive sedimentation can alter the streambed, affect spawning and rearing areas and success, and raise water temperatures, resulting in adverse effects to aquatic habitat quantity and quality and the well-being of fish and benthic invertebrate communities.

Corridors of the Salmon River, Boise, and Snake River and their tributary streams are vulnerable to weed invasions. These systems provide important natural habitat conditions for fish and benthic organisms. They support migration, spawning, rearing, and overwintering by different life stages of anadromous species, and they provide year-round habitat for all life stages of resident species. Portions of the river corridors are subject to intense use by humans and wildlife. Human activities include diversion of water from the Salmon River watershed for livestock, agriculture, and community water use. Recreational activities like camping, fishing, and whitewater rafting are popular on nearly every stretch of these waters. Mining, timber, and livestock grazing activities can also affect the quality of the habitat.

Generally, instream flows on the SNF and BNF adequately support healthy riparian communities and aquatic habitat. These flows are affected by human use (primarily irrigation) at lower elevations, sedimentation, and drought.

Roads confine many of the rivers and major streams on the SNF and BNF. These roads can contribute to the sedimentation of drainages and provide avenues for the proliferation of noxious weeds. Road construction has reduced riparian habitat, thus reducing the recruitment of wood into the stream channels that contribute to the formation of pools and provides cover for aquatic species. Conversion of some riparian areas to other uses further degrades habitat by removing native vegetation and replacing it with non-native grasses and other landscaping, thereby potentially increasing an area's vulnerability to noxious weeds.

Weed control at or near the headwaters of rivers and tributaries on the SNF and BNF can have a direct beneficial downstream effect on riparian habitat and the health of aquatic resources by reducing seed dispersal and the threat of weed establishment.

3.3.4.2. Federally Listed Fish Species

Four species of federally listed fish may occur within the SNF (Snake River sockeye salmon, Snake River spring/summer Chinook salmon, Snake River basin steelhead, and Columbia River bull trout) and 3 species within the BNF (Snake River spring/summer Chinook salmon, Snake River basin steelhead, and Columbia River bull trout) (Table 3-29). The sockeye salmon is listed as endangered, and the other fish species are listed as threatened.

In addition, the SNF and BNF contain designated critical habitat for Snake River sockeye salmon, designated critical habitat and Essential Fish Habitat (EFH) for Snake River spring/summer Chinook salmon, and proposed designated critical habitat for bull trout. The salmon and steelhead are under the jurisdiction of the National Marine Fisheries Service (NMFS) and bull trout are under the jurisdiction of the USFWS. These lists are subject to change as species are added, removed, or re-categorized.

These species occur in habitats adjacent to areas that have been invaded by weeds or are potentially vulnerable to weed invasion, and could potentially be affected by the presence and/or treatment of noxious weeds. The populations of these 4 species have historically declined due to factors such as heavy harvest pressure, habitat modifications, dams, and hatchery practices. Habitat degradation has been shown to play an important role in these declines.

Table 3-29. Federally listed fish species of the Sawtooth and Boise National Forests

Common Name/ Scientific Name	DPS or ESU[a]	Federal Status	Critical or Essential Fish Habitat located on Forest?	Forest
Snake River Sockeye Salmon *Oncorhynchus nerka*	Snake River Sockeye ESU	Endangered	Critical	SNF
Snake River Spring/Summer Chinook Salmon *O. tshawytscha*	Snake River Spring/Summer Chinook Salmon ESU	Threatened	Critical & Essential Fish Habitat	BNF and SNF
Snake River Basin Steelhead *O.s mykiss*	Snake River Basin DPS	Threatened	Critical Fish Habitat	BNF and SNF
Columbia River Bull Trout *Salvelinus confluentus*	Columbia River DPS	Threatened	Designated Critical Habitat	BNF and SNF

[a]DPS—Distinct Population Segment. ESU—Evolutionary Significant Unit

3.3.4.2.1. Snake River Sockeye Salmon (Oncorhynchus nerka)

Status—This species was listed by NMFS as endangered on November 20, 1991, and today consists of a remnant population associated with Redfish Lake in the Upper Salmon River basin in Idaho (56 FR 58619). Critical habitat for Snake River sockeye salmon was designated on December 28, 1993, within the Salmon River basin, and includes the Salmon River from its confluence with the Snake River to 5 lakes in the Sawtooth NRA and all inlet and outlet streams. The area within 300 feet of designated waterbodies is also included in the designation. Watersheds containing suitable spawning and early life rearing habitat for this species total approximately 510 square miles and lie partially or wholly within SNF lands in Blaine and Custer counties (NMFS 2002).

Life History—Sockeye salmon are an anadromous salmonid native to northwestern North America, northeastern Asia, and the Pacific Ocean. Historically, a number of lakes throughout the Columbia River basin supported sockeye salmon production (Gustafson et al. 1997). Sockeye salmon are native to the Snake River basin and historically were abundant in several lake systems in Idaho and Oregon. Today, the last remaining Snake River sockeye salmon spawn in Sawtooth Valley lakes in the Salmon River drainage within the SNF. This small remnant population migrates 900 miles downstream from the Sawtooth Valley through the Salmon, Snake and Columbia rivers to the ocean. After 1 to 3 years in the ocean, they return to the Sawtooth Valley as adults, passing once again through these mainstem rivers and through 8 major federal dams, 4 on the Columbia River and 4 on the lower Snake River. Anadromous sockeye salmon returning to Redfish Lake in Idaho's Sawtooth Valley travel a greater distance from the sea (900 miles) to a higher elevation (6,500 feet) than any other sockeye salmon population and they are the southernmost population of sockeye salmon in the world (NMFS 2015).

Snake River sockeye salmon begin their spawning migration in June and spawn in the fall, peaking in October. They spawn on shoals or beaches of lakes or inlet and outlet streams of lakes. Fry emerge from spawning shoals in early spring the following year. After emergence, fry move into the lake and remain there for 1 to 2 years when they transform to smolts (Foerster 1968). The length of stay in the nursery lake depends on the growth rate of the individual, which is determined by many factors including competition, food availability, water temperature, thermal stratification, lake turbidity, and length of growing season (Gustafson et al. 1997). Downstream migration of sockeye reared in the Sawtooth NRA begins in late April and generally peaks in mid-May.

Sockeye require cool, clear, silt-free streams and lakes during the egg through juvenile stages of their lives. Spawning sites chosen by adults generally contain medium to small sized gravel, with a limited amount of coarse sand (Foerster 1968). As adults, sockeye live in the north Pacific Ocean off the coast of Alaska, Canada, Washington, and Oregon. Snake River runs of sockeye salmon have almost been extirpated due to man-made causes.

Factors of Decline—The Snake River Sockeye salmon is one of the salmonids most at risk of those present on the SNF. The final rule listing sockeye salmon identifies the factors of decline for this species (56 FR 58619). Sockeye salmon population declines have been attributed primarily to mainstem dams on the Columbia and Snake Rivers that have blocked access to spawning and rearing areas and also caused mortalities to migrants (58 FR68543; Quigley and Arbelbide 1997). Also noted is increased predation on juvenile salmon in reservoirs and

increased predator populations due to ideal foraging areas created by impoundments, and increased delay of adults on their way to spawning grounds. Water withdrawal and storage, irrigation diversions and blockage of habitat for agriculture and other purposes are also noted as contributing to the destruction of Snake River sockeye salmon habitat. Spawning habitat has also been eliminated in some places and degraded in others from land use practices such as logging, road construction, mining, and livestock grazing. A hatchery-based captive brood stock program on the Upper Salmon River has been in operation since 1991 in an attempt to prevent extinction of the Snake River sockeye salmon.

3.3.4.2.2. Chinook Salmon (Oncorhynchus tshawytscha)

Status—The Snake River Spring/Summer Chinook Salmon was listed by NMFS as threatened on April 22, 1992 (57 FR 34953). Critical habitat was designated on December 2, 1993 (58 FR 68543), and revised on October 25, 1999 (64 FR 57399). Within the SNF and BNF, critical habitat for the Snake River spring/summer Chinook salmon includes all river reaches in the Salmon River basin presently or historically accessible to natural populations of this species, except for stream reaches upstream of impassable natural falls (NMFS 2002). An area 300 feet out from the ordinary high water markof each designated waterbody is also included in the designation.

Pursuant to Section 305(b) of the Magnuson-Stevens Act and its implementing regulations (50 CFR part 600.920), federal agencies must consult with NMFS regarding any of their actions authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken that may adversely affect EFH. The Magnuson-Stevens Act, Section 3, defines EFH as "those waters and substrate necessary for fish for spawning, breeding, feeding, or growth to maturity." Based on this definition, EFH for Snake River spring/summer Chinook salmon would include all drainages on the SNF and BNF that have been designated as critical habitat for this species.

Life History—The Chinook salmon is an anadromous salmonid native to western North America and the Pacific Ocean. This species consists of spring, summer, and fall races depending on time of primary passage over Bonneville Dam (Mathews and Waples 1991). Spring chinook cross the dam from March to May, summer cross from June to July, and fall cross from August to September (Burner 1951). Only Snake River spring/summer Chinook salmon occur within the SNF and BNF. Chinook salmon spend most of their adult lives in the ocean, but return inland to freshwater streams to spawn. Individuals that return to the Sawtooth NRA swim 900 plus miles to reach their spawning habitats. Adult spring chinook that spawn within the Sawtooth NRA initiate their migration in early spring and begin arriving at staging areas in mid-June. Spawning occurs from the first of August through the end of August. Summer Chinook that spawn within the Sawtooth NRA begin their migration in midsummer and begin arriving at staging areas in mid-July. Spawning occurs late August through September. Spawning adults within the upper Salmon River are typically 3 to 6 years of age. Fry emerge from March to May with most remaining in their natal streams until the fall, and then they migrate downstream to mainstems or large tributaries to overwinter. Generally transformation to smolts begins the following spring with seaward migration initiated in May.

Habitat requirements for Chinook salmon vary by life stage and season. Freshwater habitat variables that determine abundance and distribution are cover type, water temperature, substrate size and quality, channel morphology and stream size (Lee et al. 1997). Instream cover such as deep pools, wood, or undercut banks is important for adults prior to spawning. Temperature is

important in determining when and where spawning occurs. Generally water temperatures must fall to approximately 16 °C before spawning is initiated (Healey 1985). Clean gravel substrates are also required for spawning to occur. Survival and emergence of fry is influenced by temperature, fine sediment, and flow (Chapman 1988). Egg and fry survival can be negatively influenced by redd disturbance, excavation, and bottom scour. When fry emerge from eggs, they concentrate in shallow, slow water near stream margins (Hillman et al. 1989). They move to deeper pools with cover as they grow. During this rearing period, suspended fine sediment can affect growth and survival (Hicks et al. 1991). During the parr stage, Chinook seek areas that are segregated from other salmonids, generally low gradient, meandering streams (Scully et al. 1990). Temperature is also important during this period with upper limits of 25 °C.

Factors of Decline—The final rule listing spring/summer and fall Chinook salmon identifies the factors of decline for this species (57 FR 14653). The final rule addresses effects to habitat or range within the context of hydropower development, identifying factors such as blockage and inundation of habitat, turbine-related mortality, and increased delay of juvenile migration. Also noted are increased predation on juvenile salmon in reservoirs and increased delay of adults on their way to spawning grounds. Additionally, increased predator populations due to ideal foraging areas created by impoundments are identified as contributing to decline.

Water withdrawal and storage, irrigation diversions, siltation and pollution from sewage, farming, grazing, logging, and mining are also listed in the rule as degrading Snake River spring/summer Chinook salmon habitat.

3.3.4.2.3. Steelhead (Oncorhynchus mykiss)

Status—The Snake River steelhead were listed as threatened on August 18, 1997 (62 FR 43937) and threatened status reaffirmed on January 5, 2006 (71 FR 834). The Interior Columbia Basin Technical Recovery Team has identified six major population groups (MPGs) in this distinct population segment (DPS) for the Snake River Basin steelhead: (1) Clearwater River; (2) Grande Ronde River; (3) Hells Canyon; (4) Imnaha River; (5) Lower Snake River; and (6) Salmon River (ICBTRT 2003). Steelhead in the analysis area belong to the Salmon River MPG.

The Salmon River is the largest MPG and consists of 12 populations (Ford 2011). The area occupied by the Salmon River MPG makes up approximately 39% of the steelhead habitat in the entire DPS. Two of the MPG's populations are categorized as *Large*, eight are *Intermediate*, and two are *Basic* sized. The analysis area includes fish from two Intermediate sized populations, the East Fork Salmon River and Upper Salmon Mainstem. Critical habitat was designated for Snake River steelhead on September 2, 2005 (70 FR 52630).

Life History—Steelhead are an anadromous form of rainbow/redband trout. Two subspecies occur within the Columbia River basin, though only the inland subspecies (*O. mykiss*) occurs in Idaho. Two forms of the subspecies, winter and summer, are present. Winter-run steelhead enter freshwater 3 to 4 months prior to spawning, and summer-run steelhead enter freshwater 9 to 10 months prior to spawning. Summer-run are referred to as either "A" run or "B" run based on the time of passage over the major Columbia River dams.

Though steelhead are currently the most widely distributed anadromous salmonid, they are extinct within a large portion of their historical range. The current known range of steelhead is approximately 46% of historical, and many of the existing populations are depressed. Existing populations consist of 4 main types: wild, natural (non-indigenous progeny naturally spawning),

hatchery, and mix of hatchery and natural fish. Production of wild fish has declined 95% within the Columbia River basin and most existing populations are supported by hatchery and natural fish due to widespread hatchery mitigation production programs (Lee et al. 1997). The majority of the current Middle Fork, South Fork, and Upper Salmon River steelhead are progeny of introduced hatchery stocks from the Snake River. When Hells Canyon Dam was constructed in the 1960s, the US Fish and Wildlife Service, Army Corps of Engineer, US Forest Service, Bonneville Power Administration, Bureau of Reclamation, and Idaho Department of Fish and Game (IDFG) attempted to mitigate the effects of the dam by establishing a hatchery-managed, sport fishery in the upper Salmon River.

Life histories of steelhead are variable due to both genetic and environmental factors (Bulkey 1967, Withler 1966). Mature adult summer-run steelhead ascend the Columbia River from May through October and winter-run from November through April. Steelhead within the Salmon River watershed are summer-run, A-run, 1 year ocean steelhead from Hells Canyon stock. These fish return to fresh water during June through September, on their migration inland toward spawning areas. The adults overwinter in the larger rivers, and resume migration in early spring to natal, spawning streams. Spawning occurs during April and May. Unlike B-run steelhead which migrate downstream, A-run steelhead die after spawning. Incubation and emergence are dependent on temperature. Spawning in the Middle Fork, South Fork, and Upper Salmon typically occurs during May and June. Progeny emerge from redds in summer. The juveniles usually spend 2 to 3 years in freshwater before migrating to the ocean, where they spend up to 4 years before returning to spawn. The transformation to smolt form generally takes place from April to mid-June. It is influenced by photo-period and fish size (Hoar 1976). Steelhead may become non-anadromous if confined above barriers or in very cold waters (Mullan et al. 1992).

Habitat requirements of steelhead vary by season and life stage. Spawning occurs in sorted gravels for both mainstream and tributary waters. Like other salmonids, they require cool water with silt-free gravel for spawning. Fry move to shallow, slow-moving channel edges for rearing and move to deeper swifter water as they grow. In winter, juveniles select areas of low water velocity and seek concealment under cobbles.

Factors of Decline—Much of the same effects as discussed with chinook have contributed to the decline of Snake River steelhead. However, hatchery influences occurred much earlier and to a greater extent than to chinook. By the late 1960s hatchery production of steelhead surpassed natural production in the Columbia River basin (NWPPC 1986). The rule notes that hatchery programs, implemented in an attempt to mitigate the loss of habitat, have impacted native naturally reproducing stocks through competition, genetic introgression, and disease transmission and may reduce the production and survival of naturally reproducing steelhead.

Inadequate dam passage is one of the principle factors contributing to steelhead population declines. The construction and operation of the Columbia and Snake rivers' dams are considered the major cause of decline of anadromous fish generally (CBFWA 1990). Dams have altered habitat and changed flows, causing a significant disruption to migration and direct mortality. Nine mainstream dams occur along steelhead migration routes. Each dam causes delays in both upstream and downstream migration. During downstream migration, smolts may be injured, disoriented, or killed as they pass through turbines in the dams.

Habitat loss and degradation is another factor affecting steelhead. Forestry, agriculture, mining, and urbanization are listed in the final rule as factors that have degraded, simplified, and fragmented habitat. Water diversions for agriculture, flood control, domestic, and hydropower purposes are noted as having greatly reduced or eliminated historically accessible habitat. Loss of habitat complexity has also contributed to the decline of steelhead. Sedimentation from land use activities was specifically mentioned as a primary cause of habitat degradation in the range of this species.

The final rule concludes that natural climatic conditions have exacerbated the problems associated with degraded and altered riverine and estuarine habitats. Drought is recognized as having reduced already limited spawning, rearing, and migration habitat.

3.3.4.2.4. Bull Trout (Salvelinus confluentus)

Status—The Columbia River basin bull trout was listed by the USFWS as threatened on November 1, 1999 (64 FR 58910). The USFWS determined threatened status for all populations of bull trout within the contiguous (lower 48) United States (64 FR 58910), and on October 18, 2010 (75 FR 63898–64070; USFWS 2010) designated a final critical habitat for bull trout, including waters within the SNF and BNF. The Final Bull Trout Recovery Plan (USFWS 2015) identifies this population as the Upper Snake Recovery Unit, which occurs within central Idaho, northern Nevada, and eastern Oregon. The Upper Snake Recovery Unit contains 22 bull trout core areas found in 7 geographic regions. On the BNF and SNF, these are the Boise River (Arrowrock and Anderson Ranch Core Areas); Payette River (Middle Fork Payette, South Fork Payette Deadwood River Core Areas); and Salmon River (Upper Salmon, South Fork Salmon, Middle Fork Salmon River Core Areas). Core areas currently supporting adfluvial (rear in tributary streams and then migrate to lakes) populations of bull trout on BNF and SNF are located in the Upper Salmon River, South Fork Salmon River, Anderson Ranch, and Arrowrock core areas. All remaining core areas contain resident populations and most have fluvial (rear in tributary streams and then migrate to rivers) populations. Based on the USFWS's 5 year status review completed April, 2008, bull trout are generally "stable" overall range-wide.

Life History—The general life history of bull trout is characteristic of chars. Two distinct life-history forms, migratory and resident, occur throughout the range of bull trout (Pratt 1992; Rieman and McIntyre 1993). Migratory forms rear in natal tributaries before moving to larger rivers (fluvial form) or lakes (adfluvial form) or the ocean (anadromous) to mature. Migratory bull trout may use a wide range of habitats ranging from 2nd to 6th order streams and varying by season and life stage. Seasonal movements may range up to 186.4 miles (300 kilometers) as migratory fish move from spawning and rearing areas into overwinter habitat in downstream reaches of large basins (Bjornn and Mallet 1964; Elle et al. 1994). The resident form may be restricted to headwater streams throughout life. Both forms are believed to exist together in some areas, but migratory fish may dominate populations where corridors and subadult rearing areas are in good condition (Rieman and McIntyre 1993).

Migratory life histories have been lost or limited throughout the range (e.g., Goetz 1994; Jakober 1995; Montana Bull Trout Scientific Committee, 1995; Pratt and Huston 1993; Ratliff and Howell 1992; Rieman and McIntyre 1993, 1995). Evidence exists of declining trends in some populations (Mauser et al. 1988; Pratt and Huston 1993; Schill 1992; Weaver 1992) and extirpations of local populations are reportedly widespread.

Bull trout appear to have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Habitat characteristics, including water temperature, stream size, substrate composition, cover, and hydraulic complexity, have been associated with distribution and abundance (Dambacher and Jones 1997; Jakober 1995; Rieman and McIntyre 1993). Bull trout have repeatedly been associated with the coldest stream reaches within basins. Upper tolerance limits appear to be 12–15 °C (Goetz 1994, Ratliff 1992). Temperature also appears to be a critical factor in the spawning and early life history of bull trout. Bull trout in Montana spawned when temperatures dropped below 9–10 °C (Fraley and Shepard 1989). Spawning usually occurs during late summer and early fall, often at sites of groundwater upwelling, with young emerging the following spring (USFWS 2015). Bull trout egg survival varies with water temperature (McPhail and Murray 1979) with 4–6 °C apparently optimum (Weaver and White 1985). Temperature may be strongly influenced by land management (Henjum et al. 1994) and climate change; both effects may play an important role in bull trout persistence.

Bull trout are more strongly tied to the stream bottom and substrate than other salmonids (Pratt 1992). Substrate composition has repeatedly been correlated with the occurrence and abundance of juvenile bull trout (Dambacher and Jones 1997; Rieman and McIntyre 1993) and spawning site selection by adults (Graham et al. 1981; McPhail and Murray 1979). Fine sediments can influence incubation survival and emergence success (Weaver and White 1985) but might also limit access to substrate interstices that are important cover during rearing and overwintering (Goetz 1994; Jakober 1995).

Factors of Decline—The final rule listing bull trout identified the factors of decline for this species (63 FR 31647). The decline of Columbia River bull trout is primarily due to habitat degradation and fragmentation, blockage of migration corridors, poor water quality, past fishery management practices, and the introduction of non-native species (63 FR 31647). Grazing, road construction and maintenance, past over harvest, inadequacy of existing regulatory mechanisms, and isolation and habitat fragmentation have also played a part in the decline of bull trout and their habitat. The decline of this species has been attributed primarily to poor land management practices that have contributed to degraded instream and riparian habitat conditions (Quigley and Arbelbide 1997). Widespread introductions of non-native fishes have also caused local bull trout declines and extirpations.

Isolation and fragmentation influence the status of bull trout. Historically, bull trout populations were well connected throughout the basin. Habitat available to bull trout has become fragmented, and in many cases, populations have been isolated entirely. Dams have isolated whole subbasins throughout the basin (e.g., Brown 1992; Kanda et al. 1997; Pratt and Huston 1993; Rieman and McIntyre 1995). Irrigation diversions, culverts, and degraded mainstem habitats have eliminated or seriously depressed migratory life histories, effectively isolating resident populations in headwater tributaries (Brown 1992; Montana Bull Trout Scientific Committee 1995; Ratliff and Howell 1992; Rieman and McIntyre 1993). Loss of suitable habitat through watershed disturbance may also increase the distance between good or refuge habitats and strong populations, thus reducing the likelihood of effective dispersal (Frissel et al. 1993).

The bull trout final rule concludes that negative effects from interactions with introduced non-native species may be the most pervasive threat to bull trout in the Columbia River basin. Introductions of non-natives that compete or hybridize with bull trout, fragmentation and isolation of subpopulations due to habitat changes caused by human activities, and subpopulation extirpations due to naturally occurring events (droughts and floods) are factors affecting the

continued existence of bull trout. Brook trout are seen as an especially important problem (Kanda et al. 1997; Leary et al. 1993) and may progressively displace bull trout through hybridization and higher reproductive potential (Leary et al. 1993). Brook trout now occur in the majority of the watersheds representing the current range of bull trout.

Bull trout are widely distributed on both the SNF and BNF in several watersheds, including watersheds of the Payette, North Fork Payette, Middle Fork Payette, South Fork Payette, South Fork Salmon, Middle Fork Salmon, Upper Salmon, North Fork Boise, and South Fork Boise and Boise rivers. Large intact habitat exists primarily in the Salmon River drainage as this is the only drainage in the Upper Snake Recovery Unit that still flows directly into the Snake River; most other drainages no longer have direct connectivity due to irrigation uses or instream barriers (USWFS 2015).

3.3.4.2.5. Region 4 Sensitive Species

The FSM directs the Regional Forester to identify sensitive species for each National Forest where species viability may be a concern. The Intermountain Region (R4) Sensitive Species List was updated on June 2016. The fish species below may reside within the project area and appear on the R4 sensitive species list.

Westslope Cutthroat Trout

Westslope cutthroat trout *(Oncorhynchus clarki var lewisi)* is listed as an R4 sensitive species and as a priority species of special concern by the State of Idaho because of habitat degradation and declines of genetically pure populations (IDFG 2001b). The westslope cutthroat trout is 1 of 13 subspecies of cutthroat trout native to the inland western United States. Westslope cutthroat trout were petitioned for listing (63 FR 31691) but the USFWS determined listing was not warranted in 2000 (65 FR 20120.) This species is distributed throughout the South Fork Salmon River, Upper Middle Fork Salmon River, and the Upper Salmon River watersheds on both the SNF and BNF. However, like bull trout, it is largely dependent on high-quality habitat for survival, including cold water, numerous deep pools, and stream beds that are relatively free of sediment (Quigley and Arbelbide 1997). The strongest populations of westslope cutthroat trout occur in watersheds less influenced by roads or land management practices. Stocked, non-native species of cutthroat and rainbow trout can also adversely affect westslope cutthroat trout by hybridization. Migratory populations of this species are most significantly affected by the loss of viable habitat (Quigley and Arbelbide 1997).

Wood River Sculpin

The Regional Forester has designated the Wood River sculpin (*Cottus leiopomus*) as a sensitive species. They are native to the Big Wood River and Little Wood River and Camas drainages of central Idaho. Wood River sculpin occur within lands administered by the SNF.

Little is known about the specific habitat requirements of Wood River sculpin, but freshwater sculpin are generally found in clear streams with clean rock or gravel bottoms and require cool water with high oxygen content (Meyer et al. 2008). Sculpin are relatively intolerant of water pollution and their presence in a stream generally indicates high water quality. They are bottom dwellers and will often hide under rocks and debris when not active. Spawning usually occurs in the spring with nests scooped out beneath stones or debris (Simpson and Wallace 1982). Griffith (1996) speculates that sculpin may be less sensitive to streambank and riparian

conditions than salmonids but also notes that fine sediment embeddedness and low gradient in the stream channel appeared to be associated with lower Wood River sculpin abundance. Merkley and Griffith (1993), sampling during mid-summer, found Wood River sculpin to be much less abundant in pools (generally with high proportions of fine sediment) than in riffles in the Big Wood River and several tributary streams. On the other hand, Griffith (1996) sampled sites on Eagle Creek at low water temperature (during October and November) and found that nearly all individual sculpin were confined to pools.

Yellowstone Cutthroat Trout

The southern portion of the SNF supports Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), which is classified as an R4 sensitive species and SNF MIS. MIS are of primary concern because changes in the abundance of these species could be an indication of the effects of management activities. Yellowstone cutthroat trout historically occurred in the Snake River drainage from the headwaters down to Shoshone Falls and in the Yellowstone drainage from the headwaters down to and including the Tongue River basin within Idaho, Montana, Wyoming, Nevada, and Utah (Behnke 1992). Information on current status indicates that populations have declined from historic levels largely due to the influences of introduced non-native fish species and historic habitat degradation (Range-Wide YCT Conservation Team 2008).

A petition for listing as a threatened species under the ESA was submitted in 1998. Although listing was unwarranted in 2001, a court-ordered status review was initiated in 2005 and published in February 2006. Despite acknowledged declines in the distribution and abundance of Yellowstone cutthroat trout from historical levels (42% of its historical range is currently occupied; 28% by core, genetically unaltered, populations), the presence of many populations, especially in headwater streams, precluded listing under the ESA.

Yellowstone cutthroat trout inhabit relatively clear, cold streams, rivers, and lakes. Optimal temperatures have been reported to be from 4 °C to 15 °C (Gresswell 1995). Yellowstone cutthroat trout typically spawn between March and July after flows have declined from their seasonal peak and when water temperatures reach about 10 °C.

Northern Leatherside Chub

Northern leatherside chub (*Lepidomeda copei*) is a rare fish of the minnow family that occurs in mid-elevation desert streams throughout the Bonneville Basin and in select parts of the upper Snake River drainage of western North America (UDNR 2009). Leatherside chub (traditionally referred to as *Gila copei* or *Snyderichthys copei*) is composed of 2 distinct taxa: the northern leatherside (*L. copei*) and the southern leatherside (*L. aliciae*; Johnson et al. 2004). Only the northern leatherside chub occurs on the SNF in the Wood River, Raft River, and Goose Creek drainages.

The northern leatherside was petitioned for listing under ESA in 2007. This petition was on NatureServe data status of G1G2, indicating the population is either critically imperiled or imperiled. The USFWS completed a status review on October 11, 2011, and concluded the northern leatherside chub does not warrant protection under the ESA (USFWS 2011b).

Federal and State management agencies in Utah, Idaho, and Wyoming recognize the northern leatherside as a “species of concern” or “Protected Nongame Fish” that warrants special management and conservation planning considerations (UDWR 2005, IDFG 2005). It is

classified as an R4 sensitive species on the SNF. Monitoring efforts and surveys have identified populations are declining relative to historical levels, primarily caused by habitat fragmentation. Much of the current fragmentation has been caused by irrigation projects, water diversion, habitat degradation, and the introduction of non-native fish predators. Close examination of museum records identify a number of sites where populations once existed but now appear to be extirpated (Wilson and Belk 1996, Wilson and Belk 2001, Johnson et al. 2004).

3.3.4.2.6. Management Indicator Species

MIS on the SNF and BNF are considered to be key species that represent life forms with habitat requirements similar to other groups of plants or animals on the Forests. MIS are selected to represent special habitats, major habitat components of the SNF and BNF, economically or socially important species, and ecological indicators and are further selected based upon monitoring capability. Bull trout are the designated MIS for aquatic habitats on both the SNF and BNF. Additionally, Yellowstone cutthroat trout are designated MIS for the SNF.

Bull Trout MIS

The final Bull Trout Recovery Plan (USFWS 2015) states that bull trout were “stable” overall range-wide (species status neither improved nor declined during the reporting year), with some core area populations decreasing, some stable, and some increasing. The SNF and BNF are within the Upper Snake River Recovery Unit, which includes 22 bull trout core areas. Large intact habitat exists primarily in the Salmon River drainage as this is the only drainage in the Upper Snake Recovery Unit that still flows directly into the Snake River; most other drainages no longer have direct connectivity due to irrigation uses or instream barriers.

MIS monitoring conducted on the SNF over the past 10 years has defined the spatial distribution of bull trout as well as the presence and absence within a patch. Dunham and Rieman (1999) found that bull trout populations in the Boise River basin were linked closely to available habitat “patches” or networks of cold water. A patch is defined for bull trout as the contiguous stream areas believed suitable for spawning and rearing (Rieman and McIntyre 1995). Rieman and McIntyre (1995) analyzed bull trout in the Boise River basin and found occurrence to be positively related to habitat size (stream width) and patch (stream catchment) area, as well as patch isolation and indices of watershed disruption. Patch size (area) was the single most important factor determining bull trout occurrence.

At the subbasin scale (Upper Salmon, South Fork Boise, North Fork Boise, Middle Fork Boise, and South Fork Payette), it appears bull trout local populations have remained stable or increased in distribution since 2004. As of 2014, bull trout have been found to occupy 36 patches on the SNF and 62 patches on the BNF. This occupation is up from 21 patches on the SNF and 48 patches on the BNF when monitoring began in 2004. Bull trout have been found in several patches that were once thought to be unoccupied due to connectivity issues or where small remnant populations went undetected in past surveys (Vuono 2015; Roerick 2014).

Yellowstone Cutthroat Trout MIS

Yellowstone cutthroat trout monitoring over the past 4 years indicate that populations continue to occupy all streams where they were previously observed in Goose Creek watersheds (5 streams), Dry Creek, and the Raft River watershed (14 streams). One new observation of Yellowstone cutthroat trout occurred in 2014 and perhaps the first ever observation was made in

Beaverdam Creek. At the watershed scale, Yellowstone cutthroat trout densities and spatial distribution appear to have remained static.

As has been reported in various literature sources, results from MIS sampling indicate that patch size, stream temperature, patch connectivity, habitat condition, and the occurrence of nonnative trout can all influence the presence or absence of reproducing bull trout and Yellowstone cutthroat trout populations.

3.3.4.2.7. Introduced Salmonids

Non-native salmonids have been introduced on the SNF and BNF since the late nineteenth century to enhance angling opportunities. Arctic grayling (*Thymallus arcticus)*, lake trout (*Salvelinus manycush*), and golden trout (*Oncorhynchus mykiss aguabonita*) have been introduced to the BNF and the SNF to enhance angling opportunities in high mountain lakes. Brook trout (*Salvelinus fontinalis*) and rainbow trout (*O. mykiss*) have also been introduced throughout both forests lakes and streams. Although they have strong populations within the SNF and BNF, the latter 2 introduced salmonids pose risks of hybridization with native salmonids and compete for food and space. Kokanee (*O. nerka*) and Chinook salmon have been introduced into several lakes and reservoirs on the BNF and SNF.

3.3.4.2.8. Recreational Fisheries

Although most fisheries surveys focus on the occurrence of species that are endangered, threatened, sensitive, or of concern, a number of fish species provide recreational opportunities on the SNF and BNF, including hatchery stocks of Chinook salmon and steelhead, and rainbow trout, brook trout, golden trout, brown trout, Arctic grayling, and mountain whitefish. Hatchery-spawned, non-ESA listed steelhead and Chinook salmon that return to the Salmon River as adults support a broad recreational fishing base within the basin, including areas within the SNF and BNF (Quigley and Arbelbide 1997).

3.3.4.2.9. Non-Game Species

Commonly occurring nongame fish species that are important members of aquatic communities on the BNF and SNF include northern pikeminnow (*Ptychocheilus oregonensis*); redshine shiner (*Richarsonius balteatus*); bridgelip sucker (*Catostomus columbianus*); largescale sucker (*C. macrocheilus*); Bluehead sucker (*C. discobolus*); mountain sucker *(C. platyrhynchus)*; chiselmouth (*Acrocheilus alutaceus*); mottled, Paiute, shorthead, and Wood River sculpin (*Cottus* spp.); leopard dace (*Rhinichthys falcatus*); speckled dace (*Rhinichthys osculus*); Longnose dace *(R. cataractae*); Utah sucker (*Gila atraria*); Northern leatherside chub (*Lepidomeda copei*); Utah chub (*G. atraria*); and peamouth (*Mylocheilus caurinus*).

These species, as well as all other fish species described above, may occur in habitats adjacent to areas that have been invaded by weeds or are potentially vulnerable to weed invasion. These stream and lake habitats could potentially be affected by the presence of noxious weeds and/or land management practices associated with noxious weed control.

3.3.4.2.10. Watersheds, Invasive Plant Infestations and Fish Presence

The 156,777 acres of invasive plants have been identified across the BNF's and SNF's ninety-five 5th field watersheds (Table 3-30). About 61,689 acres of infestations are mapped within

RCAs and, of these, 49,379 acres are in 5th field HUCs containing threatened, endangered, or sensitive (TES) species. There are 65 HUC watersheds that support federally listed or regionally sensitive species. The Lower North Fork Boise River (19%), Crooked River (17%), Middle North Fork Boise River (12%), Skeleton Creek–South Fork Boise River (12%), and Alder Creek–South Fork Payette River (11%) watersheds have the greatest proportion of infested acres within TES species habitat. All of these watersheds support bull trout. Watersheds supporting Chinook salmon, sockeye salmon, or steelhead generally have infestation levels >4%. However, the Pole Creek–Salmon River watershed, which supports bull trout, Chinook salmon, steelhead, and westslope cutthroat, has an infestation level of 7%.

Many of the infested sites are on or near roads that cross either perennial or intermittent streams on the BNF and SNF. For the purpose of analyzing proximity of infested sites to listed fish, streams containing listed fish near infested sites were identified, and infested sites were identified within RCAs using guidance outlined in the BNF and SNF Forest Plans. The total infested acres within each 6th field watershed may be a sum product from multiple infested weed sites.

Many mainstem rivers, such as the Middle, North, and South Fork of the Boise River; South and Middle Fork of the Payette River; East and South Fork and Upper Salmon Rivers serve as migration corridors to Chinook salmon, sockeye salmon, steelhead, or bull trout. Tributaries to these mainstem rivers provide primary spawning and rearing habitats. Most of the spawning and rearing for bull trout occurs in the headwaters, and typically in the lower reaches only adults can be found. Herbicide application is proposed to occur within riparian areas that may be near rearing and migration habitat in 5th field watersheds listed in Table 3-30.

Table 3-30. All infested watersheds located on the Sawtooth and Boise National Forests (alphabetical order)

Watershed Name	5th Level HUC_10 Number	Total Acres in HUC on National Forest	Total Infested Acres in HUC	Percent infested in HUC	Infested acres in RCAs	Threatened, Endangered or Sensitive Species present in HUC[a]
Alder Creek-South Fork Payette River	1705012006	64157.29	7151.94	11.15	2022.25	BT
Alturas Lake Creek	1706020103	44353.43	1650.89	3.72	311.23	BT, CNS, SOS, SRS, WSC,
Anderson Creek-Middle Fork Payette River	1705012104	37657.84	876.46	2.33	419.23	NONE
Anderson Ranch Reservoir	1705011308	40695.41	484.08	1.19	202.46	BT
Bakers Creek-Big Wood River	1704021901	113485.26	3962.40	3.49	1637.41	NONE
Basin Creek-Salmon River	1706020106	32515.38	513.74	1.58	417.35	BT, CNS, SOS, SRS, WSC
Baugh Creek-Little Wood River	1704022101	50096.99	51.07	0.10	51.07	WRS
Bear Valley Creek	1706020502	61193.06	1381.47	2.26	498.70	BT, CNS, SRS, WSC,
Big Cottonwood Creek	1704021202	34392.32	1127.02	3.28	449.97	YCT
Big Creek-North Fork Payette River	1705012305	39920.06	1442.58	3.61	333.63	NONE
Big Smoky Creek	1705011301	72201.25	179.36	0.25	60.12	BT
Boise River-Lucky Peak Reservoir	1705011206	46396.72	1794.15	3.87	316.17	NONE
Bull Creek-Middle Fork Payette River	1705012101	40169.13	119.66	0.30	57.27	BT
Canyon Creek	1705010110	1814.46	2.18	0.12	1.62	NONE
Canyon Creek-South Fork Payette River	1705012002	125012.27	2223.12	1.78	1602.03	BT
Cascade Reservoir	1705012304	15602.82	760.87	4.88	157.74	NONE
Cassia Creek	1704021006	29081.00	227.16	0.78	111.44	YCT
Clear Creek	1704021003	36921.14	281.91	0.76	259.18	YCT
Clear Creek-South Fork Payette River	1705012003	111795.82	5335.34	4.77	1556.08	BT
Corral Creek-Camas Creek	1704022002	6332.64	75.16	1.19	59.35	NONE
Crooked River	1705011105	66630.57	11611.16	17.43	4514.58	BT
Deer Creek-Big Wood River	1704021905	42152.07	265.31	0.63	164.83	WRS
Dove Creek	1602030814	11318.33	90.92	0.80	28.06	NONE
Dry Creek	1704021203	19460.50	637.29	3.27	25.22	YCT
East Fork Big Wood River	1704021904	41567.65	106.17	0.26	81.46	WRS
Elk Creek	1706020501	23688.68	831.61	3.51	172.86	BT, CNS, SRS, WSC
Elkhorn Creek-Middle Fork Salmon River	1706020504	5368.04	0.96	0.02	0	BT, SRS, WSC,
Fall Creek	1705011307	37153.20	750.52	2.02	265.07	NONE

Watershed Name	5th Level HUC_10 Number	Total Acres in HUC on National Forest	Total Infested Acres in HUC	Percent infested in HUC	Infested acres in RCAs	Threatened, Endangered or Sensitive Species present in HUC[a]
Feather River-South Fork Boise River	1705011305	96208.81	2236.42	2.32	1419.93	BT
George Creek-Raft River	1704021004	17288.28	560.74	3.24	162.09	YCT
Glen Canyon	1602030902	30099.82	1917.69	6.37	717.18	NONE
Gold Fork River	1705012303	27497.73	720.26	2.62	222.85	BT
Headwaters Camas Creek	1704022001	2910.71	16.13	0.55	1.18	NONE
Headwaters Goose Creek	1704021101	45198.95	904.40	2.00	309.00	YCT
Headwaters South Fork Boise River	1705011303	66226.27	430.60	0.65	356.50	BT
Headwaters South Fork Payette River	1705012001	59554.80	73.95	0.12	27.88	BT
Hill Creek-Payette River	1705012201	9056.13	118.19	1.31	28.67	NONE
Indian Creek	1705011405	2178.47	4.76	0.22	0.02	NONE
Johnson Creek	1706020801	138192.26	1225.00	0.89	568.31	BT, CNS, SRS, WSC
Johnson Creek-Raft River	1704021002	37021.85	753.41	2.04	355.66	YCT
Junction Creek	1704021001	7218.75	78.15	1.08	10.80	NONE
Lightning Creek-Middle Fork Payette River	1705012103	44789.58	269.04	0.60	78.00	BT
Lime Creek	1705011306	63925.22	1078.68	1.69	705.45	NONE
Little Smoky Creek	1705011302	54155.75	735.16	1.36	496.39	BT
Little Squaw Creek	1705012205	13182.41	693.37	5.26	198.27	NONE
Little Weiser River	1705012407	67.96	2.30	3.39	0	NONE
Lower Deadwood River	1705012005	81858.92	747.65	0.91	258.03	BT
Lower Deep Creek-Frontal Great Salt Lake	1602030904	6527.61	173.82	2.66	43.57	NONE
Lower Goose Creek	1704021104	35234.58	347.50	0.99	34.91	NONE
Lower Grimes Creek	1705011202	27997.69	1807.56	6.46	507.60	NONE
Lower Middle Fork Boise River	1705011107	84472.50	1509.71	1.79	579.76	BT
Lower Mores Creek	1705011204	28935.03	2677.92	9.25	580.92	NONE
Lower North Fork Boise River	1705011106	53227.83	10064.18	18.91	3116.91	BT
Lower Squaw Creek	1705012204	14489.05	3339.52	23.05	796.64	NONE
Marsh Creek	1706020503	1336.89	0.63	0.05	0	CNS
Marsh Creek	1704020906	12725.28	1075.66	8.45	89.62	NONE
Meadow Creek	1704021005	18565.72	246.20	1.33	139.95	NONE
Middle East Fork Salmon River	1706020111	47103.87	300.14	0.64	184.67	BT, CNS, SRS, WSC
Middle Goose Creek	1704021103	45816.02	628.85	1.37	410.82	NLC
Middle North Fork Boise River	1705011104	69477.71	8433.67	12.14	2597.75	BT
Muldoon Creek	1704022103	19246.61	22.35	0.12	10.78	WRS
Pole Creek-Salmon River	1706020102	60905.26	4241.64	6.96	999.83	BT, CNS, SRS, WSC

Watershed Name	5th Level HUC_10 Number	Total Acres in HUC on National Forest	Total Infested Acres in HUC	Percent infested in HUC	Infested acres in RCAs	Threatened, Endangered or Sensitive Species present in HUC[a]
Queens River-Middle Fork Boise River	1705011102	80769.10	3878.30	4.80	3542.83	BT
Redfish Lake Creek-Salmon River	1706020104	108371.85	2156.60	1.99	621.80	BT, CNS, SOS, SRS, WSC
Rock Creek	1704020901	22889.70	2206.01	9.64	272.34	NONE
Rock Creek	1704021206	68542.61	944.12	1.38	519.31	NONE
Rock Creek-South Fork Boise River	1705011309	36726.54	775.61	2.11	362.89	BT
Round Valley Creek-North Fork Payette River	1705012306	25068.28	869.19	3.47	124.06	NONE
Shafer Creek	1705012202	11612.64	75.20	0.65	4.35	NONE
Sheep Creek-Boise River	1705011205	52942.85	1666.60	3.15	456.38	BT
Shoshone Creek	1704021305	44364.71	239.19	0.54	95.52	NONE
Silver Creek-Middle Fork Payette River	1705012102	68147.24	954.09	1.40	460.60	BT
Skeleton Creek-South Fork Boise River	1705011304	111088.70	13443.97	12.10	7832.48	BT
Slate Creek-Salmon River	1706020109	46139.59	1573.35	3.41	1100.60	BT, CNS, SOS, SRS, WSC
Smith Creek-South Fork Boise River	1705011311	78494.81	410.15	0.52	202.99	BT
Soldier Creek-Camas Creek	1704022003	24122.75	585.10	2.43	295.66	WRS
Sublett Creek-Warm Creek	1704021007	31560.54	527.80	1.67	439.05	NONE
Tenmile Creek-Fifteen Mile Creek	1705011402	679.77	2.34	0.34	0.52	NONE
Town of Helgar-Helgar Creek	1704021008	16759.16	338.43	2.02	235.09	NONE
Trail Creek-Big Wood River	1704021903	80258.04	1733.14	2.16	740.23	WRS
Upper Deadwood River	1705012004	69805.51	669.83	0.96	230.82	BT
Upper East Fork Salmon River	1706020110	82693.94	209.64	0.25	134.67	BT, CNS, SRS, WSC
Upper East Fork South Fork Salmon River	1706020802	1657.36	1.41	0.08	0	BT, CNS, SRS, WSC
Upper Goose Creek	1704021102	23171.15	434.60	1.88	190.82	NLC
Upper Grimes Creek	1705011201	42571.32	8274.22	19.44	2155.38	NONE
Upper Middle Fork Boise River	1705011101	76707.37	3387.76	4.42	2994.66	BT
Upper Mores Creek	1705011203	46918.67	12024.59	25.63	2773.06	NONE
Upper North Fork Boise River	1705011103	52908.59	2431.77	4.60	1726.35	BT
Upper South Fork Salmon River	1706020804	103601.37	1402.64	1.35	506.18	BT, CNS, SRS, WSC
Upper Squaw Creek	1705012203	58114.92	2612.49	4.50	826.60	BT
Valley Creek	1706020101	72710.02	271.38	0.37	141.71	BT, CNS, SOS, SRS, WSC
Warm Springs Creek	1704021902	60154.59	312.46	0.52	274.97	WRS

Watershed Name	5th Level HUC_10 Number	Total Acres in HUC on National Forest	Total Infested Acres in HUC	Percent infested in HUC	Infested acres in RCAs	Threatened, Endangered or Sensitive Species present in HUC[a]
Warm Springs Creek	1706020107	51714.60	425.32	0.82	314.49	BT, CNS, SOS, SRS, WSC
Willow Creek	1704022004	31956.40	280.81	0.88	127.59	NONE
Willow Creek	1705011310	19681.18	287.54	1.46	196.96	WRS
Yankee Fork	1706020105	52.35	2.06	3.93	1.85	BT, CNS, SRS, WSC
TOTAL		4276785.87	156777.47	3.66	61689.10	

[a]Listed threatened and endangered: Snake River sockeye salmon SOS, Snake River spring/summer Chinook salmon CNS, Snake River steelhead SRS, and bull trout BT. R4 Sensitive species: Westslope cutthroat trout WSC, Wood River sculpin WRS, Yellowstone cutthroat trout YCT, Norther leatherside chub NLC

3.3.5. Environmental Consequences

3.3.5.1. Alternative 1—No Action

3.3.5.1.1. Direct and Indirect Effects

General Effects

With the expected continued spread of noxious weeds under Alternative 1, there would be an increased potential for both short- and long-term soil erosion and stream sedimentation at weed-infested sites. Weed infestations can increase surface runoff and sediment transport by increasing fire frequency by alterating ground cover and raindrop interception. Once established, weed infestations can sometimes alter fuel characteristics of the landscape and establish a lasting fire cycle that promotes the dominance of the invasive species (Brooks et al. 2004). Many invasive species are annual plants with allopathic mechanisms that kill other plants and reduce the vegetation density. Vegetative cover can be changed to the point where the hydrology of an area is disrupted. Studies by Lacey et al. (1989) reported a 50% increase in runoff at knapweed-infested sites compared to non-infested sites.

Increased soil erosion and stream sedimentation can directly and indirectly adversely affect aquatic habitat and associated fish and aquatic invertebrate populations. These adverse effects would likely be greatest in the northern and western portions of the SNF, where extensive infestations of leafy spurge, spotted knapweed, and rush skeleton weed occur and in the central portion of the BNF where rush skeleton weed, spotted knapweed, and yellow toadflax occur.

Invasive plants found growing adjacent to or near water bodies can invade, occupy, and dominate riparian areas and indirectly impact aquatic ecosystems and fish habitat. Native vegetation growth may change as a result of infestation, and the type and quality of litter fall and quality of organic matter may decline, which can alter or degrade habitat for aquatic organisms. The Forest Service (1999; 2001c) noted that the establishment of invasive weeds such as knapweed and sulphur cinquefoil within or adjacent to riparian habitats could increase overland runoff and sediment yield from such habitats. Studies on the Lolo National Forest in western Montana showed that a site with 80% knapweed cover yielded 5 times the amount of sediment as sites covered with bunchgrass (Hickenbottom 2000, cited in USDA Forest Service 2001b). These

same studies estimated that the effects of a 20-minute thunderstorm (100-year event intensity) occurring on 1,648 acres of big game winter range infested with spotted knapweed could produce an additional 160 tons of sediment compared to a weed-free site.

Increased sediment delivery to drainages can directly and indirectly affect aquatic resources through the sedimentation of stream substrates and increased levels of turbidity and suspended sediment in the water column. Increased sedimentation can degrade stream bottom habitat used by aquatic insects such as caddisflies, mayflies, and stoneflies, which are important fish foods; a subsequent reduction in aquatic insect abundance and diversity; a reduction in the permeability between interstitial spaces within spawning gravels that inhibits the flow of oxygenated water and the removal of metabolic wastes; a subsequent reduction in spawning success, hatching success, and fish production; and a reduction in the interchange of surface and subsurface waters in the hyporheic zone beneath the stream channel (Nelson et al. 1991). Substantially increased sedimentation can eliminate or reduce the depths of pools that provide important year-round cover for juvenile, sub-adult, and adult fish. If severe enough, increased sediment loads can cause the erosion and migration of stream channels and the subsequent degradation of aquatic and riparian habitat (Meehan et al. 1991).

Invasive Aquatic Plant Species

Aquatic plants are a valuable component of aquatic ecosystems. They provide cover, habitat, and food for many species of aquatic biota, fish, and wildlife. However, invasive aquatic species can degrade water quality, impair fish habitat, block intakes that supply water for domestic or agricultural purposes, and interfere with navigation, recreation, and aesthetics.

Invasive aquatic species known to occur on the BNF and SNF, such as purple loosestrife (*Lythrum salicaria*) and Eurasian watermilfoil (*Myriophyllum spicatum*), can drastically alter the ecology of riparian areas, wetlands, and aquatic ecosystems. Purple loosestrife aggressively invades many types of wetlands, including freshwater wet meadows, marshes, river and stream banks, pond edges, reservoirs, and roadside ditches. The formation of dense, monotypic stands of purple loosestrife suppresses native plant species, decreases biodiversity, and leads to a change in the wetland's community structure and hydrological functioning, while eliminating open water habitat in many locations. Purple loosestrife dominates wetlands and almost entirely eliminates shallow open water habitat if left uncontrolled (Gettys and Balaud 2014).

Eurasian watermilfoil is a submersed perennial aquatic plant. It adversely impacts aquatic ecosystems by filling the water column and forming dense canopies that shade out native aquatic vegetation. Eurasian watermilfoil is adaptable, able to survive in a variety of environmental conditions. It grows in still-to-flowing waters, can tolerate relatively high salinities, can tolerate a wide range of pH levels, grows rooted in water depths from 1 to 10 meters, and can survive under ice. This species regenerates readily from plant fragments which are easily transported to uninfested water bodies on boats and boat trailers. Pure stands of Eurasian watermilfoil provide poor habitat for waterfowl, fish, and other wildlife. Significant plant sloughing, leaf turnover, and decomposition of large amounts of plant material at the end of the growing season increase phosphorus and nitrogen in the water column. Dense Eurasian watermilfoil mats alter water quality by raising the pH, decreasing oxygen under the mats, and increasing temperature. (IISC and ISDA 2007b).

In Idaho, Eurasian watermilfoil was first found in Bonner County, and then Kootenai County in 1998 where it infested 3 local waterways. The weed was then discovered in Payette Lake (Valley County), followed by other counties in southwestern Idaho. By 2000, Eurasian watermilfoil was considered a widespread weed in northern and southwestern Idaho (Idaho Invasive Species Council 2007). The Idaho Eurasian Watermilfoil Task Force (a subcommittee of the Idaho Invasive Species Council) surveyed 107 sites on 75 water bodies for the statewide Eurasian watermilfoil control program (Idaho Milfoil Task Force 2006). Eurasian watermilfoil has been found to be present in Ada, Boise, Gem, Valley, and Washington counties with several susceptible waters identified near both the BNF and SNF. Other aquatic invasive plants that have been found near the BNF and SNF are parrot feather (*Myriophyllum aquaticum*), Brazillian waterweed (*Egeria densa*), dioesious hydrilla (*Hydrilla verticillata*), and curly-leaf pondweed (*Potamogeton crispus*) (USGS, Nonindigenous Aquatic Species website).

Effects to Aquatic Resources

Aquatic resources potentially impacted by the direct and indirect effects of increasing weed infestations on the SNF and BNF include all of the special status, rare, sensitive, introduced, recreational, nongame, and other MIS fish species described in the “Affected Environment” section of this report. Potentially at-risk resources also include aquatic invertebrate species. The greatest potential for impacts from increased sediment delivery and possibly riparian degradation may be to the anadromous and native resident salmonids, especially protected and/or sensitive species such as Chinook salmon, sockeye salmon, steelhead, bull trout, and westslope cutthroat trout. These species have relatively narrow habitat requirements, including the need for clean, cold, well-oxygenated, interconnected water and/or gravels for spawning, egg incubation, rearing, migration, and/or adult success (Bjornn and Reiser 1991). Site-specific impacts from erosion and sediment delivery would depend on the slope, soil characteristics, precipitation amount and pattern, distance to water, riparian buffer health and extent, and the species and life stages present.

The impacts of invasive plants on the environment can last decades, while the impacts of treatment tend to be short term (1 year or less). Passive and active restoration would accelerate native vegetative recovery in treated sites. There would be no potential negative effects or risks to fisheries resources or aquatic habitats from herbicide application, or short-term increases in erosion and sediment delivery to drainages caused by mechanical treatments (soil disturbance) under the Alternative 1.

Effects to Federally Threatened and Endangered and Forest Service Region 4 Sensitive Fish Species

Implementing Alternative 1 would be considered not likely to adversely affect the following federally listed species occurring within the SNF or BNF non-Wilderness project area: Snake River spring/summer Chinook salmon, Snake River sockeye salmon, Snake River basin steelhead, and Columbia River bull trout. Implementation may result in localized increases in site erosion and stream sedimentation in association with expanding weed infestations, as described above, particularly within the northern portions of the SNF and the central portion of the BNF. Indirect effects of increased stream sediment would be reduced habitat suitability of substrate habitats for sediment-intolerant fish food organisms. Soil erosion would likely increase in infested riparian areas as a result of increased bank erosion and channel instability. Impacts

would be localized and limited to existing significant near-stream weed infestations and areas of new infestations. No negative effects or risks to TES fish species or their critical habitats would occur from herbicide application or short-term increases in erosion and sediment delivery to drainages caused by mechanical treatments or rehabilitation/restoration activities (soil disturbance) under Alternative 1.

Effects to R4 sensitive westslope cutthroat trout, Yellowstone cutthroat trout, northern leatherside chub, and Wood River Sculpin and their aquatic habitats would be similar to those identified for federally listed species and critical habitats. Implementing Alternative 1 may impact individual Westslope cutthroat trout, Yellowstone cutthroat trout, northern leatherside chub, and Wood River sculpin aquatic habitats through locally elevated sedimentation related to reduced soil stability in weed infested areas, but the level and scope of impacts would not likely contribute to a trend towards federal listing, cause a loss of viability to the population, or be expected to result in a downward trend for the species.

Effects to Management Indicator Species

Population trends for the SNF's and BNF's aquatic MIS are discussed in the "Affected Environment" section of this document. Under Alternative 1, no active weed treatments would be conducted on NFS lands. Direct and indirect effects to bull trout and Yellowstone cutthroat trout under Alternative 1 are as identified within the preceding TES species discussion above. These effects would not be expected to be of sufficient nature or magnitude to measureably influence the future trend of bull trout or Yellowstone cutthroat trout populations on the SNF or BNF.

3.3.5.1.2. Cumulative Effects

Under Alternative 1, no invasive plant treatments would be implemented by the Forest Service within the project area. Counties may continue to undertake weed control on their road ROW within NFS lands. Active weed treatments, including ground-based herbicide application, mechanical control, and biological control releases, would continue to occur on private, County, State, and adjacent land managed by the BLM through those land managers and through actions conducted by Cooperative Weed Management Area (CWMA) participants.

A lack of active treatment of noxious weeds on SNF and BNF non-Wilderness lands under Alternative 1, combined with continuing non-forest treatments conducted by the CWMAs, would be expected to result in some localized eradication, control, and containment of noxious weeds within non-NFS lands. However, weed infestations on NFS lands would be expected to continue to increase, which would impede the efficacy of ongoing CWMA efforts to eradicate, control, or contain new weeds that have spread to adjacent lands from infestations on the SNF and BNF. The resultant continued spread of noxious weeds within watersheds on the BNF and SNF could potentially adversely affect aquatic and riparian habitats both on and off NFS lands through increased erosion and sediment delivery to drainages. The potential for adverse cumulative effects on aquatic resources would be greatest in the northern portion of the SNF and BNF and on adjacent non-NFS lands because of extensive rush skeletonweed, oxeye daisy, spotted knapweed, and leafy spurge infestations on NFS lands which would not be treated.

CWMA herbicide applications to private, State, County, or BLM-administered lands adjacent to SNF and BNF non-Wilderness areas would continue to occur under Alternative 1, as would chemical applications on private lands by landowners within the project area. Potential

cumulative effects to NSF lands would be primarily limited to areas downstream from private inholdings where the potential for adverse effects to aquatic and riparian resources would exist if an herbicide spill or wind-drift-related impact occurred close to NFS boundaries.

3.3.5.1.3. Irreversible/Irretrievable Effects

As there would be no active weed treatment activities implemented under Alternative 1, there would be no irreversible or irretrievable impacts to fisheries resources or aquatic habitats associated with treatment. Invasive plants can alter native plant communities and make restoration more difficult. However, with no treatment, invasive plants can irreversibly alter habitat elements important for some species.

3.3.5.1.4. Forest Plan Consistency

Management direction for SNF and BNF fisheries resources and aquatic habitats are identified within the SNF and BNF Forest Plans. Forest Plan direction relevant to invasive plant treatments is summarized in the “Relevant Direction” section of this document.

The absence of an active implementation strategy to address and treat invasive plant infestations on NSF lands is inconsistent with Management Goals, General Direction, and Standards and Guidelines for fisheries resources and aquatic habitats identified in both the SNF and BNF Forest Plans (USDA Forest Service 2010a, 2012a).

3.3.5.2. Effects Common to All Action Alternatives

The action alternatives includes provisions to minimize or avoid chemical contamination of stream channels that could occur through drift, spillage, directly spraying chemicals into water or dry stream channels, leaching through soils, and runoff. The following are some of the key project design criteria included in the action alternatives that reduce the likelihood of chemicals reaching water:

- The action does not use high-risk application methods near water, such as aerial or boom spraying, which virtually eliminates the risk of directly spraying chemicals into water or dry stream channels, except when herbicides are sprayed into drainage ditches and when they are used on the streambank.
- Applicators are required to use more risk-averse application methods in sites that are close to stream channels; fewer safeguards are required when chemicals are applied in locations where chemicals cannot readily reach a stream channel. Key provisions include using the least toxic chemicals near water, and more precise herbicide application methods in stream side areas, such as wicking, wiping, or hand spraying with a single nozzle.
- Dyes would be used to more accurately control the application rate and reduce the likelihood of spraying chemicals directly into water by showing the applicator exactly where the herbicide is being sprayed and where herbicides have already been sprayed. Water-soluble colorants, such as Hi-Light blue dye, will be used within 100 feet of water and other situations as needed to enable applicators and inspectors to properly apply herbicides.

- For aquatic herbicide application, the protocol outlined in the Framework Strategy (Appendix F) is to first identify the need for completion of the appropriate type of site specific ESA consultation prior to implementation of any chemical, mechanical or cultural treatment. Determinations regarding the need for ESA consultation, and determining agency responsibilities for conducting it, would be made on a case-by-case basis.

If aquatic invasive species are found in any ESA-listed water sources, ESA consultation will be initiated for proper treatment.

Each of the action alternatives analyzed includes an IWM approach to invasive plant management using biological, mechanical, and chemical treatment options, as well as rehabilitation and restoration practices. These options would be implemented singly or in combination with each other to manage invasive plants. Effects of mechanical and biological treatments and rehabilitation/restoration practices are similar between the action alternatives. Chemical treatment actions vary significantly between the action alternatives and will be discussed individually by alternative.

All common mechanical, biological, and rehabilitation/restoration actions implemented under the action alternatives would benefit aquatic habitat health over the long-term by re-establishing desirable vegetation that would reduce adverse erosion and sediment delivery to waters on NFS lands. Reducing noxious weeds and establishing desirable vegetation would benefit watershed health and reduce the potential for future noxious weed encroachment into riparian areas. Short-term localized impacts to individual fish and drainages may occur; however, adverse effects may be specific to individual treatment methods as identified below.

3.3.5.2.1. Biological Treatments

Direct and Indirect Effects of Biological Treatments

Releasing biological agents to control noxious weeds should have no adverse effect on aquatic resources. The biological controls proposed (insects and plant pathogens) target specific weeds as a host and would not compete for food with aquatic organisms, but they may provide an incidental food source for fish where weed infestations occur near stream channels. As there are no approved biological control agents in use on the SNF and BNF known to attack non-target plants, there would be no expected negative effects to native riparian vegetation.

Though biological treatments involving goat or sheep grazing could have an effect on habitat indicators (e.g., riparian condition, sediment, substrate embeddedness), design criteria, including targeted short-term grazing practices and fencing to protect streambanks, have been included to protect these habitat indicators. In addition, grazing operations would be presented to the Level I Team for prior approval in ESA-listed waters.

Effects to Federally Threatened and Endangered and Forest Service Region 4 Sensitive Fish Species

Implementing biological weed control (insects, pathogens, site specific goat, or sheep grazing) would not result in effects of a scope or magnitude which would be considered likely to adversely affect federally listed species occurring within the SNF and BNF project area. Biological releases (insects) may provide a slight beneficial effect in contributing an additional

incidental fish food source to aquatic environments in and around release sites and a reduction in targeted weed populations.

If not properly managed, sheep or goat grazing treatment of invasive weeds may detrimentally impact aquatic habitats or ESA-listed fish, especially in riparian areas. Improperly managed grazing could result in a loss of riparian vegetation, reduction in bank stability, decreased shading, increase water temperatures, and detrimental changes in stream channel morphology. However, use of design criteria, including development of a site-specific project operation plan and review of the plan with NMFS and USFWS to ensure no adverse effects are likely; use of fencing to prevent bank trampling; and use of effectiveness monitoring would reduce impacts to insignificant levels.

Use of grazing under these tight controls would help to reduce invasive plants. University of Idaho (2016) recommends targeted grazing using sheep and goats to control yellow starthistle. They state that goats are probably the most effective livestock to use for grazing of yellow starthistle because they will readily eat the plant in all growth stages (University of Idaho 2016). Grazing reduces plant vigor and plant size and suppresses flower production. Effective control depends on the prevention of flower and seed production, which can be achieved by grazing at least twice a year over several years. Minor effects on fish habitat are possible but are anticipated to be insignificant for the reasons discussed.

Effects to R4 sensitive Westslope cutthroat trout, Yellowstone cutthroat trout, northern leatherside chub, and Wood River sculpin and their aquatic habitats would be similar to those identified for federally listed species and critical habitats and would not likely contribute to a trend towards federal listing, cause a loss of viability to the population, or be expected to result in a downward trend for the species.

Watershed Conditions (RCAs)—Releasing biological agents would target specific invasive species and would have no effect on native riparian species. The primary indirect effect of biological treatments on ESA-listed fish would be a reduced need for herbicide use. Therefore, the effects of biological control treatments are considered insignificant since they have little-to-no potential to affect fish or their designated critical habitat. The reduction of noxious weeds encroaching on and invading riparian areas, wetlands, and streams would benefit native plant species and improve riparian condition.

Effects to Management Indicator Species

Effects to MIS from biological control under the action alternatives would be the same as described for TES above. The slight localized beneficial effects identified with biological releases would not be of sufficient scope or magnitude to have a measureable influence on future short- or long- term trend of bull trout on the BNF or SNF or Yellowstone cutthroat populations on the SNF.

Cumulative Effects

In addition to the SNF and BNF's use of biological control agents and site-specific goat or sheep grazing, other federal, State, County, and private entities in central Idaho also implement active biological control in their IWM programs. Cumulatively, multiple releases by different entities have the effect of distributing biological control agents over a broader area. Some beneficial effects could occur for fish in the form of an incidental food source where releases occur near stream channels. No adverse cumulative effects are anticipated to occur.

Irreversible/Irretrievable Effects

Biological control treatments implemented under the action alternatives would not result in any irreversible or irretrievable commitments of aquatic resources. Irreversible loss of fisheries resources would only occur where an action was implemented that caused permanent loss of some level of fisheries production. Biological control releases would not impact fisheries resources and/or aquatic habitat integrity in any watershed containing TES species or MIS to an extent that measureable loss of production would occur.

Forest Plan Consistency

Implementing classical or augmentative biological control and/or targeted grazing treatments to reduce noxious weed infestations on the SNF and BNF would be consistent with Management Goals, General Direction, and Standards and Guidelines for fisheries resources and aquatic habitats identified in the SNF and BNF Forest Plans (USDA Forest Service 2010a, 2012a).

3.3.5.2.2. Manual and Mechanical Treatment Methods

Direct and Indirect Effects of Mechanical Control

Manual and mechanical treatments can increase bank erosion, stream sedimentation, and disturbance to aquatic organisms if carried out over a large, contiguous area near occupied stream habitat. In this scenario, sedimentation can cover eggs or spawning gravels, reduce prey availability, and irritate fish gills. However, sediment generated at a localized scale under the actions alternatives would be unmeasurable to nonexistant because of the small acreage proposed for treatment with manual and mechanical methods and due to project design criteria (e.g., treatments in RCAs would be accomplished by hand or with hand tools, a 25-foot vegetative buffer next to live water should minimize potential erosion and sedimentation).

Both short- and long-term localized impacts to individual drainages may occur in association with mechanical treatment methods. Short-term effects of mechanical weed control may include a temporary increase in the amount of bare ground. Commonly, dead plant material from plants that were mechanically removed breaks down and covers the soil surface, providing a protective litter layer. However, where this does not occur, increased areas of bare ground could result in a temporary increase in soil erosion and associated sediment delivery to stream channels, especially during a high-intensity rain event. This increase would usually be confined to very small areas since mechanical control is practiced only at a small scale.

Over the long-term, however, mechanical reductions of noxious weed infestations would benefit aquatic habitat by re-establishing desirable vegetation which in turn should reduce erosion and subsequent sediment delivery to nearby waters. Reducing noxious weeds and establishing desirable vegetation would benefit watershed health and reduce the potential for future noxious weed encroachment into riparian areas.

Effects to Federally Threatened and Endangered and Region 4 Sensitive Fish Species

Implementing mechanical control activities would not result in effects of a scope or magnitude which would be considered likely to adversely affect federally listed species occurring within the project area. Short-term localized increases in soil erosion and sediment delivery to critical habitat stream channels could occur in association with increased bare ground at mechanical treatment sites. Mechanical treatments may result in minor soil disturbance around each treated

plant or in small areas where equipment digs or tills the ground. Since some sites have large infested areas, soil could be disturbed on several acres each year. However, many of these sites would retain some native vegetation to maintain ground cover to minimize erosion. Design criteria (e.g., treatments in RCAs will be accomplished by hand or with hand tools; a 25-vegetative buffer next to live water) should minimize erosion from reaching water bodies. Surface roughness and the small number of acres treated each year should also help to minimize erosion from the treated site. In situations where many acres or sensitive sites (i.e., riparian) need to be treated, revegetation with an appropriate, certified noxious weed–free native seed mix or root stock may occur, which should help increase ground cover and further minimize erosion. Overall, the chance of sediment impacting water quality would be discountable, and subsequent re-establishment of desirable vegetation would result in a long-term reduction of erosion and sediment delivery at these sites relative to pre-treatment conditions (Havlin et al. 2013).

Manual and mechanical treatments, such as hand pulling, can cause short-term localized ground disturbance. These treatments would occur on relatively few acres in scattered locations throughout the project area because more cost-effective methods are often available (e.g., herbicide control), especially for larger infestations. Short-term ground disturbance would occur where manual control methods occur, but because this method can only be effectively used for small infestations, any impacts would be highly localized. Soil or bare ground exposed by these isolated impacts would not likely result in measurable increases in stream channel sediment loads, and the long-term effects of re-establishing native plants would be beneficial to water quality.

Effects to R4 sensitive Westslope cutthroat trout, Yellowstone cutthroat trout, northern leatherside chub and Wood River sculpin and their aquatic habitats would be similar to those identified for federally listed species and critical habitats. Implementing mechanical treatments may impact individual trout or sculpin aquatic habitats through locally elevated sedimentation related to soil disturbances at treatment sites, but the level and scope of impacts would not likely contribute to a trend towards federal listing, or cause a loss of viability to the population or species or be expected to result in a downward trend for the species.

Population Characteristics (Size and Growth/Survival)—Mechanical treatments would cause negligible effects to Watershed Condition Indicators for habitat (e.g., substrate embeddedness, streambank and riparian condition) that support the growth and survival of local fish populations due to the small areas being treated and design features (e.g., the use of power tools that dig or till the ground not occurring within the 100-year floodplain, within 25 feet of stream banks, or flood prone areas along lakes, ponds, springs, and seeps; treatments within 25 feet should only be accomplished by hand, hand tools, or power tools that pull, cut, or mow invasive plants). Harassment or take (i.e., disruption of essential feeding, breeding, or sheltering of juvenile and adult fish) of federally listed fish is also expected to be negligible since very few streamside acres are treated annually and because of the protection provided by project design features.

Water Quality—Mechanical treatments may result in minor soil disturbance around each treated plant or in small areas where equipment digs or tills the ground. Since some sites have large areas of infestation, soil could be disturbed on several acres each year. However, many of these sites would retain some native vegetation to maintain groundcover to minimize erosion. Design criteria (e.g., the use of power tools that dig or till the ground not occurring within the 100-year floodplain, within 25 feet of stream banks, or flood prone areas along lakes, ponds, springs, and seeps; treatments within 25 feet should only be accomplished by hand, hand tools, or power tools

that pull, cut, or mow invasive plants; mechanical treatments not occurring on any slopes where excessive erosion can reach waterbodies; using proper erosion control techniques on steeper ground) should minimize erosion from reaching water bodies. Surface roughness and the small number of acres treated each year should also help to minimize erosion from the treated site. In situations where many acres or sensitive sites (i.e., riparian) need to be treated, revegetation with an appropriate, certified noxious weed-free native seed mix or root stock may occur. Revegetation should help increase groundcover and further minimize erosion. Overall, any sediment that reaches a stream would have insignificant effects on species/habitat.

Using motorized equipment increases the potential for hazardous materials (e.g., fuel, oil, or other fluids) to be spilled near streams and other waterbodies. Most of these fluids, if spilled in sufficient quantities, are toxic to aquatic organisms. The risks from hazardous material spills would be minimized by the type of activity authorized under the action alternatives, and through the implementation of Forest Plan management direction and design criteria. These limitations minimize effects by 1) not be authorizing the storage of hazardous material or refueling within RCAs; 2) monitoring equipment for leaks of motor oil and hydraulic fluids and controlling leaks to prevent water contamination; and 3) requiring spill packs (capable of absorbing petroleum products) to be kept on hand if a spill occurs.

Habitat Conditions (Substrate Embeddedness)—Mechanical treatments may result in minor soil disturbance around each treated plant. Since some sites have large areas of infestation, soil could be disturbed on several acres each year. However, many of these sites would retain some native vegetation to maintain groundcover to minimize erosion that could increase substrate embeddedness. Surface roughness and the small number of acres treated each year should also help minimize erosion from the treated site. Overall, the chance of sediment impacting spawning substrate should be minimized.

Watershed Conditions (RCAs)—Mechanical treatments may result in disturbance to native vegetation as invasive species are treated. Since some sites have large areas of infestation, riparian vegetation could be disturbed on several acres each year. However, this method is very target specific and would result in only localized impacts to riparian vegetation. In situations where many acres of riparian vegetation need to be treated, revegetation with an appropriate, certified noxious weed-free native seed mix or root stock may occur. Design criteria (e.g., treatment with RCAs will be accomplished by hand or with hand tools, 25-foot vegetative buffer will be left next to live water) should minimize impacts to native riparian vegetation. Beneficial effects would be expected from the reduction of noxious weeds encroaching on and invading riparian areas, wetlands, and streams. A reduction of noxious weeds in riparian areas and along streambanks would benefit native plant species and improve streambank stability and riparian condition. Overall, impacts to riparian vegetation should be minimized and effects would be insignficant.

Effects to Management Indicator Species

Effects to MIS fish species from mechanical control treatments under the action alternatives would be as described within the TES effects discussion above. Effects from mechanical treatments would be related to temporary increases in area of bare ground, with resultant localized increases in soil erosion and sediment delivery to stream channels until sites are re-vegetated with native plant species. These temporary and localized effects would not be of

sufficient nature or magnitude to measureably influence future short- or long- term trends of bull trout on the SNF and BNF or Yellowstone cutthroat trout populations on the SNF.

Cumulative Effects of Mechanical Control

Other federal, State, County, and private entities in central Idaho implement the same mechanical control methods as the SNF and BNF. Since mechanical control methods are practiced on small and isolated acreages, there is little likelihood of adverse cumulative effects. Cumulative effects would be expected only if other federal, State, County, or private entities began to practice mechanical control methods (e.g., chaining) not currently used.

Irreversible/Irretrievable Effects

Mechanical weed treatment activities under the action alternatives would not result in any irreversible or irretrievable commitments of aquatic resources. Irreversible loss of fisheries resources would only occur in a case where an action was implemented that caused permanent loss of some level of fisheries production. Mechanical treatment activities would not impact fisheries resources and/or aquatic habitat integrity in any watershed containing TES or MIS species to an extent that measureable loss of production would occur.

Forest Plan Consistency

Implementing mechanical control methods to reduce noxious weed infestations is consistent with Management Goals, General Direction, and Standards and Guidelines for fisheries resources and aquatic habitats identified in both the SNF and BNF Forest Plans (USDA Forest Service 2010a, 2012a).

3.3.5.2.3. Rehabilitation and Restoration

Direct and Indirect Effects of Rehabilitation and Restoration Practices

The most extensive direct ground disturbance would occur during rehabilitation/ restoration activities. However, design criteria limiting treated slopes to less than 45%, a maximum of 25 acres per project, and landtype erosion hazard ratings of low or moderate would prevent large-scale erosion from occurring during and after these treatments. Also, because soils in these areas would likely be already experiencing increased erosion as a result of invasive plant infestations, additional ground disturbance would likely have minimal additional effects on erosion or water quality, and the long-term effects would be beneficial.

Use of mechanical equipment would not occur in RCAs and would not disturb soils or remaining riparian vegetation. Seeding by hand or aerial broadcasting within an RCA would not result in a measurable amount of soil disturbance.

Reestablishing desirable vegetation would benefit native species and habitat quality. Broadcast seeding would not result in short-term adverse effects to Watershed Condition Indicators as it would occur by hand and would not disturb soil, and only native weed-free seed would be used. Though localized temporary soil and vegetation disturbance may occur from mechanical activities, areas to be restored with mechanical equipment generally occur on moderate slopes and involve burned areas or areas of concentrated human disturbance, and seeding by hand or using an ATV on gentle terrain would not result in a measurable amount of soil disturbance.

Long-term benefits would occur from establishing desirable vegetation that would reduce adverse erosion and sediment. A reduction of noxious weeds and establishment of desirable vegetation would benefit watershed health and reduce the potential for noxious weed encroachment into riparian areas. Invasive plant control is a rehabilitative and restorative practice in itself, aimed at reducing or removing invasive plants and corresponding banks of viable seeds stored in the soil to promote the establishment and maintenance of desirable plant species (FSM 2900). An upward vegetative trend of desired plant species helps meet the desired conditions of plant communities. Healthy, functional plant communities containing desirable species are resilient to disturbances such as fire and are more resistant to invasive plant invasion (Masters and Sheley 2001). The beneficial direct effects of rehabilitation and restoration practices include increased cover and density of desired plant species and soil stabilization, with a resultant reduction in erosion and sedimentation risks to aquatic habitats. Indirectly, rehabilitated and restored sites are more resilient to disturbance.

Effects to Federally Threatened and Endangered and Forest Service Region 4 Sensitive Fish Species

Implementing restoration/rehabilitation activities would not result in effects of a scope or magnitude which would be considered likely to adversely affect federally listed species occurring within the analysis area.

Mechanical treatment components of restoration/rehabilitation actions could result in some localized and temporary soil and vegetation disturbances at restoration sites. Short-term localized increases in soil erosion and sediment delivery to critical habitat stream channels could occur at sites near critical habitat for TES fish species. However, the following project design criteria would prevent significant soil erosion or sediment delivery, and subsequent re-establishment of desirable vegetation would result in a long-term reduction of erosion and sediment delivery at these sites relative to pre-treatment conditions:

- A 25-foot vegetative buffer next to live water will be maintained to leave ground cover intact and prevent erosion into streams or adjacent waterbodies.
- For ESA listed waters, a site review will be completed by the appropriate resource specialists to prescribe mitigations necessary to minimize effects on ESA-listed species/habitats to an insignificant level.
- Rehabilitation and restoration activities will only be conducted in areas with slope gradients less than 45%.
- Rehabilitation and restoration activities will only be conducted in areas with low or moderate landtype erosion hazard ratings.
- When in ESA listed waters, all ground disturbing activities will be conducted outside of spawning and rearing time periods.

Effects to R4 sensitive Westslope cutthroat trout, Yellowstone cutthroat trout, and Wood River sculpin and their aquatic habitats would be similar to those identified for federally listed species and critical habitats. Implementing restoration and rehabilitation actions would not likely contribute to a trend towards federal listing, cause a loss of viability to the population or species, or be expected to result in a downward trend for the species.

Effects to Management Indicator Species

Effects to MIS fish species from restoration and rehabilitation treatments under the action alternatives would be as described within the TES effects discussion above. Localized short-term impacts to soil and vegetation resources associated with mechanical restoration/rehabilitation would not be expected to be of sufficient nature or magnitude to measurably influence the short- or long-term trend of bull trout on the SNF and BNF or Yellowstone cutthroat trout populations on the SNF.

Cumulative Effects of Rehabilitation and Restoration Practices

Other land managers (private landowners; State, local, and federal agencies; and CWMAs) also practice active restoration when necessary to re-vegetate a site. As with SNF and BNF operations, active restoration is limited to small areas and high-priority sites. Due to the very small scale and wide spatial distribution of assisted restoration actions, the potential for adverse cumulative effects is minimal to non-existent.

Irreversible/Irretrievable Effects

Restoration and rehabilitation activities implemented under the action alternatives would not result in any irreversible or irretrievable commitments of aquatic resources. Irreversible loss of fisheries resources would only occur in a case where an action was implemented that caused permanent loss of some level of fisheries production. No activities proposed for implementation in association with restoration or rehabilitation actions would impact fisheries resources and/or aquatic habitat integrity in any watershed containing TES or MIS species to an extent that measureable loss of production would occur.

Forest Plan Consistency

Implementing rehabilitation and restoration to reduce noxious weed infestations on the SNF and BNF is consistent with Management Goals, General Direction, and Standards and Guidelines for fisheries resources and aquatic habitats identified in both the SNF and BNF Forest Plans (USDA Forest Service 2010a, 2012a).

3.3.5.2.4. Ground-based Herbicide Use (Spot and Broadcast Applications)

The action alternatives allow using herbicides to treat invasive plants. While the potential for adverse effects to native fish, ESA-listed species, and/or critical habitats is possible, the incorporation of design features and the scattered nature of the invasive plant sites would limit the potential for adverse effects. To the extent that invasive plant spread is slowed in riparian areas, a beneficial impact to riparian and aquatic habitats would be expected.

To support these conclusions, detailed quantitative analysis was conducted to consider whether introducing herbicides in riparian areas might have the potential to affect aquatic organisms. Site-specific conditions were modeled using risk assessment worksheets which indicated proposed treatments have a very low potential to adversely affect fish and aquatic invertebrates in the project area.

Project design features listed in Chapter 2 of the EIS for the action alternatives were developed to avoid scenarios of concern to fish species. These restrictions go beyond label requirements by limiting the type of herbicide that may be used adjacent to waterbodies or along roads. The

design features include specific herbicide application guidelines near water that limit spot spraying for most herbicides to at least 15 feet from water and broadcast spraying to 100 feet from water. These herbicide use buffers reduce the potential for drift or run off of herbicide to surface waters.

The action alternatives use 11 herbicides (Table 2-2) for ground-based chemical treatment of noxious weeds: Aminopyralid, 2,4-D amine, chlorsulfuron, clopyralid, dicamba, glyphosate, imazapic, metsulfuron-methyl, picloram, sulfometuron-methyl, triclopyr triethylamine salt (TEA). The proposed action includes the use of 3 additional herbicides (Table 2-6)

Four aquatic herbicides are proposed for aquatic invasive plant control where such use would not affect ESA-listed species or habitats: aquatic glyphosate, imazamox, imazapyr, and triclopyr TEA. Since aquatic herbicides could be detrimental to ESA-listed fish and their designated critical habitats, aquatic herbicide applications within or with potential to affect ESA waters will be done on a case-by-case basis under individual future Section 7 consultation.

The proposed weed treatments are intended primarily to prevent the establishment of new invaders and contain the spread of existing weed infestations. With this type of treatment objective, the treatment areas tend to consist of widely scattered patches of weeds, with many sites concentrated near roads, trails, and open areas. However, in some locations, well-established expanses of weeds could be treated—particularly where treatment could occur aerially or in recently burned areas—to prevent establishment of weeds.

Background

Herbicides

<u>2,4-D amine</u>

This is the most commonly used, and most widely studied, herbicide in the United States (USDA Forest Service 2006). 2,4-D is a member of the chlorinated phenoxy family and interferes with normal plant growth processes by stimulating nucleic acid protein synthesis and affecting enzyme activity, respiration, and cell division. 2,4-D acts as a growth-regulating hormone on broad leaf plants, being absorbed by leaves, stems, and roots and accumulating in a plant's growing tips. The herbicide 2,4-D is available in a variety of chemical forms (e.g., esters, amine salts, and acids), and each form has different toxicities to fish. The action alternatives only propose use of the amine salt forms of 2,4-D. Typical product names include Amine 4 (various manufacturers), Weedar 64, and Weedestroy. The active ingredient in these products is the 2,4-D dimethylamine salt. 2,4-D is not proposed for aerial or aquatic applications.

<u>Aminopyralid</u>

Aminopyralid is a broadleaf selective herbicide that can be applied with spot spray to the water's edge and is especially effective on species in the Aster family, the dominant invasive plant group in the project area. It has a high selectivity for broad leaf plants at very low concentrations, with fewer potential environmental effects (SERA 2007a). Aminopyralid is systemic and is absorbed through the leaves and the roots where it is transported to other parts of the plant. Aminopyralid disrupts plant growth metabolic pathways, affecting the growth process of the plant. Aminopyralid provides systemic postemergence broad-spectrum control of a number of key noxious and invasive annual, biennial and perennial weed species, as well as agronomic broadleaf weeds. Aminopyralid can also provide residual weed control activity controlling re-

infestations and reducing the need for re-treatment depending on the rate applied and the target weeds. This product can be sprayed up to the water's edge and can be used on "seasonally dry" wetland. Aminopyralid is the only active ingredient in the herbicide product Milestone (40.6%). According to the product label, Milestone also contains 59.4% inert ingredients (unspecified). Milestone is applied at a maximum of 7 fluid ounces per acre per year, which is equivalent to 0.11 pounds of the active ingredient Aminopyralid per acre per year. Where used, the typical application rate of Milestone is equivalent to about 0.093 pounds of Aminopyralid per acre per year. Aminopyralid is proposed for aerial applications.

Chlorsulfuron

This herbicide is used to control many broadleaf weeds and some annual grass weeds. It is absorbed by the leaves and roots of the weed and prevents production of an essential amino acid that inhibits cell division and plant growth. Treatment areas include non-crop sites such as roadsides, rights-of-ways, and fence rows. A common formulation of this herbicide is the marketed product, Telar. Chlorsulfuron is proposed for aerial applications.

Clopyralid

Clopyralid is a 3,6-dichloro-2-pyridinecarboxylic acid, commonly manufactured formulations are Transline, Stinger, or Reclaim. Transline contains clopyralid (40.9%) and inert ingredients (59.1% [water, isopropyl alcohol, and a proprietary surfactant]). It is the active ingredient in Transline and 1 of 2 active ingredients (the other being 2,4-D) in Curtail. Clopyralid is absorbed by the leaves and roots of broadleaved plants and moves rapidly through plants, affecting plant cell respiration and growth. It is toxic to some members of only 3 plant families: the composites (Compositae), the legumes (Fabaceae), and the buckwheats (Polygonaceae). Clopyralid is very effective against knapweeds, hawkweeds, and Canada thistle at application rates of one-quarter to one-half pound per acre (U.S. Forest Service 2004c). Its selectivity makes it an attractive alternative herbicide for use on sites with non-target species that are sensitive to other herbicides. Clopyralid is more persistent than 2,4-D and dicamba but less persistent than picloram. It is degraded almost entirely by microbes and is not susceptible to photo or chemical degradation (Tu et al. 2003). Clopyralid is proposed for aerial applications.

Dicamba

Dicamba (2-methoxy-3,6-dichlorobenzoic acid) is a selective benzoic acid herbicide registered for the control of certain broadleaf weeds and woody plants before their emergence. It will kill broadleaf weeds before and after they sprout. Dicamba is rapidly taken up by the leaves and roots of plants and it is readily translocated to other plant parts. Dicamba is absorbed by the leaves and translocated throughout the plant, where it exerts an auxin-like growth regulatory effect. Weed control is generally achieved in 5 to 7 days.

Dicamba is available as a diglycolamine salt and dimethylamine salt. Typical products that include dicamba are Banvel, Vanquish, Overdrive, Clarity, Cimarron Max, and Weedmaster. The Banvel, Overdrive, Cimarron Max, and Weedmaster formulations contain the dimethylamine salt of dicamba and other ingredients at the following proportions: Banvel = 48.2% dicamba and 51.8% other ingredients; Overdrive = 55% dicamba, 21.3% diflufenzopyr, and 23.7% other ingredients; Cimarron Max = 12.25% dicamba, 35.25% 2,4-D, 0.75% Metsulfuron Methyl, and 51.75% other ingredients; Weedmaster = 12.4% dicamba, 25.7% 2.4-D, and 51.9% other ingredients. The Vanquish and Clarity formulations contain the DGA salt of dicamba along with

other ingredients at the following proportions: Vanquish = 56.8% dicamba and 43.2% other ingredients; Clarity = 58.1% dicamba and 41.9% other ingredients. Dicamba is not proposed for use near water or for aerial applications.

Glyphosate

Glyphosate is labeled for a wide variety of uses, including home use, and is marketed as Rodeo, Accord, Roundup, and numerous other brand names. Glyphosate is a non-selective, broad-spectrum herbicide that is readily absorbed by leaves, translocated throughout the plant, and disrupts the photosynthetic process. This herbicide affects a wide variety of plants, including grasses and many broadleafs, and has the potential to eliminate desirable as well as undesirable vegetation. Some plant selectivity can be achieved by using a wick applicator to directly apply glyphosate to the target plant, thereby avoiding desirable vegetation.

Within or near aquatic systems, only products labelled for aquatic application would be used. Rodeo, or other aquatic labeled glyphosate compounds, is proposed for use near water, mainly for its low toxicity to aquatic systems. Aquatic formulations of glyphosate are effective for the control of emergent and floating invasive plants. The POEA adjuvant (e.g., Roundup Pro) is only proposed for use in uplands where no potential exists for movement into aquatic systems. Glyphosate is not proposed for for aerial applications.

Imazapic (Plateau)

Imazapic (trade name Plateau® and Cadre®) is a pyridine carboxylic acid herbicide intended for use in rangelands and forests. Imazapic is a selective herbicide for both the pre- and post-emergent control of some annual and perennial grasses and some broadleaf weeds. Imazapic would be used primarily for the direct control of annual greases, leafy spurge, dalmatian toadflax, and yellow toadflax. It could be used on other noxious weed species as well where either trials or research indicate its effectiveness. Imazapic kills plants by inhibiting the activity of the enzyme acetohydroxy acid synthase (AHAS or ALS).

Imazapic may be mixed with other herbicides, such as triclopyr (Garlon®), glyphosate (RoundUp®), picloram (Tordon®), imazapyr (Arsenal®), or other products to provide total vegetation control. Mixtures of imazapic with 2,4-D and other phenoxy-type herbicides, however, provided less control of perennial grass weeds than imazapic alone. Combining imazapic with other herbicides, according to the manufacturer, should not increase the toxicological risk over that of either herbicide when used alone. Imazapic is proposed for for aerial applications.

Metsulfuron methyl

Metsulfuron methyl is methyl 2-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)-amino]carbonyl]-amino]-sulfonyl]benzoate, is commonly known as Escort. Escort contains metsulfuron methyl (60%) and inert ingredients (40%). Metsulfuron methyl is absorbed through the roots and foliage and moves rapidly through the plants. It inhibits cell division in the roots and shoots, which stops growth. This herbicide is used to control annual and perennial broadleaf weeds. Typical control areas include rights-of-way along roadsides and powerline corridors. Metsulfuron methyl can be mixed with other chemicals to provide more effective weed control. Metsulfuron methyl may be used for aerial applications.

Picloram

Picloram is 4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid, also known as Access®, Grazon®, Pathway®, or Tordon®. This is a restricted use pesticide (can only be used by certified applicators) labeled for non-cropland forestry, rangeland, rights-of-way, and roadside weed control. Picloram was placed in this category due to its mobility in water. It is the active ingredient in the marketed product Tordon®. Tordon® contains 24.4% of picloram (potassium salt) and 75.6% inert ingredients, which include water and dispersing agents, including surfactants. Although picloram is most often applied in Forest Service programs as the sole herbicide, it is also applied in combination with 2,4–D and less commonly with other herbicides.

Picloram acts as a growth regulator and is used to control a variety of broadleaf weed species. It is absorbed through the leaves and via root uptake, is easily translocated through plants, and accumulates in new growth, causing leaves to cup and curl. Picloram is generally applied at rates of one-quarter to one-half pound per acre for non-rhizomatous weeds. Picloram would not be used near water, but may be used for aerial applications.

Sulfometuron methyl

Sulfometuron methyl is an herbicide used to control a wide range of annual and perennial grasses as well as broad-leafed weeds. It is a broad spectrum urea herbicide that works by blocking cell division in the active growing regions of the stem and root tips. Commercial formulations of sulfometuron methyl currently used by the Forest Service are Oust and Oust XP®, which are manufactured by Du Pont as a water dispersible granule. The composition of the product is 75% sulfometuron methyl and 25% inert ingredients. Sulfometuron methyl is proposed for upland, riparian, and aerial applications.

Triclopyr

Triclopyr is a selective herbicide used to control broadleaf plants and invasive aquatic plants. The only formulation of triclopyr considered in this analysis is triethylamine salt (triclopyr amine [triclopyr TEA]). The ester form of triclopyr (triclopyr BEE) is exponentially more toxic to fish and is not proposed for use in the project area. Triclopyr TEA is sold under names such as Garlon 3A, Renovate 3, Renovate OTF granular, Tahoe 3A, Triclopyr 3A, Tripclopyr 3SL, and Redeem. Several TEA formulations are labeled for aquatic applications.

Triclopyr is a growth-regulating herbicide used to control woody and broadleaf perennial weeds in noncropland, forestland, range, permanent grass pasture, turf, and rights-of-way. Triclopyr mimics auxin, a natural plant hormone, causing an auxin overdose 1,000 times greater than natural levels. This overdose interferes with hormonal balance and normal growth, eventually causing death of the plant. Triclopyr has a low toxicity to grasses but can harm conifers in high doses.Triclopyr is effective for submergent, emergent, and floating aquatic invasive plants. It is not proposed for aerial application.

Adjuvants and Inert Ingredients

Adjuvants

Adjuvants are solution additives that are mixed with an herbicide solution to improve performance of the spray mixture. Adjuvants can either enhance activity of an herbicide’s active ingredient or offset any problems associated with spray application, such as adverse water quality or wind. Adjuvants include surfactants, anti-foaming agents, crop oil or crop oil

concentrates, drift retardants, compatibility agents, and pH buffers. Spray adjuvants proposed for use on the SNF and BNF include Activator 90, Spreader 90, Super Spread 90, R11, Renegade, and MSO with Leci-Tech, Syl-tac, Phase, Super Spread 7000, LI 700. Activator 90, Spread 90, and L1-700 are non-ionic surfactants, meaning they have no ionic charge and are hydrophilic (water-loving). Spray adjuvants are generally used in a 1:800 ratio of adjuvant to water as a typical rate of application. They are generally biodegradable and are compatible with many fertilizer solutions. R11 is a spreading agent that lowers the surface tension on the droplet so it covers the target plant more efficiently. MSO is a methylated seed oil adjuvant that increases the penetration of oil-soluble herbicides into a plant. It is particularly effective during drought when leaf cuticles are thick (Tu et al. 2003).

Both the herbicide and the adjuvant labels include instructions on the use of additives such as these for proper herbicide application. These additives are not hazardous or listed as Level 1 (Inert Ingredients of Toxicological Concern) or Level 2 (Potentially Toxic Inert Ingredients) compounds when used as intended and label directions are followed.

Bullseye and Hi-Light blue dyes are used in conjunction with herbicide applications, especially in riparian areas on the SNF. Dyes provide a bright blue color and are non-hazardous. The presence of a dye makes it far easier to see where the herbicide has been applied and where or whether it has dripped, spilled, or leaked. Dyes make it easier to detect missed spots and to avoid spraying a plant or area twice (Tu et al. 2003). These dyes are typically photo-oxidized and disappear within 2 to 3 days.

Inert Ingredients

Herbicide manufacturers add inert ingredients (or “other ingredients”) to enhance the action of the active ingredient. Inert ingredients may include carriers, surfactants, spray adjuvants, preservatives, dyes, and anti-foaming agents. An inert ingredient is simply any ingredient in the product that is not intended to affect a target plant. Listed inert ingredients for the herbicide formulations being considered for use on the SNF and BNF include water, ethanol, isopropanol, isopropanolamine, polyglycol 26-2, and polyoxyethylamine. The designation as "inert" does not mean an additive is chemically inactive nor does it convey any information about the toxicity of the ingredient (Tu et al. 2003). In addition to increasing the herbicidal effect of the active ingredient, inert ingredients can have toxic properties in and of themselves. Because many manufacturers consider inert ingredients in their herbicide formulations to be proprietary, they do not list specific chemicals.

Inert ingredients are not regulated by any federal agency. The Food Quality Protection Act of 1996 eliminates the "inert" classification, and requires EPA to review the effects of "inert" ingredients and other additives. As of early 2003, little has been done to begin testing pesticide additives and their combinations (Tu et al. 2003). However, BMPs, SOPs, and other mitigating application techniques can help prevent significant adverse environmental impacts (Tu et al. 2003).

Carriers are used to dilute or suspend herbicides during application and allow for proper placement of the herbicide, whether it is to the soil or on foliage. Water is the only carrier used on the SNF and BNF because it is available, cheap, and the herbicides used by the Forests are formulated to be effectively applied with water.

Herbicides currently used on the SNF and BNF may also contain "inert" ingredients, including surfactants, that are not expected to have any significant effect to fisheries resources. The dyes and other adjuvants used by the SNF and BNF identified in Appendix D are described as having little effect on fish or wildlife populations. Project design criteria for herbicide applications are expected to minimize adverse impacts, if any, of these other ingredients.

***Application* of Herbicides**

Herbicides would be applied according to EPA product label requirements and in accordance with directions specified in Forest Service Handbooks 2109 and 6709. All herbicide applications would be performed by, or directly supervised by, a State-certified applicator. Certification is managed by the ISDA under rules promulgated by the EPA.

Ground-based herbicide application would occur in infestations and along trails and roads where chemical treatment is likely the most effective means of treating or eradicating noxious and invasive non-native weeds. Ground-based herbicide application within RCAs would only occur by following the guidelines in Appendix H. All herbicides would be applied according to label instructions and specifications or Forest Service policy, whichever is more restrictive. Precautionary measures associated with the ground-based application of herbicides are described in detail in the "Project Design Features" section. Herbicides would be applied using hand selective, spot spraying or broadcast applications. Herbicide pathways in water are discussed in section 3.2.5.1.2 above.

Direct and Indirect Effects

Effects on Riparian and Upland Processes

In watersheds where non-native species have largely displaced native species, weeds can alter processes that affect the quality and quantity of fish habit. Weed infestations can increase surface runoff and sediment transport by increasing fire frequency and altering ground cover and raindrop interception. Once established, weed infestations can sometimes alter fuel characteristics of the landscape and establish a lasting fire cycle that promotes the dominance of the invasive species (Brooks et al. 2004). Many invasive species are annual plants that have allopathic mechanisms that kill other plants and reduce the density of vegetation. Vegetative cover can be changed to the point where the hydrology of an area is disrupted. Studies by Lacey et al. (1989) reported a 50% increase in runoff at knapweed-infested sites compared to non-infested sites.

The proposed weed treatments are intended primarily to prevent the establishment of new invaders and contain the spread of existing weed infestations. With this type of treatment objective, the treatment areas tend to consist of widely scattered patches of weeds, with many sites concentrated near roads, trails, and open areas. However, in some locations well-established expanses of weeds could be treated.

To the extent that weed control efforts are successful, the proposed action would benefit native, listed, and sensitive fish by conserving native vegetation and ecological process in areas that would otherwise become dominated by invasive plants. The action could cause detrimental effects when non-target plants are killed by herbicide spraying in riparian areas. Herbicide spraying in riparian areas can kill non-target plants that provide streambank stability and shade and cover for fish, and spraying can also increase surface runoff by creating areas of bare soil devoid of any vegetation. The risk of creating areas of bare soil is particularly true for non-

selective herbicides, such as glyphosate, that kill all plants. Non-target species killed by herbicides tend to be forbs, grasses, and legumes, which are capable of reestablishing themselves within a few growing seasons. Shrubs and trees are also susceptible to herbicide effects, but spot spraying is not likely to kill mature shrubs or trees that have matured beyond the pole stage since it takes a larger amount of herbicide to kill these larger plants than the amount applied through focused spot spraying.

Overall, alterations in riparian and upland vegetation caused by the proposed action are unlikely to have a significant effect on native fish, ESA-listed fish, or critical habitat through mortality of non-target plants when applied as spot treatments. Hand-spraying with the use of a marker dye allows precise herbicide application to target plants without causing widespread mortality to non-target plants. The majority of weed treatment locations are also in upland areas where they have no direct effect on streams. In general, where herbicides kill non-target riparian plants, the plant mortality is likely to be localized and short term; lasting no more than the time it takes for native plants to become re-established. In contrast, successful eradication or control of invasive plants is likely to provide long-term benefits by protecting native vegetation from invasive species and by maintaining natural riparian functions and surface erosion processes.

Effects Analysis Framework

A generalized risk assessment approach was used to evaluate the effects of chemical treatments on fish species. The effects of herbicides on native fish, ESA-listed fish, and their critical habitat depend on numerous factors that interact in complex ways that cannot be described precisely for each and every circumstance. Considerable uncertainty also exists regarding the full range of potential toxic effects on listed fish and other aquatic organisms due to incomplete information on the toxicity of the active ingredients, breakdown products, and herbicide formulations that include potentially toxic inert ingredients, surfactants, and other adjuvants. Given the incomplete information that is available, much of the effects analysis relies on extrapolation or inference from published studies on similar chemicals or surrogate fish species that may not respond to herbicides identically as salmonids. Because considerable uncertainty exists regarding many herbicide effects, worst-case scenarios are considered in the analysis along with the most probable outcomes to ensure that the assessment errors in favor of the listed species.

Herbicide Toxicity

Results of herbicide toxicity analysis for aquatic levels of concern are displayed in Table 3-31 and Table 3-32). The herbicides proposed for use are characterized by relatively low aquatic toxicity. Actual proposed treatments contain untreated buffers, or distances within which only focused spot spray or hand selective application is allowed. The herbicide use buffers proposed under the action alternatives would substantially limit the amount of herbicide potentially coming in contact with water. The potential amount of herbicide coming in contact with water after using herbicide use buffers would be minimized to almost non-detectable levels.

Photo-degradation, hydrolysis, adsorption to particles in the water column and along the channel side and bottom, dilution resulting from influx of additional water (either subsurface or surface), and accretion of volume would together minimize potential effects on fish and aquatic habitats. Herbicides coming in contact with water, if any, would either be well below levels of concern or non-detectable under the proposed alternatives.

Table 3-31. Aquatic level of concern assessment (fish) for herbicides proposed for use by the Sawtooth and Boise National Forests

Active Ingredient and Product Name	Typical Application Rate (lb a.e./ac)	Max Label App. Rate (lb a.e./ac)	Bioaccumulates	Peak EEC[a] (mg/L)	Lowest 96-hour LC_{50}[b] (mg/L a.e. or a.i.)	Lowest Sublethal Effect Threshold (mg/L)	Hazard Quotient[c]
2,4-D amine *Weedar 64*	1–2.0	4.0	No	0.08	162[d] Non-toxic	96-h LC_{50} = 95.6[e]	0.0008
Aminopyralid *Milestone*	0.078–0.11	0.11	No	0.011	100[f] Non-toxic	Partial loss of equilibrium at NOEC=50 mg/L[g]	0.0002
Chlorsulfuron *Telar XP*	0.01–0.02	0.12	No	0.025	40[h] Slightly	NOEC = 30 [h]	0.0008
Clopyralid *Transline*	0.1–0.5	0.5	No	0.01	103.5[i] Non-toxic	LC_{50} = 103.5[i]	0.0001
Dicamba *Banvel*	0.5–2.0	2.0	No	0.006	50[j] Slightly	LC_{50} = 28[k]	0.0002
Glyphosate (more toxic with surfactant) *Roundup Original*	0.5–3.0	4.0	No	0.044	**1**[l] Highly Toxic	NOAEC = 0.5[m]	0.9
Glyphosate (less toxic no surfactant) *Roundup Custom*	0.5–3.0	4.0	No	0.044	**10**[n] Moderately	NOEC = 0.5[m]	0.09
Glyphosate Aquatic (less toxic no surfactant) *Rodeo*	0.5–3.0	4.0	No	0.147	**10**[m] Moderately	NOEC = 0.5[m]	0.3
Imazapic *Plateau*	0.09–0.16	0.188	No	0.00009	**>**100[o] Non-toxic	NOEC = 100[o]	0.0000009
Metsulfuron-methyl *Escort*	0.01–0.02	0.15	No	0.0003	150[p]	NOEC = 10 Behavioral changes[p]	0.00003
Picloram *Tordon 22K*	0.25–1.0	1.0	No	0.011	**4.8**[q] Moderately	NOEC = 0.19[r]	0.06

Active Ingredient and Product Name	Typical Application Rate (lb a.e./ac)	Max Label App. Rate (lb a.e./ac)	Bioaccumulates	Peak EEC[a] (mg/L)	Lowest 96-hour LC_{50}[b] (mg/L a.e. or a.i.)	Lowest Sublethal Effect Threshold (mg/L)	Hazard Quotient [c]
Sulfometuron methyl *Oust*	0.09–0.38	0.38	No	0.0004	**7.3**[s] Moderately	NOEC=7.3[t]	0.00005
Triclopyr TEA aquatic *Renovate*	1–1.5	2.0	No	0.0735	117[u] Non-toxic	NOAEC = 20[v]	0.004
Triclopyr TEA *Garlon 3A*	1–1.5	2.0	No	0.006	117[u] Non-toxic	NOAEC = 20[v]	0.0003

[a] Peak estimated environmental concentration (EEC) is extrapolated from SERA assessments using the max application rate. Values are based modeling herbicide drift using a backpack sprayer using Worksheet Maker 6.0. The EEC is an extreme level and should be viewed as a worst-case situation.
[b] Toxicity Classifications to Address Acute Risk (LC_{50} mg/L) to Aquatic Organisms from Chemical Use — <0.1 (very highly toxic); 0.1-1 (highly toxic); >1-10 (moderately toxic); >10-100 (slightly toxic); and >100 (practically non-toxic).
[c] HQ values from Worksheet Maker 6.0 based on maximum application rates using central concentration levels.for sensitive species. When sensitive species studies are unavailable, HQ values for tolerant species are used and noted.
[u] Value based on geometric mean of 130.7 for Triclopyr TEA (triethylamine) as reported in SERA 2011b
[v] Value based on Triclopyr TEA (triethylamine) as reported in SERA 2011

Table 3-32. Standard acute aquatic species toxicity testing results (from Bakke, 2007 except where noted)

Name	Rainbow Trout 96-hour LC_{50}	Bluegill 96-hour LC_{50}	Daphnia 48-hour EC_{50}	Toxicity Level
Ethoxylated fatty amines				
Entry ™ II, POEA	4.2 mg/L 0.56 to 7.4 mg/L[a]	1.3–2.9 mg/L 1.8–4.2 mg/L[a]	2.0 mg/L	HT to MT in fish MT for invertebrates
Alkylphenol ethoxylate-based wetter/spreaders				
R-11®	3.8–6 mg/L NOEC 1 mg/L	4.2 mg/L NOEC 1 mg/L	5.7–19 mg/L NOEC= 0.25 mg/L	MT to fish ST to invertebrates
Activator 90	NA (Bakke) 1.4 mg/l (MDACR 2004)	Guppy 12.7 mg/L, NOEC 5.8 mg/L	5.2 mg/L (24 hour) NOEC 1 mg/L	MT
Spreader 90	3.3 mg/l	7.3 mg/l		MT
Super Spread 90	NA	3.8–6.3 mg/l[b] Fathead minnow	9.3–31.4 mg/l[b]	MT to fish MT to ST to invertebrates
Acidifiers				
LI-700	17-130 mg/l	60.8–210 mg/l	170-190 mg/l NOEC 100 mg/l	PN
Super Spread 7000	NA	NA	NA	Not for aquatic use[c]
Oils				
MSO®	NA (Bakke) 48 mg/l	NA (Bakke)	NA (Bakke) >100 mg/l	ST to fish PN to invertebrates
Renegade	NA	NA	NA	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.[d]
Blends of vegetable oils and silicone-based surfactants				
Syl-tac™	>5 mg/L	NA	>5 mg/L	MT-ST
Phase™	NA	NA	NA	

Name	Rainbow Trout 96-hour LC_{50}	Bluegill 96-hour LC_{50}	Daphnia 48-hour EC_{50}	Toxicity Level
Colorants				
Highlight	NA	NA	NA	No data available, however the material is not expected to have any deleterious toxic effect on environment[e]
Bullseye	NA	NA	3,574 mg/l[f]	
Other				
Bronc Max	>100 mg/l NOEC 50 mg/l[g]	NA	100 mg/l NOEC >100 mg/l[g]	PN
Choice Weather Master	NA	70.7 mg/l NOEC = 50 mg/l[h] Zebra fish	100 mg/l NOEC >100 mg/l[h] zooplankton	PN

Note: Below is the definition of LC50 (lethal concentration, 50% kill) and here are the classification levels. (MDAR 2004)

<1 mg/l: HT (Highly Toxic)
1-10 mg/l : MT (Moderately Toxic)
10-100 mg/l: ST (Slightly Toxic)
100, 1,000 mg/l: PN (Practically Nontoxic)
>1,000 mg/l: IH (Insignificant Hazard)

[a] Folmer et al. 1979 in SERA 2011a using MON 0818;
[b] Super Spread 90 SDS Wilbur-Ellis
[c] Super Spread 7000 SDS Wilbur-Ellis;
[d] Renegade Safety Data Sheet–Wibur-Ellis;
[e] MSDS Becker Underwood;
[f] MSDS Milliken;
[g] Bronc Max SDS—Wilbur Ellis;
[h] MSDS Choice Weather Master Loveland Products

Exposure of Aquatic Organisms to Contaminants

This section characterizes the concentrations of herbicides likely to occur in water, and the way in which aquatic organisms are likely to be exposed to these contaminants. The action alternatives includes numerous features that minimize the likelihood of appreciable water contamination, such as relatively small and scattered treatment areas, low application rates, ground-based application, and application methods that reduce the likelihood of water contamination through wind drift or runoff. Also, herbicides used near water would be restricted to those herbicides with relatively low toxicity to aquatic organisms. Water quality monitoring associated with similar weed treatment projects suggest that safeguards, like those in the action alternatives, limit the occurrence of water contamination and reduce the concentrations of chemicals if chemicals do reach live water (Murphy 2006). However, even with these safeguards, herbicides can still result in adverse sublethal effects to fish and certain Primary Constituent Elements (PCEs).

Chronic and Acute Exposures

A fundamental difficulty in characterizing environmental exposures arises due to constantly changing contaminant concentrations in flowing water and an ever-increasing spatial scale as herbicides disperse downstream. Once a contaminant reaches moving water, contaminants begin to disperse and become more diluted with increasing time or distance from the contaminant source. Consequently, the highest contaminant concentrations are likely to occur for brief periods of time in the immediate area surrounding the point of entry, and initially, these concentrations may be similar to the peak spray concentrations as shown in Table 3-31 and Table 3-33 (below). As contaminants become dispersed over large areas such as a stream reach or an entire drainage, they become diluted by mixing with less contaminated water. As contaminants move downstream, they affect an ever-increasing area with ever-increasing durations, but the concentrations become substantially reduced from the initial concentrations where they first entered the stream.

Two types of exposure scenarios emerge from the effects of dispersal and dilution: acute exposures that affect a small area for a short duration, with relatively high concentrations, and chronic exposures that affect a large area for a long duration, with relatively low concentrations. In addition, acute exposures may often involve only those chemicals sprayed at a single location and tend to occur only when chemicals are applied close to a stream. Chronic exposures are more likely to contain a mixture of chemicals sprayed at a variety of locations anywhere in the watershed. Since acute exposures affect a small area and chronic exposures affect a large area, the majority of organisms exposed to herbicides will experience chronic exposures.

Exposure to Contaminants from Runoff

In spite of efforts to minimize water contamination from the proposed action, herbicides cannot be kept entirely out of the water, although project design features would reduce exposure risks. The biggest concerns are if a large spill occurs and chemicals are not completely cleaned up, that residual chemicals could reach and contaminate water from surface or subsurface runoff after precipitation events. For these scenarios, peak concentrations that could reach water were determined. Peak water concentrations of each herbicide have been estimated in the Forest Service risk assessments (Syracuse Environmental Research Associates, Inc, or SERA) with the primary mechanism being surface runoff. The upper limit of the peak concentrations estimated in

the SERA assessments are used (Table 3-31 and Table 3-33) to evaluate the maximum severity of water contamination that might occur from the proposed action, but these concentrations are unrealistically high. The use of data from agricultural models generally provides an extreme upper estimate of water contamination in a forest setting, except where herbicides are applied to ditches that drain directly into streams. Pesticide concentrations estimated at the point where runoff first enters a stream may reach concentrations that approach the peak concentrations, but as spatial scale increases beyond the point of entry, mixing and dilution causes pesticide concentrations in the water column to converge on an average concentration reflective of the total amount of pesticides applied in the watershed and the size of the drainage area. In the action alternatives, herbicides will typically be applied to scattered patches or individual plants that are growing in an environment that includes organic debris and other vegetation that inhibit off site movement of the chemicals. This pattern of application creates small areas with relatively high herbicide concentrations, which are dispersed over a much larger area where the majority of the area is not sprayed. In this circumstance, 2 types of exposure can occur: acute exposures in a small area or chronic (long-term) exposures over a large area.

Peak concentrations shown in Table 3-31 and Table 3-33 represent the worst-case scenario for the proposed action from acute exposures that are likely to exist from minutes to hours, and occur only in the immediate area where herbicides are sprayed. The intensity of herbicide use in Table 3-31 and Table 3-33 also characterizes relative differences in chronic exposures that are likely to occur from the proposed action. The duration of chronic exposures is likely to span days to months, and these exposures may occur over broad portions of the analysis area. Chronic exposures caused by the proposed action are likely to mimic the patterns of the intensity of pesticide use in the watershed. Typical exposure scenarios, which have concentrations below the peak, are also described for situations that would be more commonly encountered under the action alternatives.

Herbicide Toxicity: Lethal, Sublethal and Environmental Exposures

Toxic chemicals can potentially harm fish through 3 potential pathways: outright death, sublethal changes in behavior or physiology, or environmental alterations (Scholz et al. 2005). Environmental alterations are indirect consequences of the action that may affect critical habitat through changes in cover, shade, runoff, and availability of prey.

Table 3-31 displays the upper HQs for proposed herbicides where exposure scenarios resulted in HQs greater than 1.0 for fish. The SERA worksheets were used to calculate upper bound HQs to represent the “worst case” of each exposure scenario and lower, “best-case” HQs. The calculation of upper bound HQs do not account for factors such as timing and method of application, animal behavior and feeding strategies, seasonal presence or absence within a treatment area, and/or implementation of project design criteria. Therefore, risk is overestimated when the proposed application methods for this project are considered. While some discussion of upper bound HQs occurs in this analysis, central HQs are considered a more accurate estimate of risk associated with the project.

SERA risk assessment worksheets compare the expected herbicide delivery based on the herbicide property, use rate and application method to the toxicity indices for fish, aquatic invertebrates, aquatic plants, and algae. A range of HQ values was provided, including central estimates.

Upper bound estimates are implausible for this project, given the extent of treatment and project design. However, the effect of project design features and herbicide use buffers in reducing predicted HQ values under SERA risk assessment scenarios have not been quantified. SERA worksheets are available to refine some site-specific parameters (such as application rate); however, the effect of the design features in restricting the timing, extent, location, herbicide selection, and application rate cannot be precisely modeled. Table 3-31 and Table 3-33 display which herbicides may exceed HQ of 1 under the SERA modeled acute exposure scenario assuming herbicide treatment of 10 acres adjacent to a small stream.

Table 3-33 and Table 3-39 show that the HQ of 1.0 are not exceeded for for fish or invertebrates any of the proposed herbicides at maximum application rates for acute central exposure limits. Table 3-34 shows that glyphosate and picloram exceed the HQ of 1.0 for accidental exposures. Given proposed project design features and herbicide use buffers, exceedances are not likely to actually occur for this project. Picloram is the chemical associated with greatest risk given its persistence, mobility, and toxicity. Thus, picloram would not be closer than 50 feet from streams. In contrast, aminopyralid, which is effective on some of the same target plants as picloram, poses relatively low risk to aquatic resources and may be used closer to surface waters. Glyphosate is a concern for fish and invertebrates at the upper limits but not at central limits. It does not persist in the environment due to the fact that it readily binds to organic matter in soil and is easily broken down by microorganisms. Glyphosate (no surfactants) would not be used closer than 15 feet for spot or hand selective applications. EPA classifies fluroxpyr as practically non-toxic to fish and invertebrates such as daphnia.

For this project, it is possible that herbicide concentrations may exceed the LOC for algae and macrophytes (aquatic plants). Nearly all herbicides may affect aquatic plants should they be exposed. Analyses show that chlorsulfuron and aquatic imazamox pose the highest risk to aquatic plants and algae. The use of chlorsulfuron near streams is restricted by the project design features because of the susceptibility of aquatic plants to this herbicide. Adverse effects to aquatic macrophytes could reduce food supply to aquatic invertebrates, which could negatively affect fish species indirectly by reducing their primary food prey base. Most of the herbicides have the same potential to harm aquatic plants, thus, Alternatives 2, 3, and 4 could negatively affect the aquatic food chain.

For a complete discussion on the toxicological effects of each herbicide proposed for use, see the Toxicalogical Effects Appendix in the project record. This appendix includes herbicide exposures to soil and water, end use products and toxicity to fish, invertebrates, algae, and aquatic macrophytes.

Effects on Aquatic Macrophytes, Microphytes and Invertebrates

Since herbicides would not be applied to water except in isolated incidents of aquatic invasive weed treatment, adverse effects from the action alternatives are possible only when incidental water contamination occurs from runoff or other transport mechanisms discussed previously. Apart from direct effects of herbicides on fish, herbicides present an indirect risk to salmonids through the potential alteration of primary productivity and invertebrate communities. The risks of the action alternatives from potential changes in the integrity of the foodweb and other aspects of the biological community are only partially understood. Scant toxicity data exist for many of the algal and invertebrate species found in the analysis area. Most of the toxic effects reviewed are inferred from commonly-tested invertebrate taxa such as *Daphnia*, and algal taxa such as

Navicula and *Anabaena*, which may not be representative of the taxa found in the analysis area. These taxa are relatively sensitive species that provide a general characterization of risk, but different species can have vastly different sensitivities to a particular chemical. For example, among the various marine and aquatic species investigated by Nyström et al. (1999), toxicity endpoints varied as much as 6 orders of magnitude between species. Due to a deficiency of direct information on environmental effect of herbicides, uncertainties are associated with the following factors: 1) the fate of herbicides in streams; 2) the resiliency and recovery of aquatic communities; 3) the site-specific foraging habits of salmonids and the vulnerability of key prey taxa; 4) the effects of pesticide mixtures that include adjuvants or other ingredients that may affect species differently than the active ingredient; and 5) the mitigating or exacerbating effects of local environmental conditions.

If herbicide contamination were to reduce the abundance of macroinvertebrates in streams, a corresponding reduction in salmonid biomass through reduced body size or reduced numbers would likely occur. Less food may induce density-dependent effects, such as increased competition between foragers (Ricker 1976), and changes in salmonid growth rates that are largely determined by the availability of prey in freshwater systems (Chapman 1966; Mundie 1974). Food supplementation studies (e.g., Mason 1976) show a clear relationship between food abundance and the growth rate and biomass yield of juveniles in streams. Juvenile growth rates determine the body size and age when salmon and steelhead outmigrate as smolts, and fish with larger body sizes are more capable of surviving in the estuarine and marine environments (Higgs et al. 1995). A study on size-selective mortality in Chinook salmon from the Snake River (Zabel and Williams 2002) found that naturally reared fish did not return to spawn if they were below a certain size threshold when they migrated to the ocean.

In spite of data limitations, a reasonable amount of certainty exists that significant changes in the food web would not occur under the action alternatives, based on several corroborating field studies that generally failed to detect changes in community attributes when herbicides such as those proposed are applied in similar settings (e.g., Mayack et al. 1981; Michael et al. 2006; Fowlkes et al. 2003). The weight of evidence suggests a relatively low risk of altering the food web and biological community on which salmonids depend.

The assessments used to characterize toxic effects in Table 3-33 are constant exposures that are 24 hours or longer, which is not an exposure scenario likely to be encountered under the action alternatives. Based on studies of herbicide transport discussed in the hydrology technical report (available in the project record), the duration of exposures that are likely to occur in the field are likely to be pulses of contamination less than 1.0 hour in duration. In one particular study, Michael et al. (2006) concluded that the magnitude and duration of herbicide pulses (from herbicide use similar to those proposed under the action alternatives) may be too brief to cause significant changes in invertebrate communities, and if changes were to occur, communities tend to rapidly reestablish their original composition though recolonization. Another factor that further reduces potential effects on invertebrate production and prey availability is the relatively low intensity and dispersed nature of proposed herbicide use that precludes the possibility of herbicides reaching concentrations that would affect prey availability to a meaningful extent beyond the point where herbicides first reach a stream.

The acute toxicity HQs for invertebrates are well below the LOC of 1.00 for all herbicides except for fluroxpyr. The acute toxicity HQs for most of the herbicides are below the LOC of 1.0 for algae but above an LOC of 1.0 aquatic macrophytes. These results suggest that impacts from

runoff for these herbicides may pose a risk to certain algal and macrophytic species. Risk would be greatest where contaminated runoff directly enters the stream. However, effects are expected to be localized since the contaminated runoff would further dilute as it mixes with a larger waterbody. While localized effects to food that fish depend on may occur, herbicide exposure should not result in significant changes in the food web over a large portion of stream. Furthermore, if these worst-case scenarios occurred, they would be infrequent pulse events and algal species would be expected to quickly recolonize any impacted areas.

Aquatic triclopyr and aquatic imazamox pose the greatest risk for aquatic macrophytes. However, treatment for aquatic invasives would not occur until an ESA consultation has been completed on a case-by-case basis.

Table 3-33. Most sensitive toxicological endpoint for algae and aquatic invertebrates, as reported in the Forest Service SERA or other risk assessments

Herbicide	Peak EEC[a] (mg/L)	Daphnia 96-hr LC_{50} (mg/L)	Most Sensitive Algal Endpoint	Most Sensitive Aquatic Macrophyte Endpoint	Most Sensitive Aquatic Invertebrate Endpoint	Levels of Concern Based on Hazard Quotients[b]
2,4-D amine *Weedar 64*	0.08	100 Non-toxic	1.41 mg a.e./L[c] NOAEC diatom Navicula	0.005 mg/L[c] NOAEC	75 mg/L 48-hour LC_{50} for Daphnia[c]	0.06—algae **16**—macrophytes 0.003—invertebrates
Aminopyralid *Milestone*	0.011	>98.6 Slightly	6 mg a.e./L 72-hour NOEC[d] HQ=0.01	24 mg/L[e] NOEC HQ=0.002	95.6 mg a.e./L 48-hour NOEC for *Daphnia*[f] HQ=0.0007	0.002—algae 0.0003-macrophytes 0.0001-invertebrates
Chlorsulfuron *Telar*	0.025	>100 Non-toxic	0.01 mg/L 120 hr NOEL[g]	0.0005 mg/L[h] NOEC	10 mg/L 48 hr NOEC[i]	**3.0**—algae **53**—macrophytes 0.0007-invertebrates
Clopyralid *Transline*	0.01	225[j] Non-toxic	6.9 mg/L 96-hour EC_{50}[k]	mg/L NOEC[l]	23.1 mg a.e./L NOEC for *Daphnia*[j]	0.001—algae 0.1 macrophytes 0.0004—invertebrates
Dicamba *Banvel*	0.006	100 Non-toxic	0.0049 mg/L EC_{50}[m]	0.25 mg/L NOEC[n]	3.8 mg/L 48-hour LC_{50} for *Daphnia*[o]	**1.2**—algae 0.02 macrophytes 0.002—invertebrates
Glyphosate (Terrestrial) *Roundup Original* with surfactant	0.044	50 Slightly	0.082 mg/L[p] NOAEC	0.082 mg/L[p] NOAEC	0.075 mg/L NOEC[p]	0.5—algae 0.5 macrophytes 0.6—invertebrates
Glyphosate (Terrestrial) *Roundup Custom* no surfactant	0.044	50 Slightly	0.23 mg/L[p] NOAEC	0.082 mg/L[p] NOAEC	2.7 mg/L NOEC[p]	0.2—algae 0.5—macrophytes 0.02—invertebrates
Glyphosate (Aquatic) *Rodeo*	0.147	50 Slightly	0.23 mg/L[p] NOAEC	0.082 mg/L[p] NOAEC	2.7 mg/L NOEC[p]	0.6—algae **1.8** macrophytes 0.05—invertebrates

Herbicide	Peak EEC[a] (mg/L)	Daphnia 96-hr LC_{50} (mg/L)	Most Sensitive Algal Endpoint	Most Sensitive Aquatic Macrophyte Endpoint	Most Sensitive Aquatic Invertebrate Endpoint	Levels of Concern Based on Hazard Quotients[b]
Imazapic *Plateau*	0.00009	>100 Non-toxic	0.05 mg/L 5-day LC_{50}[q]	0.001 mg/L[q] NOEC	100 mg/L 48-hour NOEC[r]	0.002—algae 0.07 macrophytes 0.0000009—invertebrates
Metsulfuron-methyl *Escort*	0.0003	>150 Non-toxic	0.01 mg/L NOEC[s]	0.0002 mg/L NOEC[s]	420 mg/L NOEL for *Daphnia*[s]	0.03 algae **1.9**—macrophytes 0.0000007—invertebrates
Picloram *Tordon*	0.011	68.3 (48 hr) Slightly	0.023 mg a.e./L NOAEC[t]	12.2 mg/L NOAEC[t]	2.15 mg/L NOAEC[t]	0.5—algae 0.0009 - macrophytes 0.005—invertebrates
Sulfometuron methyl *Oust*	0.0004	184 Non-toxic	0.003 mg a.e./L NOEC[u] HQ=3.0	0.0002 mg/L NOAEC[u] HQ=36	75 mg a.i./L LOEC for Daphnia[u] HQ=0.0001	0.2—algae **1.8**—macrophytes 0.000005—invertebrates
Triclopyr (Aquatic) *Renovate*	0.0735	>100 Non-toxic	0.23 mg a.e./L 96-hour NOEC[v]	0.0005 mg/L NOEC[v]	25 mg/L NOAEC for *Daphnia magna*[v]	0.3—algae **147**—macrophytes 0.003—invertebrates
Triclopyr (Terrestrial) *Garlon 3A*	0.006	>100 Non-toxic	0.23 mg a.e./L 96-hour NOEC[v]	0.0005 mg/L NOEC[v]	25 mg/L NOAEC for *Daphnia magna*[v]	0.03—algae **12**—macrophytes 0.0002—invertebrates

[a] Peak estimated environmental concentration (EEC) is extrapolated from SERA assessments using the max application rate. Values are based modeling herbicide drift using a backpack sprayer using Worksheet Maker 6.0.
[b] HQ values from Worksheet Maker 6.0 based on maximum application rates using central concentration levels for sensitive species. When sensitive species studies are unavailable, HQ values for tolerant species are used and noted.
[c] USFS, 2006
[d] Hancock et al. 2007 in SERA, 2007a
[e] Hoberg, 2003a in SERA, 2007 for tolerant species
[f] Marino et al. 2001b in SERA, 2007a
[g] Kallqvist et al, 1994 in SERA, 2004a
[h] Fairchild et al, 1997 in SERA 2004a for tolerant species
[i] Hessen et al. 1994 in SERA,2004a
[j] SERA 2004c for tolerant species
[k] Dill and Milazzo, 1985 in SERA, 2004c
[l] Forsyth et al. 1997 in SERA 2004c for tolerant species
[m] Hoberg, 1993a SERA, 2004b
[n] Hoberg, 1993b in SERA, 2004b for tolerant species
[o] Hurlbert 1975 in SERA, 2004b
[p] SERA 2011a
[q] Hughes et al 1994, in SERA, 2004f for tolerant species
[r] SERA 2004f for tolerant species
[s] SERA 2004d for tolerant species
[t] SERA 2011c for tolerant species
[u] SERA 2004f for tolerant species
[v] SERA, 2011b

Effects on Individual Fish

Potentially harmful effects from herbicides to native fish and ESA-listed fish by altering the food web, killing riparian vegetation, or altering hydrology were discussed previously and found to be relatively minor risks of the action alternatives. However listed species could be adversely affected through lethal or sublethal exposure, if herbicides were applied shortly before an

unexpected precipitation event contaminated runoff could reach a stream. Under the action alternatives, none of the herbicides, carriers, or surfactants proposed for use are likely to cause outright mortality of listed salmonids. The HQs in Table 3-31 show that peak EEC of the herbicides are a small fraction of the concentrations where lethal effects would be expected. Peak EEC of all herbicides are less than 1% of the lowest concentration where lethal effects have been observed. Furthermore, the estimates of peak EEC are extreme values that generally would not be encountered, which provides an additional level of assurance that direct lethality would not occur. The peak concentrations in Table 3-31 are intentionally robust to ensure that actual concentrations of contaminants would not be higher than anticipated under the most extreme circumstances that might be encountered.

Although direct lethal effects are not expected under the action alternatives, available information is generally insufficient to completely characterize the nature and extent of potentially harmful sublethal effects. The types of chemicals proposed are ones capable of causing altered fish behavior due to mechanisms such as irritation, diminution of sensory acuity, impaired motor skills, or malaise. Since the nature and extent of sublethal effects are not entirely known, all of the chemicals are assumed to potentially cause sublethal effects even though many acute toxicity HQs are well below the LOC of 1.0. Based on HQ results, fluroxypyr and glyphosate may pose the greatest sublethal impacts from runoff. However, none of these herbicides exceed the 1.0 threshold. Risk would be greatest where contaminated runoff directly enters the stream. However, effects would be expected to be localized since the contaminated runoff would further dilute as it mixes with a larger waterbody. Given the project design features and herbicide use buffers, direct lethal or indirect sublethal effects are not likely to actually occur for this project.

The amount of exposure provides a general indicator of risk where sublethal effects are unknown. Sublethal effects are considered under the ESA to constitute “take,” if the sublethal effects harm ESA-listed fish. NMFS defines harm as “an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding or sheltering” (50 CFR 222.102).

In addition to data gaps concerning sublethal effects, the herbicide formulations proposed under the action alternatives include unknown “inert” ingredients that could potentially be far more toxic than the active ingredient(s), and the toxic effects of the herbicide mixtures used under the proposed action are virtually unknown. Some of the toxicity assays for the chemicals used in this action tested the complete product formulation, some tested only on the active ingredient, and some studies did not specify which formulation was used. For herbicide mixtures proposed under the action alternatives, the toxicity of the mixture is assumed to be similar to the most toxic active ingredient in the mixture. Complex mixtures of herbicides that might develop in a stream from using multiple chemicals in the same drainage are not likely to occur to any appreciable extent due to the relatively low intensity of spray activities and the nature of herbicide inputs which occur as pulses that coincide with high stream flows and high rates of dilution and dispersal.

Common sublethal endpoints are reported for many chemicals, but none of the herbicides have been thoroughly screened for all potential sublethal effects that might have biological relevance. Herbicide concentrations likely to occur under the action alternatives appear capable of causing minor behavioral changes, but the duration of exposure to the peak concentrations is likely to be

much shorter than the duration of exposures in the toxicity assays that are used to characterize toxic effects. All acute toxicity assays cited are based on exposures lasting 24 hours or more, while peak concentrations of ground-based herbicide applications in forest settings tend to occur in brief pulses lasting for much shorter periods. With the particular herbicides proposed under the action alternatives the typical pattern of herbicide contamination from runoff is a rapid spike in herbicide concentrations at the beginning of the first runoff event following herbicide application, followed immediately by a sharp exponential decline in concentrations as the runoff continues, and in subsequent runoff events (Bergamaschi et al. 1999; Muller et al. 2004). In one particular study, Michael et al. (2006) observed that Oust (sulformeturon methyl) transportation to streams in surface runoff occurred in pulses with maximum concentrations persisting for less than 15 minutes before dropping exponentially to lower levels.

Based on the pulsed nature of herbicide contamination, the duration of peak herbicide concentrations where adverse effects are most likely to occur is unlikely to persist beyond a few hours and occurs only during the first 1 or 2 runoff events that follow herbicide application. The limited duration of exposure is not likely to cause more than minor risks to fish survival or growth if sublethal effects do not continue to occur at relatively low concentrations after pulses of contamination have passed. With the herbicides proposed under the action alternatives, the peak EEC and HQ values are generally below thresholds; consequently, there is no known risk of chronic sublethal effects, only acute sublethal effects from the proposed action. It is important to recognize that many biologically relevant indicators of sublethal effects have not been tested with the chemicals proposed under the action alternatives, and many potential sublethal toxicological effects may harm fish in ways not readily apparent in laboratory assays. Where small changes in the health or performance of individual fish are observed in toxicity assays (e.g., a small percentage change in the activity of a certain enzyme, an increase in oxygen consumption, the formation of pre-neoplastic hepatic lesions), predicting how these changes would affect essential behavior patterns of fish in the wild may not be possible. Additionally, animals tested under laboratory conditions are not subjected to predators, competitors, pathogens, and numerous other hazards found in the natural environment that affect the survival and reproductive potential of individual fish.

Although sublethal toxicity profiles are not entirely known for the herbicides proposed under the action alternatives, the potential severity of sublethal effects can be inferred in part by the patterns of exposure. Sublethal effects could compromise the viability and genetic integrity of wild populations in a situation where exposures result in significant losses of fish throughout a large geographic area or a small area occupied by a population with unique genetic traits. The likelihood of population changes from sublethal effects of the chemicals proposed is largely undocumented, but appreciable population effects can be ruled out if the exposure to harmful effects is limited to small numbers of fish and a spatial pattern that is not likely to cause the loss of a unique genetic stock. Under the action alternatives, spraying would not occur over large contiguous areas, and most of the analysis area would not be subjected to spraying in any given year, which would eliminate the possibility of significant fish losses throughout a large geographic area. Appreciable amounts of water contamination are also unlikely to occur in upland sites that are several hundred feet from streams. Only riparian spray sites, which are few in number and widely scattered across the analysis area, are likely to cause meaningful amounts of water contamination.

Table 3-34. Relative risk to fish, aquatic invertebrates, algae, and aquatic plants based on hazard quotients for riparian use of herbicides at maximum project rates at upper limits

	2,4-D Amine	Aminopyralid	Chlorsulfuron	Clopyralid	Dicamba	Glyphosate	Aquatic Glyphosate	Imazapic	Metsulfuron methyl	Picloram	Sulfometuron methyl	Triclopyr TEA
Fish	--	--	--	--	--	--*	--*	--	--	--*	--	--
Aquatic invertebrates	--	--	--	--	--	--*	--*	--	--	--	--	--
Aquatic plants	✱*	--	✱*	--*	--*	--*	✱*	--*	✱*	--	✱*	✱*
Algae	--*	--	✱*	--	✱*	--*	--*	--*	--*	--*	--*	--*

-- Hazard Quotient less than or equal to 1 indicates an extremely low level of risk; indicates a level of exposure below the level of concern (LOC) for adverse health effects.
✱ Hazard Quotient greater than 1 at maximum proposed application rates for acute central exposure limits. *Hazard Quotients greater than 1 at maximum proposed application rates for accidental central exposures.

Given the project design features and proposed herbicide use buffers, sublethal effects are possible but not likely to actually occur under the action alternatives. Fluroxpyr and glyphosate with POEA have the potential to cause sublethal effects (HQ of 0.2 and 0.9, respectively). Fluroxpyr would not be used closer than 50 feet to water and glyphosate with surfactants would not be used closer than 100 feet to water.

Effects on Fish Populations

Based on the toxic effects of the herbicides described above, the action alternatives have a range of possible consequences to fish populations that might be caused by sublethal effects due to uncertainties regarding the toxicity of the proposed products. At one end of the range, herbicide exposures may be too brief and too low to cause any appreciable effects to individual fish or fish populations. At the other end of the range, sublethal effects could possibly harm ESA-listed fish in all locations where they are exposed to a large herbicide concentration. The herbicide formulations proposed include classes of chemicals with the potential to cause sublethal effects.

If the worst-case scenario is assumed, the magnitude of risk depends almost entirely on the number, size, and geographic pattern of the areas where herbicides reach streams in an appreciable amount. The circumstances where herbicides may be capable of causing appreciable amounts of contamination are limited to occasional situations where several factors must occur in combination. Those situations are likely to be encountered when 1) herbicides are sprayed within 100 feet of a stream, in ditches hydrologically connected to streams, or locations where chemicals are capable of moving rapidly through soils into the alluvial aquifer; 2) when precipitation occurs before the herbicides break down, bind to soil particles, or get taken up by plants; 3) spray intensity is high enough to provide an appreciable source of contaminants; and 4) ESA-listed fish or redds are near the spray site or point of herbicide entry.

Project design criteria would minimize the likelihood of encountering situations that would cause an appreciable amount of contamination: 1) herbicides that would be used near streams have relatively short half-lives that reduce the period of time when herbicides are susceptible to off-site transport; 2) spray activities would be suspended when rain storms are imminent; 3) applicators obtaining a weather forecast prior to initiating spraying to ensure no precipitation

or wind events could occur during or immediately after spraying that could allow drift into surface waters; and 4) applying a 100-foot no-spray buffer zone for broadcast applications and a minimum 15-foot buffer for spot applications along all flowing water streams/ditches and ponded water bodies for those herbicides not labeled for aquatic or streamside application. Specific locations where harm is likely to occur from the action alternatives cannot be identified at this time, since most of the above factors will not be known until spray sites are selected in the field. Under the worst-case scenario, the circumstances when listed fish are likely to be exposed to herbicides capable of causing harm are too limited and isolated from one another to have an appreciable effect overall fish populations in a specific drainage or in the analysis area. We can again only anticipate that individual or small groups of fish could be exposed to sublethal effects.

Effects on Critical Habitat

The action alterantives are likely to affect critical habitat through the biological effects of herbicides and surfactants on aquatic organisms that salmonids depend on for food (e.g. bull trout critical habitat primary constituent element 3—abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish). The action alternatives are unlikely to cause appreciable changes in the physical attributes of critical habitat that are important for salmonids, such as substrate composition, water temperature, dissolved oxygen, streamflow, cover, or channel morphology. The low intensity of spraying in RCAs and patchy nature of the spray locations leaves the vast majority of the analysis area unaffected by herbicides. Where watershed processes are presently altered by weeds, if native species become established after the invasive plants are killed by the herbicides, the native plants are likely to provide ecological functions and rates of erosion that are more normative than the baseline conditions within designated critical habitat boundaries. Overall, appreciable changes in watershed processes are unlikely to occur under the action alternatives due to the small amount of area that would be treated and the scattered nature of the treatment areas.

Potential effects from weed spraying on designated critical habitat would vary at each location depending on the size of the treatment area, the chemicals used, method of application, distance from water, and vegetative characteristics of the treatment areas. If chemicals were to reach the water in an appreciable amount, a variety of biological effects could occur, including harmful effects on ESA-listed fish or other aquatic organisms due to direct exposure to the chemicals or indirectly from changes in the biotic community. In general, most instream effects of herbicides would be short-lived, discreet events associated with spills, drifts, or runoff events. Critical habitat elements would be likely to return to normal within a few hours to a few days following the events causing the contamination. None of the chemicals proposed for use are expected to result in long-term alteration of critical habitat through water contamination.

Effects of Inert Ingredients and Adjuvants

Adverse effects from exposure to surfactants may include acute toxicity (illness, death) or chronic toxicity (such as teratogenic or carcinogenic effects). Inert ingredients can contribute to the toxicity of herbicide formulations or herbicide/surfactant mixtures to selected aquatic organisms (Buehl and Faerber, 1989; Giesy et al., 2000; Paveglio et al., 1996). In some cases, the toxicity of the inert ingredient may be greater than the toxicity of the active ingredient (Solomon and Thompson, 2003).

The United States Department of Agriculture (USDA) Forest Service (Region 5) looked extensively at the risk of surfactants used in herbicide applications (Bakke, 2003). Bakke (2003)

concluded it appears that surfactants used in forestry can affect aquatic organisms at lower doses than for terrestrial organisms. However, the Forest Service found no evidence that typical exposures of surfactants would lead to dose levels of concern for aquatic wildlife (Bakke 2003). Bakke (2003) concluded that although the potential exists for surfactants to affect the environmental fate of herbicides in soil, any potential effects would be unlikely under normal conditions because of the relatively low concentration of surfactants in the soil/water matrix and surfactant degradation/dilution from the applied site before reaching a water body. Normal operation exposure doses of 3.1 parts per billion (ppb) to 31.2 ppb were found to be protective of "all aquatic organisms" (Bakke 2003). Short exposure time, dilution, binding to sediments, and the breakdown of metabolites and/or contaminants all act to reduce exposure. For fish, calculated levels of exposure in Forest Service applications were at least 30 times lower than the 1,000 ppm protective level described in the literature (Bakke 2003).

Localized effects could be seen if a surfactant spill occurred and lead to concentrations approaching or exceeding 1,000 ppm (Bakke 2003). Risk assessments have been performed by the Monsanto Company (Monsanto 1983), California Department of Fish and Game (CDFG 1998), University of Washington and Washington State University (WSDA 2004) using acute bioassay values (LC_{50}) for rainbow trout (*Oncorhynchus mykiss*) and aquatic invertebrates (*Daphnia magna*). Toxicity values for some surfactants were in the "moderately toxic" range according to EPA classifications. However, for these values to be reached, herbicide mixtures were applied directly to water at higher concentrations than what would be used by the SNF and BNF.

Listed inert ingredients for the herbicide formulations being considered for use on the SNF and BNF include water, ethanol, isopropanol, isopropanolamine, polyglycol 26-2, and polyoxyethylamine. None of these chemicals are listed as Level 1 (Inert Ingredients of Toxicological Concern) or Level 2 (Potentially Toxic Inert Ingredients) compounds. While there is some concern regarding the toxicity of polyoxyethylamine (POEA), a surfactant included in a formulation of glyphosate, POEA would only be used in uplands where no potential exists for movement into aquatic systems. Within or near aquatic systems, only products labelled for aquatic application would be used.

Bullseye and Hi-Light blue dyes would be used within 100 feet of water sources and in other areas as needed. These dyes are typically photo-oxidized and disappear within a 2 to 3 days. Hi-Light® Blue is a water-soluble dye that contains no listed hazardous substances. It is considered to be virtually non-toxic to humans. Its effect on non-target terrestrial and aquatic species is unknown; however, its use has not resulted in any known problems. The dye used in Hi-Light® Blue is commonly used in toilet bowl cleaners and as a colorant for lakes and ponds (SERA 1997).

Effects on Individual Fish through Synergy

Surfactants, by their very nature, are intended to increase the effect of a pesticide by increasing the amount of pesticide that is in contact with the target (by reducing surface tension). This is not synergism, but more accurately is a reflection of increased dose of the herbicide active ingredient into the plant. Although not much data exist in the technical literature, Abdelghani et al. (1997) and Oakes and Pollak (1999) indicate a lack of synergistic effects between surfactants and pesticides. Combined products exceeding HQ values of 1 would not be used, so no negative effects are anticipated through combining products.

Effects to Federally Threatened and Endangered and Forest Service Region 4 Sensitive Fish Species

Implementing herbicide treatments under the action alternatives is considered **likely to adversely affect** federally listed species, including Snake River spring/summer Chinook salmon, Snake River sockeye salmon, Snake River basin steelhead, and Columbia River bull trout occurring within the SNF and BNF non-wilderness project area. Implementation is further considered **not likely to adversely affect** designated critical habitats for these species occurring within the project area. This determination is mainly due the potential for temporary sublethal effects and the potential for accidental spills. Although most of the potential sublethal effects from herbicides have not been investigated, the minor amount of herbicide for transport to stream channels through off-site drift, post-storm runoff, or leaching, coupled with differences between NOEC and EEC levels, demonstrates that the probability for sub-lethal effects to listed fish species or designated critical habitat through these transport mechanisms is both insignificant and discountable.

Direct effects to federally threatened and endangered and R4 sensitive fish species as a result of exposure to herbicides proposed under the action alternatives are not likely to occur. Design criteria minimize the potential for herbicide entry to waterways via surface runoff, wind drift, leaching, or direct spill pathways. With the exception of picloram, all herbicides proposed under the action alternatives display low-to-moderate toxicity and risk values to salmonid fish species. Increased application buffers are specified for picloram, dicamba, sulfometuron methyl, and chlorsulfuron in recognition of their higher toxicity and risk classification.

Indirect effects to aquatic habitats, including designated critical habitats for federally listed species, are expected to be minimal and limited to potential short-term increases in sedimentation at sites where removal of noxious weed species temporarily leaves areas of barren ground until revegetation with native plants occurs. Broadcast herbicide applications would occur within 100 feet of water sources, so impacts to native riparian vegetation integrity would be expected to be minimal.

Effects to R4 sensitive Westslope cutthroat trout, Yellowstone cutthroat trout, and Wood River sculpin would be similar to those described for federally listed species. Implementation of the action alternatives **may impact** individual Westslope cutthroat trout, Yellowstone cutthroat trout, and Wood River sculpin but the level and scope of impacts would **not likely contribute to a trend towards Federal listing**, or cause a loss of viability to the population or species or be expected to result in a downward trend for the species.

Effects to Management Indicator Species

Population trends for the SNF and BNF's aquatic MIS are discussed in the "Affected Environment" section. Direct and indirect effects to bull trout are identified above. Effects of implementing the action alternatives are not expected to be of sufficient nature or magnitude to result in measureable influence on future trend of bull trout on SNF and BNF and Yellowstone cutthroat trout populations on the SNF.

Cumulative Effects

Other activities within the SNF and BNF have the potential to affect the native, resident, and special status species and critical habitat within the analysis area. Future federal actions, including the vegetation/fuels projects, prescribed fire, livestock management, travel

management, minerals, and other land management activities would be reviewed through separate NEPA and Section 7 consultation processes. Past federal actions have already been added to the environmental baseline in the analysis area.

Under the action alternatives, the SNF and BNF currently implement an active program of noxious weed management, including ground-based herbicide application, mechanical treatment, and biological releases. Active weed treatments, including each of these same treatment methods, would additionally continue to occur on private, County, state and BLM managed lands through actions conducted by CWMA participants. There are 12 CWMAs in and around the BNF and SNF: Blaine, Camas, Custer, Upper Payette, Boise Basin, South Fork Boise, Frank Church–River of No Return, Shoshone Basin, Goose Creek, Raft River, Power, and Utah-Idaho CWMAs. Analysis of cumulative effects will therefore address an analysis area encompassing all land ownerships within the Salmon River, Upper Snake River, Middle Snake, and Great Salt Lake basins.

Current ongoing and foreseeable SNF and BNF forest management activities within this cumulative effects analysis area are identified in Appendix B. Appendix B identified the herbicides currently being used adjacent to the project area, ownership by County, and current and foreseeable future activities on NFS lands. The extent of herbicide applications for invasive plant management on lands adjacent to or near the BNF and SNF cannot be quantified in all instances as only some of these activities are known to the Forest Service and many entities are not required to report herbicide use to the State or other government agencies. Since other governmental invasive plant management entities do not collect usage data to the extent that the Forest Service does or in the same manner, comparison can, in some instances, be difficult. Moreover, the State of Idaho does not require that private applicators collect application data to the same degree as professional applicators.

For the entire 13 county area, NFS lands comprise 35%, private lands comprise 30%, BLM-administered lands comprise 24%, State-owned lands comprise 7%, and National Park Service administered lands comprise 1% (the remaining 4% is other adjacent forests). Because consistent and complete information about herbicides use adjacent to the Forests is not available, certain assumptions were made for this analysis:

- Herbicide labels are being followed, and herbicides are being applied per the label.
- Herbicides are being used on known non-native plants adjacent to the project area.
- Herbicide treatments, including aerial and ground application, will continue on State-owned, privately owned, and public lands adjacent to and surrounding the BNF and SNF.
- The applications of herbicides outside the project area are spatially distinct from treatments within the project area.

CWMA partners are licensed pesticide applicators; therefore herbicides were applied in compliance with label direction. Given the relatively small proportion of treatment across the landscape, the implementation of design criteria designed and utilized to protect sensitive species, and the use of label guidelines for proper application, cumulative adverse effects aquatic species are not expected from implementing any of the action alternatives. All the proposed treatments used in conjunction with treatment methods that neighboring land management agencies, landowners, and CWMA partners implement may serve to increase the efficacy of treatments, which could result in beneficial cumulative impacts to aquatic habitats.

Cumulative effects from treatments under the action alternatives, combined with treatments under the CWMAs, would benefit aquatic habitat and resources compared to the No Action Alternative through the widespread eradication, control, and containment of noxious weeds. The CWMAs and the SNF/BNF weed management program would cumulatively be expected to result in increased levels of weed treatment success.

These cumulative effects could potentially benefit aquatic and riparian habitat and a range of protected and other sensitive MIS through reduced erosion and sediment delivery to drainages. No adverse downstream cumulative effects on non-NFS land would be expected from worst-case situations involving herbicide runoff or leaching because of the extremely low concentrations. There is the potential for downstream adverse effects on aquatic and riparian resources if an herbicide spill or wind-drift-related impact occurred close to Forest Service boundaries. Increased flows proceeding downstream would further dilute the herbicide. Weed management design criteria described previously are designed to prevent or reduce the risk of these types of impacts from occurring.

Additional cumulative effects on aquatic resources associated with foreseeable future activities on the SNF and BNF that are described in Appendix B. These cumulative effects include the potential for erosion and sediment delivery from road and trail-related construction and maintenance activities, livestock grazing along drainages, and recreational activities adjacent to drainages. Also, cumulative effects on aquatic resources from weed treatment activities under the action alternatives potentially include short-term increases in erosion and sediment delivery to drainages caused by more extensive mechanical treatments (soil disturbance) and chemical treatments (creation of barren ground from weed removal) than under Alternative 1. These areas would be subject to erosion until native vegetation becomes re-established, after which time, erosion and sediment delivery should be less than when weeds were present and provide correspondingly greater benefits than under Alternative 1. This would represent an overall long-term cumulative benefit to aquatic habitat and resources.

Finally, herbicide application in adjacent areas (CWMAs, BLM, state and private land) could have cumulative effects on aquatic resources. However, the CWMA efforts are coordinated with the management agencies to avoid multiple treatments within a defined geographic location. In addition, all such applications would be in accordance with EPA label guidelines, which are designed to protect aquatic organisms. The Forest Service (2001c) discussed the potential for 2 additional types of cumulative effects on aquatic organisms from herbicide application. These are the potential for the bioconcentration of herbicides in aquatic organisms and the possibility of synergistic, combined effects on aquatic organisms when several herbicides are present. For bioconcentration to occur, a pollutant must be present in a high concentration for an extended period of time, the organism must be exposed to the pollutant, and the pollutant must have a high resistance to breakdown or excretion by the organism to allow a sufficient uptake period that would result in an elevated bioconcentration. The Forest Service (2001a) concluded that the risk of bioconcentration would be low because of the relatively small amount and timing of herbicide application. The risk of herbicide bioconcentration in aquatic organisms on the SNF and BNF also would be expected to be low because of the extremely low concentrations of herbicides that aquatic organisms would be briefly exposed to during even a worst-case situation. In addition, the herbicides used to treat noxious weed infestations on the SNF and BNF do not bioaccumulate in fish and/or have very little persistence in the environment (Information Ventures, Inc. 2002).

The Forest Service (2001a) concluded that no synergistic effects from herbicide application would occur because 1) the EPA currently supports an additive model in predicting synergistic effects, 2) relatively small amounts of herbicides would be applied, and 3) where more than one herbicide is used the amount of each chemical applied would typically be reduced. This same rationale and conclusion regarding the potential for synergistic effects on aquatic resources also applies to the SNF and BNF. In addition, because the chances of multiple different herbicide activities taking place in the same drainage on the same day are unlikely, the potential for cumulative synergistic effects on aquatic organisms on the SNF and BNF would be minimal.

Irreversible/Irretrievable Effects

Fisheries resources and/or aquatic habitat integrity would not be not impacted in any watershed containing TES or MIS species to an extent that loss of production occurs for an implemented action. Irreversible loss of fisheries resources would only occur in a case where an action was implemented that caused permanent loss of some level of fisheries production. Irretrievable commitments of habitat components for fisheries resources would be limited to temporary and localized riparian vegetation reductions associated with invasive plant treatment activities that would be expected to result in overall beneficial effects over time.

Forest Plan Consistency

All actions proposed under the action alternatives are consistent with Management Goals, General Direction and Standards and Guidelines for fisheries resources and aquatic habitats identified in both the SNF and BNF Forest Plans (USDA Forest Service 2010a, 2012a) because of the following:

- Habitat within the respective ranges of species listed under ESA will be managed to contribute to their species survival and recovery (TEGO02 [USDA Forest Service 2010a, 2012a]).
- For management actions that include application of insecticides, herbicides, fungicides, or rodenticides, mitigation shall avoid or minimize adverse effects on TEPC species or their habitats (TEST05)
- Management actions will neither degrade nor retard attainment of properly functioning SWRA desired conditions (SWST04)

3.3.5.3. Alternative 2—Current Management

Alternative 2 (Current Action Alternative) would continue the IWM program as it is currently being implemented in the project area. In general, this alternative includes treating invasive terrestrial plants utilizing biological, mechanical, and\or herbicide treatments. Herbicide application under this alternative is limited to the treatment of terrestrial invasive plants with 12 herbicides and utilizing ground-based application techniques exclusively.

Currently, approximately 106,853 acres of mapped infestations of invasive plant species occur on the BNF, exclusive of the Frank Church-River of No Return Wilderness Area, and 49,924 acres occur on the SNF. The herbicide treatment component of the noxious weed program treats an average of approximately 6,169 acres annually on the SNF and about 8,478 acres on the BNF (Forest Activity Tracking System 3 year average for 2011–2015). In that same time period, the SNF mechanically treated 126 acres and biologically treated 1,503 acres,

on average. The BNF mechanically treated 53 acres and biologically treated 25 acres, on average. Alternative 2 is designed to prevent the establishment of new invasive plant species, prevent further spread of existing noxious weed species, and maintain native plant communities. Alternative 2 implements an adaptive IWM strategy to eradicate or control existing or newly discovered invasive plants. The IWM strategy is derived from FSM direction (FSM 2900) and through national and regional strategic frameworks and management plans (USDA Forest Service 2013, 2014a).

The adaptive IWM program utilizes a variety of tools, used alone or in combination, to treat weeds on the SNF and BNF. Control can often require repeat treatments and monitoring of control efficacy. Weed treatment methods implemented under Alternative 2 include ground-based herbicide application, mechanical treatment, biological control releases, cultural methods, and a combinations of these treatments.

A programmatic weeds BA written pursuant to Section 7 of the ESA on the current invasive plant treatment was completed for the northern portion of the SNF with the regulatory agencies (NMFS and USFWS) in 2012. The Biological Opinion received from the NMFS identified the incidental take would be reached annually when a maximum of 1,000 acres, of which 158 acres would be in 300 feet of surface water in the anadromous portion of the SNRA (NMFS 2012). The Biological Opinion received from USFWS identified incidental take as a total of 173 acres of herbicide treatments within 100 feet of streams within the identified populations of bull trout. This biological opinion has been authorized annually during the 10-year life of the IWM program.

The average for the SNF the past 4 years has been 23.6 acres of applied herbicide within 300 feet of anadromous waters and 22.2 acres within 100 feet of bull trout waters (Table 3-35). The herbicide applications were performed in accordance with USFWS, NOAA Fisheries, (pertains to Sawtooth NRA only), EPA, and SNF Programmatic BA/BE Terms and Conditions and Reasonable and Prudent Measures.

Under Alternative 2, the SNF has a prescribed set of buffers which consider herbicide application method, distance to open water, and wind speed.

Table 3-35. 2012–2015 Average annual applied herbicide in riparian areas[a]

	2012	2013	2014	2015	Avg
Applied Acreage in within 100 feet of bull trout waters	2.7	4.8	14.4	67.0	22.2
Applied Acreage within 300 feet of Anadromous Waters	32.8	29.0	28.1	4.6	23.6

[a]Within SNF as reported annually to USFWS and NMFS as per terms and conditions and reasonable and prudent measures outlined in NMFS Biological Opinion, 2012 for Consultation on Programmatic Noxious and Invasive Weed Management Program; Upper Salmon River Subbasin HUC 17060201; Custer and Blaine Counties, Idaho.

3.3.5.3.1. Direct and Indirect Effects

Effects of non-herbicide weed treatments, including mechanical and biological treatments, rehabilitation/restoration practices, and ground-based herbicides under Alternative 2 are the same as those described under the “Effects Common to All Action Alternatives” section. Effects to federally listed and MIS fish species would be the same as identified under the “Effects Common to All Action Alternatives” section. The irreversible/irretrievable and cumulative effects and consistency with the Forest Plans would also be the same as described in that section.

Summary of Direct and Indirect Effects

Under Alternative 2, invasive species infestations within the project area are expected to spread, but the percent of annual expansion of invasive species would be less than under Alternative 1. However, the current management strategy is not likely to be able to effectively treat large, more remote infestations using the currently approved methods. Because treatments under Alternative 2 would limit the spread of some new infestations and potentially decrease the severity of some existing infestations, the effects described above would be less severe and would occur over a longer timeframe than those described under Alternative 1.

Design criteria related to ground-based herbicide application under this alternative are expected to effectively protect SNF and BNF fisheries resources, including federally threatened and endangered and R4 sensitive species and MIS, from impacts due to herbicide delivery to aquatic habitats. Design criteria identified for ground-based herbicide applications under Alternative 2 would minimize the potential for both direct delivery of herbicides to aquatic habitats and impacts to those habitats from surface runoff, wind drift, leaching, or accidental spills. However, short-term disturbances may occur and may have a slight negative effect on aquatic resources in specific areas. These impacts could include localized short-term increases in erosion and sediment delivery to drainages caused by the creation of barren ground (from weed removal) Weed infestations would, however, progressively decline over time in response to treatment actions, reducing the potential for erosion and sediment delivery to drainages and benefiting aquatic resources. Long-term benefits to aquatic habitats, from slowing potential rates of spread, would be expected to be greatest on the BNF where weed infestations are extensive.

3.3.5.3.2. Cumulative Effects

The cumulative effects for Alternative 2 would be the same as described under the effects common to all action alternatives.

3.3.5.4. Alternative 3—Proposed Action

Currently, approximately 106,853 acres of mapped infestations of invasive plant species occur on the BNF, exclusive of the Frank Church–River of No Return Wilderness Area, and 49,924 acres occur on the SNF. Alternative 3 (Proposed Action) is designed to supplement the current SNF and BNF program to more effectively prevent the establishment of new invasive plant species, prevent the further spread of existing noxious weed species, and maintain native plant communities. Like Alternative 2, Alternative 3 would continue to implement an IWM strategy to eradicate or control existing or newly discovered invasive plants over the next 10–15 years as budgets allow. The IWM strategy is derived from FSM direction (FSM 2900) and through national and regional strategic frameworks and management plans (USDA Forest Service 2013, 2014a).

The proposed adaptive IWM program would utilize a variety of tools, used alone or in combination, to treat invasive plants in the analysis area:

- Biological treatment through the use of predators, parasites, and pathogens and through targeted grazing
- Herbicide treatment using ground-based application methods
- Herbicide treatment using helicopter aerial application methods

- Herbicide treatment using aquatic application methods
- Manual and mechanical methods, such as hand pulling, mowing, cutting, or torching
- Rehabilitation and restoration methods such as site preparation and seeding

The treatments would abide by design criteria, the purpose of which is to reduce or eliminate the potential adverse impacts of the various invasive plant treatments. Invasive plant sites that are discovered subsequent to the current invasive plant inventory would be evaluated to determine if the eradication treatments and environmental impacts are consistent with those analyzed in this DEIS.

The project design criteria for the Proposed Action were developed to avoid scenarios of concern to fish species. These restrictions go beyond label requirements by limiting the amount and type of herbicide that may be used adjacent to waterbodies or along roads with high potential to deliver herbicide to streams and other water bodies. Project design features include specific herbicide application guidelines near water that limit spot spraying for most herbicides to at least 15 feet from water broadcast spraying to 100 feet from water. The herbicide use buffers along streams, including road crossings and roadside ditches, reduce the potential for drift or run off of herbicide to surface waters. Design features such as requiring all live water (perennial streams, flowing intermittent streams, lakes, ponds, springs, and wetlands) to have a 300-foot no aerial application herbicide buffer would protect aquatic species during aerial application. Several design features are identified to protect aquatic life if aquatic invasives need to be treated including an aquatic invasive plant treatment strategy.

Alternative 3 would additionally implement a strategy to rapidly respond to new infestations of aquatic weed species though herbicide and/or mechanical treatments.

3.3.5.4.1. Mechanical and Biological Treatments and Rehabilitation and Restoration Practices

Direct and Indirect Effects

Effects of non-herbicide weed treatments, including mechanical and biological treatments and rehabilitation/restoration practices under Alternative 3 would be the same as described under the “Effects Common to All Action Alternatives” section.

3.3.5.4.2. Ground-based and Aerial Herbicide Application

Alternative 3 includes ground-based and aerial herbicide application methods to treat up to 16,000 acres of terrestrial weed infestations annually. In addition to the 11 herbicides proposed under Alternative 2 and currently used by the SNF and BNF, the Proposed Action includes an additional 3 herbicides—fluroxpyr, imazapyr and imazamox (Table 3-36). Alternative 3 also includes the option for aerial application of herbicides to treat larger infestations of terrestrial weeds. Aerial applications could utilize 7 of the 14 herbicides utilized for ground-based terrestrial weed treatments—aminopyralid, chlorsulfuron, clopyralid, imazapic, metsulfuron-methyl, picloram, and sulfometuron-methyl. The Proposed Action also implements a new aquatic invasive weed treatment strategy, with potential use of the additional herbicides imazapyr and imazamox, aquatic glyphosate, and the currently terrestrially used triclopyr, to treat new aquatic weed infestations.

Table 3-36. Herbicides and application settings currently used and proposed for use, Boise and Sawtooth National Forests

Herbicide (Active Ingredient)	Commonly Used Brand Names[a]	Maximum Label Application Rate (active ingredient [ai] or acid equivalent [ae]/acre)	Typical Application Rate (lbs active ingredient [ai] or acid equivalent [ae]acre)	General Location			
				Vegetation—Away From water	Vegetation—Near Water	Aerial Delivery	Aquatic (In Water)
Fluroxypyr	Vista® XRT®	0.5 lb ae/acre	0.25 lb/ae/ac	X			
Imazapyr	Arsenal®	1.5 lb ae/acre/year	1.0 lb ae/ac	X	X		X
Imazamox	Clearcast	0.5 lb ae/acre/year	0.5 lb ae/ac		X		X

[a] List represents brands most commonly used although brands other than those listed may also be used

Background

Additional Herbicides

Fluroxypry (Vista). Fluroxypyr is a selective post-emergent systemic herbicide registered for the control of broadleaf weeds in rangeland, non-crop areas, and grazed areas as well as for the control of woody brush. Fluroxypyr is a pyridinoxy acid herbicide. Fluroxypyr induces auxin-type responses in susceptible annual and perennial broadleaf weeds (auxin being a type of plant growth hormone).

Imazapyr is a broad spectrum herbicide that is similar to glyphosate in terms of its non-selectivity. Imazapyr is labeled for aquatic applications (SERA 2011b) and is recognized as being an effective herbicide for an array of emergent aquatic invasive plants and weed species that grow right along the water's edge, often with their roots in the water (Tu et al. 2001), such as salt cedar and knotweeds. SNF and BNF use of imazapyr would be for aquatic applications and waterline applications made to weed species that grow with their roots in the water.

Imazamox is labeled for aquatic applications (SERA 2010), and is active on submerged, emergent, and floating monocot aquatic plants (BASF 2009). The SNF and BNF propose using imazamox within riparian areas and in aquatic settings for eradicating aquatic invasive plants (e.g., Brazilian elodea, hydrilla, and invasive water milfoils) in water bodies and at the water's edge. The efficacy and selectivity of imazamox on aquatic vegetation is determined by the use rate and by the method of application. Imazamox may be applied either to the water surface for control of emergent weeds or below the water surface for control of submersed vegetation.

Inert Ingredients and Adjuvants

As discussed in section 3.3.5.2.4, adjuvants are specially designed chemical solutions that are added to an herbicide solution to improve the performance of the total spray mixture. Herbicides currently used on the SNF and BNF may also contain "inert" ingredients, including surfactants, that are not expected to have significant effect to fisheries resources.

Herbicide Application

Herbicides would be applied according to EPA product label requirements and in accordance with directions specified in Forest Service Handbooks 2109 and 6709. All herbicide applications would be performed by, or directly supervised by, a State-certified applicator. Certification is managed by the ISDA under rules promulgated by the EPA.

Ground-based application would be conducted as described above under the "Effects Common to All Action Alternatives" section.

Aerial herbicide application—This method would be used in areas where physical features, such as topography, restricted access, size and/or rate of spread of infestation, personnel safety, or other factors (such as prohibitive unit cost of ground application) occur. Invasive plants would be treated with herbicides using helicopters. The following project design criteria would protect aquatic resources:

- All live water (perennial streams, flowing intermittent streams, lakes, ponds, springs, and wetlands) would have a 300 foot no aerial application herbicide buffer.
- Aerial herbicide application would not occur in designated municipal watersheds. Idaho/Utah DEQ Source Protection Areas would not be included in aerial application project areas.
- Aerial spray units (and perennial seeps, ponds, springs, and wetlands in proposed aerial units) would be identified prior to spraying to ensure only appropriate portions of the unit are aerially treated. A GPS system would be used in spray helicopters and each treatment unit mapped before the flight to ensure that only areas marked for treatment are treated. Drift monitoring cards would be placed out to 300 feet from and perpendicular to perennial streams to monitor herbicide presence.

Aquatic herbicide application—Invasive plant sites discovered subsequent to the current invasive plant inventory would be evaluated to determine if the eradication treatments and environmental impacts are consistent with those analyzed in the DEIS. Several design features would protect aquatic life, including an aquatic invasive plant treatment strategy as outlined in the Framework Strategy (Appendix F), if aquatic invasives need to be treated. The herbicides below are proposed for treating aquatic invasives species (Table 3-37).

- *Aquatic Glyphosate*—Aquatic glyphosate is a widely used herbicide in agriculture, turf, and other specialty markets, and was registered by the EPA for use on aquatic weeds in 1977. Glyphosate is a non-selective, systemic herbicide that inhibits the plant enzyme enolpyruvyl shikimate-3-phosphate synthase, which is required for synthesizing aromatic amino acids; this inhibition subsequently disrupts protein production in plants (Senseman 2009). Growth of susceptible plants is inhibited soon after application, followed by foliar chlorosis (yellowing) within 4 to 7 days, and plant death within 10 to 21 days. Glyphosate has no soil activity and cannot be applied directly into water. It is applied post-emergence as a foliar spray and is primarily used to control emergent aquatic plant species. Aquatic glyphosate has the following advantages: it requires short contact time with target plant (4–6 hours); it is very quick acting with results evident in 1–2 weeks; and very little enters water column when it is sprayed on floating plants. Steps would be taken to prevent low dissolved oxygen due to plant decomposition by treating small areas at a time.
- *Imazamox*—Imazamox is labeled for aquatic applications (SERA 2010) and is active on submerged, emergent, and floating monocot aquatic plants (BASF 2009). Imazamox is a broad spectrum systemic herbicide. Although imazamox is an acetolactate synthase (ALS) inhibitor it requires a much shorter contact time (3–7 days) than other ALS inhibitors (sometimes 60 days or more). The SNF and BNF propose using imazamox in

riparian and aquatic settings to eradicate aquatic invasive plants (e.g., Brazilian elodea, hydrilla, and invasive water milfoils) in water bodies and at the water's edge. Imazamox has the following advantages: controls invasive plants in 14 days or less; dissipates quickly from the water column and does not accumulate in sediment; effective on both submerged and free floating plants; and does not have any drinking, swimming, or fishing restrictions. It is not for use in flowing water and treated water may not be used for irrigation for at least 5 days after application.

- *Imazapyr*—Imazapyr is a systemic herbicide that inhibits the plant-specific enzyme, ALS, which plays a critical role in production of branched chain amino acids (Senseman 2009). Inhibition of amino acids impacts protein biosynthesis in plants. Growth of susceptible plants stops within a few hours of application, but injury symptoms and plant death do not occur until weeks later. Imazapyr is typically applied post-emergence and is active on some floating and emergent aquatic weeds. It does not control submerged species. It also has soil activity, and some aquatic formulations can be applied as draw-down treatments in certain areas described in the product label. Imazapyr was registered by the EPA for use in aquatic environments in 2003. Imazapyr can be used in flowing or quiescent water. Typically used primarily on riparian plants. Imazapyr has the following advantages: very little enters water column when sprayed on floating plants; no swimming or fishing restrictions on needed treated water; and no restrictions on livestock consumption of treated water.
- *Triclopyr TEA*—Triclopyr TEA is a selective systemic herbicide similar in activity to 2,4-D (auxin mimic) and was registered by the EPA for aquatic use in 2002. Both liquid and granular formulations of triclopyr amine are available; triclopyr controls submersed, floating, and emergent dicotyledonous (and some broadleaf monocotyledonous) aquatic plants. Triclopyr, applied as a liquid, is a relatively fast-acting, systemic, selective herbicide used for controlling Eurasian watermilfoil and other broad-leaved species such as purple loosestrife. Triclopyr can be effective for spot treatment of Eurasian watermilfoil and is relatively selective to many native aquatic grass species. Triclopyr typically is used for treating isolated Eurasian watermilfoil beds as opposed to whole lake treatments. A granular formulation called Renovate OTF was approved for aquatic use in Idaho. The use of Renovate OTF allows for the bottom portion of the water column to be treated in deeper water before plants reach the water surface. Very little triclopyr would enter the water column when sprayed on floating or emerged plants. Restrictions similar to those required for imazapyr would be imposed.

Table 3-37. Aquatic invasive herbicide treatment options by growth form

Growth Form	Aquatic Use Herbicides			
	Glyphosate	Imazamox	Imazapyr	Triclopyr TEA
Submersed Invasive Plants		X		X
Emergent Invasive Plants	X	X	X	X
Broadleaf; Floating and Emergent	X	X	X	X
Floating Invasive Plants	X			

Direct and Indirect Effects

Mechanisms of potential entry of herbicides to aquatic ecosystems during ground or aerial treatment of terrestrial weeds include surface runoff, leaching through soils, accidental spills, and wind drift. The potential impact of an herbicide on aquatic organisms depends on the toxicity characteristics and exposure concentration of that herbicide.

The following examples illustrate the effectiveness of mitigation measures and BMPs in the aerial and ground-based application of herbicides to safely and effectively treat noxious weeds in the western United States. For the Mormon Ridge Winter Range Restoration Project on the Lolo National Forest in western Montana, picloram (Tordon 22K) was applied aerially in 1997 to treat noxious weeds on approximately 900 acres (TechLine 1998). This site provides important winter range for elk and deer because of the presence of large bunchgrass, but it had deteriorated due to spotted knapweed and leafy spurge infestations. Picloram was applied aerially at a rate of 1.5 pints per acre (approximately 0.37 pound per acre) using the same types of mitigation measures and BMPs that would be employed in aerial herbicide applications on the SNF and BNF, including a 300-foot no-treatment buffer to keep herbicides out of all fish-bearing water bodies. Water samples were collected from Mormon Creek prior to, during, 30 minutes after, and 60 minutes after aerial herbicide application (TechLine 1998). Water samples were tested for picloram at a detection level down to 0.01 part per billion (0.01 microgram per liter), which is far below any levels of toxicological significance. Picloram was not detected in any of the water samples, indicating the stream protection measures were effective.

Results of water monitoring studies in association with herbicide applications in Region 5 of the Forest Service illustrate the effectiveness of BMPs and buffers when properly implemented (Bakke 2001). Of 140 surface water samples collected on these Forests during reforestation and noxious weed eradication projects using ground-based applications of glyphosate and triclopyr, there were no detections of glyphosate in any samples taken after reforestation projects that were not ascribed to contamination. The one project with a detection of glyphosate involved treating noxious weeds within the riparian zone. Even here, only 1 of 12 samples had a detection of glyphosate and that was at a low level of 15 micrograms per liter, which is below any LOC for human health or aquatic resources (Bakke 2001). The few positive detections of triclopyr in non-accidental or erroneous applications in water monitoring were all at levels below any aquatic LOC (highest 2.4 micrograms per liter). The highest level of triclopyr detected (82 micrograms per liter) was the result of an absence of a no-treatment buffer on an ephemeral stream, and even this level did not represent a substantial risk of harm to humans or the environment (Bakke 2001).

To estimate the risk of possible herbicide concentration in streams, it is important to distinguish whether rainfall on a weed treatment site is infiltration-dominated or runoff dominated. Rainfall typically percolates into the soil on an infiltration-dominated site, but it is more likely to produce overland flow on a runoff-dominated site. Vegetative cover, soil type, degree of surface disturbance and compaction, and land slope determine whether rainfall infiltrates or runs off a site (USDA Forest Service 1999; 2001a,b,c). Undisturbed forests and grasslands on the SNF and BNF are typically associated with infiltration-dominated sites. The overland transport of herbicides applied to smaller weed infestations occurring on this type of landscape would be expected to be minimal. However, many of the weed infestations on the SNF and BNF are associated with roads, trails, paths, and other areas where the soil has been disturbed and/or compacted. Road prisms, road cuts, and road fills are runoff dominated features. They enhance

runoff by concentrating flows on compacted road surfaces and in ditches, and in some cases by intercepting groundwater flow from cut slopes (USDA Forest Service 2001a,b,c). Compacted, coarse-sized material with low organic matter that is used to create road fill slopes can also contribute to increased runoff. In addition, the Forest Service (1999; 2001a,b,c) noted that, in general, weed-infested areas could increase overland runoff, citing studies by Lacey et al. (1989) who reported a 50% increase in runoff at a knapweed-infested site compared to a non-infested site. In these settings on the SNF and BNF, the potential for the inadvertent introduction of herbicides to streams would be expected to occur primarily via surface runoff.

Alternative 3 proposes using herbicides to control invasive plants. While the potential for treatment in important habitats is increased under this alternative, the incorporation of design features and the scattered nature of the invasive plant sites limit the potential for adverse effects. To the extent that invasive plant spread is slowed in riparian areas, a beneficial impact to riparian and aquatic habitats would be expected.

Detailed quantitative analysis was conducted to consider whether introducing herbicides in riparian areas might have the potential to affect aquatic organisms, given the site-specific environmental characteristics in the project area. Site specific conditions were modeled using risk assessment worksheets. These worksheets indicate proposed treatments have very low potential to adversely affect fish and aquatic invertebrates in the project area.

Effects on Riparian and Upland Processes

Effects Analysis Framework

As discussed in section 3.3.5.2.4, a generalized risk assessment approach was used to evaluate the effects of chemical treatments on sensitive species. The same approach was used to analyze the Proposed Action.

Herbicide Toxicity

The herbicides proposed for use are characterized by relatively low aquatic toxicity. As noted in section 3.3.5.2.4, three methods are referenced in comparing toxicity to fish and other aquatic organisms: LC_{50}, NOEL, and HQs. Please see that section for more detailed information.

Exposure of Aquatic Organisms to Contaminants

This section characterizes the concentrations of herbicides likely to occur in water, and the way in which aquatic organisms are likely to be exposed to these contaminants for the 3 additional herbicides proposed under Alternativce 3. Alternative 3 includes numerous features that minimize the likelihood of appreciable water contamination, such as relatively small and scattered treatment areas, low application rates, ground-based application, aerial and aquatic application methods that reduce the likelihood of water contamination through wind drift or runoff. Also, herbicides used near water will be restricted to those that have relatively low toxicity to aquatic organisms. Water quality monitoring associated with similar weed treatment projects suggest that safeguards, like those in the proposed action, limit the occurrence of water contamination and reduce the concentrations of chemicals if chemicals do reach live water (Murphy 2006). However, even with these safeguards, herbicides can still result in adverse sublethal effects to fish and certain PCEs.

Chronic and Acute Exposures

As described above, a fundamental difficulty in characterizing environmental exposures arises due to constantly changing contaminant concentrations in flowing water and an ever-increasing spatial scale as herbicides disperse downstream. Please see the "Exposure of Aquatic Organisms to Contaminants" section above for more detail regarding chronic and acute exposures, exposures to contaminants from runoff, and herbicide toxisity (lethal, sublehtal, and environmental exposures).

In spite of efforts to minimize water contamination from the proposed action, herbicides cannot be kept entirely out of the water. Exposure risks would be reduced through the use of design features. The biggest concerns are when a large spill occurs where chemicals are not completely cleaned up and residual chemicals reach water and water contamination after an herbicide is applied from surface or subsurface runoff during and shortly after precipitation events. For these scenarios, peak concentrations that could reach water were determined using SERA risk assessments with the primary mechanism being surface runoff for the additional herbicides proposed under this alternative. The upper limit of the peak concentrations estimated in the SERA assessments for the 3 additional herbicides (Table 3-38 and Table 3-39) were used to evaluate the maximum severity of water contamination that might occur from the proposed action, but these concentrations are unrealistically high as described above.Therefore, peak concentrations shown in Table 3-38 and Table 3-39 represent the worst-case scenario for Alternative 3 from acute exposures that are likely to exist from minutes to hours, and occur only in the immediate area where herbicides are sprayed. The duration of chronic exposures is likely to span days to months, and these exposures may occur over broad portions of the analysis area. Chronic exposures caused by the proposed action are likely to mimic the patterns of the intensity of pesticide use in the watershed. Typical exposure scenarios, which have concentrations below the peak, are also described for situations that will be more commonly encountered under the proposed action.

Table 3-38. Most sensitive toxicological endpoint for algae, macrophytes, and aquatic invertebrates, as reported in the SERA or other risk assessments

Herbicide	Peak EEC[a] (mg/L)	Daphnia 96-hr LC_{50} (mg/L)	Most Sensitive Algal Endpoint	Most Sensitive Aquatic Macrophyte Endpoint	Most Sensitive Aquatic Invertebrate Endpoint	Levels of Concern Based on Hazard Quotients[b]
Fluroxpyr	0.011	>100[c] Non-toxic	0.021 ppm[d] NOEC	0.29 mg/L[e] NOEC	0.002 mg/L NOEC[d]	0.5—algae 0.04—macrophytes **6**—invertebrates
Imazamox (Terrestrial)	0.0055	115 Non- toxic	0.038 mg/a.e./L[f] NOAEL growth inhibition	0.0043 mg/L[g] NOAEL	89.3 mg/L[h] NOEC	0.1—algae **1.3**—macropytes 0.00006—invertebrates
Imazamox (Aquatic)	0.5	115 Non-toxic	0.038 mg/a.e./L[f] growth inhibition NOAEL	0.0043 mg/L[25] NOAEL	89.3 mg/L[h] NOEC	**13.0**—algae **116**—macropytes 0.006—invertebrates
Imazapyr (terrestrial)	0.03	>100 Non-toxic	7.6 mg/L[i] NOAEC	0.003 mg/L[i] NOAEC	41.0 mg/L[j] NOAEC	0.004—algae **10—**macrophytes 0.0007 - invertebrates
Imazapyr (aquatic)	0.055	>100 Non-toxic	7.6 mg/L[i] NOAEC	0.003 mg/L[i] NOAEC	41.0 mg/L[j] NOAEC	0.007—algae **18—**macrophytes 0.001—invertebrates

[a] Peak estimated environmental concentration (EEC) is extrapolated from SERA assessments using the max application rate. Values are based modeling herbicide drift using a backpack sprayer using Worksheet Maker 6.0.
[b] HQ values from Worksheet Maker 6.0 based on maximum application rates using central concentration levels for sensitive species. When sensitive species studies are unavailable, HQ values for tolerant species are used and noted.
[c] Jones and Willis, 1984 in SERA, 2009a
[d] SERA, 2009a
[e] SERA 2009a for tolerant species
[f] Canex et al. 1995 in SERA, 2010
[g] SERA 2010
[h] York &Wisk, 1994c in SERA, 2010
[i] SERA, 2011a
[j] Forbis et al 1984b in SERA, 2011b for tolerant species

Table 3-39. Aquatic Level of Concern assessment (fish) for herbicides proposed for use by the sawtooth and boise national forests

Active Ingredient and Product Name	Typical Application Rate (lb a.e./ac)	Max Label App. Rate (lb a.e./ac)	Bioaccumulates	Peak EEC[a] (mg/L)	Lowest 96-hour LC_{50}[b] (mg/L a.e. or a.i.)	Lowest Sublethal Effect Threshold (mg/L)	Hazard Quotient[c]
Fluroxpyr *Vista XRT*	0.012-0.5	0.5	No	0.011	16[d] Slightly	NOEC = 0.06[e]	0.2
Imazamox Terrestrial *Clearcast*	0.5	0.5	No	0.0055	115[f] Non-toxic	NOEC = 89.2[g]	0.00006
Imazamox Aquatic *Clearcast*	0.5	0.5	No	0.5	115 Non-toxic	NOEC = 89.2[g]	0.006
Imazapyr terrestrial *Arsenal*	1.5	1.5	No	0.03	115 Non-toxic	NOAEC = 10.4[h]	0.003
Imazapyr Aquatic *Habitat*	1.5	1.5	No	0.055	115 Non-toxic	NOAEC = 10.4	0.005

[a] Peak estimated environmental concentration (EEC) is extrapolated from SERA assessments using the max application rate. Values are based modeling herbicide drift using a backpack sprayer using Worksheet Maker 6.0. The EEC is an extreme level and should be viewed as a extreme-case situation.
[b] Toxicity Classifications to Address Acute Risk (LC_{50} mg/L) to Aquatic Organisms from Chemical Use— <0.1 (very highly toxic); 0.1-1 (highly toxic); >1-10 (moderately toxic); >10-100 (slightly toxic); and >100 (practically non-toxic).
[c] HQ values from Worksheet Maker 6.0 based on maximum application rates using central concentration levels.for sensitive species. When sensitive species studies are unavailable, HQ values for tolerant species are used and noted.
[d] Wan et al 1992 in SERA, 2009.
[e] Rick et al 1996a in SERA 2009.
[f] Yurk and Wisk 1994b MRID 43193231 using rainbow trout in SERA, 2010.
[g] SERA 2011 for bluegill
[h] SERA 2011

Table 3-40. Standard acute aquatic species toxicity testing results (from Bakke, 2007 except where noted)

Name	Rainbow Trout 96-hour LC_{50}	Bluegill 96-hour LC_{50}	Daphnia 48-hour EC_{50}	Toxicity Level
Ethoxylated fatty amines				
Entry ™ II, POEA	4.2 mg/L 0.56 to 7.4 mg/L[a]	1.3–2.9 mg/L 1.8–4.2 mg/L[a]	2.0 mg/L	HT to MT in fish MT for invertebrates
Alkylphenol ethoxylate-based wetter/spreaders				
R-11®	3.8–6 mg/L NOEC 1 mg/L	4.2 mg/L NOEC 1 mg/L	5.7–19 mg/L NOEC= 0.25 mg/L	MT to fish ST to invertebrates
Activator 90	NA (Bakke) 1.4 mg/l (MDACR 2004)	Guppy 12.7 mg/L, NOEC 5.8 mg/L	5.2 mg/L (24 hour) NOEC 1 mg/L	MT
Spreader 90	3.3 mg/l	7.3 mg/l		MT
Super Spread 90	NA	3.8–6.3 mg/l[b] Fathead minnow	9.3–31.4 mg/l[b]	MT to fish MT to ST to invertebrates

Name	Rainbow Trout 96-hour LC_{50}	Bluegill 96-hour LC_{50}	Daphnia 48-hour EC_{50}	Toxicity Level
Acidifiers				
LI-700	17-130 mg/l	60.8–210 mg/l	170-190 mg/l NOEC 100 mg/l	PN
Super Spread 7000	NA	NA	NA	Not for aquatic use[c]
Oils				
MSO®	NA (Bakke) 48 mg/l	NA (Bakke)	NA (Bakke) >100 mg/l	ST to fish PN to invertebrates
Renegade	NA	NA	NA	The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.[d]
Blends of vegetable oils and silicone-based surfactants				
Syl-tac™	>5 mg/L	NA	>5 mg/L	MT-ST
Phase™	NA	NA	NA	
Colorants				
Highlight	NA	NA	NA	No data available, however the material is not expected to have any deleterious toxic effect on environment[e]
Bullseye	NA	NA	3,574 mg/l[f]	
Other				
Bronc Max	>100 mg/l NOEC 50 mg/l[g]	NA	100 mg/l NOEC >100 mg/l[g]	PN
Choice Weather Master	NA	70.7 mg/l NOEC = 50 mg/l[h] Zebra fish	100 mg/l NOEC >100 mg/l[h] zooplankton	PN

Note: Below is the definition of LC50 (lethal concentration, 50% kill) and here are the classification levels. (MDAR 2004)
<1 mg/l: HT (Highly Toxic)
1-10 mg/l : MT (Moderately Toxic)
10-100 mg/l: ST (Slightly Toxic)
100, 1,000 mg/l: PN (Practically Nontoxic)
>1,000 mg/l: IH (Insignificant Hazard)
[a] Folmer et al. 1979 in SERA 2011a using MON 0818;
[b] Super Spread 90 SDS Wilbur-Ellis
[c] Super Spread 7000 SDS Wilbur-Ellis;
[d] Renegade Safety Data Sheet–Wibur-Ellis;
[e] MSDS Becker Underwood;
[f] MSDS Milliken;
[g] Bronc Max SDS—Wilbur Ellis;
[h] MSDS Choice Weather Master Loveland Products

Herbicide Toxicity: Lethal, Sublethal and Environmental Exposures

As discussed in section 3.3.5.2.4, toxic chemicals can potentially harm fish through 3 potential pathways: killing them outright, sublethal changes in behavior or physiology, or altering the environment (Scholz et al. 2005). Environmental alterations are indirect consequences of the

action that may affect critical habitat through changes in cover, shade, runoff, and availability of prey.

Table 3-38 and Table 3-39 display the central HQs for additional proposed herbicides where exposure scenarios resulted in HQs greater than 1.0 as determined by methods outlined in section 3.3.5.2.4.

Table 3-41shows that the fish exceedances only occur at accidental, which are not likely to actually occur for this project, given the PDFs and herbicide use buffers.

Effects on Aquatic Microphytes and Aquatic Invertebrates

As described above in section 3.3.5.2.4, Alternative 3 can affect algal and invertebrate species found in the analysis area. Please see that section for a detailed discussion of the risks to these species.

The assessments used to characterize toxic effects for the additional herbicides proposed under Alternative 3 (Table 3-38) are constant exposures that are 24 hours or longer, which is not an exposure scenario likely to be encountered under this alternative. Based on studies of herbicide transport discussed previously, the duration of exposures likely to occur in the field are likely to be pulses of contamination less than 1.0 hour long. In one particular study, Michael et al. (2006) concluded that the magnitude and duration of herbicide pulses (from herbicide use similar to the proposed action) may be too brief to cause significant changes in invertebrate communities, and if changes were to occur, communities tend to rapidly reestablish their original composition though recolonization. Another factor that further reduces potential effects on invertebrate production and prey availability is the relatively low intensity and dispersed nature of proposed herbicide use, that precludes the possibility of herbicides reaching concentrations that would affect prey availability to a meaningful extent beyond the point where herbicides first reach a stream.

The acute toxicity HQs for invertebrates are well below the LOC of 1.0 for all herbicides except fluroxpyr. The acute toxicity HQs are below the LOC of 1.0 for alage except for aquatic imazamox and above the LOC of 1.0 for aquatic macrophytes. Aquatic herbicides are designed to kill aquatic macrophytes. Non-targeted aquatic plants could be eliminated during aquatic treatment. Impacts from runoff for these herbicides may pose a risk to certain algal species. Risk would be greatest where contaminated runoff directly enters the stream. However, effects are expected to be localized since the contaminated runoff would further dilute as it travels downstream and tributaries add to the flow. While localized effects to food that fish depend on may occur, herbicide exposure should not result in significant changes in the food web over a large portion of stream. Furthermore, if these worst-case scenarios occurred, they would be infrequent pulse events and algal species would be expected to quickly recolonize any impacted areas.

Aquatic triclopyr and aquatic imazamox pose the greatest risk for aquatic macrophytes. However, treatment for aquatic invasives would not occur until an ESA consultation has been completed on a case-by-case basis.

Table 3-41. Relative risk to fish, aquatic invertebrates, algae, and aquatic plants based on hazard quotients for riparian use of herbicides at maximum project rates at upper limits

	Fluroxypry	Aquatic Imazamox	Terrestrial Imazamox	Imazapyr
Fish	--*	--	--	--
Aquatic invertebrates	✱*	--	--	--
Aquatic plants	--✱	✱*	✱*	✱*
Algae	--*	✱*	--*	--

-- Hazard Quotient less than or equal to 1 indicates an extremely low level of risk; indicates a level of exposure below the level of concern (LOC) for adverse health effects.
✱ Hazard Quotient greater than 1 at maximum proposed application rates for acute central exposure limits.
* Hazard Quotients greater than 1 at maximum proposed application rates for accidental exposures.

Effects to Individual Fish

As described above in section 3.3.5.2.4, potentially harmful effects of herbicides to ESA-listed fish through alteration of the food web, reducing riparian vegetation, or altering hydrology. These risks were discussed previously and found to be relatively minor risks of the Proposed Action. However, listed species could be adversely affected through lethal or sublethal exposure, if herbicides were applied shortly before an unexpected precipitation event caused contaminated runoff to reach a stream. Under Alternative 3, none of the proposed herbicides, carriers, or surfactants would likely cause outright mortality of listed salmonids. The HQs for lethality show that peak environmental concentrations of the herbicides are a small fraction of the concentrations where lethal effects would be expected. Peak EEC of all herbicides would be less than 1% of the lowest concentration where lethal effects have been observed. Furthermore, the estimates of peak EEC are extreme values that generally would not be encountered, which provides an additional level of assurance that direct lethality will not occur. The peak EEC in Table 3-39 are intentionally robust to ensure that actual concentrations of contaminants would not be higher than anticipated under the most extreme circumstances that might be encountered.

Although direct lethal effects are not expected from the proposed action, available information is generally insufficient to completely characterize the nature and extent of potentially harmful sublethal effects. The types of chemicals proposed under Alternative 3 are capable of causing altered fish behavior due to mechanisms such as irritation, diminution of sensory acuity, impaired motor skills, or malaise. Since the nature and extent of sublethal effects are not entirely known, all of the chemicals are assumed to potentially cause sublethal effects even though many acute toxicity HQs are well below the LOC of 1.0. Based on HQ results, fluroxpyr may pose the greatest sublethal impacts from runoff. However, none of these herbicides exceed the LOC of 1.0. Risk would be greatest where contaminated runoff would directly enter the stream. The effects are expected to be localized since the contaminated runoff would further dilute as it travels downstream and tributaries add to the flow. Given the project design features and incorporation of herbicide use buffers, direct lethal or indirect sublethal effects are not likely to actually occur under Alternative 3. Fluroxpyr would not be used closer than 50 feet to water.

The amount of exposure provides a general indicator of risk where sublethal effects are unknown. Sublethal effects are considered under the ESA to constitute “take,” if the sublethal effects harm ESA-listed fish. NMFS defines harm as “an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which

actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR 222.102).

In addition to data gaps concerning sublethal effects, the herbicide formulations proposed under Alternative 3 include unknown "inert" ingredients that could potentially be far more toxic than the active ingredient(s), and the toxic effects of the herbicide mixtures used under the proposed action are virtually unknown. Some of the toxicity assays for the chemicals used in this action tested the complete product formulation, some tested only on the active ingredient, and some studies did not specify which formulation was used. For herbicide mixtures proposed under Alternative 3, the toxicity of the mixture was assumed to be similar to the most toxic active ingredient in the mixture. Complex mixtures of herbicides that might develop in a stream from using multiple chemicals in the same drainage are not likely to occur to any appreciable extent due to the relatively low intensity of spray activities and the nature of herbicide inputs which occur as pulses that coincide with high stream flows and high rates of dilution and dispersal.

Common sublethal endpoints are reported for many chemicals, but none of the herbicides have been thoroughly screened for all potential sublethal effects that might have biological relevance. Herbicide concentrations likely to be used under the Proposed Action appear capable of causing minor behavioral changes, but the duration of exposure to the peak concentrations is likely to be much shorter than the duration of exposures in the toxicity assays used to characterize toxic effects. All acute toxicity assays cited are based on exposures lasting 24 hours or more, while peak concentrations of ground-based herbicide applications in forest settings tend to occur in brief pulses lasting for much shorter periods. With the particular herbicides proposed for use under Alternative 3, the typical pattern of herbicide contamination from runoff is a rapid spike in herbicide concentrations at the beginning of the first runoff event following herbicide application, followed immediately by a sharp exponential decline in concentrations as the runoff continues, and in subsequent runoff events (Bergamaschi et al. 1999; Muller et al. 2004).

Based on the pulsed nature of herbicide contamination, the duration of peak herbicide concentrations where adverse effects are most likely to occur is unlikely to persist beyond a few hours, and occur only during the first 1 or 2 runoff events that follow herbicide application. The limited duration of exposure is not likely to cause more than minor risks to fish survival or growth if sublethal effects do not continue to occur at relatively low concentrations after pulses of contamination have passed. For the herbicides proposed under Alternative 3, the peak EEC are generally below thresholds where minor sublethal effects have been reported in the literature; consequently, there is no known risk of chronic sublethal effects, only acute sublethal effects. It is important to recognize that many biologically relevant indicators of sublethal effects have not been tested with the chemicals proposed for use under Alternative 3, and that many potential sublethal toxicological effects may harm fish in ways that are not readily apparent in laboratory assays. Where small changes in the health or performance of individual fish are observed in toxicity assays (e.g., a small percentage change in the activity of a certain enzyme, an increase in oxygen consumption, the formation of pre-neoplastic hepatic lesions), predicting how these changes would affect essential behavior patterns of fish in the wild may not be possible. Additionally, animals tested under laboratory conditions are not subjected to predators, competitors, pathogens, and numerous other hazards found in the natural environment that affect the survival and reproductive potential of individual fish.

Although sublethal toxicity profiles are not entirely known for the herbicides proposed for use under Alternative 3, the potential severity of sublethal effects can be inferred in part by the

patterns of exposure. Sublethal effects could compromise the viability and genetic integrity of wild populations in a situation where exposures result in significant losses of fish throughout a large geographic area or a small area occupied by a population with unique genetic traits. The likelihood of population changes from sublethal effects of the chemicals in the proposed action is largely undocumented, but appreciable population effects can be ruled out if the exposure to harmful effects is limited to small numbers of fish and a spatial pattern that is not likely to cause the loss of a unique genetic stock. Under the Proposed Action, spraying would not occur over large contiguous areas, and most of the analysis area would not be subjected to spraying in any given year, which would eliminate the possibility of significant fish losses throughout a large geographic area. Appreciable amounts of water contamination are also unlikely to occur in upland sites that are several hundred feet from streams. Only riparian spray sites, which are few in number and widely scattered across the analysis area, are likely to cause meaningful amounts of water contamination.

Effects on Fish Populations

Based on the toxic effects of the herbicides described above, the Proposed Action has a range of possible consequences to fish populations that might be caused by sublethal effects due to uncertainties regarding the toxicity of the proposed products. Effects of the additional herbicides proposed under Alternative 3 would be the same as those effects described above for all action alternatives.

Effects of Inert Ingredients and Adjuvants

The effect of inert ingredients and adjuvants was discussed in section 3.3.5.2.4. No additional inert ingredients or adjuvents are anticipated with the 3 new herbicides.

Effects on Individual Fish through Synergy

As discussed in section 3.3.5.2.4, the Proposed Action may use combinations of herbicides. For the 3 new herbicides, triclopyr is the only herbicice that utilizes formulations that includes combinations of herbicides. Redeem is a combination of triclopyr TEA and clopyralid TEA.

In general, synergistic effects from the proposed action are not expected because of the following:

- The individual chemicals chosen for use have a low to moderate degree of risk, particularly those used within 100 feet of water
- The Forest Service incorporated a precautionary measure in their RCA use restrictions (Appendix H)
- The total number of acres treated, regardless of whether using a single chemical or combination of chemicals, amounts to a very small percentage of the RCA or the total watershed, and is generally too low to generate significant amounts of contamination beyond the initial point of entry
- Combined concentrations of the herbicides would remain relatively low compared to thresholds where lethal or sublethal effects are known to occur. The Forest Service would not use combined products that exceed HQ values of 1.

Effects to Federally Threatened and Endangered and Forest Service Region 4 Sensitive Fish Species

Implementing ground-based and aerial herbicide treatments proposed under Alternative 3 are considered **likely to adversely affect federally listed species**, including Snake River spring/summer Chinook salmon, Snake River sockeye salmon, Snake River basin steelhead, and Columbia River bull trout, occurring within the SNF and BNF non-wilderness project area. Implementation is considered **not likely to adversely affect** designated critical habitats for these species occurring within the project area. These determinations are mainly due the potential for temporary sublethal effects and the potential for accidental spills as described in detail in section 3.3.5.2.4.

Effects to R4 sensitive westslope cutthroat trout, Yellowstone cutthroat trout, and Wood River sculpin are similar to those identified for federally listed species. Implementing the Proposed Action may impact individual westslope cutthroat trout, Yellowstone cutthroat trout, and Wood River sculpin, but the level and scope of impacts would not likely contribute to a trend towards federal listing, or cause a loss of viability to the population or species or be expected to result in a downward trend for the species.

Effects of Aquatic Weed Treatments to Federally Threatened and Endangered and Forest Service Region 4 Sensitive Fish Species

Aquatic plants are a valuable component of aquatic ecosystems. They provide cover, habitat, and food for many species of aquatic biota, fish, and wildlife. However, invasive aquatic specis can degrade water quality, impair fish habitat, block intakes that supply water for domestic or agricultural purposes, and interfere with navigation, recreation, and aesthetics. As discussed under the no action alternative, noxious aquatic plant species such as Eurasian water milfoil can cause deleiterious effects to fish habitat. Significant plant sloughing, leaf turnover, and decomposition of large amounts of plant material at the end of the growing season increase phosphorus and nitrogen in the water column. Dense Eurasian watermilfoil mats alter water quality by raising the pH, decreasing oxygen under the mats, and increasing temperature. The greatest potential for impacts from increased temperatures, changes in pH and decreased oxygen levels may be to the anadromous and native resident salmonids, especially protected and/or sensitive species such as Chinook salmon, sockeye salmon, steelhead, bull trout, and westslope cutthroat trout. These species have relatively narrow habitat requirements, including the need for clean, cold, well-oxygenated, interconnected water and/or gravels for spawning, egg incubation, rearing, migration, and/or adult success (Bjornn and Reiser 1991).

Aquatic herbicides proposed to treat invasive aquatic plants include aquatic labelled glyphosate, imazamox, imazapyr and triclopyr TEA. Affects of herbicide use on fish, aquatic invertebrates, aquatic macrophytes and algae are discussed in section 3.3.5.2. When aquatic application utilizes the project design criteria and the label applications and aquatic invasive plant control framework (Appendix H) outlined in are used, adverse affect on federally-listed species are not likely to occur in the SNF and BNF project area. Implementation is further considered not likely to adversely affect designated critical habitats for these species occurring within the project area. However, the Framework Strategy (Appendix F) outlines that ESA consulation will be completed on case by case basis for aquatic treatments that could affect ESA-listed waters.

Effects to Management Indicator Species

Population trends for the SNF and BNF's aquatic MIS are discussed in the "Affected Environment" section of this document. Direct and indirect effects to bull trout and Yellowstone cutthroat trout are identified within the TES species discussion above. Effects from implementing treatments proposed under the Proposed Action are not expected to be of sufficient nature or magnitude to result in measureable influence on the past or future trend of bull trout populations on the SNF and BNF or Yellowstone cutthroat trout on SNF.

Summary of Direct and Indirect Effects

As with Alternative 2, long-term direct and indirect effects from weed treatments proposed under Alternative 3 would be expected to result in improved habitat conditions and reduced threats for aquatic and riparian resources on the SNF and BNF. Weed infestations would progressively decline at an expected rate greater than that under Alternative 2, due to the more aggressive treatment strategy and broad scale treatment opportunities afforded by aerial applications. Resultant benefits to aquatic resources through reduced erosion and sediment delivery to drainages would additionally occur at a faster rate than that under Alternative 2. Long-term broad-scale benefits to aquatic habitats would be expected to be greatest on the BNF where weed infestations are extensive.

Design criteria identified for ground-based and aerial herbicide applications under Alternative 3 would minimize the potential for both direct deliveries of herbicides to aquatic habitats, or impacts to those habitats as a result of surface runoff, wind drift, leaching, or accidental spills. As with Alternative 2, however, short-term disturbances may occur and may have a slight negative site-specific effects on aquatic resources. These impacts could include localized short-term increases in erosion and sediment delivery to drainages caused by more extensive mechanical treatments (soil disturbance) and chemical treatments (creation of barren ground from weed removal).

With implementation of the project design criteria, it is unlikely that any of the ground or aerial application worst-case situations analyzed in the preceding text would occur. If worst-case conditions did occur, the scenarios involving herbicide runoff and leaching of herbicides would not be expected to result in adverse impacts on populations of aquatic resources. Potential short-term impacts on aquatic and riparian resources could occur if an accidental spill of a relatively toxic herbicide occurred in a small drainage. The scope and magnitude of resulting effects would depend on various factors, including the volume of spill and dilution by the receiving water. Adherence to project design criteria would reduce the likelihood of such a spill occurring and would minimize or avoid the potential occurrence of wind-drift-related impacts on aquatic resources.

Cumulative Effects

Under Alternative 3, the SNF and BNF would expand its current program of noxious weed management with the addition of 3 new herbicides, inclusion of an aerial herbicide application strategy. Active weed treatments would additionally continue to occur on private, County, State, and BLM-administered lands through actions conducted by CWMA participants, utilizing ground based herbicide application, mechanical treatment, and biological treatment releases.

Cumulative effects from ground-based herbicide treatments would be the same as those described in section 0. Given the relatively small proportion of treatment across the landscape, the implementation of design criteria designed and utilized to protect sensitive species, and the use of label guidelines for proper application, cumulative adverse effects aquatic species are not expected from implementing Alternative 3.

Cumulative effects from treatments under the Proposed Action Alternative combined with treatments under the CWMAs would benefit aquatic habitat and resources compared to Alternatives 1 and 2 through the widespread eradication, control, and containment of noxious weeds. The CWMAs and the SNF/BNF weed management program would cumulatively be expected to result in increased levels of weed treatment success.

As stated above, cumulative effects could potentially benefit aquatic and riparian habitat and a range of protected and other sensitive MIS through reduced erosion and sediment delivery to drainages. No adverse downstream cumulative effects on non-NFS lands would be expected from worst-case situations involving herbicide runoff or leaching because of the extremely low concentrations. There is the potential for downstream adverse effects on aquatic and riparian resources if an herbicide spill or wind-drift-related impact occurred close to Forest Service boundaries. Increased flows proceeding downstream would further dilute the herbicide. Weed management design criteria described previously are designed to prevent or reduce the risk of these types of impacts from occurring.

Additional cumulative effects on aquatic resources associated with foreseeable future activities on the SNF and BNF that are described in Appendix B. These cumulative effects include the potential for erosion and sediment delivery from road and trail-related construction and maintenance activities, livestock grazing along drainages, and recreational activities adjacent to drainages. Also, cumulative effects on aquatic resources from weed treatment activities under Alternative 3 potentially include short-term increases in erosion and sediment delivery to drainages caused by more extensive mechanical treatments (soil disturbance) and chemical treatments (creation of barren ground from weed removal) than under the Alternative 1. These areas would be subject to erosion until native vegetation becomes re-established, after which time erosion and sediment delivery should be less than when weeds were present and provide correspondingly greater benefits than under Alternative 1. This increase would represent an overall long-term cumulative benefit to aquatic habitat and resources.

Finally, there is the possibility of herbicide application in adjacent areas (SNF/BNF, CWMAs, BLM, State and private land) and possible cumulative effects on aquatic resources through bioconcentration and synergistic effects. The 3 new herbicides and 2 additional methods of application would not change the conclusion that 1) the risk of herbicide bioconcentration in aquatic organisms on the SNF and BNF would be expected to be low because of the extremely low concentrations of herbicides that aquatic organisms would be briefly exposed to during even a worst-case situation and 2) the potential for cumulative synergistic effects on aquatic organisms on the SNF and BNF would be minimal. In addition, the 3 new herbicides proposed for use do not bioaccumulate in fish and/or have very little persistence in the environment (Information Ventures, Inc. 2002).

Aerial herbicide applications proposed by the SNF and BNF under this alternative are not currently or foreseeably implemented by other CWMA partners, and there would be no potential cumulative effects related to aerial application operations.

Irreversible/Irretrievable Effects

Fisheries resources and/or aquatic habitat integrity would not be not impacted in any watershed containing TES or MIS species to an extent that loss of production occurs for an implemented action. Irreversible loss of fisheries resources would only occur in a case where an action was implemented that caused permanent loss of some level of fisheries production. Irretrievable commitments of habitat components for fisheries resources would be limited to temporary and localized riparian vegetation reductions associated with invasive plant treatment activities that would be expected to result in overall beneficial effects over time.

Forest Plan Consistency

Management direction for SNF and BNF fisheries resources and aquatic habitats are identified within the SNF and BNF Forest Plans. Forest Plan direction relevant to invasive plant treatments is summarized in the Relevant Direction section of this document.

All actions proposed under Alternative 3 are consistent with Management Goals, General Direction, and Standards and Guidelines for fisheries resources and aquatic habitats identified in both the SNF and BNF Forest Plans because of the following (USDA Forest Service 2010a, 2012a):

- Habitat within the respective ranges of species listed under ESA will be managed to contribute to their species survival and recovery (TEGO02 [USDA Forest Service 2010a, 2012a]).
- For management actions that include application of insecticides, herbicides, fungicides, or rodenticides, mitigation shall avoid or minimize adverse effects on TEPC species or their habitats (TEST05)
- Management actions will neither degrade nor retard attainment of properly functioning SWRA desired conditions, except (SWST04)

3.3.5.4.3. Aquatic Weed Treatments

Direct and Indirect Effects

Proposed SNF and BNF chemical treatments under a newly developed aquatic weed treatment strategy would utilize 4 herbicides certified for aquatic use and selected for their efficacy in controlling aquatic macrophytes while exhibiting low toxicity to fish, aquatic invertebrates, and non-target native aquatic grasses or algae. Forest Service risk assessments for these herbicides identify the following conclusions regarding risk to aquatic organisms:

- Imazapyr and imazamox are identified as being “practically non-toxic to fish” and “practically non-toxic to *Daphnia*” (SERA 2010, 2011d).
- Neither terrestrial nor aquatic applications of triclopyr TEA pose substantial risks to aquatic animals across the range of labeled application rates (SERA 2011b).
- According to the EPA/OPP general classification scheme, the LC_{50} values for glyphosate acid and the IPA salt of glyphosate would be classified as slightly toxic (LC_{50} >10 to 100 mg/L) or practically nontoxic (LC50 >100 mg/L) to fish (SERA 2011a).

The aquatic weed treatment strategy developed as a component of Alternative 3 adds a previously non-existent framework for rapid response to future invasion of aquatic weed species to waters within the project area. Actual treatment strategies would be developed in response to site-specific infestations in collaboration with the Idaho state aquatic species coordinator and appropriate County weed program managers and service agencies whenever application could affect ESA-listed species. Weed managers in cooperation with the State would consider the available range of treatment options to implement eradication measures in the early stages of infestation.

With the implementation of design criteria associated with potential aquatic weed treatment actions undertaken under Alternative 3, it is unlikely that herbicide-related impacts to fisheries resources, fish food bases, or aquatic habitat integrity would occur**.** With rapid eradication response in the early stages of infestation, short-term reductions in the vegetative biomass at treatment sites in association with invasive aquatic weed removal would not be expected to result in significant short- or long-term impacts to the available invertebrate fish food base. As with terrestrial weed treatment operations, potential impacts on aquatic and riparian resources could occur if an accidental spill of a large amount of herbicide into target waters occured. The scope and magnitude of resulting effects would depend on various factors, including the volume of spill and factors influencing dilution in the receiving water. Adherence to project design criteria would minimize the likelihood of such a spill occurring and would minimize or avoid the potential related impacts to aquatic resources.

The aquatic weed treatment strategy would provide the SNF and BNF a mechanism to implement a rapid response to new aquatic weed invasions of waters within the project area. Rapid response in the early stages of invasion would allow more efficient eradication measures with minimal treatment scope compared to measures required for extensive and established infestations. In the event of future invasion of aquatic weed species to forest waters, direct and indirect effects of implementation of this framework would be a reduced threat of both short and long-term detrimental impact to aquatic and riparian habitat conditions through rapid containment and eradication, along with a reduction of risk of subsequent spread of aquatic weed species to other waters.

Effects to Federally Threatened and Endangered and Forest Service Region 4 Sensitive Fish Species

Aquatic weed treatments on waters within the project area under Alternative 3 are considered **not likely to adversely affect** federally listed species occurring within project area, including Snake River spring/summer Chinook salmon, Snake River sockeye salmon, Snake River basin steelhead, and Columbia River bull trout. Implementation is considered **not likely to adversely affect** designated critical habitats for these species occurring within the project area. For aquatic herbicide application, the protocol outlined in the Framework Strategy (Appendix F) will first identify the need for completion of the appropriate type of site specific ESA consultation prior to implementation of any chemical, mechanical, or cultural treatment. Determinations regarding the need for ESA consultation, and determining agency responsibilities for conducting it, would be made on a case-by-case basis. Any treatment identified will be conducted to ensure no adverse effect on listed species or critical habitats will occur.Effects to R4 sensitive westslope cutthroat trout, Yellowstone cutthroat trout, and Wood River sculpin are similar to those identified for federally listed species. Identified actions to treat aquatic weed infestations would not likely

contribute to a trend towards federal listing, or cause a loss of viability to the population or be expected to result in a downward trend for the species.

Prior to applying chemical or biological agents for the treatment of aquatic invasive species, the Framework Strategy (Appendix F) would be implemented and specific site conditions would be reviewed to determine which protection measures must be implemented to insure protection of non-target species. When treating aquatic invasive species in waterbodies with occupied habitat for listed species, the appropriate regulatory agency would be contacted at least 1 week prior to treatment to review protection measures to be implemented to insure non-target species are protected.

Effects to Management Indicator Species

Effects to SNF and BNF MIS bull trout are as described above for TES species. Incorporating the identified design criteria, aquatic weed treatments under Alternative 3 would not be expected to be of sufficient nature or magnitude, or anticipated to be of a frequency of implementation, to result in measureable influence on the past or future trend of bull trout populations on the SNF and BNF.

Cumulative Effects

Idaho has a comprehensive program to prevent new introductions and spread of unwanted invasive species, as described in the *Idaho Strategic Action Plan for Invasive Species* (IDFG 2001a), *Idaho Aquatic Nuisance Species Plan* (IISC 2007), and *2008 Statewide Strategic Plan for Eurasian Watermilfoil in Idaho* (IISC 2007).

The State of Idaho has used the successful approach of the CWMA to establish a parallel effort to address aquatic weeds, particularly Eurasian watermilfoil. The Idaho Eurasian Watermilfoil Task Force (a subcommittee of the Idaho Invasive Species Council) surveyed 107 sites on 75 water bodies throughout the state to identify locations of Eurasian watermilfoil (Idaho Milfoil Task Force 2006). Eurasian watermilfoil has been found to be present in Ada, Boise, Gem, Valley, and Washington counties with several susceptible waters identified near the BNF and SNF.

Cooperative agreements exist between the IDFG and the Counties for controlling purple loosestrife. In 2006, the Legislature appropriated $4 million for the 2006–07 treatment seasons to control Eurasian watermilfoil in Idaho. As directed by the Legislature, the ISDA is using the appropriated funds to support on-the-ground eradication and control efforts. Efforts included approving 13 locally developed projects totaling $2.5 million. Over 5,000 acres were treated, mostly with herbicides specifically approved for aquatic use. In 2007, the Idaho Legislature approved another $4 million for additional survey and control work. An additional program of cooperative agreements between the IDFG and CWMAs is in place for controlling purple loosestrife along the Snake River in southern Idaho. With funding from the CWMAs, the IDFG provides boats and staff to chemically treat or to release and monitor biological control agents in areas infested with purple loosestrife. The biocontrol agents are significantly reducing large stands of this plant. In conjunction with this program the Idaho Department of Lands has provided funding to IDFG to help contain other noxious weeds on inaccessible islands managed by the Idaho Department of Lands along the Snake River.

The State of Idaho has treated aquatic weed treatments within the project area. Eurasian watermilfoil was found on the Idaho City and Lowman RD at Lowman Nature Ponds in 2007

and was thought to be a hybrid of Eurasian and northern watermilfoil. The ponds have been treated by the IDFG since 2010. The ISDA treated a pond on Idaho City property (which is within 1 mile of the Forest Service boundary within tnhe Idaho City RD) for milfoil in 2008. Boise County and its cooperators, which include Upper Payette CWMA, Boise Basin CWMA, BNF, and IDFG, treat Horseshoe Bend Millpond for Eurasian milfoil (IISC 2007). Any new infestations of aquatic invasives within or near the boundaries of the SNF or BNF would be treated in cooperation with the State as outlined in the Framework Strategy (Appendix F).

Statewide survey and control efforts by ISDA, local CWMAs, and Idaho Invasive Species Council will help to reduce potential threat of aquatic invasive plant species to the BNF and SNF. Aquatic weed treatment actions proposed by the SNF and BNF would be coordinated with the ISDA as identified in the Framework Strategy (Appendix F). Potential cumulative effects related to aquatic weed treatment the State, CWMAs, or other entities along with those actions proposed by SNF and BNF by under Alternative 3, could affect listed and native species. However, all aquatic treatment on NFS lands would be completed by coordinating with the State. Through this coordination, no overlap in treatment areas or exceedance of application rates would occur so no negative cumulative effects are anticipated.

Irreversible/ Irretrievable Effects

Potential aquatic invasive plant treatments proposed under the SNF and BNF's aquatic weed treatment strategy would not be expected to impact fisheries or overall aquatic habitat integrity in any watershed containing TES or MIS species to an extent that loss of production would occur. Irreversible loss of fisheries resources would only occur in a case where an action was implemented that caused permanent loss of some level of fisheries production, as in the case of accidental spill of significant amount of herbicide to aquatic environments. Irretrievable commitments of habitat components for fisheries resources would be limited to temporary small scale aquatic vegetation reductions associated with localized aquatic invasive plant treatment activities that would be expected to result in overall beneficial effects to as native aquatic vegetation replaced invasive infestations.

Forest Plan Consistency

Aquatic weed treatment actions implemented under Alternative 3 would be consistent with Management Goals, General Direction, and Standards and Guidelines for fisheries resources and aquatic habitats identified in both the SNF and BNF Forest Plans because of the following (USDA Forest Service 2010a, 2012a):

- Habitat within the respective ranges of species listed under ESA will be managed to contribute to their species survival and recovery (TEGO02 [USDA Forest Service 2010a, 2012a]).
- For management actions that include application of insecticides, herbicides, fungicides, or rodenticides, mitigation shall avoid or minimize adverse effects on TEPC species or their habitats (TEST05)
- Management actions will neither degrade nor retard attainment of properly functioning SWRA desired conditions (SWST04)

3.3.5.5. Alternative 4—No Aerial Herbicide Application

Alternative 4 would implement the same adaptive IWM strategy to eradicate or control existing or newly discovered invasive plants as described for Alternative 3 (Proposed Action), but would not include aerial application of herbicides as a proposed treatment option. Weed treatment methods implemented under this alternative would include ground-based terrestrial herbicide application, aquatic herbicide application, mechanical treatment, biological control releases, cultural methods, and combinations of these treatments. As identified under the Alternative 3, control could often require repeat treatments and monitoring of control efficacy.

3.3.5.5.1. Direct and Indirect Effects

Mechanical and Biological Treatments and Rehabilitation and Restoration Practices

Effects of non-herbicide weed treatments, including mechanical and biological treatments and rehabilitation/restoration practices conducted under Alternative 4 would be the same as described under the “Effects Common to All Action Alternatives” section.

Ground-based Herbicide Application

Alternative 4 would not include aerial application of herbicides as a treatment option. Herbicide treatment of terrestrial noxious weed infestations would be limited to ground-based application methods utilizing chemicals and applicable design criteria as identified under Alternative 2. Effects analysis scenarios, including surface runoff, wind drift, leaching and accidental spill worst case scenarios, would therefore be similar to those described for terrestrial herbicide applications under Alternative 2.

Direct and indirect effects of implementing aquatic weed treatments under this alternative would be identical to those described for Alternative 3.

Effect to federally listed TES fish species, R4 sensitive fish species, and MIS would be the same as those described under Alternative 3.

The scope and magnitude of potential direct and indirect effects to aquatic resources and habitats of weed treatments under Alternative 4 fall between those described for Alternatives 2 and 3. Without an aerial application option, potential effects of terrestrial weed treatments would be similar to those of Alternative 2, but with a slight incremental level of additional potential effects risks related to use of additional herbicide formulations. Toxicities and calculated risk levels of the 3 new herbicides—aminopyralid, imazapyr and imazamox—would be within the range of those used under the current program, and their addition under both Alternative 3 and Alternative 4 would not constitute a significant elevation of risk of adverse effects to aquatic resources. As with Alternatives 2 and 3, terrestrial herbicide application design criteria would minimize potential risks of herbicide introduction to aquatic habitats.

There is currently no forest strategy to address the threat of aquatic weed introductions to waters of the SNF or BNF. Inclusion of a new aquatic weed EDDR strategy under Alternatives 3 and 4 places the SNF and BNF in better position to rapidly respond to threats to aquatic habitats from new aquatic weed infestations.

As with Alternatives 2 and 3, Alternative 4 would be expected to result in improved habitat conditions and reduced threats, over time, for aquatic and riparian resources on the SNF and

BNF. The same short-term disturbances identified under Alternatives 2 and 3, may also occur under Alternative 4, with slight negative effects on aquatic resources in specific areas. Terrestrial weed infestations would progressively decline, most likely at a rate somewhere between those expected under Alternatives 2 and 3. Reductions in noxious weed infestations would reduce the potential for erosion and sediment delivery to drainages and benefit aquatic resources, particularly on the BNF.

As with Alternatives 2 and 3, implementation of design criteria and an adaptive strategy would likelyk prevent any of the analyzed worst-case scenarios from occurring. Additionally, as with Alternatives 2 and 3, potential short-term impacts on aquatic and riparian resources could occur if there was an accidental spill of a relatively toxic herbicide in a small drainage, with resultant effects being dependent on various factors, including the volume of spill and dilution by the receiving water. As with all action alternatives, adherence to project design criteria would reduce the likelihood of an herbicide spill and would minimize or avoid the potential occurrence of wind-drift-related impacts on aquatic resources.

3.3.5.5.2. Irreversible/Irretrievable Effects

No irreversible or irretrievable effects are identified in association with implementing Alternative 4.

3.3.5.5.3. Cumulative Effects

Similar to Alternative 3, Alternative 4 would implement an expansion of Alternative 2 to include 3 additional herbicides and development of an aquatic weed response strategy. The aerial herbicide application component of Alternative 3 would not be retained under this alternative, however, and only ground-based herbicide treatments would be implemented.

Cumulative effects from weed treatments under this alternative, combined with treatments under the 3 CWMAs, would benefits aquatic habitat and resources comparable to those benefits described under Alternative 3. The CWMAs and the SNF/BNF weed management program would cumulatively be expected to increase levels of weed treatment success. Under Alternative 4, weed infestations on the SNF and BNF would be expected to progressively decline at a rate greater than expected under Alternative 2, but somewhat less than that expected under Alternative 3. The CWMAs and the SNF/BNF weed management program would cumulatively be expected to result in increased levels of weed treatment success relative to Alternative 2. This increase would reflect the eradication, control, and/or containment of new weeds that have invaded the SNF and BNF from adjacent lands covered by the CWMAs and increased success in preventing weeds presently occurring on the SNF and BNF from invading adjacent lands.

As with other action alternatives, additional cumulative effects on aquatic resources associated with other ongoing activities on the SNF and BNF would occur under Alternative 4. These include potential effects of herbicide applications related to runoff, leaching, wind drift, and direct herbicide spills. Project design criteria along with similar design criteria employed by CWMA partners are designed to prevent or reduce the risk of these types of impacts from occurring. These potential cumulative effects would similar to those described under Alternative 2, due to the absence of aerial herbicide application as a treatment option under this alternative.

Potential cumulative bioconcentration and synergistic effects from adjacent area herbicide applications, as well as potential cumulative erosion and sediment delivery effects, would be similar to those described under Alternative 2. These cumulative effects could potentially benefit aquatic and riparian habitat and a range of protected and other sensitive MIS through reduced erosion and sediment delivery to drainages.

3.3.5.6. Alternative 5—No Aquatic Herbicide Application

Alternative 5 would implement the same adaptive IWM strategy to eradicate or control existing or newly discovered invasive plants as described for Alternative 3 (Proposed Action), but would not include an aquatic weed response strategy. Terrestrial weed treatment methods that would be implemented under this alternative would include ground and aerial-based herbicide application, mechanical treatment, biological treatment releases, cultural methods, and combinations of these treatments. As identified for the Proposed Action, control could often require repeat treatments and monitoring of treatment efficacy.

3.3.5.6.1. Direct and Indirect Effects

Mechanical and Biological Treatments and Rehabilitation and Restoration Practices

Effects of non-herbicide weed treatments, including mechanical and biological treatments and rehabilitation/restoration practices conducted under Alternative 5 would be the same as those described under “Effects Common to All Action Alternatives”.

Ground and Aerial-based Herbicide Application

Alternative 5 would retain both the ground and aerial herbicide application options, including the range of chemicals and applicable design criteria, identified under Alternative 3. Effects analysis scenarios for ground-based and aerial terrestrial herbicide treatments, including surface runoff, wind drift, leaching and accidental spill worst case scenarios, would therefore be similar to those described for terrestrial herbicide applications under Alternative 3.

While mechanical treatments of aquatic weeds could be employed, no aquatic herbicide treatments would be implemented under this alternative. There would, therefore, be no potential for direct or indirect effects related to application of herbicides to aquatic environments. While absent under Alternatives 1 and 2, the SNF and BNF’s strategic response to aquatic weed infestations would be limited relative to that of Alternatives 3 and 4 in not providing an herbicide-based treatment option to address new infestations. Given the rate of spread of these species and the number of vectors possible to move the species to another location, it is probable that an aquatic plant, if introduced and not mechanically removed soon after detection, could become established.

Effects to federally listed species, R4 sensitive fish species, and MIS would be similar to those described under Alternative 3. However, there would be no potential for effects from herbicide-based treatments of aquatic weeds as described under Alternative 3.

The scope and magnitude of potential direct and indirect effects of terrestrial weed treatment under Alternative 5 would be similar to those identified for Alternative 3. Like Alternative 3, Alternative 5 would be expected to result in the greatest rate of improved aquatic and riparian habitat conditions and reduced threats for aquatic and riparian resources from treating terrestrial

weeds. Terrestrial weed infestations would be expected to progressively decline at rates similar to those expected under Alternative 3, reducing the potential for erosion and sediment delivery to drainages and benefiting aquatic resources. Declines would be most significant on the BNF, where infestations are extensive.

As with all action alternatives, short-term disturbances may occur and may have a slight negative effect on aquatic resources in specific areas. Additionally, as with all action alternatives, potential short-term impacts on aquatic and riparian resources could occur if an accidental spill of a relatively toxic herbicide occurred in a small drainage, with resultant effects depending on various factors, including the volume of spill and dilution by the receiving water. Implementation of design criteria and an adaptive strategy would make it unlikely that any of the analyzed worst-case situations would occur or be expected to result in adverse impacts on populations of aquatic resources. Adherence to project design criteria would reduce the likelihood of an herbicide spill occurring and would minimize or avoid the potential occurrence of wind-drift-related impacts on aquatic resources.

In the absence of an herbicide-based option for aquatic weed treatment under this alternative, potential for direct or indirect effects related to treating aquatic weeds would be reduced relative to those described under Alternative 3. However, the efficacy of the SNF and BNF's strategic mechanism to address new infestations of aquatic weeds would be less robust under this alternative, due to reliance on only manual removal methods.

3.3.5.6.2. Cumulative Effects

Similar to Alternative 3, Alternative 5 would implement an expansion of current management (Alternative 2) to include 3 additional herbicides and aerial herbicide application as a treatment method. However, an aquatic weed treatment response strategy is not proposed under this alternative.

Cumulative effects from weed treatments under this alternative, combined with treatments under the 3 CWMAs, would benefit aquatic habitat and resources generally comparable to those benefits described for Alternative 3. The CWMAs and the SNF and BNF weed management program would cumulatively be expected to result in increased levels of weed treatment success. Under Alternative 5, terrestrial weed infestations on the SNF and BNF would be expected to progressively decline at a rate similar to that expected under the Proposed Action. The CWMAs and the SNF/BNF weed management program would cumulatively be expected to result in increased levels of weed treatment success relative to Alternative 2. This increase would reflect the eradication, control, and/or containment of new weeds that have invaded the SNF and BNF from adjacent lands covered by the CWMAs, and increased success in preventing weeds presently occurring on the SNF and BNF from invading adjacent lands.

As with other action alternatives, additional cumulative effects on aquatic resources associated with other ongoing activities on the SNF and BNF would also occur under the Alternative 5. These include potential effects of herbicide applications related to runoff, leaching, wind drift and direct herbicide spills. Weed management design criteria described for SNF/BNF weed treatment applications, along with similar design criteria employed by CWMA partners are designed to prevent or reduce the risk of these types of impacts from occurring. With inclusion of aerial herbicide application as a treatment option under this alternative, these potential cumulative effects would be expected to be similar to those described under Alternative 3.

Potential cumulative bioconcentration and synergistic effects from adjacent area herbicide applications, as well as potential cumulative erosion and sediment delivery effects would be similar those described under Alternative 2.

3.3.5.6.3. Irreversible or Irretrievable Effects

No irreversible or irretrievable effects are identified in association with implementing Alternative 5.

Forest Plan Consistency

All actions proposed under Alternative 5 are consistent with Management Goals, General Direction, and Standards and Guidelines for fisheries resources and aquatic habitats identified in both the SNF and BNF Forest Plans because of the following (USDA Forest Service 2010a, 2012a):

- Habitat within the respective ranges of species listed under ESA will be managed to contribute to their species survival and recovery (TEGO02 [USDA Forest Service 2010a, 2012a]).
- For management actions that include application of insecticides, herbicides, fungicides, or rodenticides, mitigation shall avoid or minimize adverse effects on TEPC species or their habitats (TEST05)
- Management actions will neither degrade nor retard attainment of properly functioning SWRA desired conditions (SWST04)

3.3.5.7. Summary of Effects

The following table summarizes the effects to federally listed, sensitive and management indicator fish species and habitat from the Sawtooth and Boise Forest Invasive Species Project.

Table 3-42. Summary of effects to federally listed, sensitive and Management Indicator fish species and habitat from the Boise and Sawtooth Forest Invasive Species Project

Species	Alternative 1		Alternatives 2, 3, 4 & 5		Alternatives 2, 3, 4, & 5 Rationale
	Individuals	Designated Critical Habitat	Individuals	Designated Critical Habitat	
Federally Listed Species					
Spring/Summer Chinook Salmon	MA, NLAA	MA, NLAA	MA, LAA	MA, NLAA	Design Features minimize potential for effects from herbicides and disturbance Potential adverse effects include sublethal effects on individuals due temporary decrease of algae and/or invertebrates. Potential exists for accidental exposure due to spills.
Snake River Sockeye Salmon	MA, NLAA	MA, NLAA	MA, LAA	MA, NLAA	Potential adverse effects include sublethal effects on individuals due temporary decrease of algae and/or invertebrates. Potential exists for accidental exposure due to spills.
Snake River Steelhead	MA, NLAA	MA, NLAA	MA, LAA	MA, NLAA	Potential adverse effects include sublethal effects on individuals due temporary decrease of algae and/or invertebrates. Potential exists for accidental exposure due to spills.
Bull Trout	MA, NLAA	MA, NLAA	MA, LAA	MA, NLAA	Potential adverse effects include sublethal effects on individuals due temporary decrease of algae and/or invertebrates. Potential exists for accidental exposure due to spills.
Sensitive Species					
Westslope Cutthroat Trout	MI, NLT	N/A	MI, NLT	N/A	Design Features minimize potential for effects, adverse effects from herbicide unlikely.
Yellowstone Cutthroat Trout	MI, NLT	N/A	MI, NLT	N/A	Small amount of suitable habitat proposed for treatment, short-term disturbance possible, Design Features minimize potential for adverse impacts from herbicide exposure and disturbance
Northern Leatherside Chub	MI, NLT	N/A	MI, NLT	N/A	Small amount of suitable habitat proposed for treatment, short-term disturbance possible, Design Features minimize potential for adverse impacts from herbicide exposure and disturbance
Wood River Sculpin	MI, NLT	N/A	MI, NLT	N/A	Design Features minimize potential for effects, adverse effects from herbicide unlikely.

Species	Alternative 1		Alternatives 2, 3, 4 & 5		Alternatives 2, 3, 4, & 5 Rationale
	Individuals	Designated Critical Habitat	Individuals	Designated Critical Habitat	
Management Indicator Species					
Bull Trout	No measureable influence on short- or long- term trend of bull trout on the BNF or SNF or Yellowstone cutthroat populations on the SNF				Effects of implementing the action alternatives are not expected to be of sufficient nature or magnitude to result in measureable influence on future trend of bull trout on SNF and BNF and Yellowstone cutthroat trout populations on the SNF.
Yellowstone Cutthroat Trout					

NE = No Effect
NI = No Impact
MI, NLT = May Impact individuals or habitat, not likely to contribute to contribute to a trend toward federal listing or loss of viability to the population or species
MA, NLAA = May Affect, Not likely to Adversely Affect, not likely to jeopardize the continued existence of the species or result in the adverse modification of critical habitat
MA, LAA = May Affect, Likely to Adversely Affect, not likely to jeopardize the continued existence of the species or result in the adverse modification of critical habitat
*Note that a finding of MI, NLT does not mean that there would be no adverse impacts on individuals, but rather that no adverse population level effects would be expected

3.4. Wildlife

Wildlife Summary: Generally, minimal to no adverse effects are expected from direct exposure to, or primary or secondary ingestion of, herbicide-treated vegetation or herbicide-exposed prey animals. Weed treatment activities are expected to result in long-term habitat improvements. This situation is expected to directly and indirectly benefit terrestrial wildlife species.

3.4.1. Introduction

This section describes how the alternatives address the purpose of the project to reduce the negative effects of existing and future invasive plants on wildlife resources that may be adversely impacted. This section also addresses the issues and concerns identified during internal and public scoping that herbicide exposure, resulting from herbicide toxicity, may harm terrestrial wildlife species.

3.4.2. Methodology for Analysis

The effects of invasive plant treatment on the following species were analyzed:

- Wildlife species listed as threatened, endangered, proposed, or candidate under the ESA
- USDA Forest Service R4 sensitive wildlife species
- BNF and SNF MIS
- Migratory birds and their habitat
- Ungulate big game species (elk, mule deer, moose)

3.4.3. Risk Assessments

The effects of herbicide use depend on the toxicity of the herbicide, the level of exposure to that herbicide, and the duration of that exposure. Risk assessments evaluate the potential effects to non-target plants, wildlife, human health, soils, and aquatic organisms from the herbicides considered for use on the SNF and BNF. The Forest Service contracted with Syracuse Environmental Research Associates, Inc (SERA) to evaluate human health and ecological effects of herbicides using EPA studies and other peer-reviewed articles from the open scientific literature. Information from laboratory and field studies of herbicide toxicity, exposure, and environmental fate was used to estimate the risk of adverse effects to non-target terrestrial and aquatic organisms, humans, water, and soil. SERA risk assessments were used to evaluate the potential effects to wildlife from the herbicides and other substances associated with herbicide applications (e.g. adjuvants) considered for use on the SNF and BNF (SERA 2004a–f, 2006, 2007a, 2009a,b, 2010, 2011a–d; available at: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml).

Risk assessments look at both human health and ecological aspects and contain the following information:

- Hazard characterization—What are the dangers inherent with the active ingredient?

- Exposure assessment—Who could come into contact and how much?
- Dose response assessment—How much is too much?
- Risk characterization—Is there a plausible basis for concern?

The risk assessments considered worst-case scenarios, including accidental exposures and application at maximum label rates. Although the risk assessments have limitations, as detailed in the project record, they represent the best science available. The risk assessment methodologies and detailed analyses are incorporated into references of conclusions about herbicide toxicity in this document.

3.4.3.1. Exposure Scenarios

For each ecological risk assessment, a set of general exposure scenarios are analyzed. For wildlife, exposure scenarios included the animal being directly sprayed; ingestion of contaminated vegetation, prey species, or water; grooming activates; and indirect contact with contaminated vegetation (SERA 2007c).

Direct spray scenarios include a 20 gram mammal being sprayed directly over half of the body surface. One scenario is the absorbed dose over a 24 hour period based on the relationship between body weight and surface area. The other scenario is complete absorption of the dose over a 24 hour period due to grooming and increased dermal permeability. Direct spray scenarios are not given for large mammals unless toxicity date indicates that large mammals are more sensitive to the active ingredient than small mammals. The other direct spray is a honeybee with assumed complete absorption over a 24 hour period (SERA 2007c).

Indirect contact scenarios, both acute and chronic, are based upon ingestion of contaminated vegetation or prey. One is a 20 gram mammal consuming 3.6 grams (18% of body weight) of contaminated vegetation per day. One is for a 70 kilogram mammal, with caloric requirements for the animal and the caloric content of the vegetation used in the modeling. Acute scenarios assume that the vegetation was sprayed directly and that 100% of the diet is contaminated. Two chronic scenarios are modeled; the animal consumes vegetation for a 90 day period after herbicide application (consisting of 30% of the diet) , and the animal eats vegetation 25 to 100 feet from the application site, but 100% of the diet is assumed to be contaminated by drift. Both chronic exposure scenarios are modeled for large birds (4 kg), as well (SERA 2007c).

For predatory species, exposure scenarios for a small bird (10 g) and a small mammal (20 g) consuming contaminated insects (residue rates of 45-135 ppm per lb/acre) were modeled. The consumption of small mammals by predatory mammals or birds was modeled; the assumption made was that the small prey mammal was directly sprayed with 100% absorption. Both acute and chronic exposure scenarios for the consumption of contaminated fish by predatory birds were modeled; since birds consume more food per body unit than mammals, so the consumption of fish by predatory mammals was not analyzed (SERA 2007c).

The ingestion of contaminated water was also modeled. A 20 g mammal consumes about 0.005 L water/day which equates to 0.25 L/kg bodyweight per day. The acute exposure scenario was based on the field dilution rate and the amount spilled (generally assumed to be 200 gallons) and the chronic exposure scenario was based on the water contamination rate and the application rate of the herbicide (SERA 2007c).

3.4.3.2. Factors Influencing Exposure and Dose

The exposure of an animal to an herbicide is greatly influenced by the relationships between body size and several physiological, metabolic, and pharmacological processes (allometry). For example, allometric relationship dictates that smaller animals have a larger amount of surface area for their mass than larger animals. This relationship greatly influences basic physiological properties, such as food consumption and thermoregulation. Some of the allometric factors influencing exposure to herbicides are detailed below.

3.4.3.2.1. Body Weight

Several parameters used to estimate herbicide contact are reported on a "per body weight" basis, expressed in grams or kilograms. For example, both food and water ingestion rates are reported on a per body weight basis (such as gram of fresh food or water per gram of body weight per day). Body weights, in units of mass, are reported as fresh weight that might be obtained by weighing a live animal in the field. Also, body weight data are used in empirical models to calculate some parameters, such as surface area, when no specific measurements are available. Calculations of "potential dose to animal" use animal body weight.

3.4.3.2.2. Metabolic Rate

Metabolic rate is not directly calculated in this document or in the SERA risk assessments, but reported values for various species were used to calculate food consumption requirements. Metabolic rate is reported on the basis of kilocalories per kilogram of body weight per day (kcal/kg/day). Metabolic rate is closely related to body size, with smaller animals generally having higher metabolic rates than larger animals.

3.4.3.2.3. Contact Route

Exposure involves direct contact with the herbicide, and wildlife may be exposed to herbicides by ingesting the chemical (oral) or by external contact (dermal). Oral exposures may occur from eating contaminated vegetation or prey, drinking contaminated water, or through grooming activities. Dermal exposures may occur from direct spray or contact with contaminated vegetation or water. These contact routes are influenced by allometric relationships, as well as habitat preferences and feeding behaviors.

3.4.3.2.4. Oral Routes

Food Ingestion—Small animals generally have higher caloric requirements than large animals, so a small animal ingests a greater amount of food per unit of body weight compared to large animals. A 20 g mouse, for example, will generally consume an amount of food equal to about 15% of its body weight every day, depending on calorie content of the diet. A value of 3.6 g of food consumed per day for a 20 g mouse is used in the SERA risk assessments for calculating exposure from contaminated food. This calculation is equivalent to 18% of the body weight and is generated from general allometric relationships for food consumption in rodents (EPA/ORD 1993, p. 3-6, as cited in SERA 2003a). This value may underestimate exposure to small mammals that consume primarily vegetation rather than seeds (SERA 2003a). Food consumption is calculated from caloric requirements for different sized animals for the various exposure scenarios in the SERA risk assessments.

Dietary Composition—Dietary composition is an important consideration in exposure assessments because different foods have varying herbicide residues. Grasses may have substantially higher residues than fruits or other vegetation (Kenaga 1973; Fletcher et al. 1994;

Pfleeger et al. 1996). The SERA risk assessments use data from Siltanen et al. (1981) for concentrations of herbicide residues on fruit. Also, small insects may contain higher residues than large insects based on empirical relationships (Pfleeger et al. 1996). Some herbicides have the potential to bioaccumulate in fish; therefore, fish-eating birds may be exposed. Caloric content of various foods, in combination with caloric requirements of animals, was used to estimate the daily amount of food consumed based on data from EPA/ORD (1993; as cited in SERA 2003a). In the FS/SERA risk assessments, exposure scenarios used a large herbivore consuming a 100% grass diet, a large bird consuming grass, a small bird consuming small insects, and a predatory bird consuming contaminated fish (SERA 2003a, pp. 4-14 to 4-15).

Water Ingestion—Well-established relationships occur between body weight and water consumption across a wide range of mammalian species. Mice, weighing about 20 g (0.02 kg) consume about 0.005 L of water per day (i.e., 0.25 L/kg/day). These values were used in the exposure scenarios for small mammals. Since the body size to volume relationship dictates that smaller animals will receive larger doses for a given exposure, consumption of contaminated water was not calculated for larger animals. Water ingestion is obviously influenced by environmental factors, such as heat and availability. But estimates for the variability in water consumption are not available for wildlife.

Grooming—Birds and mammals may spend a great deal of time grooming fur or feathers. If the animal has been exposed to herbicide, some chemical may be absorbed through the grooming process. However, a study by Gaines (1969, as cited in SERA 2001) suggests that grooming is not significant in the toxic response of small mammals. At any rate, the doses received from grooming would be less than those received through contaminated food or direct spray, given the assumptions in the exposure scenarios. See dermal exposure route information below.

3.4.3.2.5. Dermal Route

Dermal contact can occur from direct spray or contact with contaminated vegetation or water. Since only a small portion of an applied herbicide would be available as dislodgeable residue on vegetation, or in a water body where it was diluted, dermal exposure was modeled only for direct spray scenarios in FS/SERA risk assessments. The extent of dermal contact for an animal would depend on the application rate of the herbicide, the surface area of the animal, and the rate of absorption. Since a larger proportion of a small animal's body would be involved, relative to larger animals, direct spray scenarios were only conducted for a small mammal and a honeybee in the FS/SERA risk assessments (SERA 2001). Skin, fur, and feathers provide some protection from chemicals, and not all of the chemical on an animal would be absorbed.

3.4.3.3. Herbicide Toxicology Terminology

The following terminology is used throughout this analysis to describe relative toxicity of herbicides proposed for use in the alternatives.

3.4.3.3.1. Hazard Quotient

The HQ is the amount of herbicide or additives to which an organism may be exposed over a specified period divided by that estimated daily exposure level at which no adverse health effects are likely to occur. An HQ less than or equal to one indicates an extremely low level of risk; therefore, an HQ less than or equal to one is presumed to indicate a level of exposure below the LOC for adverse health effects.

3.4.3.3.2. Level of Concern

An estimate of exposure above which there may be adverse effects; in risk assessments this is defined as an HQ of more than one.

3.4.3.3.3. Exposure Scenario

Exposure scenario considers the toxicity of a given chemical and the mechanism by which an organism may encounter it. The application rate and method influences whether a person, animal, or nontarget plant could be adversely affected by exposure to a particular herbicide.

3.4.3.3.4. Plausible Effects

The analysis focuses on whether possible effects (based on risk assessments) are plausible, given site conditions, herbicide application methods, and design criteria. Design criteria are used to minimize or eliminate the plausibility of effects identified in the risk assessments.

3.4.3.4. Reference Dose

A reference dose (RfD) is a defined level that is not believed to be associated with any adverse effect. Both chronic and acute RfDs are characterized in risk assessments.

3.4.3.5. Limitations Associated with Risk Assessments

Risk assessments have a degree of uncertainty in their interpretation and extrapolation of data. Uncertainty may result from a study design, data collection, data interpretation, and extreme variability associated with aggregate effects of natural and synthesized chemicals on organisms, including humans, and with ecological relationships. Numbers used, particularly in ecological realms, are uncertain, and limits exist on our ability to understand or demonstrate causal relationships. Because of data gaps, assessments rely heavily on extrapolating from laboratory animal tests (USDA Forest Service 2005). Regardless of disadvantages and limitations of ecological and human health risk assessments, risk assessments can determine (given a particular set of assumptions) whether a basis exists for asserting that a particular adverse effect is plausible. The bottom line for all risk analyses is that absolute safety can never be proven and the absence of risk can never be guaranteed (SERA 2007c).

Better risk estimates could be calculated if laboratory data on the toxicity of the herbicides considered in this analysis were available for more groups of animals and more individual species. These additional data would provide more information on the comparative sensitivities of different wildlife groups and the types of adverse effects that may occur in different species.

However, because of the dynamic nature of wildlife and their habitat (e.g., behavior, weather, nutrient availability, contaminant presence), significant uncertainties would remain for predicting short- and long-term reactions to herbicide presence in natural settings even if more laboratory data were available.

Limitations notwithstanding, substantial scientific data exist on the toxicity of these herbicides to birds and mammals, as well as amphibians and some invertebrates. These data are generated by manufacturers to meet EPA regulations before an herbicide may be registered for use, and by independent researchers who have published findings in peer-reviewed literature. These data are analyzed according to standard risk assessment methodology to reach a characterization of risk for each herbicide. The summary of the available scientific evidence and our evaluation of reasonably foreseeable impacts are detailed in the following sections.

Research has not been conducted on the effects of these herbicides to most free-ranging wildlife species, so the relevant data to specifically evaluate effects to different wildlife species are incomplete or unavailable as noted below:

- Analysis of effects for any project involving herbicide use relies upon extrapolations from laboratory animals to free-ranging wildlife and controlled conditions to the natural environment.
- More data are available for mammals than for birds, which necessitated using mammal toxicity values in bird exposure scenarios for some of the herbicides considered in this analysis.

3.4.3.6. Analysis Area and Project Area Description

The analysis area for direct and indirect effects to wildlife includes the wilderness and non-wilderness portions of the SNF and the non-wilderness portion BNF. The analysis area for cumulative effects encompasses the entire subwatersheds (6th level HUCs) where weed treatments occur. At least a portion of 561 subwatersheds are within the administrative Forest unit boundary and often extend outside.

The project area includes 4.3 million acres of lands administered by the SNF and BNF (Figure 1-1 and Figure 1-2). Currently, 155,000 acres of inventoried non-native invasive plant species infestations are known to occur in over 25,981 locations in this area (Table 1-1 and Table 1-2). These 154,000 acres do not include overlapping occurrences of weedy species. However, because of the likely existence of un-inventoried infestations, the actual area infested may be underestimated by these figures. These values represent only estimates for the purpose of characterizing the existing condition.

The BNF and SNF are located in the temperate desert division of the Middle Rocky Mountain Ecoregion. The BNF occurs almost exclusively within the Idaho Batholith province of this ecoregion, with only a small portion of the Mountain Home RD falling into the Snake River Basalts province. The SNF lies within three separate provinces of this Ecoregion. The Fairfield RD and the western half of the Sawtooth NRA are within the Idaho Batholith, the Ketchum RD and the eastern half of the Sawtooth NRA are within the Challis Volcanics, and the Minidoka RD is within the Eastern Basin and Range province. This ecoregion, with its associated provinces, consists of mountain ranges, basins, and river canyons. The climatic regime is broadly similar across the ecoregion, although precipitation varies based on altitude; overall, the ecoregion is semi-arid. Lower elevations are dominated by grasslands and shrub steppe vegetation, with conifer cover increasing with elevation. Ponderosa pine and Douglas-fir dominate low-elevation conifer forests. Lodgepole pine, Engelmann spruce, and subalpine firs occupy the mid-elevation range, while whitebark pine occupies the upper elevations.

Found within or near the SNF and BNF are 27 noxious[9] and 15 invasive[10] plant species that are considered in this analysis. Appendix A includes maps that depict inventoried weed infestations occurring in the project area by RD and area. Table 3-43 displays the estimated acres infested within each vegetation cover type occurring in the project area.

[9]Legally designated as noxious by the states of Idaho and Utah

[10] Considered invasive by the USFS and University of Idaho, but not including *Bromus tectorum*

Table 3-43. Inventoried weed infestations within cover types occurring on the Boise and Sawtooth National Forests

Vegetation Category	Acres of Vegetation	Acres of Noxious Weed Infestation
Alpine	21,806	7
Aspen	132,258	3,711
Barren	442,497	5,698
Bitterbrush	50,294	3,013
Conifer	2,118,642	92,455
Developed	1,691	697
Dwarf Sage	56,605	790
Grassland	167,359	9,124
Juniper	56,336	1,115
Mixed Shrubland	362,549	15,577
Mountain Big Sage	652,029	17,398
Mountain Mahogany	8,196	50
Riparian	58,312	5,169
Water	24,811	0
Whitebark Pine	150,362	103
Wyoming Big Sagebrush	20,614	622
Total Acres	4,324,360	155,529

Elevations within the project area range from about 2,772 feet along the Payette River in the Emmett RD to 11,958 feet at Hyndman Peak in the Ketchum RD. The project area includes portions of several mountain ranges including the Sawtooth Range, Boulder Mountains, White Mountains, Smokey Mountains, Soldier Mountains, Boise Mountains, Sublett Range, Black Pine Mountains, and Raft River Range. NFS lands are generally located at higher elevations in the headwaters of the watersheds, while the broad valleys between the mountain ranges consist of private, municipal, and other federal ownership.

3.4.3.7. Measurement Indicators

Herbicide exposure, resulting from herbicide toxicity, may harm terrestrial wildlife species. The effects of invasive plant treatment on the following species will be analyzed: wildlife species listed under the ESA and are proposed or a candidate for listing; Forest Service R4 Sensitive wildlife species; MIS; migratory birds and their habitat; and ungulate big game species of interest.

Measurement Indicators

- Toxicity potential of herbicides being used
- Direct and indirect effects of invasive plant species treatment activities (disturbance)

3.4.4. Compliance with Forest Plan and Other Relevant Direction

3.4.4.1. Relavent Laws, Regulations and Policy

The ESA Section 7(a)(2) requires that federal agencies ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat. A biological assessment is required to facilitate consultation with the U.S Fish and Wildlife

Service (USFWS) on any federally threatened, endangered, or proposed species determined to be affected by the proposed project. Please refer to the *Terrestrial Wildlife Resource Biological Assessment & Biological Evaluation* (Wildlife BA/BE) in the project record.

FSM 2670.32 directs the Forests to avoid or minimize impacts to species whose viability has been identified as a concern, and is therefore listed as sensitive by the Regional Forester. If impacts cannot be avoided, then the Forests must analyze the significance of the potential adverse effects on the population or its habitat within the area of concern and on the species as a whole. Impacts may be allowed but the decision must not result in a trend toward federal listing.

The NFMA of 1976 mandates the use of MIS (FSM 2621.1).

The Migratory Bird Treaty Act (MBTA) prohibits taking of migratory birds, their parts, nests, eggs, and nestlings. EO 13186, signed January 10, 2001, directs federal agencies to protect migratory birds by integrating bird conservation principals, measures, and practices into agency activities and to avoid or minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions. Additional direction comes from the MOU between the Forest Service and USFWS, signed December 2008. The purpose of this MOU is to strengthen migratory bird conservation through enhanced collaboration between the Forest Service and USFWS, in coordination with State, tribal, and local governments. The Forest Service will collaborate with the USFWS, as needed, if project actions produce measurable impacts to avian resources.

The revised SNF and BNF Forest Plans outline management direction for the Forests in Chapter III, including direction for Forest-wide desired conditions, goals, objectives, standards, and guidelines for the management of habitat for threatened, endangered, and proposed species (USDA Forest Service 2010a, 2012a, pp. III 8-15). Standard TEST01 states, “The Forest shall consult with the NMFS and Fish and Wildlife Service as needed, and appropriate, to comply with consultation requirements under the ESA and Magnuson-Stevens Act.” The FSM directs the Forest Service to avoid all adverse impacts on threatened and endangered species and their habitats, except when it is possible to compensate through alternatives identified in a biological opinion rendered by the USFWS (FSM 2670.31).

3.4.4.2. Consultation History

Correspondence with the USFWS to date includes a review of the draft Biological Assessment and conference calls to discuss the Federal Action for the Invasive Plant Treatment Project for the SNF and BNF and assess the need to initiate consultation and conferencing. Representatives from those meetings included USFS, USFWS, and NOAA-Fisheries Level 1 consultation team members for the SNF and BNF, and the SNF Environmental Coordinator.

Meeting notes, telephone conversations, and e-mail correspondence between the Forest Service and the Services (USFWS and NOAA-Fisheries) are on file in the Project Record. Federally listed, Proposed, or Candidate species included in this BA are based on the Official Species List prepared by the USFWS ECOS-IPaC system for the project area (Consultation Code 06E23000-2016-SLI-0006), dated May 27, 2016. Regional Forester sensitive species included in this document are based on the most current revision to the Intermountain Region sensitive species list dated June 2016. Consultation on the individual federally listed species at the project level has been ongoing for a number of years.

3.4.4.3. Relationship of this Project to the 2010 Boise Forest Plan and 2012 Sawtooth Forest Plan Goals, Objectives, and Desired Future Conditions Relevant to this Resource

Forest Plan standards and guidelines potentially relating specifically to the proposed action and about which compliance questions may arise include: TEST05, TEST09, TEST10, TEGU07, WIG001, WIG002, WIG003, WIGO04, WIOB07, WIOB14, WIOB11, WIST01A, WIST01B, WIST02, WIST03, WIST04, WIST05, WIST06, WIGU11, SWST01, SWST04, SWGU09, VEGU04, BTST04, BTST05, BTGU02, NPST03, NPST10, NPST11, NPGU01, NPGU05, NPGO01, NPGO02, NPGO03, NPGO04, NPGO05, NPOB01, NPOB02, NPOB03, NPOB04, NPOB05, NPOB06, NPOB07, NPOB08, NPST05, NPST12, NPST11, NPGU01, NPGU03, NPGU05, and NPGU06. Compliance to these standards and guidelines help to minimize effects from Alternative 3.

3.4.5. Affected Environment

No Endangered or Candidate terrestrial wildlife species occur within the analysis area. Effects to three Threatened species, one Proposed species, 20 Regional Forester's Sensitive species that are known or expected to occur on the SNF and BNF, two MIS, three big game species of interest, and 31 high priority migratory bird species known or suspected to occur in the analysis area are included in this analysis. Please refer to the wildlife specialist report and biological assessment & biological evaluation (BA/BE) in the project record for additional information on these species, including the listing status, biological requirements, status, trend, potential occurrence, and additional information on the effects to the species and their habitat.

3.4.5.1. Federally Listed or Proposed Species

Three terrestrial wildlife species listed as threatened under the ESA could potentially occur within the analysis area (Table 3-44). No known occurrences or designated critical habitat for endangered or candidate terrestrial wildlife species occur within the analysis area. On April 4, 2016, the US District Court of Montana vacated the US Fish and Wildlife Service decision to withdraw its proposal to not list the wolverine as threatened. Since that decision is vacated, the wolverine reverts back to the most current legal status which is Federally Proposed (See Federal Register Feb 2013).

Table 3-44. Threatened terrestrial wildlife species occurring or potentially occurring on Sawtooth (SNF) and Boise (BNF) National Forests

ESA Listed Wildlife Species	Scientific Name	Status	Forest
Canada lynx	*Lynx* canadensis	Threatened	BNF/SNF
Northern Idaho ground squirrel	Spermophilus brunneus	Threatened	BNF
Yellow-billed cuckoo	Coccyzus americanus	Threatened	BNF/SNF
Wolverine	*Gulo gulo*	Proposed	BNF/SNF

On October 2, 2015, the USFWS found the greater sage-grouse (*Centrocercus urophasianus*) does not warrant listing at this time. Greater sage-grouse is a MIS, but will be analyzed below as a Region IV sensitive species.

3.4.5.2. Region 4 Sensitive Species

Those Sensitive animal species known or expected to occur on the SNF and BNF include 20 species (Table 3-45). The greater sage-grouse, white-headed woodpecker, northern goshawk, and Columbia spotted frog are also designated as MIS, but are analyzed as Sensitive species in this analysis.

Table 3-45. Sensitive terrestrial wildlife species occurring or potentially occurring on Sawtooth (SNF) and Boise (BNF) National Forests

Regional Forester Sensitive Species	Scientific Name	Status	Forest
Bighorn sheep	*Ovis canadensis*	Sensitive	BNF/SNF
Gray wolf	*Canis lupus*	Sensitive	BNF/SNF
Pygmy rabbit	*Brachylagus idahoensis*	Sensitive	SNF
Spotted bat	*Euderma maculatum*	Sensitive	BNF/SNF
Fisher	*Martes pennanti*	Sensitive	BNF/SNF
Southern Idaho ground squirrel	*Spermophilus brunneus endemicus*	Sensitive	BNF
Townsend's big-eared bat	*Corynorhinus townsendii*	Sensitive	BNF/SNF
Bald eagle	*Haliaeetus leucocephalus*	Sensitive	BNF/SNF
Boreal owl	*Aegolius funereus*	Sensitive	BNF/SNF
Greater sage-grouse (also MIS)	*Centrocercus urophasianus*	Sensitive	BNF/SNF
Peregrine falcon	*Falco peregrinus anatum*	Sensitive	BNF/SNF
Common loon	*Gavia immer*	Sensitive	BNF/SNF
Mountain quail	*Oreortyx pictus*	Sensitive	BNF
Flammulated owl	*Otus flammeolus*	Sensitive	BNF/SNF
White-headed woodpecker (also MIS)	*Picoides albolarvatus*	Sensitive	BNF/SNF
American three-toed woodpecker	*Picoides tridactylus*	Sensitive	BNF/SNF
Great gray owl	*Strix nebulosa*	Sensitive	BNF/SNF
Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	Sensitive	BNF/SNF
Northern goshawk (also MIS)	*Accipiter gentilis*	Sensitive	BNF/SNF
Columbia spotted frog (also MIS)	*Rana luteiventris*	Sensitive	BNF/SNF

3.4.5.3. Management Indicator Species

While numerous wildlife species occur within the proposed analysis area, MIS are used to assess effects of management activities on groups of species with similar habitats (Table 3-46). Greater sage-grouse, northern goshawk, Columbia spotted frog, and pileated woodpecker are MIS for the SNF (USDA Forest Service 2012). Pileated woodpecker, white-headed woodpecker, and black-backed woodpecker are MIS for the BNF (USDA Forest Service 2010a). Greater sage-grouse, northern goshawk, Columbia spotted frog, and white-headed woodpecker are also R4 sensitive species.

Table 3-46. Management indicator species (MIS) considered for this analysis

Species	Scientific Name	Status
Greater sage-grouse	*Centrocercus urophasianus*	Sawtooth National Forest MIS and Region 4 sensitive
Northern goshawk	*Accipiter gentilis*	Sawtooth National Forest MIS and Region 4 sensitive
Columbia spotted frog	*Rana luteiventris*	Sawtooth National Forest MIS and Region 4 sensitive
Pileated woodpecker	*Dryocpus pileatus*	Sawtooth and Boise National Forest MIS
White-headed woodpecker	*Picoides albolarvatus*	Boise National Forest MIS and Region 4 sensitive
Black-backed woodpecker	*Picoides arcticus*	Boise National Forest MIS

3.4.5.4. Migratory Bird Species

The MBTA prohibits taking of migratory birds, their parts, nests, eggs, and nestlings. EO 13186, signed January 10, 2001, directs federal agencies to protect migratory birds by integrating bird conservation principals, measures, and practices into agency activities and to avoid or minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions.

The *Idaho Bird Conservation Plan* (Idaho PIF 2000) lists bird species that are prioritized based on a number of factors, including relative density in planning unit compared to maximum in range, population trend, threats in breeding habitat, relative abundance, size of breeding range, size of non-breeding range, and threats in non-breeding habitat. High priority species are those species that scored high in the Idaho Partners in Flight (PIF) prioritization process, which indicates a high vulnerability of populations. A complete explanation of the rationale is found in the *Idaho Bird Conservation Plan* (Idaho PIF 2000).

The entire project area provides potential breeding habitat for migratory birds. Thirty-one species identified as high priority species in *The Idaho Bird Conservation Plan* (Idaho PIF 2000) and known to occur or suspected to occur in the project area are listed below in Table 3-47 in association with their primary breeding habitat. Within the analysis area, the following Idaho PIF avian habitats occur and are used by a number of high priority species know to occur or potentially occurring on the SNF and BNF during the breeding season (Table 3-47; Idaho PIF 2000):

- High-elevation mixed conifer— used by 2 high priority species
- Low-elevation mixed conifer—used by 7 high priority species
- Juniper/pinyon/mountain mahogany—used by 3 high priority species
- Grassland—used by 2 high priority species
- Riparian—used by 9 high priority species
- Sagebrush/salt desert scrub—used by 8 high priority species

For the purposes of this analysis, high priority birds in these primary breeding habitats that could be affected by the action alternatives will be addressed.

Table 3-47. Idaho Partners in Flight high priority species potentially occurring in the project area[a]

Primary Breeding Habitat	Species	Scientific Name	Idaho BBS Trend[b] 1966–2012 Percent/y	Idaho BBS Trend[b] 2002–2012 Percent/yr	BCC[c]	Global Ranking[d]	State SGCN Ranking[e]
High-elevation mixed conifer	Olive-sided flycatcher	*Contopus cooperi*	–3.09	–3.26	Yes	G4	S4B
	Hammond's flycatcher	*Empidonax hammondii*	1.05	0.38	No	G5	S5B
Low-elevation mixed conifer	Sharp-shinned hawk	*Accipiter striatus*	2.83	2.67	No	G5	S5
	Brown creeper	*Certhia americana*	–3.07	–1.92	No	G5	S5
	Varied thrush	*Ixoreus naevius*	–3.87	–3.57	No	G5	S5B
	Townsend's warbler	*Setophaga townsendi*	1.82	1.55	No	G5	S4B
	Western tanager	*Piranga ludoviciana*	2.27	1.75	No	G5	S5B
	Lewis's woodpecker	*Melanerpes lewis*	–0.69	2.06	Yes	G4	S3B
	Williamson's sapsucker	*Sphyrapicus thyroideus*	1.18	1.96	Yes	G5	S4B
Juniper/pinyon/mountain mahogany	Ferruginous hawk	*Buteo regalis*	2.90	2.73	Yes	G4	S3B
	Gray flycatcher	*Empidonax wrightii*	3.98	–6.16	No	G5	-
	Plumbeous vireo	*Vireo plumbeus*	–16.74	–15.95	No	G5	S4
Grassland	Grasshopper sparrow	*Ammodramus savannarum*	–2.49	–4.05	No	G5	S2B
	Long-billed curlew	*Numenius americanus*	2.14	1.57	Yes	G5	S2B
Riparian	Black-chinned hummingbird	*Archilochus alexandri*	6.21	8.34	No	G5	S5B

Primary Breeding Habitat	Species	Scientific Name	Idaho BBS Trend[b] 1966–2012 Percent/y	Idaho BBS Trend[b] 2002–2012 Percent/yr	BCC[c]	Global Ranking[d]	State SGCN Ranking[e]
	Calliope hummingbird	*Stellula calliope*	–1.26	–1.33	Yes	G5	S5B
	Rufous hummingbird	*Selasphorus rufus*	–1.18	–0.57	No	G5	S5B
	Willow flycatcher	*Empidonax traillii*	–1.80	–1.81	Yes	G5	S5B
	Dusky flycatcher	*Empidonax oberholseri*	0.11	2.87	No	G5	S5B
	Black-billed magpie	*Pica hudsonia*	–0.43	–2.04	No	G5	-
	American dipper	*Cinclus mexicanus*	–0.50	2.12	No	G5	S5
	Yellow warbler	*Setophaga petechia*	–1.41	–1.67	No	G5	S5B
	MacGillivray's warbler	*Geothlypis tolmiei*	–0.46	–0.82	No	G5	S5B
Sagebrush/ salt desert scrub	Swainson's hawk	*Buteo swainsoni*	2.28	3.76	Yes	G5	S4
	Short-eared owl	*Asio flammeus*	–1.61	–1.38	No	G5	S4
	Loggerhead shrike	*Lanius ludovicianus*	–0.49	–0.40	Yes	G4	S3
	Rock wren	*Salpinctes obsoletus*	–1.62	–0.42	No	G5	S3B
	Sage thrasher	*Oreoscoptes montanus*	–1.36	–1.06	Yes	G5	S3B
	Brewer's sparrow	*Spizella breweri*	–0.62	–0.83	Yes	G5	S3B
	Lark sparrow	*Chondestes grammacus*	-2.71	-2.90	No	G5	S5B
	Sage sparrow	*Amphispiza belli*	-4.66	-4.97	Yes	G5	S3B

[a] All habitat type descriptors are from Idaho PIF 2000
[b] BBS = Breeding Bird Survey data (Sauer et al. 2014)
[c] USFWS Birds of Conservation Concern in the Northern Rockies Bird Conservation Region—Designated by the US Fish and Wildlife Service (U.S. Fish and Wildlife Service 2008)
[d] NatureServe assign each species a global rank which applies across its entire range.
[e] Idaho State Species of Greatest Conservation Need (SGCN) from Idaho's Comprehensive Wildlife Conservation Strategy (2005).

3.4.5.5. Big Game Species of Interest

Three big game species of interest were considered for this analysis (Table 3-48).

Table 3-48. Big game species of interest considered for this analysis

Big Game Species	Scientific Name
Mule Deer	*Odocoileus hemionus*
Shiras Moose	*Alces alces shirasi*
Rocky Mountain Elk	*Cervus elaphus*

3.4.6. Environmental Consequences

3.4.6.1.1. Direct and Indirect Effects of Toxicity Potential of Herbicides Proposed

The quantitative analysis for several of the herbicides revealed that exposures over the no adverse effect level (i.e., toxicity threshold) are mathematically possible, given extreme assumptions such as a bird or mammal feeds on nothing but contaminated vegetation that has been heavily laden with herbicide. More realistic central and lower estimates, assuming less contamination in the vegetation and less feeding, indicate exposures over the no adverse effect level are not likely. The analysis below focuses on possible exposures over a LOC using central HQ values. In some cases, upper HQ values are discussed to provide context; however, herbicides that have only one or two scenarios over a LOC for wildlife at the upper estimates are not discussed in detail because the level of exposure that would have to occur is implausible, given the type of infestations that would be treated and the project design criteria that would apply to new detections as well as current infestations.

3.4.6.1.2. Alternative 1—No Action (No Treatments)

No impacts from herbicide exposure would occur because herbicides are not part of Alternative 1. However, invasive plant species would continue to spread, increasing detrimental effects to native flora and fauna. The following detrimental impacts from invasive plants have been documented in peer-reviewed literature:

- Changes in fire frequency, leading to type conversions of habitat (cheatgrass, Arundo spp.) (D'Antonio and Vitousek 1992; Mack 1981; Randall 1996; Whisenant 1990)
- Changes in nutrient cycling (cheatgrass, knotweed) (Sperry et al. 2006; Sweeny 1993)
- Injury and mortality from 'foxtails' (McCrary and Bloom 1984)
- Toxicity to livestock (tansy ragwort, yellow starthistle)
- Loss of forage quality and quantity for big game (leafy spurge, knapweeds, yellow starthistle) (Bedunah and Carpenter 1989; Rice et al. 1997a; Trammell and Butler 1996)
- Changes in stream and river hydrology (knotweed, blackberry) (Talmadge and Kiviat 2004)
- Loss of native bird diversity with increase in exotic plants (Mills et al. 1989, Germaine et al. 1998)

- Reduction in availability of surface water (Horton 1977; Brotherson and Field 1987; Dudley 2000)
- Disruption of rumen microbial activity resulting in reduced food consumption (Olson 1999)
- Fewer and less diverse populations of mammals, reptiles, and amphibians (tamarisk) (Jakle and Gatz 1985; Olson 1999)
- Unsuitable habitat for numerous birds, reptiles and mammals (purple loosestrife) (Blossey et al. 2001; Kiviat 1996; Lor 1999; Rawinski 1982; Thompson et al. 1987; Weihe and Neely 1997; Weiher et al. 1996)
- Loss of suitable habitat for Oregon spotted frogs (reed canarygrass) (Cushman and Pearl 2007, White 2002, Watson et al. 2003)

3.4.6.1.3. Alternative 2—Current Management

Under Alternative 2, no change would occur from current weed management efforts. This alternative would continue the same weed management programs, treatments, and levels of effort for controlling weeds on the SNF and BNF that are currently used. In general, this alternative includes treating invasive terrestrial plants using biological, mechanical, and/or herbicide treatments. Herbicide application under this alternative is limited to the treatment of terrestrial invasive plants with 12 herbicides and the utilization of ground-based application techniques exclusively. The toxicity potential of herbicides proposed in Alternative 2 are included in the Alternative 3 discussion below.

3.4.6.1.4. Alternative 3—Proposed Action

Under Alternative 3, noxious weeds and non-native weed species would be eradicated, controlled, or contained using a variety of methods. Treatment sites would be restored (where determined to be appropriate) to native vegetation following treatment. Loss of native habitat to weed infestations would decrease over time as weed populations are reduced and eliminated. Wildlife species would benefit as native plant communities are restored following weed treatment. Restored plant communities would provide improved forage, hiding cover, and reproductive cover for wildlife as native and desired non-native plant density increases, plant canopy cover increases, plant diversity increases, and multi-layered grass/forb/shrub canopies develop compared to existing conditions in weed infested areas. Wildlife species with habitat in grassland, forb communities, riparian areas, and low-elevation pine and fir forests would benefit since these plant communities generally have a higher incident of weed infestation than other plant communities occurring on the Forests.

Generally speaking, mammals and birds that eat insects or grass may be harmed by some herbicides and surfactants. Amphibians also appear to be at higher risk of adverse effects due to their permeable skin and aquatic or semi-aquatic life history. The 2011 glyphosate risk assessment indicates that use of POEA surfactants may be associated with greater impacts than use of glyphosate alone. The POEA adjuvant (i.e., Roundup Pro) would only be used in uplands where there is no potential for movement into aquatic systems. Only products labeled for aquatic application would be used within or near aquatic systems.

Risk from herbicide exposure was determined using data and methods outlined in the SERA risk assessments. Quantitative estimates of dose for each animal grouping for each herbicide are contained in the project file worksheets.

Upper HQs calculated for taxa groups by body size and diet, do not account for factors such as timing and method of application, animal behavior and feeding strategies, seasonal presence or absence within a treatment area, and/or implementation of design criteria. As a result, these values represent the most extreme exposure scenario to the animal and actual exposure would be less due to the factors listed above.

Nonetheless, caution in the design and implementation of the project is warranted. In many cases, sufficient data is not available to allow for a quantitative risk assessment. For instance, there is no quantitative scenario for a peregrine falcon, a predatory bird that eats primarily other birds. The closest surrogate was determined to be the “fish-eating bird” scenario. This scenario likely over-estimates the dose to the peregrine falcon because the hypothetical fish consumed are from a pond contaminated by a large spill of herbicide. Therefore, these hypothetical fish likely have higher concentrations of herbicide in their bodies (and thus a higher dose to the predatory bird) than would a small bird that incidentally ingested herbicide before it was preyed upon. Also, data was insufficient to assess risk of chronic exposures for insect-eating birds and mammals for several herbicides.

The spatial extent of infestations, which are often limited primarily to disturbed roadsides and the limits placed on herbicide applications, would reduce the exposure risk of wildlife to herbicides. To account for uncertainty, design criteria place restrictions on how and where herbicides are applied.

Professional judgment was used to evaluate the life history traits (e.g., diet, habitat, activity patterns, seasonal occurrence) of each wildlife species to determine the likelihood of exposure to herbicides used to treat invasive plants. The combination of likelihood of exposure, dose estimated from exposure scenarios, and GIS wildlife location data for the USFS were used to conclude a risk of effect from herbicide treatments. The exposure scenarios result in a dose below the toxicity index for aminopyralid, chlorsulfuron, clopyralid, fluroxypyr, imazamox, imazapic, imazapyr, picloram, sulfometuron methyl, and metsulfuron-methyl. However, terrestrial glyphosate, 2,4-D, dicamba, and triclopyr TEA pose low, but comparatively greater risk.

Data is limited regarding the potential for adverse effects of herbicides on amphibians. Some data suggestsamphibians may be as sensitive to herbicides as fish (Berrill et al. 1994; Berrill et al. 1997; Perkins et al. 2000), so for this analysis, herbicides that pose potential risk to fish (as determined by the quantitative estimates from exposure scenarios) will also be considered to pose a risk to amphibians.

3.4.6.1.5. Mechanical Treatment

Mechanical treatments would not involve spraying herbicides. It is expected that mechanical treatments would result in no impacts to terrestrial wildlife and plant species relative to chemical toxicity.

3.4.6.1.6. Biological Treatment

Biological treatments would not involve spraying herbicides. It is expected that biological treatments would result in no impacts to terrestrial wildlife and plant species relative to chemical toxicity.

3.4.6.1.7. Chemical Treatment—Wildlife

Direct impacts to wildlife species could occur from the potential exposure to various herbicides and associated chemicals through several routes. Wildlife can come in direct contact with herbicides externally from direct spray, grooming activities, or contact with contaminated vegetation, or internally through foraging on plants or prey species, or in a diluted form in drinking water. Wildlife can also be exposed to herbicides topically by inhalation through breathing direct spray or evaporated herbicide.

For wildlife in general, the risk characterization is limited by the relatively few species on which data is available compared to the large number of species that could potentially be exposed. This limitation and consequent uncertainty is common to most if not all ecological risk assessments. To account for this limitation, wildlife species were placed into groups based on taxa (i.e. bird, mammal, amphibian), body size (i.e., large, small), and diet (i.e., insectivore, piscivore, herbivore; Table 3-49).

Wildlife can also be affected by herbicides from changes in vegetation structure which depends on the specific treatment used, the particular herbicide, the rate of application, and the season of application. Direct impacts from herbicide application would be a change in composition of weeds, other forbs, grasses, and shrubs in treatment areas. Short-term impacts to plant composition and community diversity would likely last for as little as 3 years as native forbs recovered on the site. Proposed treatments are not expected to have any long-term loss of species diversity of native vegetation. Vegetative species composition can be expected to resemble native plant communities within 3 years.

In general, the introduction of contaminants into an ecosystem can cause direct harm to organisms, or may indirectly affect their ability to survive and reproduce. The most important factors regulating chemical toxicity in animals are the exposure dose, the duration of exposure, and the potency of the chemical. The nutritional, physiological, and genotypic state of an ecological receptor at the time of exposure can significantly modify the toxicity of the chemical or chemical mixture. Herbicide properties (i.e., toxicity, metabolism, environmental fate and transport) will also influence the impact herbicides will have on wildlife (WSDOT 2005). Information regarding the environmental fate of each herbicide being proposed is listed in the project record. Applications of herbicides are likely to alter terrestrial vegetation and may impact terrestrial animals by altering food availability and habitat quality. Secondary effects such as changes in reproductive capability or survivability, food availability or habitat quality are common to all herbicides (SERA 2011).

Table 3-49. Relationship between exposure scenarios considered to calculate hazard quotients in SERA risk assessments and species evaluated in this analysis

Species	Exposure Scenarios Considered
Canada Lynx	Small mammal direct spray, consuming contaminated water (spill), carnivore consuming small mammal
Northern Idaho ground squirrel	Small mammal direct spray, consuming contaminated water (spill), consuming contaminated vegetation & insects
Yellow-billed cuckoo	Small bird, consuming contaminated vegetation & insects
Wolverine	Small & large mammal scenarios considered, carnivore consuming small mammal, consuming contaminated vegetation & insects
Bighorn sheep	Large mammal, consuming contaminated vegetation
Gray wolf	Large mammal, carnivore consuming small mammal
Pygmy rabbit	Small mammal direct spray, consuming contaminated water (spill), consuming contaminated vegetation
Spotted bat	Small mammal direct spray, consuming contaminated water (spill), consuming contaminated insects
Fisher	Small mammal direct spray, consuming contaminated water (spill), consuming contaminated vegetation & insects, carnivore consuming small mammal
Southern Idaho ground squirrel	Small mammal direct spray, consuming contaminated water (spill), consuming contaminated vegetation & insects
Townsend's big-eared bat	Small mammal direct spray, consuming contaminated water (spill), consuming contaminated insects
Bald eagle	Large bird, predatory bird consuming small mammal & fish
Boreal owl	Small bird, predatory bird consuming small mammal
Greater sage-grouse	Large bird, consuming contaminated vegetation & insects
Peregrine falcon	Small & large bird scenarios considered, predatory bird consuming small mammal
Common loon	Large bird, predatory bird consuming fish
Mountain quail	Small bird, consuming contaminated vegetation & insects
Flammulated owl	Small bird, consuming contaminated vegetation & insects
White-headed woodpecker	Small bird, consuming contaminated insects & vegetation
American three-toed woodpecker	Small bird, consuming contaminated insects
Great gray owl	Large bird, predatory bird consuming small mammal
Columbian sharp-tailed grouse	Small & large bird scenarios considered, consuming contaminated vegetation & insects
Northern goshawk	Large bird, predatory bird consuming small mammal
Columbia spotted frog	Amphibian
Pileated woodpecker	Small bird, consuming contaminated insects & vegetation
Black-backed woodpecker	Small bird, consuming contaminated insects
PIF High Priority Bird Species[a]	Large & small bird scenarios considered, consuming contaminated vegetation & insects, predatory bird consuming small mammal scenario also considered
Mule Deer	Large mammal, consuming contaminated vegetation
Shiras Moose	Large mammal, consuming contaminated vegetation
Rocky Mountain Elk	Large mammal, consuming contaminated vegetation

[a] High priority species are those species that scored high in the Idaho Partners in Flight (PIF) prioritization process, which indicates a high vulnerability of populations. A complete explanation of the rationale is found in the Idaho Bird Conservation Plan (Idaho PIF 2000).

The SERA risk assessments evaluate the potential effects to organisms by calculating HQs. The HQ is the amount of herbicide or additives to which an organism may be exposed over a specified period divided by that estimated daily exposure level at which no adverse health

effects are likely to occur. The SERA risk analyses include HQs for ‘acute’ and ‘chronic’ exposure scenarios. Acute scenarios are single exposures or exposures that occur over a short period of time, typically 10-days or less. Chronic scenarios, or longer-term scenarios, are intended to estimate dose levels associated with a negligible or at least defined level of risk over a lifetime of exposure.

Table 3-50 and Table 3-51 display the central HQs (e.g., median of the typical application rate range) for proposed herbicides where exposure scenarios resulted in HQs greater than 1.0. An HQ less than or equal to one indicates an extremely low level of risk, and is presumed to indicate a level of exposure below the LOC for adverse health effects. The potential adverse health effects for scenarios involving HQs that exceed 1.0 are discussed under each herbicide in the following section.

Proposed herbicides not included in Table 3-50 and Table 3-51 (aminopyralid, chlorsulfuron, clopyralid, fluroxypyr, imazamox, imazapic, imazapyr, metsulfuron methyl, sulfometuron methyl, aquatic glyphosate, and picloram) resulted in HQs less than 1.0 for all exposure scenarios. Please see the project record for exposure scenarios of all proposed herbicides. An analysis of effects to wildlife species for each proposed herbicide, regardless of the central HQ value, has been completed and is included in the following discussion.

The SERA risk analyses calculate upper bound HQs to represent the “worst case” of each exposure scenario and lower, “best-case” HQs. The calculation of upper bound HQs do not account for factors such as timing and method of application, animal behavior and feeding strategies, seasonal presence or absence within a treatment area, and/or implementation of project design criteria. Therefore, risk is over-estimated when the proposed application methods for this project are considered. While some discussion of upper bound HQs occurs in this analysis, central HQs are considered a more accurate estimate of risk associated with the project. All upper and lower bound HQs can be found in the full SERA worksheets located in the project record.

Table 3-50. Proposed herbicides which *central* Hazard Quotients exceeded 1.0 when applying median of *typical*[a] application rate (herbicides not exceeding 1.0 not listed)

Exposure Scenario	Central Hazard Quotient		
	2,4-D amine	Dicamba	Triclopy TEA
Application Rate lbs (ae or ai)/acre	1.5	1.25	1.5
Acute[b]			
Direct spray, small mammal	1.5	-	-
Amphibians	-	-	-
Consume contaminated vegetation[c]			
Large mammal	1.0	-	4.0
Small mammal	-	-	-
Large bird		2.0	-
Small bird	-	-	4.0
Consume contaminated water			
Spill, small mammal	-	-	-
Consume contaminated insects			
Small mammal	1.4	-	-
Small bird	-	3.0	-
Consume contaminated prey			
Carnivore (consuming small mammal)	3.0	-	-
Predatory bird (consuming small mammal)	-	-	-
Predatory bird (consuming fish)	-	-	-
Chronic[d]			
Consume contaminated vegetation[c]			
Large mammal	-	-	7.0
Small mammal	-	-	-
Large bird	-	-	-
Small bird	-	-	7.0
Consume contaminated water			
Small mammal	-	-	-
Consume contaminated insects			
Small mammal	-	-	-
Small bird	-	-	-
Consume contaminated prey			
Carnivore (small mammal)	-	-	-
Predatory bird (small mammal)	-	-	-
Predatory bird (fish)	-	-	-

[a] Typical application rate is the median of the typical application rate range proposed for the SNF and BNF
[b] Acute scenarios - single exposures or exposures that occur over a short period, typically 10-days or less.
[c] Includes hazard quotients for contaminated grass and fruit
[d] Chronic scenarios – longer term exposure, intended to estimate dose levels associated with a negligible or at least defined level of risk over a lifetime of exposure.

Table 3-51. Proposed herbicides which *central* Hazard Quotients exceeded 1.0 when applying *maximum* application rates (herbicides not exceeding 1.0 not listed)

Exposure Scenario	Central Hazard Quotient			
	2,4-D amine	Dicamba	Glyphosate Terrestrial	Triclopyr TEA
Application Rate lbs (ae or ai)/acre	4.0	2.0	4.0	2.0
Acute[a]				
Direct spray, small mammal	4.0	1.1	-	-
Amphibians[b]	-	-	1.1	-
Consume contaminated vegetation[c]				
Large mammal	3.0	-	-	5.0
Small mammal	2.0	-	-	-
Large bird		4.0		-
Small bird	-	-	-	6.0
Consume contaminated water				
Spill, small mammal	-	-	-	-
Consume contaminated insects				
Small mammal	4.0	1.0	-	-
Small bird	-	6.0	-	-
Consume contaminated prey				
Carnivore (consuming small mammal)	8.0	-	-	-
Pred. bird (consuming small mammal)	-	-	-	-
Pred. bird (consuming fish)	-	-	-	-
Chronic[d]				
Consume contaminated vegetation[c]				
Large mammal	-	-	-	9.0
Small mammal	-	-	-	1.3
Large bird	-	-	-	1.1
Small bird	-	-	-	9.0
Consume contaminated water				
Small mammal	-	-	-	-
Consume contaminated insects				
Small mammal	-	-	-	-
Small bird	-	-	-	-
Consume contaminated prey				
Carnivore (small mammal)	-	-	-	-
Pred. bird (small mammal)	-	-	-	-
Pred. bird (fish)	-	-	-	-

[a] Acute scenarios - single exposures or exposures that occur over a short period, typically 10-days or less.
[b] Application of terrtrial glyphosate is restricted to distances greater than 100 feet from the waterline.
[c] Includes hazard quotients for contaminated grass and fruit
[d] Chronic scenarios – longer term exposure, intended to estimate dose levels associated with a negligible or at least defined level of risk over a lifetime of exposure.

2,4-D amine

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): In general, 2,4-D is considered to be moderately toxic to

mammals based on criteria specified by EPA (1985). In acute dermal toxicity studies, the effects range from slightly toxic to practically non-toxic through dermal exposures (USDI 1989; WSDOT 2003). Chronic toxicity of 2,4-D was tested in dietary studies on dogs (canids). These studies resulted in death most likely due to canids' inefficiency of excreting organic acids (WSDOT 2005). Under EPA classifications for acute toxicity, 2,4-D is slightly to moderately toxic to mammals.

At any application rate or scenario measured, an HQ greater than 1.0, exceeds the LOC. At the typical application rate of 1.5 pound (lb) acid equivalent (a.e.)/acre, central HQs exceed 1.0 for small mammals consuming contaminated insects (acute exposure, HQ = 1.4); large mammals consuming grass (acute exposure, HQ = 1.0); carnivorous mammals consuming small mammals (acute exposure, HQ = 3.0); and the direct spray of a small mammal (acute exposure, HQ = 1.5) (SERA 2006). HQs do not exceed 1.0 for any exposure scenarios assessed under longer-term (chronic) conditions.

Five exposure scenarios resulted in central HQs that exceed the LOC (HQ = 1.0) when applying the maximum application rate (4 lb a.e./acre). For acute exposures, these scenarios involve direct spray of a small mammal (HQ = 4.0), a large mammal consuming contaminated grass (HQ = 3.0), a small mammal consuming contaminated grass (HQ = 2.0), a small mammal consuming contaminated insects (HQ = 4.0), and a carnivorous mammal consuming a small mammal (HQ = 8.0).

For non-canid mammals, the acute No Observed Adverse Effect Level (NOAEL)[11] of 25 milligrams/kilograms (mg/kg)/day is from the developmental study by Nemic et al. (1983a) in which adverse effects (i.e., decreased body-weight gains in dams and skeletal abnormalities in offspring) were noted at 75 mg/kg/day. Based on these values, adverse effects could be anticipated at HQ values of 3 or more (i.e., 75 mg/kg/day ÷ 25 mg/kg/day). The potential effects at intermediate HQ values (i.e., >1 to <3) cannot be characterized. Using this approach, adverse effects could be expected at the typical application rate of 1.5 lb a.e./acre for carnivores consuming small mammals and three exposure scenarios at the highest application rate (SERA 2006). This risk characterization for non-canid mammals is consistent with the risk assessments by the EPA/OPP (2004b) in which HQs for acute exposure exceed the LOC for mammals foraging on vegetation and insects, following broadcast spray application of 2,4-D. The EPA risk assessment does not give risk characterizations for canids, thus no comparison is possible. For canids, the acute NOAEL of 1.3 mg/kg/day is from the toxicity study in dogs by Beasley et al. (1991) in which adverse effects (i.e., changes in the behavior of muscles) were noted at 8.8 mg/kg/day. Based on these values, adverse effects could be anticipated at HQ values of about 7 or more (i.e., 8.8 mg/kg/day ÷ 1.3 mg/kg/day).

However, reported HQs likely over-estimate risk because not all acres treated would be treated at the highest application rate, and for individuals to be exposed to potentially harmful doses, 100% of their diet would have to be contaminated. It is unlikely that large numbers of small mammal prey species would be directly sprayed because 2,4-D is not

[11] NOAEL (No Observed Adverse Effect Level) - Effects that are attributable to treatment but do not appear to impair the organisms' ability to function and clearly do not lead to such impairment.

proposed for aerial application. 2, 4-D is also restricted from application within and near occupied pygmy rabbit and NIDGS habitat.

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Dietary studies indicate that 2,4-D ranges from moderately toxic to practically non-toxic in birds. Under EPA classifications for acute toxicity, 2,4-D is practically non-toxic to moderately toxic to birds.

Based on reproductive studies, birds appear to be more tolerant to 2,4-D than mammals. Longer-term exposure to 2,4-D is not likely to cause adverse effects in birds. All longer-term HQ values for birds are below the LOC (i.e., 1.0) even at the highest application rate. While adverse effects due to the acute toxicity of 2,4-D remains a matter of concern, the plausibility of adverse effects in birds is much less compelling than in the risk characterization for mammals (SERA 2006).

All chronic HQ values for birds are below the LOC (i.e., 1.0) even at the highest application rate. Thus, there is no basis for asserting that toxic effects from longer-term exposures to 2,4-D are plausible.

For amphibians (Columbia spotted frog): Under EPA classifications for acute toxicity, 2,4-D acid/salts formulations are practically non-toxic to amphibians. Several acute exposure studies showed that toads exposed to 2,4-D acid were the most sensitive, while leopard frogs exposed to 2,4-D were the most tolerant.

Over the range of 2,4-D acid/salt application rates, adverse effects on amphibians are likely only in the event of an accidental spill; however, with 2,4-D esters, adverse effects on amphibians are plausible in association with runoff and would be expected in direct application for weed control and in cases of relatively large accidental spills (2006). For 2,4-D acid and salts, the HQ values associated with non-accidental exposures (i.e., typical application rates) are below the trigger values (HQ less than 1.0), where at the maximum application rate of 4 lb a.e./acre, HQ values are recorded as 2.0 (SERA 2006).

Central HQ values associated with non-accidental (i.e., acute and long-term scenarios) exposures are well below the trigger values (HQ less than 1.0) for the typical and maximum application rates (SERA 2006). All upper HQ values associated with acute and long-term exposure scenarios are also below 1.0. Over the range of 2,4-D application rates, adverse effects on amphibians are only likely in the event of an accidental spill. Project design criteria further reduce risk to amphibians by restricting broadcast application of 2,4-D to distances greater than 100 feet from the waterline.

The results of the 2,4-D risk assessment for all taxa suggest that consideration should be given to alternate herbicides, and that use of 2,4-D should be limited to situations where other herbicides are ineffective or to situations in which the risks posed by 2,4-D can be mitigated (SERA 2006).

Aminopyralid

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn

sheep, mule deer, moose, elk): For Aminopyralid, there is no basis for asserting that adverse effects are plausible in large or small mammals (HQs for all exposure scenarios less than 1.0) (SERA 2007a). The risk characterization for mammals is consistent with the risk characterization presented by the EPA, which found no basis for asserting that adverse effects in mammals are plausible (EPA/OPP-EFED 2004).

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): For Aminopyralid, the risk characterization for birds is similar to that of mammals in that no HQs exceed the LOC (all exposure scenarios resulted in HQs less than 1.0). Unlike the case with mammals, the upper bound of the acute HQs approach a LOC at the highest application rate (i.e., a HQ of 0.6 for a large bird consuming contaminated grasses, and a HQ of 0.9 for a small bird consuming contaminated insects) HQs for the longer-term exposure scenarios for birds are also very low: a maximum HQ of 0.01 for a large bird consuming contaminated vegetation and 0.00001 for a fish-eating bird consuming contaminated fish (SERA 2007a).

For amphibians (Columbia spotted frog): Based on an acute toxicity study on northern leopard frog larvae (Henry et al. 2003), the EPA has classified aminopyralid as practically non-toxic to aquatic-phase amphibians (EPA.OPP-EFED 2004). The NOAEL value used in this study is very similar to the 100 mg a.e./L for tolerant species of fish; hence the HQs for amphibians are similar to those in fish and do not exceed or approach a LOC. The risk characterization for amphibians is particularly weak based on the severe limitation of available data. The most that can be said is that the very limited acute toxicity data on amphibians indicate that leopard frog larvae are no more sensitive to aminopyralid than fish (SERA 2007a). Since the risk assessment is based on only one study, caution should be use when spraying aminopyralid formulations around amphibians, especially knowing the high permeability of amphibian skin.

Chlorsulfuron

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): For chlorsulfuron, there is no basis for asserting that adverse effects are plausible in large or small mammals (HQs for all exposure scenarios <1.0) (SERA 2004a). Based on acute oral, dermal, and inhalation studies, chlorsulfuron is considered to be practically non-toxic to mammals (Dupont 2001; Denny 1991; USDA 1994). The most consistent toxic effects observed in mammals after exposure to chlorsulfuron are body weight loss and decreased body weight gain. In standard experimental toxicity studies, chlorsulfuron has low acute oral toxicity (EPA 1999).

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Studies indicate that chlorsulfuron is practically non-toxic to birds (WSDOT 2006b). Quantitative risk characterization is that no adverse effects in mammals or birds appear to be plausible using exposure assumptions at the typical application rate of 0.015 lb a.e./acre or the maximum application rate of 0.25 lb a.e./acre.

Feeding studies by Hinkle (1979) and Fink et al. (1981) did not result in any mortality or signs of toxicity. In a feeding study by Beavers et al. (1992), no treatment related mortalities, signs of toxicity (including weight loss), or effects on reproductive parameters were observed in ducks that were fed chlorsulfuron in the diet (SERA 2004a).

For amphibians (Columbia spotted frog): Neither the published literature nor the EPA files include data regarding the toxicity of chlorsulfuron to amphibian species. Since there is no specific data available for amphibians, it is assumed that during amphibians' aquatic life stages this herbicide is considered as low in toxicity as it is for aquatic species; and during amphibians' terrestrial life stages, it is considered as low in toxicity as it is for terrestrial organisms. Since the risk assessment is based on limited or no data, caution should be use when spraying chlorsulfuron formulations around amphibians, especially knowing the high permeability of amphibian skin. Therefore, design criteria prohibiting broadcast spraying near water (see Appendix G) and restrict herbicide application in RCAs were developed to minimize risk to amphibians.

Clopyralid

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): For clopyralid, there is no basis for asserting that adverse effects are plausible in large or small mammals (HQs for all exposure scenarios <1.0) (SERA 2005). Based on acute oral, dermal, and inhalation studies, clopyralid is considered to be practically non-toxic to mammals (Dow Agroscience 1999). Numerous toxicity studies demonstrate that the acute toxicity of clopyralid is relatively low for mammals. Consequently, no adverse effects are anticipated in terrestrial wildlife from the use of clopyralid at the typical application rate of 0.3 lb a.e./acre or maximum application rate of 0.5 lb a.e/acre. Concerning the characterization of risk, clopyralid has been tested in only a limited number of species and under conditions that may not well-represent populations of free-ranging non-target wildlife. However, the available data is sufficient to assert that adverse effects in terrestrial wildlife from the use of clopyralid do not appear to be likely (SERA 2005).

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Studies indicate that clopyralid is practically non-toxic to birds (WSDOT 2006c). A limited number of acute toxicity and dietary studies have been conducted on birds. None of the exposures tested resulted in significant data to estimate mortality. In a standard acute toxicity study, Dabbert et al. (1997) found that direct spraying of bobwhite quail eggs at up to 0.56 kg a.e./ha caused no gross effects (i.e., viability, hatchability, body weight) and no effects on immune function in chicks. Based on very limited data, birds may be somewhat more sensitive to clopyralid than mammals (SERA 2005).

For amphibians (Columbia spotted frog): Neither the published literature nor the EPA files include data regarding the toxicity of clopyralid on amphibian species (SERA 2005). Since there is no specific data available for amphibians, it is assumed that during amphibians' aquatic life stages, this herbicide is considered as low in toxicity as it is for aquatic species;

during amphibians' terrestrial life stages, this herbicide is considered as low in toxicity as it is for terrestrial mammals. Since the risk assessment is based on limited or no data, caution should be use when spraying chlorsulfuron formulations around amphibians, especially knowing the high permeability of amphibian skin. Therefore, design criteria that prohibit broadcast spraying near water and restrict herbicide application in RCAs were developed to minimize risk to amphibians (Appendix G).

Dicamba

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): Based on acute oral and dermal studies (USDA 1994), dicamba is considered to have a relatively non-toxic to slight to moderate toxicity for mammals, with LC_{50} values ranging from approximately 500 mg/kg to greater than 4600 mg/kg (SERA 2004c). Acute dermal studies have shown a slight toxicity, and acute inhalation tests have shown a moderate toxicity to dicamba (WSDOT 2006d).

Diet/consumption chronic studies have shown mixed toxicity levels. Daily doses of dicamba produced no observable effects for survival, body weight, food consumption, organ weight, blood chemistry, or tissue structure (WSDOT 2006d; EXTOXNET 1996a). Consumption of the chemical at high levels for a long period of time has been shown to cause changes in the liver and a decrease in body weight. Varying doses of dicamba during pregnancy in rabbits has resulted in slightly reduced fetal weights, toxic effects on the mothers, and increased loss of fetuses (EXTONET 1996a). At the typical application rate of 1.25 lb/acre, HQs did not reach a LOC.

At the highest application rate of 2 lb/acre, HQs meet and slightly exceed a LOC in acute exposure scenarios involving small mammals consuming contaminated insects (HQ = 1.0) and small mammals being directly sprayed (HQ = 1.1). None of the longer-term scenarios resulted in HQs that exceed the LOC at the highest application rate (SERA 2004b).

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Based on acute oral/diet studies, dicamba is practically non-toxic to slightly toxic in acute exposures to birds (WSDOT 2006d). Two chronic reproductive studies were conducted on mallard ducks and bobwhite quail (Beavers et al. 1994). The diet included a NOAEL of 800 parts-per million (ppm) (92 mg/kg/day) and a LOAEL[12] of 1,600 ppm (184 mg/kg/day). Mallards appeared to be more sensitive with the dietary NOAEL and LOAEL. The LOAEL was based on reduced hatchability and survival of offspring. No signs of neurotoxicity were reported. In bobwhite quail, no effects were seen on any reproductive parameters at 1,600 ppm (SERA 2004b).

At the typical application rate of 1.25 lb/acre, adverse effects on birds are plausible for acute exposures involving large birds consuming contaminated vegetation (HQ = 2.0) and small birds consuming contaminated insects (HQ = 3.0). At the highest application rate of 2 lb/acre, adverse reproductive effects are plausible in acute exposure scenarios involving birds

[12]Lowest Observed Effect Level (LOEL): The lowest exposure concentration associated with an adverse effect.

consuming contaminated vegetation or contaminated insects. The HQs associated with the long-term consumption of contaminated vegetation are significantly below the LOC. For acute consumption of contaminated vegetation, a HQ of 1.7 is associated with a dose of 152 mg/kg/day. This dose approaches the dietary reproductive LOAEL of 184 mg/kg/day that was associated with reduced hatchability and survival of offspring. Therefore, adverse effects on offspring appear to be plausible at the upper ranges of exposure that are associated with the typical and maximum application rates (SERA 2004b).

However, dicamba is not proposed for aerial application and design criteria prohibits broadcast spraying more than 0.5 acre per application, reducing the risk estimated by the reported HQ values.

Reported HQs likely over-estimate risk because not all acres treated would be treated at the highest application rate, nor would all acres be treated by broadcast spray applications on greater than 0.5 acre per application. For animals to be exposed to potentially harmful doses, herbicides would have to be broadcast sprayed over a large enough area that the animal could forage exclusively within the treatment area to result in 100% of their diet being contaminated.

For amphibians (Columbia spotted frog): Based on limited studies, dicamba is slightly toxic to terrestrial-phase amphibians, with a reported LC_{50} concentration of greater than 10 ppm, (USDA 1995). Other acute toxicity studies with 24- to 96-hour LC_{50} values in the range of 106 to 220 mg/L indicate that dicamba is relatively non-toxic to terrestrial-phase amphibians.

Available toxicity information for some herbicides indicates that amphibians and fish have a similar sensitivity to herbicides (Berrill et al. 1997). Therefore, fish were used as surrogates to predict risk to amphibian species for aquatic scenarios.

A large number of toxicity studies are available on dicamba in several aquatic species, but the reported values are highly variable, with LC_{50} values in some studies being less than reported NOAEC[13] values in the same species from another study. Consequently, for the characterization of risk, NOAEC values are not used directly and risks are characterized using LC_{50} values. This is an atypical expression of risk and is presented solely as means of comparing exposures to the available toxicity data. Within these very serious limitations, there is little basis for asserting that adverse effects in aquatic animals are plausible. For acute exposures, the HQs are in the range of 0.000003 to 0.0001. For longer term exposures, the HQs are in the range of 0.000000009 to 0.000002. While these values cannot be overly interpreted, both acute and longer term NOAEL values are generally below LC_{50} values by factors of far less than 10,000 (SERA 2004b). Design criteria that prohibit broadcast spraying near water and restrict herbicide application in RCAs were developed to minimize risk to amphibians (Appendix G).

Fluroxypyr

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn

[13] No Observed Adverse Effect Level (Human Health Risk Assessment)/No Observed Adverse Effect Concentration (Ecological Risk Assessment) (NOAEL/NOAEC): Effects that are attributable to treatment but do not appear to impair the organisms ability to function and clearly do not lead to such impairment.

sheep, mule deer, moose, elk): Fluroxypyr was found to be practically non-toxic to small mammals based on acute oral and dermal toxicity studies. The risk characterization for mammals is simple and unambiguous; there is no basis for asserting that exposure to fluroxypyr will cause adverse effects in mammals. At the maximum application rate of 0.5 lb a.e./acre and over the range of the estimated exposures, the upper bounds of the HQs for mammals range from 0.000008 (the longer-term consumption of surface water by a small mammal) to 0.3 (the consumption of contaminated insects by a small mammal). This range is below the LOC (1.0) by factors of 10 to 125,000 (SERA 2009a).

This risk characterization for mammals is qualitatively consistent with the EPA risk characterization, which finds no basis for asserting that adverse effects in mammals are plausible based on both acute RQs and chronic RQs (EPA/OPP 1998b). Note that RQ, a term used by the EPA, is essentially the same as an HQ, in that the RQ is the ratio of the estimated exposure to the toxicity value. The EPA RQs for acute and chronic exposure are all below 0.01. These values are much lower than the maximum RQ of 0.3 in the current SERA risk assessment. The difference is due primarily to the selection of toxicity values (i.e., the EPA uses an LD50 of 880 mg/kg body weight, while this SERA risk assessment uses the oral NOAEL of 100 mg/kg body weight/day).

Since all HQ values are based on the maximum application rate and are all below the LOC, the use of lower application rates does not qualitatively affect the risk characterization (i.e., there is no basis for asserting that adverse toxic effects to mammals are plausible).

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): The risk characterization for birds is qualitatively identical to that for mammals. At the maximum application rate of 0.5 lb a.e./acre, there is no basis for asserting that adverse toxic effects in birds are plausible. However, the upper bounds of the HQs for birds are somewhat higher than those for mammals, ranging from 0.00007 (the longer-term consumption of surface water by a small bird) to 0.5 (the consumption of contaminated fish by a predatory bird). This range of HQ values is below the LOC (1.0) by factors of 2 to somewhat over 14,000.

Qualitatively, the risk characterization for birds presented in the risk assessment is similar to the EPA's (EPA/OPP 1998b) in that none of the HQs (referred to as RQs by EPA) exceed a LOC. The RQs developed by the EPA are not directly comparable to those in SERA risk assessments because of differences in the toxicity values as well as differences in the exposure assessments. For acute toxicity, EPA/OPP (1998b) does not present formal RQs but notes that the highest expected concentration in the food of wildlife would be 60 ppm, compared with a dietary toxicity value of 5,000 ppm, which corresponds to a RQ of 0.012. The highest longer-term RQ given by EPA/OPP (1998b) is 0.24, virtually identical to the chronic HQ value in the SERA risk assessment for the longer-term consumption of contaminated vegetation by a large bird feeding exclusively on the treated site.

Since all HQ values are based on the maximum application rate and are all below the LOC, the use of lower application rates does not qualitatively affect the risk characterization (i.e., there is no basis for asserting that adverse toxic effects to birds are plausible).

For amphibians (Columbia spotted frog): No information on toxicity to reptiles or terrestrial-phase amphibians was identified. For aquatic scenarios, fish were used as surrogates to predict risk to amphibian species. Available toxicity information for some herbicides indicates that amphibians and fish have a similar sensitivity to herbicides (Berrill et al. 1997).

The risk characterization for fish, which is based on expected peak concentrations of fluroxypyr-MHE in surface water, is relatively simple; there is no basis for asserting that adverse effects on tolerant or sensitive species of fish are plausible. As discussed in section 4.3.3.1 of the risk assessment, fluroxypyr-MHE and fluroxypyr acid are classified as practically non-toxic to fish, and there is no defined adverse effect level for fish. More importantly, acute toxicity studies in fish indicate that nominal exposure levels of up to 100 mg/L to fluroxypyr-MHE do not cause detectable adverse effects. As discussed in the exposure assessment for aquatic organisms (Section 4.2.5), this apparent lack of toxicity is likely to be at least partially attributable to the low water solubility of fluroxypyr-MHE (i.e., about 0.09-0.136 mg/L). Thus, the maximum HQ of 0.7, upper bound of the HQ for sensitive species of fish, should not be interpreted as meaning that twice the estimated level of exposure would exceed a LOC. For fluroxypyr-MHE, it does not appear that fluroxypyr-MHE could reach a LOC. This conclusion is consistent with the assessment by the EPA/OPP (1998b).

Glyphosate

Terrestrial Formulations

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): For the typical application rate of 1.75 lb a.e./acre, the highest HQ for mammals is the upper bound HQ of 0.7 associated with the acute exposure of a small mammal consuming contaminated insects. For the maximum application rate of 4 lb a.e./acre, the highest HQ for mammals is the upper bound HQ of 1.6 associated with the acute exposure of a small mammal consuming contaminated insects exclusively.

At application rates above 2.5 lb a.e./acre, risks to mammals cannot be ruled out based on upper bound estimates of exposure, but no risks are apparent based on central estimates of exposure. Field studies in mammalian wildlife have failed to note adverse effects on reproduction. Sullivan et al. (1990) stated that, based on a number of parameters in populations of small mammals, no adverse effects in small mammals could be associated with Roundup spray.

At application rates of 2.5 lb a.e./acre or less, "worst-case" exposure assessments indicate that mammals are not at risk. Based on the central and more likely estimates of exposure, no risks to mammals are apparent. The SERA risk assessment is also supported by well-documented field studies that failed to identify adverse effects in populations of small mammals following applications of Roundup (Sullivan 1990) as well as another unidentified formulation of glyphosate (Ritchie et al. 1987).

Tu et al. (2001) cited a study that measured residue levels in litter and ground cover and were detectable for 55 days at declining levels. The study concluded that carnivores were at lower risk to herbicide exposure than herbivores due to the lower relative visceral weights and a proportionally lower level of food intake.

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Based on studies in acute oral, dietary, and terrestrial applications, glyphosate is considered practically non-toxic to birds. The risk characterization for birds is based on a somewhat higher acute NOAEL (540 mg/kg body weight vs 175 mg/kg body weight for mammals), but a somewhat lower longer-term NOAEL (43 mg/kg body weight versus 175 mg/kg body weight for mammals). These differences are reflected in lower acute but higher chronic HQs for birds, relative to mammals (SERA 2011).

As with mammals, none of the HQs for birds exceed the LOC at the typical application rate of 1.75 lb a.e./acre. For the typical application rate, the highest HQ for birds is the upper bound HQ of 0.5 associated with the longer-term consumption of contaminated grass by a large bird. The upper bound HQ for consumption of contaminated grass by a large bird would reach a LOC (HQ = 1) at an application rate of about 3.3 lb a.e./acre. At the maximum application rate of 4 lb a.e./acre, the highest upper bound HQ (1.2) is associated with the longer-term consumption of contaminated grass by a large bird. The highest central estimate (i.e., most likely) HQ for the maximum application rate is associated with short-term consumption of contaminated insects by a small bird (HQ = 0.3).

In the study by Kubena et al. (1981) on which the NOAEC level of 43 mg/kg bw/day is based, a 10-fold higher dietary exposure is only associated with mild signs of toxicity, including decreased body weight and changes in bone composition. Thus, no basis exists for asserting that severe adverse effects are likely to be observed in birds exposed to application rates greater than 3.3 lb a.e./acre or at the maximum rate of about 4 lb a.e./acre (SERA 2011a). According to the 2011 SERA risk assessment, application rates greater than about 3.3 lb a.e./acre will result in modest excursions above an HQ of 1 at the upper bounds for some exposures (SERA 2011); however no direct evidence exists that these exposures would likely be associated with overt adverse effects.

For amphibians (Columbia spotted frog): For the typical application rate of 1.75 lb a.e./acre, the non-accidental, short-term exposure scenario for sensitive amphibians resulted in a central HQ of 0.5 and an upper bound, “worse case” HQ of 4.0. For the maximum application rate of 4 lb a.e./acre, the SERA risk assessment reports a central HQ of 1.1 and a “worse case,” upper bound HQ of 8.0. Long-term exposure HQs did not exceed 1.0 for the typical or maximum application rates.

Based on mixed results from numerous studies, this proposal prohibits the application of terrestrial formulations of glyphosate (i.e., those containing POEA) near water (within 100 feet) and within riparian areas.

Aquatic Formulations

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend’s big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): Aquatic formulations of glyphosate are considered practically non-toxic to mammals (WSDOT 2006). HQs for the typical application rate were all well below zero. At the maximum application rate of 4 lb a.e./acre, the highest upper bound HQ (0.02) is associated with a spill scenario resulting in the consumption of contaminated water by a small mammal. The highest central estimate (i.e., most likely) HQ for the maximum

application rate is associated with a spill scenario resulting in the consumption of contaminated water by a small mammal (HQ = 0.005). Therefore, aquatic formulations of glyphosate pose no apparent risks to mammals.

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Based on studies in acute oral, dietary, and terrestrial applications, aquatic glyphosate is considered practically non-toxic to birds. The risk characterization associated with the aquatic formulations of glyphosate is extremely simple for birds, as is the case for mammals. As with mammals, none of the HQs for birds exceed the LOC at the typical or maximum application rates. At the maximum application rate of 4 lb a.e./acre, the highest upper bound HQ is 0.01, associated with the consumption of contaminated water by a small bird. Thus, there is no basis for asserting aquatic formulations of glyphosate pose risks to birds (SERA 2011a).

For amphibians (Columbia spotted frog): The accidental spills associated with the aquatic formulation of glyphosate lead to exceedances in the upper bound of the HQ for most, but not, all sensitive aquatic species (i.e., 36 for fish, 0.05 for amphibians, 7 for invertebrates, 14 for macrophytes, and 79 for algae). The relatively low HQ (0.05) for sensitive amphibian species is associated with several studies that clearly indicate that the acute toxicity of aquatic glyphosate to amphibians is very low (SERA 2011a).

Imazamox

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): There is no basis for asserting that adverse effects are plausible in mammals. For terrestrial applications, the highest HQ is 0.1, the upper bound of the HQ for a small mammal consuming contaminated insects. This HQ is below the LOC (HQ = 1) by a factor of 10. For aquatic applications, the highest HQ is 0.01, the upper bound of the HQ for small mammal consuming contaminated water following an accidental spill. This HQ is below the LOC by a factor of 100 (SERA 2010).

The only elaboration associated with these HQs is that they probably overestimate risk. The NOAEL for mammals is taken as 300 mg/kg bw/day, the NOAEL used to derive the RfD for imazamox in the human health risk assessment. Other NOAELs from chronic toxicity studies suggest that no adverse effects are likely to occur in mammals at doses of up to 1300 mg/kg bw/day. While the use of the lower NOAEL of 300 mg/kg bw/day may be viewed as conservative, this has no impact on the risk characterization (SERA 2010).

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): As with mammals, there is no basis for asserting that the use of imazamox will lead to toxic effects in birds. For terrestrial exposures, the maximum HQ is 0.06, below the LOC by a factor of about 17. This HQ is associated with the longer-term consumption of contaminated vegetation by a large bird that feeds exclusively on vegetation treated with imazamox. For aquatic applications, the highest HQ is 0.003, below

the LOC by a factor of over 300, and this HQ is associated with the consumption of contaminated water following an accidental spill (SERA 2010).

As with the HQs for mammals, the only reservation with the HQs for birds is that they probably overestimate risk. As detailed in the dose-response assessment for birds, toxic exposure levels of imazamox have not been defined for birds.

For amphibians (Columbia spotted frog): Risks to reptiles and terrestrial-phase amphibians cannot be characterized directly because of the lack of data on the toxicity of imazamox to this group of organisms. Based on the risk characterization for birds, as well as all other groups of terrestrial animals for which data is available, there is no basis for assuming that reptiles or terrestrial-phase amphibians are likely to be at risk from exposures to imazamox.

For aquatic scenarios, fish were used as surrogates to predict risk to amphibian species. Available toxicity information for some herbicides indicates that amphibians and fish have a similar sensitivity to herbicides (Berrill et al. 1997).

While limited, the available toxicity data on fish suggests that imazamox concentrations in surface water are unlikely to have an adverse effect on fish. For terrestrial applications of imazamox, the upper bound HQ for an accidental spill is 0.08, below the LOC by a factor of about 12. Based on peak expected concentrations of imazamox in surface water, the upper bound of the HQ is 0.0008, below the LOC by a factor of 1,250. For aquatic applications, the HQs are higher but still below the LOC. The upper bound HQ for an accidental spill is 0.2 and the upper bound HQ based on the maximum target concentration of 0.5 mg a.e./L is 0.004, below the LOC by a factor of 250. The lack of an adequately documented chronic toxicity value for fish precludes the development of a chronic HQ for fish. Nonetheless, given the very low HQs associated with expected peak concentrations of imazamox in surface water, as well as the general lack of any dose-duration relationship for imazamox in terrestrial animals, there is no basis for substantial concern about longer-term adverse effects in fish, and in this comparison, aquatic-phase amphibians.

Imazapic

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's b-Big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): Based on dietary concentration studies, larger mammals, such as canids and lagomorphs, may be more sensitive to imazapic than smaller mammals, such as rodents. No toxic effects have been observed in rodents tested at very high dietary concentrations of imazapic over prolonged periods of time (SERA 2004c). Based on dose-response assessments (i.e., acute NOAEL of 350 mg/kg/day and chronic NOAEL of 45 mg/kg/day), none of the exposure scenarios, acute or chronic, result in exposure estimates that exceed the applicable NOAEL (i.e., HQ less than 1.0). Based on the maximum application rate of 0.1875 lb/acre, the highest HQ for acute and chronic exposure is 0.02, which is below the LOC by a factor of 25. Therefore, the weight of evidence suggests that no adverse effects in mammals are plausible using the "worst-case" exposure assumptions at the maximum application rate of 0.1875 lb/acre (SERA 2004c).

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-

backed woodpecker, and migratory birds): Based on dietary concentration studies, chronic toxicity of imazapic to birds is comparable to that in canids, and has a low order of acute and chronic toxicity in birds (i.e., very low HQs for acute and chronic exposure) (SERA 2004d). For dose-response assessments, birds appear to be somewhat less sensitive to imazapic than mammals. For studies on sub-chronic toxicity and reproductive effects in both ducks and quail (dietary concentrations of 1,658 ppm to 1,907 ppm), no signs of systemic toxicity or reproductive effects (i.e., egg production, hatchability, and survival of hatchlings) were observed (Mortensen et al. 1998; Miller et al. 1998). Pharmacokinetic studies have been conducted in birds (hens) (Afzal 1994; Gatterdam 1993); these studies indicate that imazapic is rapidly excreted unchanged and does not accumulate in body tissue and no detectable concentrations of imazapic were found in eggs. Based on the maximum application rate of 0.1875 lb/acre, the highest HQ for acute and chronic exposure is 0.02, which is below the LOC by a factor of 25. Therefore, the weight of evidence suggests that no adverse effects in birds are plausible using the "worst-case" exposure assumptions at the maximum application rate of 0.1875 lb/acre (SERA 2004c).

For amphibians (Columbia spotted frog): No toxicity data is available for terrestrial-phase amphibians. Therefore, no quantitative risk characterization for terrestrial-phase amphibians can be made (SERA 2004c).

For aquatic scenarios, fish were used as surrogates to predict risk to amphibian species. Available toxicity information for some herbicides indicates that amphibians and fish have a similar sensitivity to herbicides (Berrill et al. 1997). All HQs for aquatic animals are extremely low, ranging from 0.00000001 (the lower range for long-term exposures in fish and invertebrates), to 0.00001 (the upper range for acute exposures for fish and invertebrates). Thus, there is no basis for asserting that effects on non-target aquatic species, including aquatic-phase amphibians, are plausible.

Imazapyr

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): Imazapyr is practically non-toxic to mammals based on an acute oral LD50 of greater than 5,000 mg/kg in rats. Acute dermal toxicity of greater than 2,000 mg/kg was reported in rabbits (MDL 1996; USDA 1995). For aquatic applications, none of the HQs approach a LOC. The highest HQ of 0.009 is associated with the upper bound of the HQ for a canid consuming contaminated fish following an accidental spill. This HQ is below the LOC (HQ = 1) by a factor of over 100.

As with aquatic applications, none of the HQs for terrestrial applications exceed the LOC. The highest HQs are associated with consumption of contaminated grass by a small mammal (i.e., HQs of 0.2 [0.02 to 0.9]). This scenario assumes that the small mammal will consume nothing but contaminated grass following a direct spray. While this activity may occur in some instances, most small mammals have a more diverse diet, particularly in a forest environment, and residues on contaminated short grass will often be diminished by foliar interception. Thus, this scenario should be viewed as an extreme worst case (SERA 2011).

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl,

white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Imazapyr is practically non-toxic to birds. Oral LD50 values of greater than 2,150 were reported for both quail and duck (MDL 1996). As is the case with mammals, there is no basis for asserting that signs of toxicity will be observed in birds after exposure to imazapyr. For terrestrial exposures, the upper bound of the longer-term HQ for the consumption of contaminated grass is 1.4, which modestly exceeds the LOC (HQ = 1). The exposure scenarios for the exclusive consumption of contaminated grass by either a small bird or a small mammal should be viewed as extreme "worst-case" scenarios. Typically, neither small birds nor small mammals will consume only contaminated grass. All other HQs for birds following terrestrial applications of imazapyr are below, and in most cases substantially below, the LOC.

For aquatic applications, the highest HQ is 0.002, which is below the LOC by a factor of 500; this HQ is associated with the upper bound exposure for a small bird that consumes water contaminated by an accidental spill of imazapyr.

As with the HQs for mammals, the only reservation with the HQs for birds is that they probably over-estimate risk. As discussed in the dose-response assessment for birds, toxic exposure levels of imazapyr are not defined for birds (SERA 2011b).

For amphibians (Columbia spotted frog): Risks to terrestrial-phase amphibians cannot be characterized directly because of the lack of data regarding toxicity of imazapyr to this group of organisms. Based on the risk characterization for birds, as well as all other groups of terrestrial animals for which data is available, there is no basis for assuming that reptiles or terrestrial-phase amphibians are likely to be at risk from exposures to imazapyr. This approach has been adopted for amphibians in the recent EPA/OPP (2007a) risk assessment of imazapyr.

For aquatic scenarios, fish were used as surrogates to predict risk to amphibian species. Available toxicity information for some herbicides indicates that amphibians and fish have a similar sensitivity to herbicides (Berrill et al. 1997). And given the very low acute and chronic HQs in fish, and the conservative assumptions used to derive these HQs, there is no basis for asserting that acute or longer-term exposure to imazapyr will cause toxic effects in aquatic-phase amphibians (SERA 2011b).

Metsulfuron-methyl

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): Several studies (i.e., acute oral, acute inhalation, chronic dietary exposure, and reproduction) show metsulfuron-methyl to have a range of practically non-toxic to slightly toxic to mammals (WSDOT 2006f). In acute exposure scenarios, the highest exposures for small terrestrial mammals will occur after a direct spraying and could reach up to 0.7 mg/kg under typical exposure conditions. The highest HQ for any acute exposure is 0.08, which is the upper range of the HQ for the consumption of contaminated insects by a small mammal. Thus, there is no basis for asserting that adverse effects are likely from the application of metsulfuron-methyl at any application rate, even the maximum application rate of 0.15 lb a.e./acre. Assessing both the central and upper estimated ranges of exposure, the determination is that there is only low toxicity potential to mammals. The

available data is sufficient to assert that no adverse effects are anticipated in terrestrial animals when using the typical or "worst-case" exposure assumptions at the typical application rate of 0.015 lb a.e./acre, or the maximum application rate of 0.15 lb a.e./acre (SERA 2004d).

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Acute oral and dietary studies have determined that metsulfuron-methyl is practically non-toxic to birds (WSDOT 2006). Based on several acute toxicity studies and two reproductive studies, birds appear to be no more sensitive than mammals to the toxic effects of metsulfuron-methyl, with the major effects being decreased body weight gain. Assessing both the central and upper estimated ranges of exposure, the determination is that there is only low toxicity potential to birds. The available data is sufficient to assert that no adverse effects are anticipated in terrestrial animals when using the typical or "worst-case" exposure assumptions at the typical application rate of 0.015 lb a.e./acre, or the maximum application rate of 0.15 lb a.e./acre (SERA 2004d).

For amphibians (Columbia spotted frog): Risks to terrestrial phase amphibians cannot be characterized directly because of the lack of data on the toxicity of metsulfuron-methyl to this group of organisms.

For aquatic scenarios, fish were used as surrogates to predict risk to amphibian species. Available toxicity information for some herbicides indicates that amphibians and fish have a similar sensitivity to herbicides (Berrill et al. 1997). At the maximum application rate of 0.15 lbs/acre, the highest HQ is 0.00015, below the LOC by a factor of over 6,000. Given the very low acute and chronic HQs in fish and the conservative assumptions used to derive these HQs, there is no basis for asserting that acute or longer-term exposure to metsulfuron-methyl will cause toxic effects in aquatic-phase amphibians (SERA 2004d).

Picloram

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): All central estimates of the HQs, for both the typical and maximum application rates, for mammals are below the LOC. Because the central estimates of the HQs are based on average or mean estimates of the exposure parameters for the different scenarios, the central estimates of the HQs may be viewed as the expected or most likely measures of risk. For the typical application rate, the highest *upper* bound HQ of 1.3 for mammals associated with the short-term consumption of contaminated insects by a small mammal is only slightly above 1.0. Even for the maximum application rate, the highest *upper* bound HQ (HQ = 2.0) for mammals that is associated with the short-term consumption of contaminated insects by a small mammal is just above 1.0 (SERA 2011d).

Due to picloram's persistence in the environment, chronic exposure could be a concern to these species. Pearson and Callaway (2008) indicate that the observed decreases in the populations of small mammals were apparently due to decreases in food supply rather than any direct toxic effect of picloram to mammals. Based on the Proposed Action and design

criteria listed in this document, picloram is expected to pose a low risk to mammalian species.

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Based on data from several studies (i.e., acute gavage toxicity, acute dietary toxicity, and reproductive effects) (Beavers 1986, Mach 2002), picloram is considered practically non-toxic to birds. For the typical application rate, the highest HQ for birds is the upper bound HQ of 0.9 associated with the longer-term consumption of contaminated vegetation by a large bird. For the maximum application rate, the highest HQ for birds is the upper bound HQ of 1.4 associated with the longer-term consumption of contaminated vegetation by a large bird (SERA 2011d).

For amphibians (Columbia spotted frog): Several literature reviews have not identified toxic information for amphibians. It is reasonable to assume that amphibians are potentially the most sensitive to herbicides because of their complex life cycles and more permeable skin. Risks to terrestrial phase amphibians cannot be characterized directly because of the lack of data regarding toxicity of imazapyr to this group of organisms.

No dose-response assessment for aquatic-phase amphibians is developed. Consequently, no quantitative risk characterization can be derived. Based on a marginal data set involving bioassays of one species of fish and two species of amphibians using a herbicide formulation containing picloram, and perhaps 2,4-D as well, no remarkable differences in sensitivity between fish and amphibians are apparent (Johnson 1976, 1978). While this information is marginal, it is generally supportive of the approach taken in EPA/OPPS (2004), in which data on freshwater fish are used as surrogates for aquatic-phase amphibians. Exceedances in the LOC for fish are limited to accidental spill exposures in sensitive fish species (SERA 2011d).

When estimating the effects of pesticides on amphibians, it is appropriate to be very conservative. Carey and Bryant (1995) discussed a number of pathways through which amphibians could be impacted by environmental contaminants. They stated “while a variety of results have been obtained (concerning amphibian tolerance levels of various environmental toxicants) because of the number of species, life stages, and techniques used, the literature suggests that adult and larval amphibians are not necessarily more sensitive to chemicals than other land or aquatic vertebrates.” However, they caution that toxicants need not be directly lethal to impact amphibians. Sub-lethal concentrations of some contaminants may increase susceptibility of larvae to disease; increase predation of larvae by impacting swimming ability, or by retarding growth rates. They point out that “endocrine-disrupting toxicants can have effects at tissue levels well below detectable levels,” and that “toxicants designated as safe should not be considered to be free of endocrine-disrupting effects until proven otherwise.” Therefore, design criteria that prohibit broadcast spraying near water and restrict herbicide application in RCAs were developed to minimize risk to amphibians (Appendix G).

Sulfometuron Methyl

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend’s big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn

sheep, mule deer, moose, elk): Sulfometuron methyl is generally considered to be practically non-toxic with a very low acute oral toxicity. Consideration is based on an acute LD_{50} of greater than 5,000 mg/kg for the male rat (WSDOT 2005). Acute dermal LD_{50} values range from over 2,000 mg/kg for the female rabbit to over 8,000 mg/kg for the male rabbit, which also indicates a rating of practically non-toxic. The USDA (1995) reported an inhalation toxicity value of 5 mg/L (ppm) after a 4-hour acute exposure to Oust.

Several studies indicate rats have exhibited multiple toxic effects due to chronic dietary exposures to sulfometuron methyl. For example, rats experienced reduced red blood cell counts and increased liver weight when fed the compound at relatively low doses (LD_{50} of 50 mg/kg) for a one-year period (Jordan and Cudney 1987). In a study conducted over a 90-day period, rats exhibited an increased production of white blood cells at 250 mg/kg (the highest dose tested). However, in a two-year feeding study, no effects were found below 50 mg/kg (Retnakaran and Wright 1987 as cited in summarized in EXTOXNET 1996d). The formulation Oust produced mild erythema and slight edema for 72 hours in rabbits (USDA 1995).

Using the maximum application rate of 0.38 lb a.e./acre, the highest HQ for any acute exposure is 0.3, the upper range of the HQ for the consumption of contaminated insects by a small mammal. The only exceedance for chronic exposures occurs in the upper bound HQ for large mammals consuming contaminated vegetation (HQ = 1.5). Thus, there is no basis for asserting that adverse effects are likely from the typical application rate proposed for sulfometuron methyl. For chronic exposures, all central HQs are also well below 1.0 (SERA 2004e).

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Sulfometuron methyl is considered practically non-toxic to birds. A dietary acute LC_{50} value of greater than 5,000 mg/kg is reported for mallards, and dietary LC_{50} values of greater than 5,620 mg/kg is reported for the northern bobwhite quail (summarized in EXTOXNET 1996h).

Results of all acute exposure studies in birds show that sulfometuron methyl has very low toxicity, with LD50 values exceeding 5,000 mg/kg by gavage (Dudeck and Bristol 1981a), and exceeding 5,620 ppm in the diet (equivalent to 1,068 mg/kg/day) (Fink et al. 1981). Only one study reported signs of toxicity following acute sulfometuron methyl exposure: a gavage study in mallard ducks using single doses of technical grade sulfometuron methyl ranging from 312 to 5,000 mg/kg (Dudeck and Bristol 1981a).

Using the maximum application rate of 0.38 lb a.e./acre, the highest HQ for any acute exposure is 0.1, the upper range of the HQ for the consumption of contaminated insects by a small bird. For chronic exposures, all central HQs are well below 1.0. The only exceedance for chronic exposures occurs in the upper bound HQ for large birds consuming contaminated vegetation (HQ = 2.0). Thus, there is no basis for asserting that adverse effects are likely from the typical application rate proposed for sulfometuron methyl (SERA 2004f).

For amphibians (Columbia spotted frog): Central HQ values associated with non-accidental (i.e., acute and long-term scenarios) exposures are well below the trigger values (HQ less than 1.0) for the typical and maximum application rates (SERA 2004f). All upper HQ values

associated with acute and long-term exposure scenarios are also below 1.0. Project design criteria further reduce risk to amphibians by restricting broadcast application of sulfometuron methyl to distances greater than 100 feet from the waterline, only permitting spot application between 50 and 100 feet from the waterline, and only permitting hand selective application methods between 15 feet and the waterline.

The risk characterization for aquatic animals is relatively simple and unambiguous. Sulfometuron methyl appears to have a very low potential to cause any adverse effects in aquatic animals. All of the HQs for aquatic animals are extremely low, with a range of 0.000000002 (lower range for acute exposures in tolerant aquatic invertebrates) to 0.004 (longer-term exposures to amphibians). It should be noted that confidence in this risk characterization is reduced by the lack of chronic toxicity studies and lack of data in amphibians (data only available in a single species). Even with these uncertainties, there is no basis for asserting that adverse effects on aquatic animals are likely (SERA 2004f).

Triclopyr: Trimethylamine Salt (TEA)

For mammals (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk): The risk characterization for mammals is dominated by exposure scenarios associated with the consumption of contaminated vegetation or insects. The HQs for mammals increase as body weight increases. While small mammals may consume more than larger animals, the higher sensitivity of larger mammals to triclopyr suggest they are at greater risk. At the typical application rate of 1.5 lb a.e./acre, the acute HQs for a large (i.e., 70 kg) mammal consuming contaminated short grass is 4.0. The corresponding chronic HQs is 7.0. For the small (i.e., 20 g) mammal, the corresponding HQs are much lower (i.e., 0.5 for acute exposures and 1.0 for longer-term exposures).

As discussed in the SERA risk assessment, HQs of about 4.0 might be associated with subclinical[14] adverse effects, although overt signs of toxicity might not be evident. It should be noted that the scenarios used to develop the HQs are based on the assumption that the consumption of contaminated vegetation makes up 100% of the mammal's diet (SERA 2011b). Reported HQs likely over-estimate risk because not all acres treated would be treated at the highest application rate, nor would all acres be treated on greater than 0.5 acre per application. For animals to be exposed to potentially harmful doses, these herbicides would have to be broadcast sprayed over a large enough area that the animal could forage exclusively within the treatment area for one day and have 100% of their diet contaminated. Other exposure scenarios involving direct spraying and the consumption of contaminated water and fish lead to HQs below the LOC.

In the EPA assessment for mammals, acute and chronic-based and chronic dietary-based RQs exceed the agency's acute and chronic endangered species LOC for all foliar application uses of triclopyr (EPA/OPP 2009). Triclopyr TEA is not proposed for aerial application and design criteria prohibits broadcast spraying more than 0.5 acre per application; therefore, actual risk to grazing mammals is less than the reported HQ values indicate.

[14] Subclinical effects - not severe enough to present definite or readily observable symptoms

For birds (yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Based on the findings of available field studies, triclopyr is not likely to cause adverse effects in birds. Applying the maximum application rate, exposures associated with the consumption of contaminated water and contaminated fish are negligible. In the accidental spill scenarios, the highest HQ for birds is 0.08, which is the upper bound of the HQ for a small bird consuming contaminated water. The exposure scenario for a small bird consuming contaminated insects approaches a LOC at 0.7, but does not exceed 1.0 (SERA 2011b).

For amphibians (Columbia spotted frog): Aquatic application of triclopyr does not pose substantial risks to aquatic animals across the range of labeled application rates. The typical application rate for triclopyr is 1.5 lb a.e./acre, and the maximum rate proposed is 2 lb a.e./acre. Application rates in excess of about 3 lb a.e./acre, which are peak concentrations of triclopyr in surface water, could pose acute risks to aquatic-phase amphibians (SERA 2011b). The EPA conducted risk assessments on amphibians by using toxicity studies on birds. Acute risks to amphibians following applications of triclopyr would reach a LOC at an application rate of 3 lbs a.e./acre, based on potential peak exposures to triclopyr (SERA 2011b). The BNF and SNF will not be applying this chemical at or above 3.0 lbs a.e./acre because that exceeds the maximum application rate. Studies of silvicultural application scenarios state that the ecological risk to native amphibian population under the current use practices would be considered negligible (Wojtaszek et al. 2005). The risk characterization for amphibians associated with aquatic applications of triclopyr does not lead to HQs that exceed the LOC for either emergent applications or submergent applications (SERA 2011b).

3.4.6.1.8. Indirect Effects Common to all Herbicides

For mammals and birds (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk, yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): The application of herbicides is likely to alter terrestrial vegetation. This alteration is likely to lead to some secondary changes that could impact mammals and bird species (e.g., changes in food availability and habitat quality). These secondary effects are likely to vary over time and among species.

Secondary effects on some species of birds may occur through changes in vegetation that may impact food availability and habitat. These effects may be beneficial to some species and detrimental to others, and the magnitude of any effects is likely to vary over time.

Indirect effects from habitat alteration are expected to be negligible. The limited extent of inventoried invasive weed infestations (approximately 155,000 acres) within the total project area (4,324,360 acres) minimize impacts to available habitat. There would be no broadcast application in riparian areas, and no applications would occur if sustained wind speeds

exceed 5 mph or label directions in order to prevent drift and damage to non-target riparian plant species.

Conifers are largely tolerant of the proposed herbicides at typical application rates. Common injuries to conifers include chlorosis, needle shed, needle curl, and branch die-back. Aminopyralid, dicamba, and picloram can result in root uptake if applied within the dripline. Seedlings are susceptible to injury from application of 2,4-D and seedling mortality may result for application of aminopyralid. Woody species are susceptible to imazapyr (Appendix J).

Perennial grasses, once they are past the seedling stage, are largely tolerant of the 14 herbicides being analyzed. Some herbicides, such as imazapyr, imazypic, metsulfuron methyl, and sulfometuron methyl are used to control annual grasses.

Evergreen shrubs seedling injury or mortality can result from the application of 2,4-D, aminopyralid, chlorsulfuron, dicamba, metsulfuron methyl, and picloram; mature shrubs are largely tolerant, although minor foliar injury such as leaf curl/cupping, chlorosis, epinasty, or defoliation could occur. Shrubs are very tolerant to applications of clopyralid and imazapic. Applications of sulfometuron methyl could result in injury or mortality of all age classes of shrubs at application rates of above one ounce per acre (Appendix J).

Since most of the target species are forbs, it is reasonable to expect that forbs are susceptible to herbicide application. All forb families are susceptible to 2,4-D to some degree and most forb families are susceptible to dicamba, glyphosate, and imazapyr. The legume/pea (Fabaceae) family is susceptible to chlorsulfuron, clopyralid, dicamba, picloram, sulfometuron methyl, and triclopyr. The aster/composite (Asteraceae) family is susceptible to clopyralid and picloram, yet is tolerant to chlorsulfuron, imazapic, sulfometuron methyl, and triclopyr. Most native forbs are tolerant to aminopyralid and most forb families are not susceptible to imazapic and metsulfuron methyl (Appendix J).

Aerial application of herbicides would have the potential to have an effect on more non-target species than more targeted ground-based application methods. The seven herbicides proposed for aerial use are selective and are used to target specific families of plants. Most native forbs are moderately tolerant to tolerant of aminopyralid and most forbs are tolerant to metsulfuron methyl, since it is used to target annual grasses. Impazapic does not target families identified as being especially important to sage-grouse. Clopyralid targets the aster/composite and legume/pea families; and chlorsulfuron and sulfometuron methyl target the legume/pea family. Many plant families are susceptible to picloram, but the aster/composite and legume/pea are especially susceptible (Appendix J).

<u>For amphibians</u> (Columbia spotted frog): Treatment of upland sites with herbicides could result in a substantial, though temporary, reduction in vegetative cover, particularly if a site was broadcast sprayed with a broad-spectrum formulation. Such a loss of vegetation could indirectly impact TEPCS (Threatened, Endangered, Proposed, Candidate, Sensitive) amphibians by removing cover. However, other important components for cover, such as duff and woody debris, would be maintained, and could even increase in quantity. It is possible that prey items, such as invertebrates, could also be reduced temporarily as a result of crushing, toxicity from spraying, or loss of habitat. However, long-term negative effects to habitat should not occur. Furthermore, treatments to reduce weedy species could benefit herpetofauna habitat by returning it to a more native state.

3.4.6.1.9. Effects from Inert Ingredients and Adjuvants

Adjuvants are specially designed chemicals added to an herbicide solution to modify the performance of the total spray mixture. Adjuvants are not regulated by the EPA in the same way that pesticides are. The EPA does not register or approve the labeling of spray adjuvants. Field testing is generally completed by the adjuvant manufacturer (Bakke 2007). Labels accompanying adjuvants describe their properties and prescribe use rates. Information on types of adjuvants to use can also be found on herbicide labels and in publications by university extension services (Prather et al. 2011, Zollinger 2012).

Adjuvants perform various functions, including enhanced plant uptake of the herbicide; better mixing of otherwise incompatible herbicides; increased adhesion of the spray to plant surfaces; and reduced spray drift. In many herbicide products, adjuvants are included as part of the pre-mixed formulation as purchased. Applicators can also add adjuvants to spray mixtures prior to application.

For many pesticide products containing adjuvants as part of the formulation, the compounds are not explicitly identified on the label or the Material Safety Data Sheet. Unless they are on one of EPA's lists of more toxic chemicals, they do not have to be identified. The identity of these ingredients in a pesticide or adjuvant product is legally protected from full disclosure as "Confidential Business Information."

At least one adjuvant is known to pose hazards to aquatic wildlife—the surfactant used in the original formulation of RoundUp®, POEA. This surfactant is more toxic to aquatic life than the active ingredient glyphosate. The POEA adjuvant (Roundup Pro) will only be used in uplands where no potential for movement into aquatic systems can occur. Within or near aquatic systems, only products labelled for aquatic application would be used. Adjuvants used on the BNF and SNF are identified below in Table 3-52.

Adjuvants with low toxicity to wildlife include modified seed oils, alkyl ethoxylates, and silicones. The most commonly used adjuvant is marker dye and it is analyzed in *Use and Assessment of Marker Dyes Used with Herbicides* (Pepling et al. 1997).

"Activator" adjuvants enhance activity of an herbicide's active ingredient, while "special purpose or utility modifier" adjuvants offset common problems occurring during application, including poor water quality or foam produced during agitation of the spray mixture (Bakke 2007). Many adjuvants have properties that place them on a continuum between these two definitions and enable them to function as both activators and utility modifiers. Special purpose or utility adjuvants are used to offset or correct certain conditions associated with mixing and application, such as impurities in the spray solution, extreme pH levels, and drift. These adjuvants include acidifiers, buffering agents, water conditioners, anti-foaming agents, compatibility agents, and drift control agents. Acidifiers enhance absorption of weak acid type herbicides. Drift reduction agents generally increase the average droplet size. Defoamers reduce foaming that occurs during agitation of the spray mixture. Colorants or dyes help applicators determine what area has been treated, which helps to prevent skips and overlaps and treatment of non-target areas. Colorants or dyes reduce the chance of human exposure to recently treated vegetation (Bakke 2007).

Surfactants (surface active agents) are a broad category of activator adjuvants designed to improve or facilitate the dispersing/emulsifying, absorbing, spreading, sticking, and/or pest-

penetrating properties of the spray mixture. Pure water will stand as a droplet, with a small area of contact with the waxy leaf surface. Water droplets containing a surfactant will spread in a thin layer over a waxy leaf surface (Bakke 2007).

Post-emergence herbicide effectiveness depends on spray droplet retention and herbicide absorption by weed foliage. Adjuvants and spray water quality influence post-emergent herbicide efficacy (USDA Forest Service 2006). Because post-emergence herbicide effectiveness is greatly influenced by plant factors such as age and size and the growing conditions encountered before application, herbicide performance can vary. Variations in post-emergence herbicide performance can be avoided by using an adjuvant or surfactant in the spray solution. Surfactants generally improve the effectiveness of post-emergence herbicides. Typically, surfactants are not added to herbicides that are soil applied (pre-emergence) (Zollinger 2012). Surfactants used on both Forests include non-ionic surfactants, methylated or ethylated vegetable oils, nitrogen sources, and organosilicone/silicone surfactants.

Non-ionic surfactants (NIS) are all-purpose surfactants comprised of linear or nonyl-phenol alcohols and/or fatty acids. This class of surfactant reduces water surface tension and improves spreading and sticking and herbicide uptake (USDA Forest Service 2006a). Often, non-ionic surfactants will have additional additive properties, as described on their label.

Methylated or ethylated vegetable (seed) oils (MSO) are produced by reacting fatty acids from seed oils (corn, soybean, sunflower, and canola) with an alcohol to form esters. The methyl or ethyl esters produced by this reaction are combined with surfactants/emulsifiers to form esterified seed oil. These surfactants reduce water surface tension and improve herbicide uptake by improving herbicide distribution on the leaf surface (USDA Forest Service 2006a). Adverse environmental conditions, such as low humidity, hot weather, lack of rain, drought-stressed weeds, or weeds not actively growing due to some environmental stress, favor the use of MSO. These oils are more effective than non-ionic surfactants as an adjuvant for post-emergence herbicides (Zollinger 2012).

Nitrogen sources typically consist of premixed combinations of various forms of nitrogen and surfactants. They are generally used with broadleaf herbicides and herbicides that recommend adding ammonium sulfate or 28% nitrogen. These surfactants reduce water surface tension and improve leaf surface spreading (Miller and Westra 1998). Fertilizers containing ammonium nitrogen have increased the effectiveness of herbicides like glyphosate and 2, 4-D amine. Fertilizer applied with other herbicides may reduce weed control or cause crop injury. Some fertilizers enhance nontarget plant growth to stimulate competition and keep weed species from re-establishing. Fertilizers should be used with herbicides only as indicated on the label or where experience has proven acceptability (USDA Forest Service 2006a).

Organosilicones and silicone surfactants are two types of nonionic surfactants. Organosilicone surfactants drastically reduce water surface tension to the point where the herbicide droplets thin and coalesce to form a thin layer on the leaf surface (known as “superspreading”). In addition, this class of surfactant provides improved effectiveness through maximum rainfastness (Tu et al. 2001). Table 3-52 lists the recommended adjuvant types for each herbicide.

Table 3-52. Recommended adjuvant type by herbicide

Herbicide	Recommended adjuvant types
2,4-D	Non-ionic surfactants (NIS), fertilizer, crop oil concentrate
Aminopyralid	NIS
Chlorsulfuron	NIS, seed oil, organosilicone
Clopyralid	NIS, crop oil concentrate
Dicamba	Any as allowed by label
Glyphosate	NIS
Imazamox	NIS, seed oil, organosilicone
Imazapic	NIS, seed oil, organosilicone
Imazapyr	NIS, seed oil
Imazamox	NIS, fertilizer, seed oil, petroleum/crop oil concentrate
Metsulfuron methyl	NIS, seed oil, organosilicone
Picloram	None needed but can add as per surfactant manufacturer's label
Sulfometuron methyl	Any allowed by label
Triclopyr triethylamine salt (TEA)	NIS

Source: Prather et al. 2011 and product labels

3.4.6.1.10. Toxicity of Adjuvants

Of the adjuvants discussed in this section, only two carry the Danger signal word 5 (Entry™ II and LI-700®), which is due to the potential effects to the eyes (severely irritating or corrosive). The bulk of the remainder carry the Caution signal word, while several carry the Warning signal word (again because of potential irritant effects to the skin or eyes). None of these adjuvants carry the poison symbol. All of the adjuvants discussed here are no more than slightly toxic when ingested, inhaled, or absorbed through the skin (Acute Toxicity Categories III or IV. (Table 3-53; Bakke 2007). "Normal" environmental exposure levels of surfactants and emulsifiers to humans… would appear to be negligible based on the extremely high dosages that are typically necessary to cause toxic responses in mammals (Tu et al. 2001).

Testing of LD_{50} (lethal dose, 50% kill) on a range of wildlife shows that while some adjuvants are toxic to wildlife at small concentrations, others are considered "practically nontoxic" (Table 3-54).

Below is the definition of LC_{50} (lethal concentration, 50% kill) and here are the classification levels (MDAR 2004):

- <1 mg/l: HT (Highly Toxic)
- 1-10 mg/l : MT (Moderately Toxic)
- 10-100 mg/l: ST (Slightly Toxic)
- 100, 1,000 mg/l: PN (Practically Nontoxic)
- >1,000 mg/l: IH (Insignificant Hazard)

Table 3-53. Standard acute aquatic species toxicity testing results

Product Name	Principal Functioning Agents	Acute toxicity - rainbow trout	Toxicity Category	Acute toxicity - daphnids	Toxicity Category
Activator 90	Nonylphenol polyethoxylate, Tall oil fatty acids, Alcohol ethoxylate, Glycols, and Dimethylpolysiloxane	LC_{50} (96 hour) 1.4 mg/l	Moderately-toxic[a]	LC_{50} (48 hour) 2.0 mg/l	Moderately-toxic[a]
LI 700	Lecithin, propanoic (propionic) acid, and alkylphenol ethoxylate	LC_{50} (96 hour) 130 mg/l	Practically non-toxic[b]	LC_{50} (48 hour) 170 mg/l	Practically non-toxic[b]
Methylated Seed Oil	Methylated soybean seed oil, Alcohol ethoxylate, and Tall oil fatty acids	LC_{50} (96 hour) 48 mg/l	Slightly-toxic[c]	LC_{50} (48 hour) >100 mg/l	Practically non-toxic[c]
R11	Nonylphenol polyethoxylate, 1-Butanol (n-Butanol), Compounded silicone, dimethylpolysiloxane, and water	LC_{50} (96 hour) 3.8 mg/l	Moderately-toxic[d]	LC_{50} (48 hour) 19 mg/l	Slightly toxic[d]
Spreader 90	Alkyl phenol ethoxylate and Isopropyl Alcohol	LC_{50} (96 hour) 3.3 mg/l	Moderately-toxic[c]	LC_{50} (96 hour) 7.3 mg/l	Moderately-toxic[c]
Syl-tac	3-(3-hydroxypropyl)-heptamethyltrisiloxane, ethoxylated acetate, Allyloxy polyethylene glycol monallyl acetate, Polyethylene glycol diacetate, Ethyl oleate (esterified vegetable oil), Polyoxyethylene dialkylester, and Nonylphenol polyethoxylate	LC_{50} (96 hour) >5 mg/L	Moderately-toxic[c]	LC_{50} (48 hour) >5 mg/L	Moderately-toxic[c]

[a] McLaren-Hart Environmental Engineering Corporation, 1995;
[b] WSDA, 2004
[c] Bakke, 2003
[d] CDFG, 1998

Table 3-54. Standard mammalian acute toxicity testing results

Name	Oral LD_{50}	Dermal LD_{50}	Inhalation LC_{50}
Ethoxylated fatty amines			
Entry™ II, POEA	1.2 to 14 g/kg (III)	NA	NA
Alkylphenol ethoxylate-based wetter/spreaders			
R-11®	>3.7 g/kg (NPEO) (III)	>2 g/kg (NPEO) (III)	>25 mg/L (est.) (IV)
Activator 90	3.87 to 5.0 g/kg (III)	>2 g/kg (III)	>1.33 mg/L in males (lowest) (III)
X-77®	3.87 to 5.0 g/kg (III)	>2 g/kg (III)	>1.33 mg/L in males (lowest) (III)
Pro-Spreader Activator	>3.3 g/kg (III)	>2 g/kg (III)	NA
Latron AG- 98® (N)	>5 g/kg (NPE) (IV) 0.79 g/kg (butanol) (III)	>3 g/kg (NPE) (III) 3.4 g/kg (butamol) (III)	NA
Latron AG- 98®	2 g/kg (III)	3 g/kg (III)	NA
Alcohol ethoxylate-based wetter-spreader			
Activator N.F.	NA	NA	NA
Silicone-based wetter/spreaders			
Sylgard® 309	>2 g/kg (III)	>2 g/kg (III)	NA
Freeway®	>2 g/kg (III)	>2 g/kg (III)	NA
Dyne-Amic®	>5.05 g/kg (IV)	>2.02 g/kg (III)	NA
Silwet L-77®	>2.0 g/kg (III)	>2 g/kg (III)	NA
Kinetic	3.3 g/kg (III)	>2 g/kg (III)	NA
Sticker/Spreaders			
Bond®	>5 g/kg (IV)	>2 g/kg (III)	4.73 mg/L (III)
Tactic™	>5 g/kg (IV)	>2 g/kg (III)	>0.19 mg/L (4 hr)
R-56®	NA	NA	NA
Cohere®	NA	NA	NA
Oils			
MSO®	>5 g/kg (IV)	> 4 mg/kg (III)	NA
Hasten®	>5 g/kg (IV)	>5 g/kg (III)	5.79 ml/L (III)
Improved JLB Oil Plus	>5 g/kg (IV)	>3.16 g/kg (III)	NA
Cide-Kick®	>5 g/kg (IV)	NA	>5.16 mg/L (III)
Cide-Kick® II™	>5 g/kg (IV)	>2 g/kg (III)	>90.04 mg/L (IV)
Cygnet Plus	NA	NA	NA
Blends of vegetable oils and silicone-based surfactants			
Syl-tac™	>5 g/kg (IV)	>5 g/kg (III)	>2.07 ml/L (III)
Phase™	>5 g/kg (IV)	>2 g/kg (III)	>0.19 mg/L
Crop Oils and Crop Oil Concentrates			
Kerosene	28 g/kg (IV)	>2 g/kg (III)	NA
Agri-dex®	>5.01 g/kg (IV)	>2.02 g/kg (III)	NA
Mor-Act®	>5 g/kg (IV)	NA	NA
Herbimax®	>5 g/kg (IV)	>2 g/kg (III)	NA

Name	Oral LD_{50}	Dermal LD_{50}	Inhalation LC_{50}
Fertilizer/Surfactant Mixtures			
First Choice® Exciter	NA	NA	NA
Magnify	NA	NA	NA
Class Act® Next Generation	NA	NA	NA
Intensify	NA	NA	NA
Acidifiers			
LI-700®	>5 g/kg (IV)	>5 g/kg (III)	>6.04 mg/L (III)
Tri-Fol	NA	NA	NA
Drift Reduction Agents			
In-Place®	NA	NA	NA
Sinker	>9.8 g/kg	>9.8 g/kg	NA
Defoamers			
Foaminator™	NA	NA	NA
No Foam	NA	NA	NA
No Foam Dry	NA	NA	NA
No Foam® B	>5 g/kg (IV)	NA	NA

3.4.6.1.11. Alternative 4—No Aerial Herbicide Application

The effects of this alternative to analyzed terrestrial wildlife species would be very similar to those disclosed for Alternative 3. Implementing Alternative 4 would decrease the already low risk of impacts from herbicide exposure. The primary difference between Alternatives 3 and 4 would be fewer acres treated and less habitat improved under Alternative 4. Infestations which are exceedingly difficult to access by foot or vehicle and/or wide-spread infestations covering a large geographic area would be logistically or practically impossible to manage and would continue to spread with little or no management action taken.

3.4.6.1.12. Alternative 5—No Aquatic Herbicide Application

The effects of this alternative to analyzed terrestrial wildlife species would be very similar to those disclosed for Alternative 3. Alternative 5 would limit the ability of the Forest Service to respond to a new invasive aquatic plant species detection. Given the rate of spread of these species and the number of vectors possible to move the species to another location, an aquatic invasive plant, if introduced and not eradicated soon after detection, could become established. The subsequent result would be diminished aquatic habitat quality, reduced water quality, and changes in trophic interactions.

3.4.6.2. Direct and Indirect Effects of Invasive Plant Species Treatment Activities (Disturbance)

Most of the treatment methods pose little risk to wildlife species or habitat. Risks from non-herbicide invasive plant treatment to wildlife were evaluated by consulting peer-reviewed literature, previous biological opinions, and species experts, as well as using professional judgment.

3.4.6.2.1. Alternative 1—No Action (no treatments)

No disturbance from invasive plant treatments would occur because invasive plant treatments are not part of Alternative 1.

3.4.6.2.2. Alternative 2—Current Management

Under Alternative 2, no change would occur from current weed management efforts. This alternative would continue the same weed management programs and treatments and levels of effort for controlling weeds on the SNF and BNF that are currently used. In general, this alternative includes treating invasive terrestrial plants using biological, mechanical, and/or herbicide treatments. Herbicide application under this alternative would be limited to the treatment of terrestrial invasive plants with 12 herbicides and using ground-based application techniques only. Potential disturbance from invasive plant species treatments proposed under Alternative 2 would be the same as Alternative as 3 discussed below.

3.4.6.2.3. Alternative 3—Proposed Action

Under Alternative 3, weeds would be aggressively eradicated, controlled, or contained using a variety of methods, and treatment sites would be restored (where appropriate) to native vegetation following treatment. Loss of native habitat to weed infestations would decrease over time as weed populations are reduced and eliminated. Many wildlife species would benefit in the short-term and long-term as native plant communities are restored following weed treatment. Restored plant communities would provide improved forage, hiding cover, and reproductive cover for wildlife as native plant density, canopy cover, and species diversity increase and multi-layered grass/shrub canopies develop on formerly weed-infested sites, as compared to Alternative 1 and existing conditions. Wildlife species relying on grassland shrubs, forb communities, riparian areas, and low-elevation pine and Douglas-fir forests would benefit the most, as these plant communities are potentially the most impacted by weed infestations.

The short-term and long-term indirect effects of more effective weed control under Alternative 3 would benefit more wildlife species in the long run than Alternative 1. Long-term benefits to wildlife, TEPCS species, migratory birds, and MIS species under Alternative 3 would be considerably greater than those discussed for Alternative 1 because of more effective weed control. All of these species would benefit from reducing the rate of native plant community loss resulting from weed expansion.

Consideration of impacts by treatment option suggests that mechanical treatment would have a somewhat longer-term displacement effect on wildlife than chemical treatments, and biological control agents that only feed on target plants would have almost no direct effect on wildlife.

Mechanical Treatment

For mammals and birds (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk, yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Mechanical treatments would result in minimal impacts to

terrestrial wildlife populations. Increased human activity in noxious weed and invasive non-native weed infestation areas would occur and result in short-deration local avoidance of these areas by some wildlife species. Mechanical treatments would be considered a low risk activity for most wildlife species based on habitat distribution and use, and their proximity to treatment areas. Project design criteria listed in this document establish buffers around known nesting and denning sites of TEPCS species, and restrict treatments from occurring during nesting and denning seasons.

Disturbance from manual and mechanical treatments is likely to pose greater risks to terrestrial wildlife species than herbicide application methods. Small species that lack rapid mobility (e.g., amphibians and very young individuals) are vulnerable to crushing or injury from people or equipment. Manual treatments can take longer to implement than other methods, increasing the length of time of disturbance. Manual treatments are often used at small sites, where the potential to impact wildlife would be concentrated at that site, but may also be used in large areas with scattered invasive plants. In these situations, crews (typically of three to five people) may be in an area for more than a day. Mechanical methods can generate more noise disturbance than other methods. Use of vehicle-mounted equipment, such as mowers, is less selective and more likely to directly impact small animals than use of hand-operated equipment, such as string trimmers. Mechanical treatment methods would typically occur along roadsides or in dispersed use sites, and areas that are unlikely to provide wildlife habitat.

Loud and sudden noises above background or ambient levels (i.e., those above 92 dB) can cause disturbance that might flush a bird off the nest or abort a feeding attempt. Based on field measurements, vehicles used to spray roadside vegetation with herbicides do not generate noise above 92 dB; therefore, no “injury” or “harassment” from noise will occur. Other mechanical devices proposed for use on invasive plants include brushing machines, mowers, chainsaws, and string trimmers. These tools have potential to create noise above background levels that may disturb some species if used near nests during biologically-sensitive periods (i.e., nesting and denning).

Rehabilitation seeding treatments require native seed mixes. The planting or seeding of desirable species following other invasive plant treatments can be effective at shading or out-competing invasive plants. This treatment can also cause short-term disturbance, but has potential to restore wildlife habitat faster than passive re-vegetation.

Temporary direct displacement effects on wildlife (including big game species) resulting from disturbance during weed treatments would be localized and minor relative to the total SNF and BNF acreage. This displacement would likely last only a few days or weeks while the actual treatment is occurring, but could occur during any time of the year that treatments are implemented.

Project design criteria for wildlife protection includes use of a buffer (i.e., distance set by wildlife biologists specific to species and nest site) around active raptor nests for aerial and ground treatments, and temporal restrictions for treatments near active bald and golden eagle nests. However, a rapid exit from the nest by adults frightened by the sudden occurrence of an aircraft or human disturbance may cause partial or complete reproductive failure if eggs or young are ejected from the nest. Similarly, young birds might also fledge prematurely in

response to a nearby aircraft, thereby reducing their chances of survival. However, treatment buffers required by design criteria would minimize the likelihood of this occurring.

TEPCS species may be directly affected by temporary disturbances associated with implementation of mechanical treatments. Canada lynx might be temporarily displaced by human activity; however, the likelihood of such interactions would be low and limited to individuals and no population-level effects would be expected.

Sensitive species would be directly disturbed, temporarily, during mechanical weed treatment procedures. Potential disturbance and displacement of sensitive species would likely last only a few days or weeks while the actual treatment is occurring, but could occur during any year that treatments are implemented. Sustained human disturbance in the immediate vicinity of a nest or den site during sensitive periods could result in reproductive failure during that year, or could result in re-nesting or den relocation. However, the likelihood of such an occurrence is very low because project design criteria would minimize disturbance to sensitive species.

In areas proposed for mechanical treatments, negative impacts to pileated and black-backed woodpeckers would not be expected to occur. Negative impacts on woodpeckers from increased human activity, noise, and weed treatment operations would also be unlikely due to the paucity of activity proposed within woodpecker habitat. Because weed treatment operations would be of short duration, woodpeckers would likely resume their natural behavior within 1 day of any disturbance. No risk of trampling nestlings or eggs would occur because nests are located in tree cavities. Hand pulling treatments would contribute minimal impact through disturbance to birds as crews are mobilized near and within infestation sites. While crews treat infestations, avian species would tend to abandon the area; once infestations are treated, most avian species would quickly return.

Temporary displacement of individual migratory birds may occur during mechanical treatments activities. Design criteria to avoid active bird nests during treatments would minimize impacts to nesting. Mechanical treatments could result in trampling or harm to eggs/young of ground-nesting or low-nesting species during the breeding season. The short-term, low-magnitude, and limited extent (typically 1 acre or less scattered over larger areas) of disturbance that would occur from mechanical treatments would not negatively impact migratory bird populations.

Indirect effects from manual or mechanical treatments are expected to be largely beneficial and would occur incrementally over a long period of time, as weed-infested areas recover to more natural conditions. Restoration of disturbed areas (where appropriate) would not be expected to adversely affect wildlife resources. A short period of time would exist when habitat values on areas being restored would be low, because of low vegetation density. As restored areas mature, habitat quality would improve as ecological functions and processes are restored. This would beneficially affect wildlife.

For amphibians (Columbia spotted frog): Equipment used during mechanical treatments can directly affect herpetofauna in upland habitats by killing or injuring individuals, including those seeking cover in shallow burrows. During removal of downed woody material, placing the material into piles could also crush animals.

Mechanical treatments can expose soil by crushing or removing vegetation and would be expected to increase potential for erosion over the short-term, resulting in some sediment

inflow into aquatic habitats. Like ash and sediment resulting from fire, this sediment could cause mortality by smothering eggs and larvae, and could inhibit respiration in invertebrates on which the herpetofauna feed. Use of equipment may also crush other invertebrates and vertebrates upon which certain species feed.

Biological Treatment

For mammals and birds (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk, yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, and migratory birds): Biocontrol treatments used on the NFs are expected to result in a decrease to the negative impacts from noxious weed and non-native weed infestations on terrestrial wildlife species by utilizing insects to decrease the targeted weed species. It is anticipated there would be minimal or no direct or indirect effects on terrestrial wildlife species across the Forests from the introduction of insects as part of a biocontrol method of treatment.

In addition, studies have found that native rodents, such as ground squirrels, may take advantage of the food source provided by biological control agents (Pearson and Ortega 2000). Biological controls that reduce invasive plant populations, increase native plant populations, and provide a supplemental food source would be indirectly beneficial to wildlife.

Targeted sheep and goat grazing would decrease the negative consequences of noxious weed and non-native weed infestations on terrestrial wildlife. However, sheep and goats introduced to control weed populations would likely also graze on native plants and may cause unintended consequences to the very plant community that is trying to be restored. Sheep and goat grazing may displace some wildlife during the treatment period and could reduce forage in the treatment area for the remainder of the treatment year. Design criteria to ensure targeted grazing within big game winter range would occur when targeted plant species are more palatable than nontarget plant species would minimize possible impacts. Grazing of goats and sheep may cause brief disturbance to big game species and may cause a local reduction in nontarget vegetation due to nonselective grazing; however, long-term improvements to big game habitat would occur.

In areas proposed for biological treatments, no impacts to pileated or black-backed woodpeckers would be expected to occur. Black-backed and pileated woodpecker nestlings or eggs would not be trampled because nests are located in tree cavities. Biological control treatments would also have little-to-no effect on most migratory bird species. Grazing of goats and sheep may briefly disturb migratory bird species and may locally reduce nontarget vegetation due to nonselective grazing; however, long-term improvements to habitat used by these species would occur as additional habitat with the necessary structure and diversity would be created.

For amphibians (Columbia spotted frog): Use of domestic animals to contain weeds in upland or aquatic habitats occupied by amphibians can cause death or injury to animals through trampling. Domestic animals may also disturb egg masses and larvae, potentially reducing the number of individuals that reach reproductive age.

Use of domestic animals could negatively affect aquatic and riparian habitats utilized by amphibians if not managed to maintain riparian ecologic functions and processes. One study indicated that exclusion of cattle grazing resulted in re-establishment of native trees and native wetland plants, re-establishment of creek pools, and an expansion of frog populations into streams and ungrazed stock ponds (Dunne 1995). When cattle drink from small ponds and streams, they can draw down water levels, leaving egg masses above the water surface, thereby subjecting them to desiccation and/or disease (SERA 2002).

Other effects of grazing on aquatic habitats include nutrient loading; reduction of shade and cover, which result in increases in water temperature; more intermittent flows; changes in stream channel morphology; and sedimentation caused by bank degradation and off-site soil erosion (USDA Forest Service 2002). Presence of domestic animals in riparian vegetation can cause mass erosion from trampling, hoof slide, and streambank collapse, all of which cause soils from the bank to enter the stream, reducing the quality of habitat. Trampling can also compact the soils and reduce infiltration, which in turn may decrease the recharge of the saturated zone and increase peak flow discharge. Removal of streambank vegetation, in addition to causing greater fluctuations in temperature, can also result in decreased water storage capacity and increased erosion potential. The removal of vegetation in upland areas can also increase erosion, as well as reducing water infiltration and accelerating runoff.

There would likely be long-term positive effects from using domestic animals to contain weeds, provided guidelines to increase protection of riparian vegetation and streambanks were followed. Grazing can result in reduced erosion through the growth of stabilizing vegetation, and aquatic habitat improvement by increasing the number and size of woody shrubs along streams. Over the long-term, there might also be a reduction of sediment loading into streams for most flow regimes, and a reduction of summer stream temperatures as woody vegetation along streambanks began to provide increasing levels of shade.

Chemical Treatment

For mammals, birds, and amphibians (Canada lynx, Northern Idaho ground squirrel, southern Idaho ground squirrel, wolverine, spotted bat, Townsend's big-eared bat, pygmy rabbit, fisher, gray wolf, bighorn sheep, mule deer, moose, elk, yellow-billed cuckoo, greater sage grouse, common loon, bald eagle, northern goshawk, peregrine falcon, mountain quail, great gray owl, flammulated owl, boreal owl, white-headed woodpecker, American three-toed woodpecker, pileated woodpecker, black-backed woodpecker, migratory birds, and Columbia spotted frog): Human disturbance, in the form of human activity and noise of short duration, is expected to occur in most treatment areas. Disturbance from vehicles, helicopters used for aerial application, and humans on horseback or on foot would increase during treatment activities. As a result of increased human activity and noise from vehicle use and other activities, some wildlife may be locally displaced in or near the treatment areas during the period of treatment. Due to the brief duration of these activities, wildlife is expected to resume normal behaviors after treatments are complete. If wildlife displacement occurs, it could reduce the risk of direct herbicide exposure to those displaced individuals. Design criteria call for wildlife biologists to identify nest and denning sites, establish buffers around known nesting and denning sites of TEPCS species, and restrict treatments from occurring during nesting and denning seasons.

3.4.6.2.4. Alternative 4—No Aerial Herbicide Application

Implementing Alternative 4 would eliminate aerial spraying of proposed treatment areas, which would reduce effects from noise and visual harassment on wildlife from helicopter use. In instances of difficult access or in areas with safety concerns for ground based treatment, specific weed populations would likely expand, migrate, and continue to cause land degradation, increased runoff and erosion, and loss of habitat and forage availability across the SNF and BNF under Alternative 4. The effects of this alternative to analyzed terrestrial wildlife species would be very similar to those disclosed under Alternative 3, except that none of the disturbance effects related to helicopter application would occur.

3.4.6.2.5. Alternative 5—No Aquatic Herbicide Application

The effects of this alternative to analyzed terrestrial wildlife species would be very similar to those disclosed under Alternative 3. This alternative would limit the ability to respond to a detection of invasive aquatic plant species. Given the rate of spread of these species and the number of vectors possible to move the species to another location, an aquatic plant, if introduced and not eradicated soon after detection, could become established. The subsequent result would be diminished aquatic habitat quality, reduced water quality, and changes in trophic interactions.

3.4.6.3. Cumulative Effects

Cumulative effects under NEPA are the impact on the environment that results from the incremental impact of Alternative 3 when added to the other past, present, and reasonably foreseeable future actions regardless of which agency undertakes them (i.e., State, private, or federal).

Cumulative effects under ESA are the “effects of state or private activities, not involving Federal activities that are reasonably certain to occur within the analysis area.” The ESA defines analysis area as “all areas to be affected directly or indirectly by the Federal action…” (USDI 1998). Other activities within the SNF have potential to affect listed species and critical habitat within the analysis area. Future federal actions, including the on-going operation of hydropower systems, hatcheries, fisheries, and land management activities are being reviewed through separate Section 7 consultation processes. Past federal actions have already been added to the environmental baseline in the analysis area.

The analysis area for all of the terrestrial wildlife species analyzed in this document consists of the lands within the boundaries of the SNF and BNF. The analysis area consists primarily of USFS lands. The vast majority of actions in the analysis area are subject to Section 7 consultation. Only a small amount of the analysis area is private land, with potential uses of recreation, timber management, housing sites, mines, livestock grazing, and noxious weed treatments.

The project record contains a discussion of what is known about herbicide use on other land ownerships adjacent to the project area, including adjacent federal, tribal, state, and private lands. Precise information about herbicide use off NFS lands is not available. There is no requirement for land owners or counties to report herbicide use or other invasive plant treatment information, thus an accurate accounting of the total acreage of invasive plant treatment for all land ownerships is unavailable.

For terrestrial wildlife and plant species addressed in this document, the activities that likely had the most impact include past and current livestock grazing, past and current mining activities, road maintenance, motorized use of roads, firewood gathering, past and current timber harvest, and developed and dispersed recreation.

Livestock grazing on private lands has lessened the quality of habitat for some species, mainly through effects to habitat for prey species. Livestock grazing on private lands has lessened the quality of habitat for greater sage-grouse. Reduction of residual cover in both upland and riparian habitat has resulted from decades of livestock grazing.

Noxious weed treatments involve relatively small, well-defined spatial areas. Most treatments are confined to linear areas along travelways and small acreage patches infested with invasive plants, leaving other native vegetation intact. Native wildlife habitat is not removed, modified, or degraded, nor are any hydrologic regimes affected. Treatments would occur one, and possibly up to three times, per year, generally from late-spring to mid-fall. Treatments are low intensity, of small magnitude, and generally short duration (i.e., one day or less). Given the spatial and temporal scale of invasive plant treatments, and the design criteria that reduces disturbance, potential for cumulative effects is low.

For terrestrial wildlife species, the actions assessed in this report for noxious weed treatment related activities on federal lands would increase the extent and amount of human disturbance contributing to displacement of individual animals from habitats. Areas of disturbance can create barriers to movement, reduce foraging opportunities, may affect reproductive success, etc. Design criteria for invasive weed treatment related activities on NF lands can minimize the extent of noxious weed negative effects to these species and habitats.

Cumulative exposure to herbicides could occur only for animals that move between USFS lands and other ownerships. Because the herbicides proposed for use in this project are rapidly excreted, do not bioaccumulate or biomagnify, and pose low risk to wildlife, even if exposures occurred from multiple ownerships, they are unlikely to result in any cumulative toxic effect.

Every mile of road has an associated area of vulnerability to non-native plant species invasion due to use and maintenances, as well as the associated herbicide treatments that occur in known areas of noxious plant species. This has created positive and negative impacts on sensitive species that prefer disturbed habitats. The potential negative impacts depend on the non-native plant species and the type of herbicide applied.

Amphibians have potential to be most affected by herbicide exposure because of rapid absorption through their skin. Only three of the herbicides being proposed for use—glyphosate, 2,4-D, sulfometuron methyl, which all have HQs over 1.0 resulting from accidental spill exposure—have more than a very low potential of causing effects to amphibians. Amphibians that are exposed to low levels of herbicides within the project area are not likely to be exposed to herbicides from some other additive source because these species are relatively limited in their movements. Design criteria for this project also limit application near riparian habitat to spot spray methods (Appendix G), further reducing the likelihood of exposure. Even if exposure occurred from multiple ownerships, most herbicides pose only a low risk to all wildlife species and are unlikely to result in any cumulative toxic effect.

The definitive cumulative effects from non-native plant species competition and the related treatments are unknown. Past, on-going, and foreseeable NF management activities mentioned above and public use of forest lands have and would continue to contribute to the introduction and spread of non-native plant species.

3.4.6.4. Forest Plan Consistency

All action alternatives would comply with Forest Plan standards and environmental laws and regulations.

3.4.6.5. Effects Determinations

Professional judgment was used to evaluate the life history traits (e.g., diet, habitat, activity patterns, seasonal occurrence, etc.) of each wildlife species and whitebark pine to determine the likelihood of exposure to herbicides used to treat invasive plants. The combinations of likelihood of exposure, dose estimated from exposure scenarios, and GIS wildlife location data for the NFs were used to conclude a risk of effect from herbicide treatments (Table 3-56).

3.4.6.5.1. Federally Listed or Proposed Species

For ESA-listed terrestrial wildlife species analyzed in this document, the effects determinations are based on the expectation that wide-spread weed control efforts have potential to result in short-term disruption and displacement of these species. Generally, minimal to no adverse effects are expected from direct exposure to, or primary or secondary ingestion of, herbicide-treated vegetation or herbicide-exposed prey animals. Weed treatment activities are expected to result in long-term habitat improvements. This situation is expected to directly and indirectly benefit federally listed and proposed terrestrial wildlife species.

Canada lynx: Currently, the Canada lynx is listed as Threatened under the ESA. The finding for lynx is **May Affect, Not Likely to Adversely Affect**. This finding is based on the fact there will be limited impact from the assessed weed treatment activities on habitat quantity or quality for lynx and effects from toxicity are unlikely. Treatment activities within LAUs are expected to be very limited and any activities would be of short duration, thereby limiting potential adverse impacts. Only a small fraction, (approximately 0.49% on the BNF and 12% on the SNF) of LAUs contain infestations (see biological assessment and biological evaluation available in the project record). Most invasive plant treatments would occur along roadsides and within rangeland, outside of suitable lynx habitat.

Lynx foraging habitat is not expected to become locally or temporarily unsuitable from invasive plant treatment related activities. Habitat alterations will not become unsuitable in the short-term (3 to 15 years) for snowshoe hares, red squirrels, or forest grouse. Lynx habitat predominantly consists of two structurally different forest types: early successional forests which contain higher numbers of prey, and late-successional forests which provide cover for denning and kittens. Common injuries to conifers include chlorosis, needle shed, needle curl, and branch die-back. Aminopyralid and picloram can result in root uptake if applied within the dripline and aminopyralid can result in mortality to seedlings. Conifers are largely tolerant of the herbicides proposed for both ground-based and aerial application, so only discountable impacts to lynx habitat would be anticipated.

There would be no impacts to habitat connectivity or travel corridors. Indirect effects as a result of improvement of prey habitat from all weed treatment methods are likely to be beneficial.

Lynx denning habitat will not become unsuitable from invasive plant treatment activities. Design criteria would avoid or minimize disturbance to lynx by establishing spatial and seasonal buffers near occupied den sites during the denning season. Disturbance to individuals may occur, but would be localized and temporary. Human disturbance associated with invasive plant treatment related activities is considered temporary and would not likely result in a lower quality or quantity of lynx prey habitat than currently exists.

Direct effects to Canada lynx as a result of herbicide toxicity are unlikely. Of the 13 herbicides proposed for use in upland areas, one, 2,4-D has an exposure scenario that exceeds a LOC (HQ>1.0) for carnivores consuming contaminated prey. The assumption regarding the consumption of small mammals by predatory mammals is that the small prey mammal was directly sprayed with 100% absorption. At the typical application rate of 2,4-D (1.5 lb a.e per/acre), HQs exceed the LOC for the acute scenario of carnivorous mammals eating small mammals (HQ = 3.0). At the maximum application rate of 4 lb a.e./acre this scenario also exceed the LOC (HQ =8.0) (SERA 2006). However, the combination of the small number of infested acres within the LAUs, the improbability of the exposure scenario (it is not likely that a snowshoe hare would be directly sprayed by 2,4-D then preyed upon by a lynx), and the low number of observations of lynx on both Forests, decreases the possibility of effects. 2,4-D and dicamba exceed a LOC for an acute exposure scenario of accidental direct spray of a small mammal. However, neither herbicide is proposed for aerial delivery, which practically eliminates risk of accidental direct spray.

As directed in the LCAS (p. 7-17) “Management activities should seek to minimize the loss or modification of lynx habitat as a result of the spread of non-native invasive plant species” (LCAS, p. 7-17). Control and eradication of noxious weeds will help maintain or improve lynx habitat; therefore, the proposed treatments may benefit Canada lynx.

Northern Idaho ground squirrel (NIDGS): Currently, the NIDGS is listed as Threatened under the ESA. The finding for NIDGS is **May Affect, Not Likely to Adversely Affect**. This finding is based on the fact there will be limited impact from invasive weed treatment activities on habitat quantity or quality for NIDGS.

Direct effects to NIDGS as a result of herbicide toxicity are not likely to occur. Of the 13 herbicides proposed for upland use, one herbicide, 2,4-D, has an acute exposure scenario of a small mammal being directly sprayed, two herbicides, 2,4-D and triclopyr TEA have acute exposure scenarios that exceed a HQ LOC for small mammals eating contaminated vegetation; and one herbicide, triclopyr TEA, has chronic exposure scenarios that exceed a HQ LOC for small mammals eating contaminated vegetation.

For 2,4-D, at the maximum application rate of 4 lb a.e./acre, two acute scenarios have HQs that exceed the LOC; direct spray of a small mammal (HQ = 4.0) and small mammals eating contaminated grass (HQ = 2.0).

For triclopyr, the HQs for mammals increase as body weight increases. At the maximum application rate of 1.5 lb a.e./acre, only the chronic exposure scenario for small mammals eating contaminated vegetation exceeded the LOC (HQ =1.3). Data suggest that HQs of

about 4.0 could be related to adverse effects such as changes in blood chemistry or birth defects and overt signs of toxicity would not likely be observed. The exposure scenario is designed to be extreme; the assumption is that 100% of the diet would be contaminated, which would not realistically occur.

The herbicides discussed above are believed to have risk estimates that overestimate potential field exposures, adverse effects are not likely to occur, there is no basis to assert that signs of toxicity would be observed after exposure, and the prevalence and severity of potential effects cannot be characterized. Triclopyr TEA is the only herbicide that could result in adverse effects (to offspring). Design criteria that requires establishing a buffer to prohibit applying picloram, 2,4-D, and triclopyr TEA within NIDGS habitat minimize risk of exposure and impacts to forage.

Treatment activities within suitable NIDGS habitat are expected to be very limited and any activities would be of short duration, thereby limiting potential adverse impacts. Design criteria would minimize the effects of noxious weed treatment related activities to known NIDGS colonies.

Yellow-billed cuckoo: Currently, the cuckoo is listed as Threatened under the ESA. The finding for yellow-billed cuckoo is **May Affect, Not Likely to Adversely Affect**. This finding is based on the fact there will be limited impact from invasive weed treatment activities on habitat quantity or quality for yellow-billed cuckoo. There are 5,169 acres of inventoried invasive weed infestations in approximately 58,312 acres of riparian cover type (0.09%) (Table 3-43). Treatment activities within suitable cuckoo habitat (i.e., large tracts of cottonwood) are expected to be very limited and any activities would be of short duration, thereby limiting potential adverse impacts. Design criteria also prohibit invasive plant treatments within 330 feet of occupied cuckoo nests during the nesting season, reducing the risk of disturbance to nesting activities.

Elevent of the herbicides proposed for use in riparian areas had no exposure scenarios that exceeded a LOC (HQ>1.0) for birds (dicamba is proposed for use in upland application only). While triclopyr TEA exceeds a LOC for the exposure scenario of small birds consuming contaminated vegetation (HQ = 6.0), triclopyr TEA is not proposed for aerial application and yellow-billed cuckoo are primarily insectivores. For the vegetation consumption scenario, cuckoos would have to eat enough vegetation (fruit) that was directly sprayed to result in a high enough dose to exceed the LOC. Triclopyr TEA is proposed for ground-based application only, so the probability of 100% of a cuckoo's diet being contaminated is very low. The very small chance of this scenario occurring makes impacts unlikely.

Deciduous trees and shrubs, which are an important habitat component for this species, are largely tolerant of the herbicides proposed for use in riparian areas at application rates used for forbs. Injury, such as leaf cupping or curling, chlorosis, and/or potential defoliation, as well as injury or mortality for seedlings could occur. Deciduous woody species are more susceptible to injury or death from two herbicides, imazapyr and sulfometuron methyl. There would be no broadcast application in riparian areas, and no applications would occur if sustained wind speeds exceed 5 mph or label directions in order to prevent drift and damage to non-target riparian plant species. Therefore, impacts to yellow-billed cuckoo habitat is expected to be limited.

Wolverine: On April 4, 2016, the legal status for wolverine reverted back to Proposed (see Federal Register Feb 2013). The finding for wolverine is **May Affect, Not likely to jeopardize the continued existence of the species or adversely modify proposed critical habitat**. This finding is based on the fact that there will be limited impact from the proposed weed treatment activities on habitat quantity or quality for wolverine and effects from toxicity are unlikely.

Treatment activities within suitable wolverine habitats are expected to be very limited and any activities would be of short duration, thereby limiting potential adverse impacts. Design criteria that require spatial and seasonal buffers near occupied den sites during the denning season, would avoid or minimize effects of treatment related disturbance to wolverine denning sites. Disturbance to individuals may occur, but is considered localized and temporary.

Direct effects to wolverine as a result of herbicide toxicity are unlikely. Of the 13 herbicides proposed for use in upland areas, one, 2,4-D has an exposure scenario that exceeds a LOC (HQ>1.0) for carnivores consuming contaminated prey. The assumption regarding the consumption of small mammals by predatory mammals is that the prey mammal was directly sprayed with 100% absorption. At the typical application rate of 2,4-D (1.5 lb a.e per/acre), HQs exceed the LOC for the acute scenario of carnivorous mammals eating small mammals (HQ = 3.0). At the maximum application rate of 4 lb a.e./acre this scenario also exceed the LOC (HQ = 8.0) (SERA 2006). However, the combination of the small number of infested acres within suitable wolverine habitat, the prohibition of aerial application of 2,4-D, and the improbability of the exposure scenario (it is not likely that prey species or carrion would be directly sprayed by 2,4-D then consumed by a wolverine), decreases the possibility of effects.

The summer diet of wolverines can include berries and other vegetation. Triclopyr TEA and 2,4-D result in exposure scenarios that exceed a LOC (HQ>1.0) for mammals consuming contaminated vegetation. The assumption of this scenario is that contaminated vegetation makes up 100% of the mammal's diet. At the typical application rate of 2,4-D (1.5 lb a.e per/acre) and triclopyr TEA (1.5 lb a.e per/acre), HQs approach the LOC for the acute scenario for 2,4-D (HQ = 1.0) and exceed for both the acute (HQ = 4.0) and chronic (HQ = 7.0) scenarios of mammals consuming contaminated vegetation for triclopyr TEA. At the maximum application rate of 4 lb a.e./acre for 2,4-D and 2 lb a.e./acre for triclopyr TEA, this scenario also exceeds the LOC for the acute scenario (HQ = 3.0) for 2,4-D and both the acute (HQ = 5.0) and chronic (HQ = 9.0) scenarios for triclopyr TEA (SERA 2006). However, the combination of the small number of infested acres within suitable wolverine habitat, the prohibition of aerial application of 2,4-D and triclopyr TEA, and the improbability of the exposure scenario (it is not likely that 100% of vegetation consumed by a wolverine would be sprayed by 2,4-D or triclopyr TEA), and the decreases the possibility of effects.

2,4-D and dicamba exceed a LOC for an acute exposure scenario of accidental direct spray of a small mammal. However, neither herbicide is proposed for aerial delivery, which practically eliminates risk of accidental direct spray.

Indirect effects as a result of habitat alteration from herbicide applications are not likely. In general, wolverines occupy high elevation conifer forests that have a relatively low occurrence of weed infestations. Common injuries to conifers include chlorosis, needle shed,

needle curl, and branch die-back. Aminopyralid and picloram can result in root uptake if applied within the dripline and aminopyralid can result in mortality to seedlings. Conifers are largely tolerant of the herbicides proposed for both ground-based and aerial application, so only discountable impacts to wolverine habitat would be anticipated.

The combination of the small number of infested acres within potential habitat and the improbability of the exposure scenario (it is not likely that 100% of vegetation consumed by a wolverine is contaminated or that a prey species would be directly sprayed then preyed upon by a wolverine) decreases the possibility of effects.

3.4.6.5.2. Region 4 Sensitive Species

For SNF and BNF **Sensitive Terrestrial Wildlife Species**, implementation of the proposed weed treatment activities **may impact individuals or habitat** of pygmy rabbit, fisher, gray wolf, bighorn sheep, SIDGS, bald eagle, boreal owl, greater sage-grouse, peregrine falcon, spotted bat, Townsend's big-eared bat, common loon, mountain quail, great gray owl, northern goshawk, Columbia sharp-tailed grouse, and Columbia spotted frog, **but would not likely contribute to a trend toward federal listing or cause a loss of viability to the population or species.** Implementation of the proposed weed treatment activities would have **No Impact** on flammulated owl, white-headed woodpecker, and three-toed woodpecker. These determinations are based on the conclusion that weed treatment activities would not remove or lessen the quality of any habitat components to the degree that survival or reproductive success for these species are negatively affected.

The following tables (Table 3-55 and Table 3-56) summarize the determinations and rational for determinations for federally listed and R4 sensitive species analyzed in the Biological Assessment/Biological Evaluation.

Table 3-55. Summary of determinations for Endangered Species Act and Sensitive species analyzed in the Terrestrial Wildlife and Botany Biological Assessment and Biological Evaluation

Species Analyzed	Alt. 1 No Action	Alt. 2 Current Management	Alt. 3 Proposed Action	Alt. 4 No Aerial Herbicide Application	Alt. 5 No Aquatic Herbicide Application
Canada lynx	NI	NLAA	NLAA	NLAA	NLAA
Northern Idaho Ground Squirrel	NI	NLAA	NLAA	NLAA	NLAA
Yellow-billed Cuckoo	NI	NLAA	NLAA	NLAA	NLAA
Wolverine	NI	NLJ	NLJ	NLJ	NLJ
Bighorn Sheep	NI	MI	MI	MI	MI
Gray wolf	NI	MI	MI	MI	MI
Pygmy Rabbit	NI	MI	MI	MI	MI
Spotted bat	NI	MI	MI	MI	MI
Fisher	NI	MI	MI	MI	MI
Southern Idaho Ground Squirrel	NI	MI	MI	MI	MI
Townsend's big-eared bat	NI	MI	MI	MI	MI
Bald eagle	NI	MI	MI	MI	MI
Boreal owl	NI	MI	MI	MI	MI
Greater sage-grouse	NI	MI	MI	MI	MI
Peregrine falcon	NI	MI	MI	MI	MI
Common loon	NI	MI	MI	MI	MI
Mountain quail	NI	MI	MI	MI	MI
Flammulated owl	NI	NI	NI	NI	NI
White-headed woodpecker	NI	NI	NI	NI	NI
American three-toed woodpecker	NI	NI	NI	NI	NI
Great gray owl	NI	MI	MI	MI	MI
Columbia sharp-tailed grouse	NI	MI	MI	MI	MI
Northern Goshawk	NI	MI	MI	MI	MI
Columbia Spotted frog	NI	MI	MI	MI	MI

NE = No Effect
NI = No Impact
MI = May Impact individuals or habitat, not likely to contribute to contribute to a trend toward federal listing or loss of viability to the population or species
NLAA = May Affect, Not likely to Adversely Affect, not likely to jeopardize the continued existence of the species or result in the adverse modification of critical habitat
NLJ = May Affect, Not likely to jeopardize the continued existence of the proposed or candidate species, or adversely modify proposed critical habitat*Note that a finding of MI, NLT does not mean that there would be no adverse impacts on individuals, but rather that no adverse population level effects would be expected

Table 3-56. Summary of rationale for determinations

	All Action Alternatives	Rationale
Federally Listed Species		
Canada lynx	NLAA	Exposure to herbicides or surfactants is not likely; disturbance to denning activity from invasive plant treatments is minimized through design criteria; no effects to primary constituent elements of LAUs
Northern Idaho ground squirrel	NLAA	Design criteria restrict application and treatment methods of herbicides posing greater risk to NIDGS within and near occupied habitat design criteria also minimizes potential distrubrnace from treatment activities; treatments likely maintain or improve habitat
Yellow-billed cuckoo	NLAA	Design criteria restrict potential disturbance to nesting birds; minimal amount of preferred habitat proposed for treatment; herbicide application restrictions in riparian habitat further reduce possible exposure
Wolverine	NLJ	Not likely present in invasive plant treatment areas; contamination of carrion and prey species unlikely; design criteria require spatial and temporal buffers near occupied den sites
Sensitive Species		
Mammals		
Bighorn sheep	MI	Minimal amount of suitable habitat proposed for treatment, short-term disturbance possible; design criteria prohibit targeted grazing within core herd home ranges
Gray wolf	MI	Design criteria require spatial and temporal buffers near occupied denning and rendezvous sites; minimize exposure to herbicides; habitat for prey species will be maintained
Pygmy rabbit	MI	Design criteria prohibit application of herbicides posing greater risk within and near occupied habitat; design criteria also minimizes potential effects to preferred forage; treatments could improve habitat.
Spotted bat	MI	Minimal amount of habitat proposed for treatment; disturbance to nocturnal foraging activity unlikely; hibernacula and roost locations minimize potential for disturbance and exposure to herbicides
Fisher	MI	Minimal amount of habitat proposed for treatment; low likelihood of disturbance from invasive plant treatment activities due to primarily nocturnal behavior; potential for consuming contaiminated prey and vegetation unlikey in preferred habitat
Southern Idaho ground squirrel	MI	Minimal amount of habitat proposed for treatment; design criteria minimize potential for effects to known SIDGS sites; adverse effects from herbicide are unlikely; suitable habitat would likely be maintained or improved
Townsend’s big-eared bat	MI	Minimal amount of habitat proposed for treatment; disturbance to nocturnal foraging activity unlikely; hibernacula and roost locations minimize potential for disturbance and exposure to herbicides

	All Action Alternatives	Rationale
Birds		
Bald eagle	MI	Treatments are restricted spatially and temporally near occupied nests; disturbance to foraging birds is unlikely; design criteria, habitat requirements, and foraging behavior minimize potential for adverse effects from herbicide exposure
Boreal owl	MI	Minimal amount of habitat proposed for treatment; short-term disturbance is possible; design criteria, habitat requirements, and nocturnal foraging behavior minimize potential for adverse effects
Greater sage-grouse	MI	Design criteria spatially and temporally restrict invasive plant treatment activities near breeding and nesting habitat to minimize potential effects from disturbance and herbicide exposure; adverse effects are unlikely
Peregrine falcon	MI	Adverse effects from herbicide exposure and disturbance from invasive plant treatment activity unlikely due to location of primary nesting and foraging habitat; contamination of preferred avain prey species unlikely
Common loon	MI	Herbicide exposure and disturbance from invasive plant treatment activity unlikely due to location of preferred nesting and foraging habitat; minimal amount of habitat proposed for treatment; design criteria minimize potential effects of herbicide application in riparian habitat
Mountain quail	MI	Minimal amount of habitat proposed for treatment; seasonal movements reduce potential for disturbance and exposure to herbicides; design criteria minimize potential effects of herbicide application in riparian habitat; trampling/crushing of nests/chicks may occur during treatment; suitable habitat would likely be maintained or improved
Flammulated owl	NI	Minimal amount of habitat proposed for treatment; short-term disturbance is possible; seasonal migration reduces potential disturbance and herbicide exposure; disturbance to birds foraging nocturnally will not occur
White-headed woodpecker	NI	Minimal amount of habitat proposed for treatment; nesting and foraging strategies limit herbicide exposure and disturbance from invasive plant treatment activities
Three-toed woodpecker	NI	Minimal amount of habitat proposed for treatment; nesting and foraging strategies limit herbicide exposure and disturbance from invasive plant treatment activities
Great gray owl	MI	Minimal amount of habitat proposed for treatment; short-term disturbance is possible; design criteria spatially and temporally restrict invasive plant treatments near occupied nest sites; disturbance during hunting may reduce potential for consumption of contiaminated prey
Northern goshawk	MI	Design criteria spatially and temporally restrict invasive plant treatments near occupied nest sites; short-term disturbance may occur to foraging birds; minimal amount of habitat proposed for treatment
Columbia sharp-tailed grouse	MI	Minimal amount of habitat proposed for treatment; trampling/crushing of nests/chicks may occur during treatment; design criteria minimize potential impacts from herbicide exposure and disturbance; preferred cover/forage may be improved

	All Action Alternatives	Rationale
Amphibians		
Columbia spotted frog	MI	Design criteria restrict application and treatment methods of herbicides posing greater risk to amphibians within and near primary habitat; some individuals may be trampled; suitable habitat would likely be maintained or improved

NE = No Effect
NI = No Impact
MI = May Impact individuals or habitat, not likely to contribute to contribute to a trend toward federal listing or loss of viability to the population or species
NLAA = May Affect, Not likely to Adversely Affect, not likely to jeopardize the continued existence of the species or result in the adverse modification of critical habitat
NLJ = May Affect, Not likely to jeopardize the continued existence of the proposed or candidate species, or adversely modify proposed critical habitat

3.4.6.5.3. Management Indicator Species

Effects to greater sage-grouse, northern goshawk, Columbia spotted frog, and white-headed woodpecker are discussed above in the R4 Sensitive Species section. Impacts on pileated and black-backed woodpeckers from increased human activity, noise, and weed treatment operations would be unlikely due to the small amount of treatment proposed within woodpecker habitat. Dicamba, which is not proposed for aerial application, is the only herbicide proposed with HQ values over 1.0 at maximum and typical application rates. However, given the varied diet and movement of these woodpeckers, they would not likely forage exclusively within treated vegetation, and actual doses exceeding levels of concern for any herbicide or surfactant would be unlikely. Adverse effects to **pileated and black-backed woodpeckers** are not likely to occur from disturbance or herbicide exposure; therefore, no appreciable difference in effects between action alternatives exists.

3.4.6.5.4. Migratory Bird Species

The short-term, low-magnitude, and limited extent (typically 1 acre or less scattered over larger areas) of disturbance that would occur from chemical treatments would not negatively impact populations of migratory birds. While two herbicides resulted in HQs above the LOC, direct effects to migratory birds as result of herbicide toxicity would not likely occur. The risk estimates discussed in this analysis overestimate potential field exposures, and adverse effects would not likely occur. Only minimal impacts to **migratory bird species** are likely from disturbance or herbicide exposure; therefore, no appreciable difference in impacts between action alternatives exists.

3.4.6.5.5. Big Game Species of Interest

Temporary direct displacement effects on big game species resulting from disturbance during weed treatments would be localized and minor relative to the total acreage of the SNF and BNF. This displacement would likely last only a few days or weeks while the actual treatment is occurring. Of the 14 herbicides being analyzed for use, 2 resulted in HQs exceeding the LOC for the scenario of large mammals consuming contaminated vegetation. However, these values likely over-estimate risk because they assume 100% of the individual’s diet would consist of contaminated vegetation. Only minimal impacts to **big game species** are likely from disturbance or herbicide exposure; therefore, no appreciable difference in impacts between action alternatives exists.

3.5. Sensitive Plants and Native Vegetation

Sensitive Plants and Vegetation Summary: The No Action Alternative would result in the expansion of noxious weeds across 5% to 24% of the project area over the next 10 years, potentially reducing native vegetation vigor and increasing the risk of extirpation to special status plants from the project area. The action alternatives (Alternatives 2, 3, 4, and 5) comply with laws, regulations, and policy, adhere to Forest Plan standards and guidelines, and would aid forest health, diversity, and resiliency in moving toward desired conditions. Alternative 3 provides the greatest advantage in treating noxious weeds, as it has the largest toolbox by allowing for aerial and aquatic herbicide applications. Alternative 2 would be the most limiting of the action alternatives, as it proposes the use of fewer herbicides and fewer acres of treatment by biocontrols, herbicides, and mechanical. Alternative 5 would be more beneficial than Alternative 4, as aerial application of herbicide allows for treating large and remote areas more effectively than through ground-based application methods; however, with this increase in benefit, the risk to nontarget species also increases.

The impacts to special status plants and native vegetation from the action alternatives would be negative in the short term but beneficial in the long term. However, design criteria have been put in place to reduce risk and protect individual special status plants and their habitats. In general, all action alternatives may impact individuals and habitat in the short term, due to the risk of individual mortality to special status plants and nontarget plants in their habitats, but would have beneficial impacts in the long run.

3.5.1. Introduction

This section describes how the alternatives address the purpose of the project to reduce the negative effects of existing and future invasive plants on the structure and function of native plant communities in the Project Area. This section also addresses the issues and concerns identified during public scoping that proposed weed treatments could affect Forest Service Intermountain Region (R4) sensitive plant species and candidate species the USFWS has concluded should be proposed for listing as endangered or threatened, and specifically that herbicide exposure, resulting from herbicide drift, residue, or direct application, may cause harm to non-target plants and their pollinators.

3.5.2. Methodology for Analysis

The potential effects of invasive plant control methods are predictable and well documented. On the basis of the foregoing, the IDT considered science relevant to the effects of this project on vegetation and special status plants, along with their pollinators, within the project area.

Because invasive plant management treatment results may vary based on soils, vegetation (i.e., cover type), and climatic regime, the effects of invasive plant management for the action alternatives are based on local and regional information from sites best representing the conditions found in the project area.

The relevant science considered for this analysis consists of these elements:

- **Scientific literature—**Relevant literature was used for understanding potential effects.

- **Methods—**The methods used to develop data for quantitative analysis were accomplished using software developed by Environmental Systems Research Institute (ESRI). Attribute queries, spatial queries, and generation of new datasets from the original Forest Service GIS corporate data were the 3 types of operations utilized. The degree of spatial analysis ranged from simple queries about the spatial events to more complicated combinations of attribute queries, spatial queries, and alterations of corporate data to create new layers for the purpose of this analysis.
- **Experience—**The IDT integrated science with local conditions and knowledge.

This analysis incorporates management activities for controlling all 67 plant species legally designated as noxious weeds by the State of Idaho (Table 3-57), all 27 species legally designated as noxious weeds by the State of Utah (Table 3-58), and other nonnative invasive plants causing economic or environmental harm. Only 26 of these species are known to infest lands within the project area. The remaining species, however, are present elsewhere in Idaho, Utah, and neighboring states and have the potential to become established within the project area.

Not all nonnative plants are considered deleterious to the environment and subject to eradication efforts, as defined by federal and state weed management requirements (USDA Forest Service 2013). The proposed management activities deal only with noxious and invasive plant species identified as damaging to human health, to economic interests, or to the environment by county, state, or federal entities (EO 13112). The 2 Forests track a number of nonnative invasive plant species that may not be listed as noxious in Idaho, Utah, or other western states, but which are recognized as causing economic or environmental harm. For example, cheatgrass (*Bromus tectorum*), medusahead rye (*Taeniatherum caput-medusae*), and curveseed butterwort (*Ceratocephala testiculata*).

Table 3-57. Idaho terrestrial and aquatic noxious weeds: Early detection/rapid response, control, and containment lists

Common Name	Scientific Name	Aquatic, Wetland, Riparian, or Upland	Present in Idaho	Occurrence in Boise National Forest Counties[a]	Occurrence in Sawtooth National Forest Counties[b]
Idaho Statewide Early Detection/Rapid Response List					
Feathered Mosquitofern	*Azolla pinnata*	Aquatic	no	no	no
Red Star-thistle	*Centaurea calcitrapa*	Upland	yes	no	yes
Iberian Knapweed	*Centaurea iberica*	Upland	no	no	no
Squarrose Knapweed	*Centaurea virgata*	Upland	no	no	no
Carolina Fanwort	*Cabomba caroliniana*	Aquatic	no	no	no
Brazilian Waterweed	*Egeria densa*	Aquatic	eradicated	yes, but eradicated in Ada County	no
Water Hyacinth	*Eichhornia crassipes*	Aquatic	yes	no	yes, but eradicated in Twin Falls County
Giant Hogweed	*Heracleum mantegazzianum*	Upland	no	no	no
Queen-devil Hawkweed	*Hieracium glomeratum*	Upland	yes	no	yes
Tall Hawkweed	*Hieracium piloselloides*	Upland	yes	no	no
Common Frogbit	*Hydrocharis morsus-ranae*	Aquatic	no	no	no
Waterthyme (also known as hydrilla)	*Hydrilla verticillata*	Aquatic	yes	yes	no
Ornamental Jewelweed	*Impatiens glandulifera*	Wetland	yes	no	no
Twoleaf watermilfoil	*Myriophyllum heterophyllum*	Aquatic	no	no	no
Yellow Floatingheart	*Nymphoides peltata*	Aquatic	yes	yes	no
Kariba-weed (also known as giant salvinia)	*Salvinia molesta*	Aquatic	no	no	no
Water Chestnut	*Trapa natans*	Aquatic	no	no	no
Syrian Beancaper	*Zygophyllum fabago*	Upland	yes	yes	yes

Common Name	Scientific Name	Aquatic, Wetland, Riparian, or Upland	Present in Idaho	Occurrence in Boise National Forest Counties[a]	Occurrence in Sawtooth National Forest Counties[b]
Idaho Statewide Control List					
Heardheads (also known as Russian knapweed)	*Acroptilon repens*	Upland	yes	yes	yes
Small Bugloss	*Anchusa arvensis*	Upland	yes	no	no
Nodding Plumeless Thistle	*Carduus nutans*	Upland	yes	yes	yes
Meadow Knapweed	*Centaurea debeauxii*	Upland	yes	no	no
Common Crupina	*Crupina vulgaris*	Upland	yes	yes	yes
Scotch Broom	*Cytisus scoparius*	Upland	yes	no	no
Common Viper's Bugloss	*Echium vulgare*	Upland	yes	no	no
Orange Hawkweed	*Hieracium aurantiacum*	Upland	yes	yes	yes
Meadow Hawkweed	*Hieracium caespitosum*	Upland	yes	yes	no
Black Henbane	*Hyoscyamus niger*	Upland	yes	yes	yes
Dyer's Woad	*Isatis tinctoria*	Upland	yes	yes	yes
Parrot Feather Watermilfoil	*Myriophyllum aquaticum*	Aquatic	yes	yes	no
Eurasian Watermilfoil	*Myriophyllum spicatum*	Aquatic	yes	yes	no
Matgrass	*Nardus stricta*	Upland	yes	no	yes
Common Reed	*Phragmites australis*	Wetland	yes	yes	yes
Bohemian Knotweed	*Polygonum bohemicum*	Upland	yes	yes	no
Japanese Knotweed	*Polygonum cuspidatum*	Upland	yes	yes	yes
Giant Knotweed	*Polygonum sachalinense*	Upland	yes	no	no
Mediterranean Sage	*Salvia aethiopis*	Upland	yes	yes	yes
Buffalobur Nightshade	*Solanum rostratum*	Upland	yes	yes	no
Field Sowthistle	*Sonchus arvensis*	Upland	yes	no	yes
Johnsongrass	*Sorghum halepense*	Upland	yes	no	yes

Common Name	Scientific Name	Aquatic, Wetland, Riparian, or Upland	Present in Idaho	Occurrence in Boise National Forest Counties[a]	Occurrence in Sawtooth National Forest Counties[b]
Idaho Statewide Containment List					
Jointed Goatgrass	*Aegilpos cylindrica*	Upland	yes	yes	yes
Hoary Alyssum	*Berteroa incana*	Upland	yes	yes	yes
White Bryony	*Bryonia alba*	Upland	yes	yes	yes
Flowering Rush	*Butomus umbelltus*	Wetland/Aquatic	yes	no	yes
Whitetop	*Cardaria draba*	Upland	yes	yes	yes
Plumeless Thistle	*Carduus acanthoides*	Upland	yes	no	yes
Diffuse Knapweed	*Centaurea diffusa*	Upland	yes	yes	yes
Yellow Star-thistle	*Centaurea solstitialis*	Upland	yes	yes	yes
Spotted Knapweed	*Centaurea stoebe* ssp. *micranthos*	Upland	yes	yes	yes
Rush Skeletonweed	*Chondrilla juncea*	Upland	yes	yes	yes
Canada Thistle	*Cirsium arvense*	Upland	yes	yes	yes
Poison Hemlock	*Conium maculatum*	Riparian/Wetland	yes	yes	yes
Field Bindweed	*Convolvulus arvensis*	Upland	yes	yes	yes
Gypsyflower (Hound's Tongue)	*Cynoglossum officinale*	Upland	yes	yes	yes
Leafy Spurge	*Euphorbia esula*	Upland	yes	yes	yes
Paleyellow Iris	*Iris pseudacorus*	Aquatic/Wetland	yes	yes	yes
Broadleaved Pepperweed	*Lepidium latifolium*	Upland/Riparian/ Wetland	yes	yes	yes
Oxeye Daisy	*Leucanthemum vulgare*	Upland	yes	yes	yes
Dalmatian Toadflax	*Linaria dalmatica* ssp. *dalmatica*	Upland	yes	yes	yes
Butter and Eggs	*Linaria vulgaris*	Upland	yes	yes	yes
Purple Loosestrife	*Lythrum salicaria*	Riparian/Wetland	yes	yes	yes
Spring Milletgrass	*Milium vernale*	Upland	yes	no	no
Scotch Cottonthistle	*Onopordum acanthium*	Upland	yes	yes	yes
Curly Pondweed	*Potamogeton crispus*	Aquatic	yes	yes	yes
Stinking Willie	*Senecio jacobaea*	Upland	yes	yes	yes
Saltcedar	*Tamarix ramosissima*	Riparian	yes	yes	yes
Puncturevine	*Tribulus terrestris*	Upland	yes	yes	yes

Source: Note that some common names above may differ from State lists as the USDA Plants Database (www.plants.usda.gov) was used as the source for botanical common names
[a] Boise National Forest counties = Ada, Adams, Camas, Elmore, Gem, Valley, Washington.
[b] Sawtooth National Forest counties = Blaine, Box Elder (Utah), Camas, Cassia, Custer, Elmore, Oneida, Power, Twin Falls.

Table 3-58. Utah noxious weeds: Early detection/rapid response, control, and containment lists

Common Name	Scientific Name	Aquatic, Wetland, Riparian, or Upland	Present in Utah	Occurrence in Box Elder County
Utah Statewide Class A Weeds (Early Detection/Rapid Response List)				
Diffuse Knapweed	*Centaurea diffusa*	Upland	yes	yes
Yellow Star-thistle	*Centaurea solstitialis*	Upland	yes	yes
Spotted Knapweed	*Centaurea stoebe* ssp. *micranthos*	Upland	yes	yes
Leafy Spurge	*Euphorbia esula*	Upland	yes	yes
Black Henbane	*Hyoscyamus niger*	Upland	yes	yes
St. Johnswort	*Hypericum perforatum*	Upland	yes	yes
Oxeye Daisy	*Leucanthemum vulgare*	Upland	yes	yes
Butter and Eggs	*Linaria vulgaris*	Upland	yes	yes
Purple Loosestrife	*Lythrum salicaria*	Riparian/Wetland	yes	yes
Sulphur Cinquefoil	*Potentilla recta*	Upland	yes	no
Johnsongrass	*Sorghum halepense*	Upland	yes	yes
Medusahead	*Taeniatherum caput-medusae*	Upland	yes	yes
Utah Statewide Class B Weeds (Control List)				
Heardheads	*Acroptilon repens*	Upland	yes	yes
Whitetop	*Cardaria draba*	Upland	yes	yes
Nodding Plumeless Thistle	*Carduus nutans*	Upland	yes	yes
Squarrose Knapweed	*Centaurea virgata*	Upland	yes	no
Poison Hemlock	*Conium maculatum*	Riparian/Wetland	yes	yes
Bermudagrass	*Cynodon dactylon*	Upland	yes	yes
Dyer's Woad	*Isatis tinctoria*	Upland	yes	yes
Breadleaved Pepperweed	*Lepidium latifolium*	Upland/Riparian/ Wetland	yes	yes
Dalmatian Toadflax	*Linaria dalmatica* ssp. *dalmatica*	Upland	yes	yes
Scotch Cottonthistle	*Onopordum acanthium*	Upland	yes	yes
Utah Statewide Class C Weeds (Containment List)				
Canada Thistle	*Cirsium arvense*	Upland	yes	yes
Field Bindweed	*Convolvulus arvensis*	Upland	yes	yes
Gypsyflower (Hound's Tongue)	*Cynoglossum officinale*	Upland	yes	yes
Quackgrass	*Elytrigia repens*	Upland/Riparian/ Wetland	yes	yes
Saltcedar	*Tamarix ramosissisma*	Riparian	yes	yes

Sources: USDA Plants Database website, plants.usda.gov; Utah Weed Control Association, Noxious Weeds web site, http://www.utahweed.org/weeds.htm; Utah State University Cooperative Extension 2009.

3.5.2.1. Primary Sources Informing the Analysis

Primary sources of information used to assess the effects of the alternatives on Sensitive plants are as follows:

- NRIS database for invasive plant inventory (USDA Forest Service 2016)
- NRIS database for Sensitive plant species populations occurring within the project area (USDA Forest Service 2016)

- Forest Service risk assessments for herbicides in use or proposed for use
- Herbicide labels that provide highly specific instructions for use of an herbicide

3.5.2.2. Analysis Area

The project area forms the analysis area for effects to BNF and SNF native vegetation communities and sensitive plants, for all alternatives. The analysis area for cumulative effects includes all of the BNF counties (Ada, Adams, Camas, Elmore, Gem, Valley, and Washington) and all of the SNF counties (Blaine, Box Elder [Utah], Camas, Cassia, Custer, Elmore, Oneida, Power, and Twin Falls).

Per the Forest Plans, in this analysis, the term temporary effects refers to a duration of less than 3 years, short-term effects refers to time frames of 3 to 15 years, and long-term effects refers to a time frame lasting longer than 15 years.

3.5.2.3. Measurement Indicators

The issue related to proposed activities for sensitive plant species and native vegetation communities is herbicide exposure resulting from herbicide drift, residue, or direct application may cause harm to nontarget plants and their pollinators.

Measurement Indicators:

Effects of the following weed treatment types to BNF and SNF sensitive plant species, native vegetation communities, and their pollinators:

- Biological control
- Herbicide application
- Mechanical control

3.5.3. Compliance with Forest Plan and Other Relevant Direction

The federal government recognizes the serious economic and environmental threats posed by the establishment and spread of invasive plants across public and private lands (Westbrooks 1998). The regulatory authority for managing invasive species, including noxious weeds, comes from the following:

- The Federal Noxious Weed Act of 1974 (Public Law 93-629, as amended by the 1990 Farm Bill and as superseded by the Plant Protection Act of 2000)
- The 1990 Farm Bill (Public Law 101-624, Title 14—Conservation, Subtitle D)
- Presidential EO 13112 (1999)
- The Plant Protection Act of 2000 (Public Law 106-224)
- The Noxious Weed Control and Eradication Act of 2004 (Public Law 108-412)

As a federal land management agency, the Forest Service is responsible for implementing the federal government’s responsibilities for invasive plant management on NFS lands. The Forest Service specifies national, regional, and local responsibilities through FSM direction

(FSM 2900) and through national and regional strategic frameworks and management plans (USDA Forest Service 2013, 2014a).

The Forest Service is directed to practice an adaptive, collaborative, and integrated approach to invasive species management (FSM 2900; USDA Forest Service 2013). This approach, often known as IWM, addresses weed management strategies in terms of economic or environmental impacts from nonnative invasive plants and deviations from desired conditions. IWM incorporates a number of elements, including 4 broad control strategies: biological, chemical, cultural, and mechanical. IWM also incorporates several other fundamental elements of successful invasive plant management, including prevention and monitoring. Importantly, IWM is an adaptive, iterative method that assesses response to management actions and makes adjustments to management strategies in response to feedback from monitoring.

The Forest Service's National Strategic Framework for Invasive Species Management (USDA Forest Service 2013) exhibits a 4-pronged approach: 1) prevention, 2) detection, 3) control and management, and 4) rehabilitation and restoration. EDRR includes management actions associated with the framework elements of detection and control and management; the Forest Service places emphasis on protecting plant communities from invasive plants by preventing the establishment and spread of invasive plants into noninfested areas. Prevention is the most effective and cost-efficient means of invasive plant management. Prevention helps to maintain healthy native plant communities, soil stability, watershed function, and habitat for fish and wildlife species.

The Forest Service's Intermountain Region (R4) adheres to and emphasizes national direction in its Invasive Species Management Strategy (USDA Forest Service 2014a). R4 directs Forests to comply with the National Strategic Framework for Invasive Species Management (USDA Forest Service 2013) and offers concrete guidance for IWM objectives. Alternative 3's intent is to align the BNF and the SNF invasive plant management plans with current national and regional direction.

The land and resource management plans (Forest Plans) for the BNF and the SNF contain applicable standards and guidelines throughout the resource sections in Chapter 3. The Forest Plans also contain management direction for nonnative plants. These standards and guidelines would be followed along with the design features and BMPs detailed in the action alternatives.

The U.S. Fish and Wildlife Service (USFWS) oversees listed as well as Candidate species proposed for listing, under the ESA. The latter distinction comprises species for which sufficient information exists regarding threats to species populations and habitat to warrant listing as an Endangered or Threatened species under the ESA, but which are precluded from listing due to higher listing priorities. One Sensitive plant species, whitebark pine, is a Candidate species for federal listing.

The Forest Service defines Sensitive species as "those plant and animal species identified by a Regional Forester for which population viability is a concern," as evidenced by the following:

- Significant current or predicted downward trends in population numbers or density
- Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (FSM 2670.5, 19)

In compliance with national law and policy to conserve Sensitive plant species, FSM 2670 instructs the Forest Service to

- Maintain viable populations of existing native and desired nonnative plants in habitats distributed throughout their geographic range and
- Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions.

Regarding native plant communities, the Forest Plans for the BNF and SNF contain goals of providing representations of the various ecological stages of endemic plant communities. The Forest Plans state that Sensitive plant species will be maintained and contain the following goals, objectives, and standards regarding the treatment of nonnative species (USDA Forest Service 2012a):

Botanical Resource Direction:

- **BTGO01**—Provide habitat capable of a) Supporting viable populations of native plant species within the Forest, and b) Supporting plant biodiversity to meet social needs, biological diversity, and ecological and functional integrity.
- **BTGO02**—Emphasize conservation and recovery of Region 4 Sensitive species, Forest "Watch" plants, and other species at risk where quantity and quality of habitat needed to support viability is a concur.
- **BTGO03**—Maintain or restore globally rare plants identified as the Natural Heritage Program G1, G2, and G3 and/or S1 and S2 species, and provide for their continued compositional and functional integrity for those species for which we have habitat.
- **BTGO04—**Maintain habitats for native plants that provide nectar, floral diversity, and pollen throughout the season during which pollinator species are active, with emphasis on rare plant species.
- **BTGO05—**Maintain or restore unique habitats (e.g., unique assemblages of rare plant species, tall forb communities, etc.) throughout the Forest.
- **BTGO06—**Manage plant community habitats (e.g., riparian, wetland, and upland forest, shrub, and grassland habitats) to provide for a) The desired amount, quality, and distribution of habitats, b) Reduced fragmentation within habitats, c) Juxtaposition and connectivity to other habitats, d) Ecosystem processes that shape habitat
- **BTOB02**—During fine-scale analyses in areas containing Sensitive species habitat, identify and prioritize opportunities for restoring degraded Sensitive species habitat.
- **BTOB08—**During fine- and site/project-scale analyses, identify and map areas of non-native plant invasions within rare plant habitat.
- **BTST01—**Management actions that occur within occupied sensitive plant species habitat must incorporate measures to ensure habitat is maintained where it is within desired conditions, or restored where degraded.
- **BTST04—**For projects or activities that include application of insecticides, herbicides, fungicides, or rodenticides, degrading effects on sensitive plant species will be mitigated.

- **BTGU02—**During site/project-scale analysis and review, a Forest botanist should review insecticide or herbicide spray plans and prescribed burning plans to determine whether degrading effects to Sensitive and Forest Watch plants and their pollinators should be mitigated.

Non-native Plant Direction:

- **NPGO01—**Manage noxious weeds with an Integrated Weed Management approach that uses prevention, education, eradication, containment, and control treatment strategies in a coordinated effort that includes potentially affected resources, users, funding sources, and activities.
- **NPGO02—**Prevent new infestations of undesirable non-native plants or noxious weed species, with emphasis on areas of high susceptibility where those species have a strong probability for establishment and spread.
- **NPGO03—**Promote and participate in establishment of Coordinated Weed Management Areas. Support the State of Idaho Weed Management Strategy.
- **NPGO04**—Re-establish vegetation that is compatible with desired long-term vegetative conditions, Forest-wide management direction, and management area priorities.
- **NPGO05**—Work to reduce the risk of establishing new noxious weed populations by minimizing weed seed transport and reducing favorable establishment conditions on disturbed sites.
- **NPOB01**—Maintain, and use current field data to update, the Forest-wide database and map library of current status of noxious weed infestations, treatment activities, and locations of newly established infestations.
- **NPOB02**—Designate Coordinated Weed Management Areas on Sawtooth National Forest System lands.
- **NPOB03**—Develop strategic noxious weed management plans for Coordinated Weed Management Areas. Cooperate on a regular basis with federal agencies, tribal governments, the State of Idaho, county weed organizations, state and local highway departments, and private individuals in establishing Coordinated Weed Management Area strategic priorities, and locating and treating noxious weed species.
- **NPOB04**—Coordinate with the Idaho Department of Transportation and county officials to assist and promote cooperative efforts to reduce introduction and spread of noxious weeds.
- **NPOB05**—Cooperatively work with holders of special use authorizations to identify and manage noxious weed infestations within areas of use to prevent further expansion or reduce existing densities.
- **NPOB06**—Emphasize prevention of noxious weed establishment through education and cooperation with recreation user groups such as ATV, motorcycle, and stock user groups.
- **NPOB07**—Use Burned Area Emergency Rehabilitation or other appropriate procedures to reduce the risk of noxious weed expansion in wildland fire areas, especially those

identified in the Forest-wide database and map library as being highly susceptible to invasion.

- **NPGU01**—Noxious weeds and undesirable non-native plants should be eradicated. Where it is not practical to eradicate existing infestations, infestations should be managed to prevent seed production and spread.

3.5.4. Affected Environment

3.5.4.1. Ecoregions of the Boise and Sawtooth National Forests

The BNF and SNF are located in the temperate desert division of the Middle Rocky Mountain Ecoregion. The BNF occurs almost exclusively within the Idaho Batholith province of this ecoregion, with only a small portion of the Mountain Home RD falling into the Snake River Basalts province. The SNF lies within 3 separate provinces of this Ecoregion. The Fairfield RD and the western half of the Sawtooth NRA are within the Idaho Batholith, the Ketchum RD and the eastern half of the Sawtooth NRA are within the Challis Volcanics, and the Minidoka RD is within the Eastern Basin and Range province. This ecoregion, with its associated provinces, consists of mountain ranges, basins, and river canyons. The climatic regime is broadly similar across the ecoregion, although precipitation varies based on altitude; overall, the ecoregion is semi-arid. Lower elevations are dominated by grasslands and shrub-steppe vegetation, while conifer cover increases with elevation. Ponderosa pine and Douglas-fir dominate the low-elevation conifer forest. Lodgepole pine, Engelmann spruce, and subalpine fir occupy the mid-elevation range, while whitebark pine occupies the upper elevations (USDA Forest Service 2007a).

3.5.4.2. Native Vegetation Communities

The BNF and SNF cover 4.3 million acres and contain a diverse and interspersed mixture of native plant communities. These communities vary according to elevation, topography, and soil type. In general, they may be categorized by cover type; these broad groupings are defined by the predominant vegetation currently occupying a site (e.g., shrubland or conifer). Many of the cover types provide habitat for sensitive plants found on forests. Table 3-59 summarizes cover types occurring on the Forests, by acreage. Barren areas include ground that has been burned or is sparsely vegetated.

Table 3-59. Cover types of the Boise and Sawtooth National Forests

Vegetation Category	Acres of Vegetation	Acres of Noxious Weed Infestation
Alpine	21,806	7
Aspen	132,258	3,711
Barren	442,497	5,698
Bitterbrush	50,294	3,013
Conifer	2,118,642	92,455
Developed	1,691	697
Dwarf Sage	56,605	790
Grassland	167,359	9,124
Juniper	56,336	1,115
Mixed Shrubland	362,549	15,577
Mountain Big Sage	652,029	17,398
Mountain Mahogany	8,196	50
Riparian	58,312	5,169
Water	24,811	0
Whitebark Pine	150,362	103
Wyoming Big Sagebrush	20,614	622
Total Acres	4,324,360	155,529

On the 2 forests, approximately 155,000 acres are occupied by invasive and noxious plant species (BNF = 91,000 acres, and SNF = 64,000 acres) named by the State of Idaho or the State of Utah as official noxious weeds (see Table 3-57 and Table 3-58). The 155,000 acres do not include overlapping occurrences of weedy species.

3.5.4.3. Sensitive Plant Species Presence and Distribution

The BNF and SNF provide potential habitat for 1 federally listed threatened terrestrial plant species (Ute ladies'-tresses [*Spiranthes diluvialis*]) and 1 candidate species (whitebark pine [*Pinus albicaulis*]). In September 2002, the USFWS removed Ute ladies'-tresses from the BNF and SNF 90-day Species List and noted that future biological assessments need not address the species because the USFWS believes the plant does not occur on the Forests (USFWS 2002, 1-4-02-SP-911). As part of rare plant surveys on projects, however, the Forest Service surveys for Ute ladies'-tresses orchid. Due to direction from the USFWS and because the Ute ladies'-tresses orchid is not known to occur within the Proposed Alternative's area, the species will not be examined further in the analysis. Whitebark pine occurs on both forests.

The Regional Forester has identified 22 sensitive plant species and/or their habitats for the BNF and SNF. Both Forests also maintain a list of watch species, which currently contains 33 species and/or their habitats. Some of these species possess highly specific habitat requirements and only occur in a few places. Other species exhibit broad distributions and occur in a variety of cover types.

Specific species accounts, including listing status, description, habitat characteristics, existing condition, and factors of decline/threats for the ESA-listed plant species, R4 sensitive plant species, and forest watch species are available in the project record in the Botany and Native Vegetation Technical Report.

Of these 57 special status plant species on the 2 forests, 27 have populations co-occurring with invasive and noxious weed species. Some of these species are at a greater threat from invasive and noxious plant species than others. Table 3-60 displays the acres of infestation within a quarter mile of special status plant populations. Nearly 8,200 acres of invasive and noxious species infestations occur within a quarter mile of special status plants. This close proximity puts those populations at greater risk both from the impacts of weed invasion and weed treatments.

Table 3-60.Special status plant species and acres infested by invasive and noxious weeds

Common Name	Forest		Infestation within 0.25 Miles of Plant Population (acres)
	Boise	Sawtooth	
Endangered Species Act List			
Ute Ladies'-tresses Orchid (threatened)	?	?	0
Whitebark Pine (candidate)	X	X	103
Forest Service Region 4 Sensitive List			
Bryum Moss	X	X	1,385
Bugleg Goldenweed	X	X	240
Christ's Indian Paintbrush		X	47
Cottam Cinquefoil		X	61
Davis' Wavewing		X	47
Great Basin Desert Buckwheat		X	0
Douglass' Biscuitroot		X	0
Goose Creek Milkvetch		?	0
Guardian Buckwheat		X	1
Idaho Douglasia	X		1,161
Idaho Pennycress		X	0
Idaho Penstemon		X	2
Little Grapefern	X	X	0
Marsh's Bluegrass		X	0
Sacajawea's Bitterroot	X	?	274
Scalloped Moonwort	X		326
Slender Moonwort	X	X	0
Least Phacelia	X	?	0
Stanley's Whitlow-grass		X	7
Sticky Tofieldia	X		0
Tolmie's Onion	X		9
White Clouds Milkvetch		X	0
Forest Watch List			
Armed Pricklypoppy		X	0
Blandow's Helodium Moss	X	X	6
Bulblet-bearing Water Hemlock	X		0
Buxbaum's Sedge		X	0
Challis Milkvetch		X	512
Engelmann's Sedge		X	0
Farr's Willow		X	16
Fivefinger Chickensage	X		0
Giant Helleborine Orchid		X	2,100
Grouse Creek Rockcress		X	2
Kruckeberg's Hollyfern	X	X	181

Common Name	Forest		Infestation within 0.25 Miles of Plant Population (acres)
	Boise	Sawtooth	
Leiberg Stonecrop	X		0
Malheur Cryptantha		X	0
Mt. Shasta Sedge	X	X	417
Nodding Saxifrage		X	0
Northern Sagewort		X	0
Northern Sanicle	X		0
Pale Sedge	X	X	13
Park Milkvetch		X	6
Parry's Sedge	X		0
Petalless Campion		X	0
Rannoch-rush	X		0
Sand Sedge		X	0
Silvery Primrose		X	1
Simpson's Hedgehog Cactus		X	55
Spoonleaf Sundew	X	X	7
Sweetgrass	X		0
Tall Swamp Onion		X	1,153
Tufted Penstemon	X		0
Rock Violet		X	0
Wedgeleaf Saxifrage		X	61
White Beakrush	X		0
Yellowstone Draba		X	0
Total			8,193

3.5.4.4. Pollinators

Very little information on insect pollinator species occurrence and population trends is known on the BNF and SNF. No known surveys have been conducted. Species present are most likely typical for the climate and plant communities present. These include species of bees within the families Apidae (bumblebees), Colletidae (plasterer bees), Andrenidae (mining bees), Halictidae (solitary bees), Megachilidae (leafcutting bees), and Anthophoridae (digger bees and carpenter bees), along with many species within the Order Diptera (flies) (Tepedino and Cane 2001).

Many species of plants rely on insects for pollination. Some species of plants are pollinated by many species and others are more specific (i.e., depending on a single pollinator species). Plant and pollinator diversity have been shown to be positively correlated. Recent evidence suggests that many species of insect pollinators may be in decline due to many factors, including habitat alteration and fragmentation, pesticides, and competition from nonnative species (Kearns 1997). Native plant species diversity is essential to maintain pollinator populations.

3.5.4.5. Invasive Species Presence and Distribution

Within the counties encompassing the BNF and SNF, 49 known terrestrial noxious invasive plant species are infesting native plant communities (Table 3-57). The Forests have records of 26 of these species infesting approximately 155,000 acres within the Forests' boundaries (USDA Forest Service 2016). With a project area of 4.3 million acres, 155,000 acres represents 3.6% of the project area known to be infested by Idaho and Utah State designated noxious invasive plant species.

The most common invasive plant species in the project area are rush skeletonweed, spotted knapweed, leafy spurge, and Canada thistle (USDA Forest Service 2016) (Table 3-61). These 4 noxious plant species account for 66% of the acreage of known noxious plant infestations. Rush skeletonweed is the most prevalent invasive plant species, with nearly 53,000 acres infested (USDA Forest Service 2016).

It is important to note that the acres shown in Table 3-61 contain duplicate acreage. This happens because Forest Service NRIS database protocols require that a site-identified invasive plant infestation may consist of only one invasive plant species. When more than one invasive plant species occupies a site (e.g. spotted knapweed and hoary alyssum), then two invasive plant infestations are recorded in the NRIS database, one for each of the invasive plants present, resulting in a double count. This means that the acreage of invasive plant infestations reported in Table 3-61 is an over-estimate of actual noxious weed infestations.

Table 3-61. Top terrestrial noxious weed infestations in the project area

Scientific Name	Acres Infested
Chondrilla juncea (rush skeletonweed)	52,681.00
Centaurea stoebe ssp. *micranthos* (spotted knapweed)	26,187.00
Euphorbia esula (leafy spurge)	14,852.00
Cirsium arvense (Canada thistle)	13,977.00
Linaria vulgaris (yellow toadflax)	10,723.32
Linaria dalmatica (Dalmation toadflax)	8,180.00
Cynoglossum officinale (gypsyflower, a.k.a. hound's tongue)	7,383.00
Centaurea diffusa (diffuse knapweed)	6,171.00
Leucanthemum vulgare (oxeye daisy)	5,679.00
Cirsium vulgare (bull thistle)	4,617.00
Carduus nutans (nodding plumeless thistle)	2,327.00

Nonnative invasive plant species are neither distributed evenly among RDs of each Forest nor among plant community cover types (USDA Forest Service 2016). Topography and plant communities in the project area are variable, ranging from flat to gentle terrain to very steep slopes, and from large expanses of sagebrush–steppe to densely forested areas. However, invasive plant establishment and spread are not determined by topography, but are closely tied to cover types (the type of vegetation currently occupying a site; see Table 3-59), patterns and sources of disturbance (e.g., fire), invasive plant vectors (e.g., roads and trails), site-specific variables, and the invasion potential of any given nonnative invasive plant species. Overall, the fact that only 3.6% of the project area contains infestations of noxious invasive plants means that the project area is dominated by native and desirable plant communities functioning within intact ecosystems.

3.5.5. Environmental Consequences

Of the 24 plant species listed by the Regional Forester as Sensitive for the forests, no populations of the following 5 species have been found in the project area in surveys to date: Ute ladies'–tresses orchid, Douglass' biscuitroot, Goose Creek milkvetch, slender moonwort, and least phacelia. Of the 33 forest watch species, no populations of the following 6 species have been found in the project area in surveys to date: Leiberg stonecrop, northern sanicle, petalless

campion, tufted penstemon, sand sedge, and Yellowstone draba. Yellowstone draba occurs in 1 location on BLM land adjacent to the Sawtooth NRA, and though 1 reported occurrence of this species was reported on Galena Summit on the Sawtooth NRA, it has not been confirmed.

Regionally, 6 sensitive species, along with 13 forest watch species, are not currently associated with any threats from invasive plant establishment and spread or from effects of invasive plant control activities in the project area, including Great Basin Desert buckwheat, Idaho pennycress, little grapefern, Marsh's bluegrass, sticky tofieldia, White Clouds milkvetch, armed pricklypoppy, bulblet-bearing water hemlock, Buxbaum's sedge, Engelmann's sedge, fivefinger chickensage, Malheur cryptantha, nodding saxifrage, northern sagewort, Parry's sedge, Rannoch-rush, sweetgrass, rock violet, and white beakrush. These species either occur in very specific habitats, such as cliffs or talus or at high to very high elevations above treeline, or do not occur within a quarter mile of known noxious weed infestations. These habitats are often away from roads or trails and experience less human activity than the more accessible areas, which provides a greater degree of protection from the effects of invasion and invasive plant control activities.

Based on the available information summarized above, the other 27 Sensitive plant species and Forest Watch species could be vulnerable to, and therefore impacted by invasive plant invasion and by invasive plant control measures, because 1) they grow in habitats susceptible to noxious plant invasion and spread, 2) there may be known invasive plant infestations in or in close proximity to populations, or 3) there are roads or trails through or near populations, making these populations more vulnerable to invasive plant invasion due to human presence and activity.

3.5.5.1. Alternative 1—No Action

Under Alternative 1, no management of invasive plants within the project area would occur. Both Forests would discontinue all invasive plant management activities, including invasive plant inventory, monitoring, control, and restoration activities, to meet invasive plant management objectives, except for those NFS lands under road ROW agreements with the different counties. In the latter situations, the authority to undertake treatments is vested in the County agencies.

The No Action Alternative provides a baseline for comparison and analysis of effects.

3.5.5.1.1. Direct and Indirect Effects of Alternative 1

Native Vegetation Communities

Under Alternative 1, invasive plant control would cease. There would be no use of biological control, herbicide, or mechanical control, and there would be no annual treated or applied acres of invasive plant control in either aquatic or terrestrial settings (aerial or ground-based).

Invasive plants would infest plant communities across both forests unimpeded because existing invasive plant populations would no longer be controlled, and no detection inventories would exist for new invasive plant species. Existing infestations would eventually expand to the limits of suitable habitat, with the abandonment of current containment boundaries. These existing infestations would act as reservoirs to infest new areas, including steep, inaccessible, or remote areas, as invasive plants would be transported by birds, animals, wind, and water.

There would be an increase in the number of spot infestations arising from these existing infestations, contributing to increased rates of growth. The density of existing infestations would also increase.

New invasive plants could become common and widespread if they were introduced onto lands in the Forests. Eventually, existing and new invasive plant species could colonize and occupy all suitable habitats. The cessation of detection and rapid response efforts could result in the establishment and spread of new invasive plant species and new infestations.

Invasive plants would move along vector routes, such as roads and trails, as spread by human activities and animal movements. Infestations would establish and spread rapidly along the length of roads and trails with the cessation of invasive plant control activities (Ferguson et al. 2003, Gelbard and Belnap 2003). Road and trail corridors would become heavily infested with invasive plants. Vehicles, people, and animals would pick up invasive plant seeds traveling along infested roads and trails and could then introduce seeds into areas that are currently uninfested.

Without control, invasive plants would have a high potential for exponential growth. Spread rates would vary depending on the invasive plant species, size of current infestation, disturbance history, present disturbances, and site productivity at each site. For example, a 5-acre sulphur cinquefoil infestation, at a spread rate of 10% per year, could occupy 5.5 acres 1 year later, but would occupy 8 acres within 5 years. The larger the infestation became, the greater the number of acres it would occupy in every subsequent year. With increasing infestation size and density, outcomes such as increased rate of spread and increased spot infestations (i.e., occurring away from the main body of the infestation) could result.

Seed banks of the most invasive plant species would build rapidly, as many species produce large amounts of seed every year, much of which remains viable for several years to more than a decade (Schulz 2011). Rhizomatous weeds would spread faster than many taprooted weeds because they spread both via seed and through rhizome expansion (Sakai 2001). This dual spread mechanism would allow rhizomatous weeds such as leafy spurge and yellow toadflax to spread more rapidly. Wind-dispersed seeds, such as rush skeletonweed, would spread quickly across broad geographic areas, with many small, separate infestations combining rapidly (Kinter et al. 2007). Over time, a new invasive plant could be introduced, establish, and eventually come to co-dominate or replace existing invasive plant species (Sheley and Petroff 1999, Sakai 2001).

Mechanical control would cease under Alternative 1, leading to an increase in invasive plant density and the outward expansion of infestations that are currently controlled mechanically. Invasive plant seeds widely distributed by animals or by wind may spread long distances once mechanical control ends.

Existing populations of biological control agents would probably continue to spread naturally as invasive plant infestations expand. Biological control agents would not slow or halt the spread of invasive plant infestations, but would provide a low level of control, reducing invasive plant density.

Under Alternative 1, however, no new releases of biological control agents would occur. For example, newly available agents that could help provide more effective control of species such as rush skeletonweed would not be released.

Indirectly, as invasive plants spread out into uninfested plant communities, an entire set of cascading plant community changes result (Sheley and Petroff 1999). Native plants become stressed from the additional competition imposed by invasive plants. The percentage of native vegetation occupying a site declines as invasive plant density increases. Eventually, there is a decline in native plant diversity as more and more native species are eliminated from the community. In some cases, changes in fire regime and other natural disturbance processes occur as invasive plants alter natural successional stages.

In turn, these changes in plant community composition lead to another set of indirect effects at the ecosystem level (Sheley and Petroff 1999). For example, changes in insect populations may occur, such as those seen with pollinator populations or those groups of insects eaten by birds and small mammals, changing species' interactions. Leaf litter and organic input to streams and ponds may be altered or reduced. Palatable and nutritious native grasses and forbs would be replaced with invasive plant species that do not provide necessary nutrition and that may not be palatable, reducing wildlife forage values. Some invasive plant species are known to be toxic or an irritant to some kinds of animals (as well as to humans). Changes in the composition and structure of plant communities can lead to changes in arthropod populations, including pollinator populations, and can profoundly affect food webs for all resident and migratory fish and wildlife species. These changes in native plant community composition and structure can have severe impacts on wildlife populations and on livestock carrying capacity by altering forage availability and by reducing cover and habitat.

Soil erosion may increase as deep or fibrous-rooted native plants that bind and hold soil are replaced by invasive plant species with shallow roots or those with simple taproots. As vacant niches are left in the root profile, cover may be reduced on the soil surface, organic material is lost from the top of the soil profile, and areas of bare soil may increase. The loss of protective vegetative cover and organic matter in the soil leaves it more vulnerable to erosion, especially in the event of high-intensity rainstorms (Lacey et al. 1989).

Under Alternative 1, no rehabilitation or restoration actions would be taken on sites severely degraded by invasive plant invasion. Sites that would benefit from intervention would not receive treatments that enrich the diversity of desired plants on the site, increase the cover representation of desired plant species, reduce the area of bare soil, fill vacant soil niches, and reverse soil erosion. Site recovery would be left entirely to natural causes; however, in the absence of any invasive plant management, it seems unlikely that recovery would take place.

These changes in plant community composition, structure, and function could all lead ultimately to reduced ecosystem function and reduced quality of services. These changes could include decreased biodiversity, nutrient cycling, pollination of native plants and desirable nonnative food crops, land productivity, soil formation and fertility, erosion control, and water cycling (Charles and Dukes 2007). Other tangible ecosystem services include support of businesses engaged in recreation and tourism, such as outfitters and guides. Less tangible, but still vital, services include aesthetic, bequest, cultural heritage, educational, and scientific values.

Special Status Plant Species

The impacts of nonnative invasive plant species have assumed crisis proportions throughout much of the United States, including on NFS lands (Westbrooks 1998, USDA Forest Service 2004). The numbers of invasive plant species and areas occupied continue to increase as

a result of human uses and movement patterns. Invasive plants arrive in this country without the array of insect and disease organisms that control their density and distribution in their native countries (LeJeune and Seastedt 2001). As a result, some species become unusually aggressive in their new environment; they are able to establish monocultures and crowd out native plants. Another reason nonnative plant species can become invasive in new environments is that they are often highly competitive in acquiring resources such as water, soil, nutrients, or light (Whitney and Gabler 2008). They may have long seed longevity, germinate and establish root systems quickly, produce large amounts of seed, or have longer periods of active growth that enable them to gain an advantage over less competitive plant species that do not share these traits.

At a landscape level, the process of invasion by nonnative plant species translates into a cascading set of changes in complex ecological interactions and ecosystem processes. These changes include loss of native plant diversity, loss of soil stability, increased erosion, and increased and more frequent natural disturbance cycles (Westbrooks 1998, Sheley and Petroff 1999, Harrod 2001, Chornesky et al. 2005).

There are many thousands of acres of native plant communities across the project area that are invasive and noxious plant-free but that are vulnerable to the introduction and establishment of invasive plants, particularly with respect to grassland, low-elevation shrubland, and dry forest (i.e., Douglas-fir and ponderosa pine) cover types. Furthermore, vulnerability is not evenly distributed among cover types. Low-elevation forest cover types become more vulnerable to invasive plant invasion after disturbance events (e.g., fire) or when roads and trails provide vector routes for new invaders (such as invasive hawkweeds) that are well adapted to growing under a forest canopy. Forest cover types in early successional stages after a disturbance event are the most vulnerable to invasion (Dodson 2004).

Under Alternative 1 and without intervention, invasive plants would infest vulnerable plant communities across the project area. Existing infestations would eventually expand to the limits of suitable habitat, with the abandonment of current containment boundaries. These existing infestations would act as reservoirs to infest new areas, including even steep, inaccessible, or remote areas, as invasive plants would be transported by birds, animals, wind, and water. There would be an increase in the number of spot infestations arising from these existing infestations, contributing to an increased rate of growth. The density of existing infestations would also increase.

Invasive plants would move along vector routes, such as roads and trails, as spread by human activities and animal movements. Infestations would establish and spread rapidly along the lengths of roads and trails with the cessation of invasive plant control activities (Ferguson et al. 2003, Taylor et al. 2012). Road and trail corridors would become heavily infested with invasive plants. Vehicles, people, and animals would pick up invasive plant seeds traveling along infested roads and trails and could then introduce those seeds into areas that are currently uninfested.

Without control, invaders would have a high potential for exponential growth. The rate at which invasive plant infestations expand can sometimes be difficult to determine because spread rates vary depending on the invasive plant species, size of current infestation, disturbance history, present disturbances, and site productivity at each site. Moreover, invasive plant expansion may be exponential (i.e., a constant proportional rate of increase) or 2-phased (a sudden range

expansion following a period of little or slow increase in distribution). Once established, however, invasive plant populations typically increase rapidly. Duncan and Clark (2005) found rates of spread ranging from 8% to more than 30% annually. Table 3-62 and Table 3-63, display the increase in acreage over a 10-year span at average annual rates of spread (Duncan and Clark 2005) for several nonnative invasive plant species found in the project area. These tables illustrate how invasive plants, once introduced, can spread quickly without intervention.

Table 3-62. Depiction of leafy spurge infestation expansion in 1 decade without control

Year	Spread Rate of 12% (acres)	Spread Rate of 16% (acres)
Current	14,852	14,852
1	16,634	17,228
2	18,630	19,985
3	20,866	23,182
4	23,370	26,892
5	26,174	31,194
6	29,315	36,185
7	32,833	41,975
8	36,773	48,691
9	41,186	56,482
10	46,128	65,519

Table 3-63. Depiction of spotted knapweed infestation expansion in 1 decade without control

Year	Spread Rate of 10% (acres)	Spread Rate of 24% (acres)
Current	26,187	26,187
1	28,806	32,472
2	31,686	40,265
3	34,855	49,929
4	38,340	61,912
5	42,174	76,770
6	46,392	95,195
7	51,031	118,042
8	56,134	146,372
9	61,748	181,502
10	67,922	225,062

Invasive plant invasion and spread can impact native plant populations in a myriad of ways, of which many are intricate and involve interconnected relationships. These ways include direct competition for resources such as growing space, nutrients, pollinators, sunlight, and water (Sheley and Petroff 1999). Native plant richness and abundance may decline as invasive plant density increases (Ortega and Pearson 2005). Perennial native plant species may be more affected than annual species (Ortega and Pearson 2005). Lesica and Shelly (1996) found that spotted knapweed invasion affected the population dynamics in a study of the rare native plant *Arabis fecunda*; spotted knapweed affected population growth by inhibiting recruitment.

Indirectly, invasive plant invasion impacts the biotic and abiotic components of native plant communities, both above ground and underground (Kironomos 2002, Callaway et al. 2004, Yurkonis et al. 2005), including alterations to soil and soil microflora and microfauna assemblages, increases in soil erosion, and a reduction in water-holding capacity. Nutrient levels and nutrient cycling may be affected. Distinctive shifts in plant community structure and function may occur. Some of these shifts can be unexpected and have long-term repercussions. For example, pollinator populations and the populations of species preying on pollinators (e.g., spiders) may be affected as invasive plant invasion changes the structural composition of the plant community (Pearson 2009). Other plant reproductive mechanisms, such as seed dispersal, may also be impacted (Traveset and Richardson 2006).

Native plants become stressed from the additional ecological burden imposed by invasive plants. The percentage of native vegetation occupying a site may decline as invasive plant density increases. Eventually, a loss of native plant diversity may occur as native species decline or, in some cases, are eliminated from the community. Native plants that become stressed by invasive plant invasion become more vulnerable to other stressors, such as drought or fire. Some species may be unable to effectively recover on a site impacted by invasive plant invasion and other site disturbances. In extreme cases, native plants may be relegated to “refugia”; that is, marginal habitats unsuitable to invasive plant invasion (Gilbert and Levine 2012). These refugia may be patchy and disconnected, leading to a breakdown of native plant community metapopulation structure.

Native plant species designated as Sensitive are often already precariously situated. Sensitive plant species may be threatened by loss of habitat or may be experiencing downward trends in habitat quality and population status across all or part of their range, such as in the example of the whitebark pine.

Even Sensitive plant species not in decline due to habitat or population factors may naturally exhibit limited distribution and population numbers. For example, some Sensitive plant species may grow only in very specific habitat conditions. These plants may simply be uncommon species that are minor components of the plant communities in which they are found. Other Sensitive plant species might be relatively common and widespread throughout their range but experience a number of threats to habitat.

3.5.5.1.2. Cumulative Effects of Alternative 1

Native Vegetation Communities

With invasive plant management discontinued under Alternative 1, human activities, animal movements across the landscape, and natural events would still contribute to the dissemination of invasive plant seeds and root fragments.

Past human activities and human uses of natural resources in the project area have introduced and spread invasive plants in the project area, particularly in rangeland, riparian areas, and low-elevation conifer forest cover types. These existing invasive plant infestations would persist, new infestations would establish, and new invaders would arrive; this cannot be changed with the cessation of control activities. There would be no restrictions on human activities and human uses of natural resources in the project area with the intent of preventing continued persistence and spread of existing invasive plant infestations. Under Alternative 1, these human activities and uses of resources in the project area would, in combination with the existing condition,

contribute to cumulative temporal and spatial increases in invasive plants in terms of number, size, and density of infestations.

Events such as flooding, fire, and drought would continue to create disturbed areas susceptible to invasion. In conjunction with the cessation of invasive plant control, these natural events would have cumulative negative impacts upon native vegetation. For example, invasive plants could spread more rapidly in burned areas because post-fire conditions often favor many of the invasive plant species. These characteristics include recent soil disturbance, opening of the overstory canopy, soil damage from heat, removal of competing native vegetation, fire suppression activities by hand crews, and equipment and vehicles that could spread existing, and introduce new, invasive plant weed seed and rhizomes.

Because invasive plant management would be discontinued under Alternative 1, the project area would become a very large and broadly distributed source of invasive plants for non-NFS lands, with spread occurring through human activities, animal movements, water, and wind. As invasive plant seeds were brought in from other places, they would establish new infestations in places such as those with heavy traffic or human use. They would then begin to spread out along roads, trails, and streams from the initial point of origin, with a high likelihood of spreading onto other land ownerships.

Private, State, County, and municipal entities would continue to implement active IWM programs. Landowners adjacent to NFS lands would likely see an increase in invasive plants spreading onto their lands over time. Cumulatively, if this alternative were to be chosen, the burden of management would shift entirely to other federal, State, and local entities. This would include CWMAs and private landowners. The repeated events of invasive plant introduction and establishment to lands in other ownerships in central Idaho would severely impact the budgets and personnel resources of these other weed management programs. In turn, their efforts could become less successful, resulting in worsening conditions over time.

These other invasive plant management entities would continue to practice invasive plant control, including herbicide applications and biological control. The potential would exist for natural movement and establishment of these agents into the BNF and the SNF. However, there would be no deliberate redistribution of agents by either forest and no cooperative efforts with other land managers to coordinate the use of biological control methods.

Long-term control has been practiced on many invasive plant infestations in the project area, with the goal of eradicating the seed bank and restoring native plant communities. These areas are usually re-inventoried every few years, and scattered individual plants and small patches are eradicated as soon as they are found. Over time, the density of invasive plants and annual seed production has declined greatly, and native plant communities are thriving in places that were formerly infested. If invasive plant inventory and control were to end, the long-term investments made over the years would be lost. The remaining viable seeds in the seed bank would sprout and reproduce, re-establishing infestations. Were invasive plant management to be discontinued, this effect would be exacerbated by present and foreseeable human activities and resource uses in the project area. Wildlife movements and natural events, such as drought or wildfire, would also contribute to setbacks in seed bank management should these past investments in invasive plant control be lost.

Future control costs would be increased if either forest elected to re-initiate an invasive plant management program at a later date. The likelihood of successfully re-establishing an IWM

program would be substantially reduced after a hiatus. The chance of effective control would be diminished as infestations grow larger and denser. Past and current investments in control and restoration would be lost as invasive plants re-occupied sites that had once been restored to healthy, desired plant communities.

Special Status Plant Species

Detrimental changes resulting from human activities and uses to native plant communities or to soil resources in occupied habitat have the potential to impact Sensitive plant populations. These can be one-time events or small, incremental changes cumulatively leading to decreases in habitat quality, habitat fragmentation or, in some cases (such as mine development), habitat loss. Humans are the ultimate source of the global introduction and spread of invasive species. Human activities and land uses on the BNF and SNF are typical of those that introduce invasive plants and create conditions leading to invasive plant invasion and spread.

Most human activities and uses affect native plant communities through soil and vegetation disturbance. Effects can range from mild to severe. Impacts to vegetation can include outright removal of native vegetation for construction of facilities or travel routes, invasive plant introduction and spread, changes in cover type and structural stage, or changes in plant community composition and structure.

Effects on soil resources can include soil disturbance, compaction, erosion, changes in water holding capacity, or changes in soil structure. Extreme impacts can involve major erosion events such as gullying, mass wasting, slumping, or landslides.

Even with invasive plant management discontinued under Alternative 1, human activities, animal movements across the landscape, and natural events would still contribute to the continued spread of invasive plants.

In the absence of invasive plant management, existing invasive plant infestations would persist, new infestations would establish, and new invaders would continue to arrive. New invaders could become common and widespread without EDRR management actions. Eventually, given enough time, existing and new invasive species could potentially colonize and occupy all suitable habitats. The No Action Alternative would contribute to cumulative increases in invasive plants in terms of number, size, and density of infestations.

The No Action Alternative would place an additional burden on other invasive plant management entities as well. Were the Forest Service to discontinue invasive plant control on NFS lands, new invasive plants and new infestations would increase the potential for invasive plants to be vectored via animals or humans to lands under other jurisdictions.

The daily and seasonal movements of the large number of wildlife species continue, regardless of the decision the Forests make regarding invasive plant management; however, wildlife movements can play a substantial role in the introduction and distribution of nonnative invasive plants. For example, mourning doves are known to spread hoary alyssum and leafy spurge seeds to uninfested areas and, thus, contribute to the spread of these invasive plant species. Large mammals such as deer, elk, and black bears are known to vector gypsyflower (hound’s tongue [*Cynoglossum officinale*]) seeds broadly across the landscape and are primarily responsible for the spread of this species into remote areas or sites largely inaccessible to humans. Along with the natural movements of wildlife, the lack of invasive plant management under Alternative 1 would cumulatively contribute to the continued establishment and spread of invasive plants.

Because seasonal animal movements often cover very large areas, the cumulative effects of unchecked spread of invasive plants combined with animal movements could vector invasive plants into habitats occupied by Sensitive plant species.

Natural events (e.g., flooding, fire, storms, and drought) would continue to create disturbed areas susceptible to invasion. In conjunction with the cessation of invasive plant control, these natural events could have cumulative negative impacts upon Sensitive plant species. For example, invasive plant species could spread more rapidly in burned areas because post-fire conditions often favor many of the invasive plant species, such as spotted knapweed, that occur on the Forests. Although early seral plant species often respond positively to disturbance events, the added burden of invasive plant invasion and the associated changes in the abiotic and biotic components of a given habitat can overwhelm the capacity of a Sensitive plant species to recover (Elzinga 1997, Heidel and Shelly 2001, Stucki et al. 2013). For example, invasive plant invasion can affect soils by reducing water holding capacity and litter cover and increase the amount of interstitial space. These factors can result in increased erosion and loss of water holding capacity. Late seral plant species that depend on stable habitat conditions can be greatly affected by disturbance events. Any declines in habitat capability and productivity possess the potential to negatively affect Sensitive plant species.

Moreover, the cumulative effect of unmanaged invasive plant infestations combined with the disturbance potential of natural events could result in increases of the annual rate of invasive plant spread. As depicted in Table 3-62 and Table 3-63, unmanaged invasive plants have the capacity for rapid increases in density and distribution. Unchecked invasive plant spread could result in the movement of invasive plants into currently uninfested habitat occupied by Sensitive plant species. This places a greater ecological burden on a rare plant species and the habitat that sustains it.

3.5.5.1.3. Alternative 1 Summary

Alternative 1, does not comply with legal requirements or with Forest Service national and regional direction on the management of nonnative invasive plants species. Neither does it contribute to attainment of the desired condition for native plant communities, including Sensitive plant species, in the project area.

Ending all invasive plant management practices could result in an unchecked expansion of invasive plants into vulnerable habitats occupied by Sensitive plant species. If, at a later time, invasive plant management is re-established, many more acres of vulnerable habitat would have been infested and new invasive plant species would likely have established, making invasive plant control that much more difficult and expensive. In areas occupied by Sensitive plant species, this would result in greater impacts due both to the ecological burden placed on Sensitive plants by invasive plant invasion and to the effects of invasive plant control actions on Sensitive plant populations. Table 3-64 displays the determination of effects to habitat and Sensitive plant populations, by species, as a result of implementing Alternative 1.

Table 3-64. Determination of effects to sensitive plant habitat and plants resulting from Alternative 1

Sensitive Plant Species	Effects to Habitat	Effects to Plants	Effects Determination
ESA			
Whitebark Pine (candidate)	Long-term adverse impacts.	Unknown.	May impact individuals and habitat, but not likely to cause a trend towards federal listing or loss of viability
R4 Sensitive List			
Tolmie's Onion	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Scalloped Moonwort	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Bryum Moss	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Christ's Indian Paintbrush	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Davis' Wavewing	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability

Sensitive Plant Species	Effects to Habitat	Effects to Plants	Effects Determination
Idaho Douglasia	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Stanley's Whitlow-grass	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Guardian Buckwheat	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Sacajawea's Bitterroot	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Idaho Penstemon	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Cottam Cinquefoil	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Bugleg Goldenweed	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Forest Watch List			
Tall Swamp Onion	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Grouse Creek Rockcress	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Challis Milkvetch	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Park Milkvetch	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability

Sensitive Plant Species	Effects to Habitat	Effects to Plants	Effects Determination
Pale Sedge	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Mt. Shasta Sedge	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Spoonleaf Sundew	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Giant Helleborine Orchid	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Blandow's Helodium Moss	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Simpson's Hedgehog Cactus	Short-term and long-term adverse impacts	Long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Kruckeberg's Hollyfern	Long-term adverse impacts	Long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Silvery Primrose	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Farr's Willow	Short-term and long-term adverse impacts	Long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Wedgeleaf Saxifrage	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability
Rannoch-rush	Short-term and long-term adverse impacts	Short-term and long-term adverse impacts to individuals and populations	May impact individuals and habitat, but not likely to cause a trend toward federal listing or loss of viability

3.5.5.2. Effects Common to All Action Alternatives

3.5.5.2.1. Design Criteria

Because invasive plant control activities can affect nontarget, native plant species, including Sensitive plant species, a set of design criteria was developed to provide guidance when planning invasive plant control around Sensitive plant populations. These criteria are intended to minimize impacts to Sensitive plants from invasive plant control activities while working toward the desired condition for Sensitive plant populations and habitats.

Protecting Sensitive plants during invasive plant control activities is very attainable. Design criteria include practices such as using mechanical control methods where practicable, using herbicides with very short residual activity, or applying herbicides using highly targeted specific methods such as spot spraying and making sponge, wand, or wiper applications using specialized equipment.

3.5.5.2.2. Effects to Pollinators

Uncertainty exists regarding the effects of herbicides on nontarget plant species and pollinators because native species are not the usual test species for EPA toxicity studies. The EPA performs studies predominantly on pollinators of crop species (honeybees). It has been suggested that the current suite of tested species was not representative of the habitats found adjacent to agricultural treatment areas and also has been suggested that the current suite of tested species might cause an unacceptable bias and underestimated risk (Boutin et al. 2004). Given all the uncertainties related to pollinators, the risks must be weighed in relation to impacts to native plant communities and ecosystem processes as a whole and in relation to the ability of the action alternatives to control, eradicate, and/or contain invasive species.

Over the past 2 decades, the threat of invasive species has become broadly recognized (Blossey et al. 2001), with the majority of studies focused on larger-scale issues related to invasive species establishment in arenas such as native plant population structure and alteration of native plant communities, the competitiveness of invasive plants, and the invasibility of certain plant communities (Levine et al. 2004). Limited research is available addressing impacts from invasive plants on mutualistic relationships between plant pollinators and native plant communities. One study has indicated that exotic plants may compete better for native plant pollinators by producing more desirable nectar and therefore increasing fitness and reproductive ability of the nonnative plant (Levine et al. 2004). Presently, little is known about native plant pollinators. Researchers estimate there may be between 130,000 and 200,000 invertebrate and vertebrate species that regularly visit the flowers of higher plants, which depend on these animals to ensure cross-pollination. The majority of flowering plants in the world (88%) are pollinated by beetles, followed by wasps (18%) and bees (16.6%) (Buchman and Nabhan 1996). Research efforts are just beginning to investigate basic aspects of plant–pollinator interactions and how these relationships impact management decisions for plant conservation in natural systems (Kearns and Waser 1998).

Although most herbicides don’t directly target pollinators, they do eliminate plants that provide a food source. Unless alternate flowers are available nearby, pollinators nesting in an area are subsequently forced to forage more widely for nectar and pollen, which requires more energy and exposes them to more threats. As a result, the pollinators produce fewer offspring to emerge the following year (Vaughan and Black 2007).

Many pesticides are acutely toxic to bees and result in death. Carbamates, organophosphates, synthetic pyrethroids, chlorinated cylcodienes, and neonicotinoids are highly toxic to bees. None of the chemicals proposed for use in the project area contain these ingredients.

Herbicide levels that do not kill pollinators at significant rates may nonetheless have effects on performance that inhibits tasks such as olfactory learning, foraging, and reproduction, which affects hive survival. Poison risk is not restricted to contact with chemicals in the field. Poisonings occur when pollinators contact chemical residue on plants in the hours or days after application. Slow-acting toxins may be carried back to the nest, where they are stored with pollen and nectar and later consumed or absorbed. Contaminated pollen can remain toxic for a long time, killing the larvae or, in social species, the other adults in the nest. Also, many solitary pollinator species gather nest-building materials, such as pieces of leaves, mud, plant hairs, or plant resins. If these materials are taken from recently treated plants, they can contaminate the nests. Sublethal doses of chemicals can affect the behavior of pollinators. This includes trouble navigating their way back to the nest after foraging, or simply being unable to fly. All these changes in behavior make foraging and nest building difficult and, ultimately, can lead to the premature death of pollinators and their offspring (Vaughan and Black 2007).

Very little information is available surrounding the effects of herbicides on native pollinators. Most information concerns the nonnative honey bee. It is known that pollinators can be directly affected by spray or indirectly when plants needed as food for adults or larvae are eliminated by herbicides. Effects on pollinators were derived from risk assessment information regarding direct spray on honey bees (Table 3-65). Herbicide labels were also used for more species-specific information. By using label information about controlled species, however, effects upon closely related species can only be extrapolated. Table 3-65 shows that the active ingredients of herbicides proposed for use in the action alternatives are not expected to exhibit toxic effects when directly sprayed on honey bees at the typical Forest Service application rate. Glyphosate and triclopyr may exhibit some toxic effects if applied at the maximum application rate proposed by the Forest Service (SERA 2011a).

Potential impacts to pollinators that reside near invasive plant infestations and would likely be available to pollinate listed plants would be minimized by using techniques that mitigate effects on listed plants (section 2.2.2.1.2 and section 2.2.3.5.1)

It is assumed herbicide use will decrease over time as current infestations are treated and as EDRR to newly discovered sites allows treatment with the most effective methods. The remaining Forest Service land base not treated with herbicides should provide adequate habitats for native pollinators to survive and re-establish in areas where they might be impacted. In relation to indirect impacts to rare plants and their habitats, it is assumed that any treatment reducing invasive plants within a native plant community would result in a positive impact on the community as the native component is restored.

Table 3-65. Potential doses for bees in a direct spray scenario

Herbicide	Typical Application Rate	Potential Dose for Bees	Toxic Level for Bees
2,4-D amine	1.4 lb/ac	180 mg/kg	>1,000 mg/kg (no mortality)
Aminopyralid	0.093 lb/ac	175 mg/kg	5,000 mg/kg (NOAEC)
Chlorsulfuron	0.056 lb/ac	8.98 mg/kg	>25 mg/kg (LD50)
Clopyralid	0.35 lb/ac	56.1 mg/kg	909 mg/kg (no mortality)
Dicamba	0.56 lb/ac	50.2 mg/kg	>1,000 mg/kg (no mortality)
Fluroxypyr	0.5 lb/ac	50 mg/kg	>1,000 mg/kg
Glyphosate	2.0 lb/ac	321 mg/kg	540 mg/kg (NOAEC)
Imazapic	0.13 lb/ac	16 mg/kg	387 mg/kg (no mortality)
Imazapyr	0.45 lb/ac	72.1 mg/kg	1,000 mg/kg (no mortality)
Imazamox	0.40 lb/ac	10.1 mg/kg	1,000 mg/kg (no mortality)
Metsulfuron-methyl	0.03 lb/ac	4.81 mg/kg	270 mg/kg (NOEC)
Picloram	0.35 lb/ac	56.1 mg/kg	1,000 mg/kg (no mortality)
Sulfometuron-methyl	0.045 lb/ac	7.21 mg/kg	1,075 mg/kg (NOEC)
Triclopyr TEA (triethylamine salt)	1.0 lb/ac	160 mg/kg	>1,075 mg/kg (LD50)
NP9E (main generic ingredient in most surfactants)	1.67 lb/ac	268 mg/kg	unknown

Notes: LD50 (lethal dose 50) = The dose of a chemical calculated to cause death in 50% of a defined experimental animal population over a specified observation period; NOAEC = No observed adverse effects concentration; NOEC = No observed effects concentration.

Impacts associated with mechanical treatments are variable in their extent. Ground disturbances, soil compaction, and native vegetation removal at small scales could have little negative affect on pollinators in the area. Large-scale ground disturbances and vegetation removal could alter the native plant communities, causing a species composition shift and subsequent loss of pollen sources for pollinators. This reduction of food availability makes the pollinator's survival more difficult, which in turn has effects throughout the food chain, as reduced pollination leads to reduced fruit on which birds and other animals depend. Ground disturbance and fire could destroy the nests of ground-nesting species and trample individuals. Compliance with design criteria, specific targets, treatment timing, and a well-informed treatment crew would result in only localized impacts, preventing native community alteration.

The USDA's APHIS rigorously screens and tests new biological agents for impacts on native insects. Only APHIS-approved biological controls may be used and would be released according to APHIS requirements or Forest Service policy, whichever is more restrictive. Biological treatments with insects or pathogens are usually specific to a single nonnative plant species and not known to negatively affect other native insects. If pollinator species rely on a specific nonnative plant species being treated, the pollinator could experience a reduction in food availability if other food sources are not available in the area, making its survival more difficult.

Prescriptive grazing removes the flowers of perennial species during bloom or before it occurs. If other flowering plants are not available, pollinator species could experience a reduction in food availability, making survival more difficult which, again, has effects throughout the food chain, as reduced pollination leads to reduced fruit on which birds and other animals depend. Goats or sheep used for prescriptive grazing could cause ground disturbance (trampling) and destroy the nests of ground-nesting species. Compliance with design criteria, grazing prescription, and an

informed treatment crew and herders would minimize the grazing of nontarget species and thus the negative effects to pollinators.

3.5.5.2.3. Effects of Herbicides

Most of the proposed herbicides are selective, translocated herbicides, some of which remain active in the soil after application, providing an additional period of invasive plant control after the initial application. Selective herbicides kill some plant species, while other plant species may be unharmed. The primary difference between susceptibility to an herbicide and tolerance is metabolic. Tolerant plants resist the herbicide by not absorbing it or by metabolizing the herbicide into natural, nonharmful components. Translocated herbicides move from plant foliage (or in the case of herbicides with soil residual capability, from the soil) into areas of active plant growth in root and leaf tissue. It is here in the growing points of a plant that active ingredients exert their effects.

2, 4-D

The herbicide 2,4-D is a selective, systemic herbicide used to control broadleaf weeds in a wide range of plant families. It works by affecting plant growth processes. Plant roots are usually more sensitive to 2,4-D than shoots, although above-ground vegetation shows typical signs of 2,4-D soon after application (e.g., wilting and chlorosis) as the active ingredient impacts plant growth.

Due to its low toxicity and environmental fate profile, aquatic formulations of 2,4-D are used for weed control primarily in riparian areas and wetlands within 15 feet of surface water. It is also used to control broadleaf weeds in the spring when plants are still young and actively producing basal vegetation. The herbicide 2,4-D has very limited soil residual capability and is useful for sites where herbicide is not desired to remain active in the soil.

Woody species are generally tolerant of 2,4-D applied at rates used to control forbs, although damage can occur to seedlings and saplings. Conifers and evergreen shrubs are more tolerant than deciduous species; deciduous trees and shrubs may exhibit signs of injury on sprayed foliage.

Grass species are generally very tolerant to 2,4-D after the seedling stage of growth. However, grass seed production may be affected when applied to grasses in the boot to dough or milk stage (NuFarm 2010). Grasses are not affected when 2,4-D is applied after grass is established or when not in the flowering stage.

As a broadleaf herbicide, 2,4-D has the potential to affect many different forb species. Mortality (or the degree of injury) depends on the use rate and the application method. While 2,4-D can be quite toxic to plants, using spot applications and the fact that it does not remain active in the soil make precision applications possible in settings where nontarget damage needs to be minimized. 2,4-D is used in a mix with other herbicides to stop seed production quickly, while the other herbicide in the mix provides soil residual capability.

Chlorsulfuron

Chlorsulfuron is a selective herbicide formulated as a dry flowable (i.e., small granular pellets) that controls an array of broadleaf weeds (DuPont 2011). It is in the sulfonylurea class of herbicides and works by inhibiting an enzyme, ALS, which is essential for plant growth

(SERA 2004a). Chlorsulfuron can be applied as a pre- or post-emergent treatment (DuPont 2011). It works best on plants in the early or vegetative stages of growth. Chlorsulfuron is one of only a few herbicides in use that control weeds in the mustard plant family. It is also very useful in controlling weeds in the borage family.

Chlorsulfuron is taken up in both the foliage and roots of susceptible plant species. Chlorsulfuron also incorporates into the soil and provides a period of soil residual activity. This period is typically short—at most, a year. Because chlorsulfuron remains active in the soil for some time, it can be transported away from the treatment site in wind or water erosion. The herbicide label cautions users when making applications to powdery or light, sandy soils (DuPont 2011).

Chlorsulfuron can be used up to the water's edge and can be applied to seasonally wet areas when no surface water is present (DuPont 2011). This, and the tolerance that woody species have to chlorsulfuron, makes it a valuable herbicide for treatment in riparian areas or wetlands.

Woody species are tolerant of chlorsulfuron applied at typical use rates for most broadleaf weeds, although seedlings and saplings could be injured or killed by overspray that covers the foliage and stems.

Graminoids are also tolerant of chlorsulfuron, although graminoids stressed by environmental conditions may be injured and experience temporary setbacks in vigor and growth. Chlorsulfuron can injure or kill seedling grasses that have not yet established sufficient root systems. It may also affect seed production in some grasses, depending on the use rate and the stage of seed production.

Members of the borage, mustard, and pea plant families are the most susceptible to chlorsulfuron, while many members of the sunflower family are tolerant at typical use rates. Annual broadleaf weeds are best controlled by chlorsulfuron when in early stages of growth. Perennial weeds are best controlled when in a rosette stage in the spring or fall, or prior to the bloom stage.

Clopyralid

Clopyralid is a systemic herbicide that controls broadleaf weeds in a number of plant families (SERA 2004b). It is in the same class of herbicides as aminopyralid, picloram, and triclopyr and functions by interfering with plant growth (Trevathan 2002a). Plant uptake of clopyralid occurs in both the foliage and the roots. Members of the sunflower and pea plant families are the most susceptible to clopyralid, while members of the mustard family are tolerant (Tu et al. 2001). Clopyralid is more selective than other herbicides in this same class, such as picloram or triclopyr (Tu et al. 2001).

Clopyralid exhibits much less soil residual capability than aminopyralid or picloram. At best, residual control is usually 1 year or less. Like other members in the same class of herbicide, clopyralid can be mobile in permeable soil and the label recommends caution in making applications in cobbled soil where the water table is shallow.

Woody species are generally tolerant of clopyralid (with the exception of trees and shrubs in the pea family), although transitory or temporary damage may occur. Clopyralid is labeled for weed control in deciduous tree plantations because deciduous trees are tolerant. Likewise, conifers are tolerant of clopyralid.

Newly seeded grass that is not yet well established may be injured by clopyralid, but graminoid species are otherwise tolerant to clopyralid.

Clopyralid controls broadleaf weed species. Clopyralid is most active on members of 4 plant families: the buckwheat, nightshade, pea, and sunflower families. Conversely, mustards are not at all susceptible to clopyralid. Compared to picloram, clopyralid is less harsh and is used in settings where the use of picloram could result in severe nontarget effects.

A number of field studies from western Montana by Rice and his colleagues have researched the effects of herbicides, including clopyralid, on target and nontarget forbs. Rice and Harrington (2007) found broadcast applications of clopyralid reduced native plant abundance less than picloram. Rice et al. (1997b) also found that reductions in plant community diversity were small and short term. Rice and Toney (1998) found that lower rates of picloram and clopyralid still provided 3 years of control on spotted knapweed.

Dicamba

Dicamba is a selective herbicide used in control of broadleaf weeds and some woody species (SERA 2004c). There are 2 forms of dicamba, both of which are approved for use by the Forest Service, a diethylamine salt and a diglycolamine salt (SERA 2004c). The diglycolamine form is preferred because the volatilization potential is much lower compared to the diethylamine form (SERA 2004c). Dicamba translocates through foliage, stems, and roots to growing points.

Dicamba is active in the soil, and if sprayed around nontarget plants it may move laterally and downward and affect the root systems of nontarget plants, potentially resulting in injury or death (NuFarm 2011b). However, dicamba is not persistent in the soil and does not provide residual control.

Dicamba can leach in permeable soils under some environmental conditions, so it is not suitable for use next to water (NuFarm 2011b). Label direction recommends caution when considering dicamba applications in areas with permeable soils and shallow water tables. Label direction for the diethylamine form of dicamba specifies that it may not be applied to soils classified as sand containing less than 3% organic matter where water tables are shallow.

Graminoids (grass, sedges, rushes) are generally tolerant of dicamba, although graminoids stressed by environmental conditions (e.g., insect outbreaks or drought) may be injured and experience temporary setbacks in vigor and growth. Dicamba can injure seedling grasses that have not yet established sufficient root systems.

Dicamba is an effective herbicide that controls a wide variety of broadleaf weeds in a number of different plant families. Correspondingly, native forbs are likely to be injured or killed by dicamba applications.

Dicamba is a broad-spectrum herbicide that controls trees and brush and, as such, woody conifer and deciduous species are generally susceptible to dicamba (NuFarm 2011b). There are several methods for applying dicamba to woody weed species, depending on the presence and type of nontarget woody vegetation present. The 2 primary methods are cut surface or directed foliar spray techniques (SERA 2004c). Cut surface application methods provide a high degree of protection to surrounding nontarget vegetation, while directed foliar spray methods may be used when the potential for nontarget damage is not a concern. For example, cut surface treatments on saltcedar would be appropriate when saltcedar occurs mixed in with native trees or shrubs, while

directed foliar spray would be appropriate should saltcedar occur in stands unmixed with native trees or shrubs.

Glyphosate

Glyphosate is a broad-spectrum, nonselective, post-emergence herbicide that can kill or injure vegetation to which it is applied (NuFarm 2011a). Glyphosate only works when applied to living plant tissue. It cannot be used as a pre-emergent herbicide or as a soil residual herbicide. Glyphosate works by affecting the production of aromatic amino acids essential to plant growth (SERA 2011a).

Glyphosate molecules bind strongly to soil particles, which prevents leaching into areas where it was not applied or into groundwater (Trevathan 2002b, NuFarm 2011a). Glyphosate is not mobile in soil and provides no soil residual activity, as glyphosate molecules bind very strongly to soil particles (NuFarm 2011a).

Woody species can be injured or killed by glyphosate when sprayed on living tissue. Younger age classes (seedlings/saplings) are likely to be killed. Actively growing foliage on mature plants affected by direct spray or drift may be injured, resulting in leaf drop and branch tip necrosis. Spraying thick woody or corky bark with glyphosate will not affect trees and shrubs. However, spraying thin or green bark that is metabolically active could result in injury or, in the case of seedling/sapling trees or shrubs, in mortality. There is no root uptake of glyphosate, so it can be sprayed under foliage and inside the drip line (i.e., circumference of foliage).

Glyphosate is a nonselective herbicide that can kill or damage graminoids, sometimes even at low use rates. Formulations manufactured without surfactant are generally less toxic because surfactants can increase the toxicity of glyphosate (SERA 2011a). Adding a surfactant to glyphosate or applying glyphosate at higher use rates will increase the degree of injury or mortality to grasses.

As a nonselective herbicide, glyphosate kills most forb species. Selectivity can only be achieved through avoidance of nontarget vegetation, including the use of targeted spot applications, barriers, and timing of glyphosate applications. For example, because glyphosate has no soil residual capability, it will have no effect on nontarget forbs when applied during periods when these species are dormant.

Imazapic

Imazapic is a systemic herbicide that provides selective pre- and post-emergence control of annual grasses (particularly cheatgrass and medusahead), some perennial grasses, and some broadleaf weeds. Imazapic inhibits amino acid production necessary for protein synthesis and cell growth (SERA 2004d). Imazapic is taken up in the foliage, stems, and roots of susceptible plant species. A surfactant must be used in post-emergent applications, most commonly a seed or vegetable oil.

Imazapic incorporates into the soil and provides a moderate period of soil residual activity (1 to 2 growing seasons). Imazapic is not known to move laterally in the soil or leach deeply downward, so it remains within the treatment area (Tu et al. 2001).

Imazapic can be applied to seasonally wet, low-lying areas where the water has drained. However, since imazapic can be mobile in water, it is not recommended for use up to water's edge.

Woody species are generally tolerant of imazapic applied at typical use rates for most graminoid and broadleaf weeds, although seedlings and saplings could be injured or killed by overspray that covers the foliage and stems. Dormant trees are much less likely to be injured. Direct spray to foliage could result in minor damage. Trees or shrubs that are usually tolerant to imazapic but that are experiencing physiological stress due to environmental conditions (e.g., drought, storm damage, or insect or disease outbreaks) may become susceptible to injury.

As a selective herbicide, imazapic controls a specific range of annual and perennial grasses and forbs. Imazapic can be mixed with other herbicides such as picloram to provide dual control of annual grasses and weeds in the sunflower and mustard plant families in a single application (Tu et al. 2001). Post-emergent applications must be made to perennial weed species.

In some cases, target weed species are susceptible to imazapic while desirable native species are tolerant to this active ingredient. This makes imazapic very valuable for restoration projects in which weed control is required as a site preparation measure. For example, many native graminoids and forbs are tolerant of imazapic and can be seeded at the same time as imazapic is applied. Caution must be used, however, if herbicides with soil residual capability have been applied recently because compounded injury or mortality of newly seeded vegetation could result.

Imazapic is also used as a component of IWM for leafy spurge (Tu et al. 2001). Leafy spurge is a rhizomatous, very deep-rooted weed that is difficult to control. Fall applications of imazapic can be followed by seeding with graminoids to provide vegetation can compete with leafy spurge. Additionally, imazapic applications can assist with the establishment of biological control agents for leafy spurge by modifying stand structure of the weed infestation.

Metsulfuron-methyl

Metsulfuron-methyl is in the same sulfonylurea class of herbicides as chlorsulfuron and is very similar to chlorsulfuron. It is a selective herbicide formulated as a dry flowable (i.e., small granular pellets) that controls an array of broadleaf weeds. It works by inhibiting an enzyme, ALS, which is essential for plant growth (SERA 2004e). Metsulfuron-methyl is applied as a post-emergent treatment, unlike chlorsulfuron, which also works as a pre-emergent herbicide. Metsulfuron-methyl activity is promoted by warm, moist conditions and is slower in cooler, dry weather (Trevathan 2002d). Metsulfuron-methyl works best on plants in the early or vegetative stages of growth. Metsulfuron-methyl is one of only a few herbicides in use that control weeds in the mustard plant family. It is also very useful in controlling weeds in the borage family.

Metsulfuron-methyl is taken up in both the foliage and, to a lesser degree, the roots of susceptible plant species. It also incorporates into the soil and provides a period of soil residual activity. This period is, approximately, only 1 to 2 growing seasons. Because metsulfuron-methyl remains active in the soil for some time, it can be transported away from the treatment site in wind or water erosion. The herbicide label cautions users when making applications to powdery or light, sandy soils. Metsulfuron-methyl is also more mobile in alkaline soils as compared to acidic soils (Trevathan 2002d) because it breaks down more quickly in moist, acidic environments.

Metsulfuron-methyl can be used up to the water's edge and can be applied to seasonally wet areas when no surface water is present. This makes it a valuable herbicide treatment in riparian areas or wetlands.

Woody species are generally tolerant of metsulfuron-methyl applied at typical use rates for most broadleaf weeds, although seedlings and saplings could be injured or killed by overspray that covers the foliage and stems. Conifers are more tolerant than deciduous species. Metsulfuron-methyl is labeled for weed control in conifer plantations, including Douglas-fir and ponderosa pine. However, conifer trees or shrubs that are experiencing physiological stress due to environmental conditions, such as drought or insect or disease outbreaks, may be susceptible to injury from metsulfuron-methyl.

Although metsulfuron-methyl may injure some deciduous tree or shrub species, it generally must be tank mixed with another herbicide (e.g., glyphosate or imazapyr) and applied as a canopy overspray to kill those species. Such applications are not made to native deciduous trees or shrubs.

Graminoids are also tolerant of metsulfuron-methyl, although graminoids stressed by environmental conditions may be injured and experience temporary setbacks in vigor and growth. Metsulfuron-methyl can injure or kill seedling grasses that have not yet established sufficient root systems. It may also affect seed production in some grasses, depending on the use rate and the stage of seed production.

Members of the borage, mustard, and pea plant families are the most susceptible to metsulfuron-methyl, while many members of the sunflower family are tolerant at typical use rates for most broadleaf weeds. Annual broadleaf weeds are best controlled by metsulfuron-methyl when in early stages of growth. Perennial weeds are best controlled when in a rosette stage in the spring or fall, or prior to the bloom stage.

Picloram

Picloram is a systemic herbicide that provides excellent control of broadleaf and woody weed species in a number of different plant families. It is in the same class of herbicides as aminopyralid, clopyralid, and triclopyr. It functions by interfering with plant growth processes and is particularly active on broadleaf plants in the sunflower family and pea family, providing excellent control of weeds such as spotted knapweed at low use rates. It also works very well on deep-rooted perennial weed species such as leafy spurge and toadflax that are difficult to control. Plant species in the mustard family are tolerant of picloram and must be controlled with other herbicides.

Picloram is moderately to highly active in the soil (Trevathan 2002e) and can provide 1 to 2 years of residual control, reducing weed control costs. However, because picloram is persistent in the soil and because it is also very mobile in water, it can move through permeable soils into groundwater (Tu et al. 2001). For these reasons and because picloram is highly toxic to plants, picloram is a restricted-use herbicide that can only be used by trained and licensed herbicide applicators.

Because picloram controls woody species as well as broadleaf forbs, picloram can injure evergreen and deciduous tree and shrub species. Care must be taken during applications to control forbs to avoid spraying picloram on trees and shrubs and to remain well outside the drip line (i.e., outer circumference of the foliage). Mature plants are less susceptible than seedlings or

saplings. Tolerance to picloram varies by species as well. Mountain mahogany and bitterbrush are highly susceptible to picloram, while many sagebrush species are tolerant to picloram at the rates applied to control broadleaf weeds.

Graminoids (grass, sedges, rushes) are generally tolerant of picloram. Graminoid growth and biomass may be set back by picloram, but the effects are temporary. Because picloram is so toxic to forbs, while graminoids are tolerant, picloram applications favor graminoids. Graminoid abundance and density in a plant community often increase when broadleaf weeds such as spotted knapweed are controlled with picloram. Although this can be a favorable outcome, for example, when native grasses replace spotted knapweed, unintended side effects may occur. Researchers have noticed secondary invasion of nonnative weedy mustards and cheatgrass (Pearson and Ortega 2009), especially when picloram is applied at high rates or applied repeatedly without a rest and recovery period. This is most likely to occur in areas that are highly infested with weeds such as spotted knapweed and with little desirable relict vegetation.

Picloram is highly toxic to forbs, even at low use rates (12–16 ounces/acre). One notable exception is the mustard family. Nonnative invasive plants as well as native members of the mustard family are tolerant of picloram. Numerous studies have examined the effects of picloram to target and nontarget forbs in other plant families, particularly in the sunflower family. Results from short-term and long-term studies in western Montana all note the effectiveness of picloram to target broadleaf weeds and the potential injury or mortality it may cause to nontarget forbs (Rice et al. 1997). Broadcast applications of picloram result in much greater impacts to nontarget plant species than do spot applications (Ortega and Pearson 2011).

Rice and his colleagues have studied spotted knapweed control in western Montana for several decades using a variety of herbicides including aminopyralid, clopyralid, dicamba, and picloram. Their research results show that plant communities are capable of recovery after weed invasion and weed control, including from picloram applications. Picloram can provide effective control of weeds for multiple years, and a recovery period between re-applications allows desired and native plant species to re-establish.

A 10-year study on big game winter range on the Lolo National Forest showed that lower picloram use rates provided good weed control for up to 3 years and had less effect on plant community diversity and more rapid recovery rates than did higher application rates. To counteract secondary invasion, imazapic was mixed with picloram; this provided early reductions in cheatgrass.

Sulfometuron-methyl

Sulfometuron-methyl is in the same sulfonylurea class of herbicides as chlorsulfuron and metsulfuron-methyl. It is a broad-spectrum, nonselective herbicide (SERA 2004f). It is formulated as a dispersible granule that controls a wide range of graminoid and broadleaf weeds. It works by inhibiting an enzyme, ALS, which is essential for plant growth (SERA 2004f). Sulfometuron-methyl is taken up in both the foliage and roots. Sulfometuron-methyl is one of only a few herbicides in use that control weeds in the mustard plant family. It is also very useful in controlling weeds in the borage family.

Sulfometuron-methyl can be used for pre- and post-emergent weed control and is applied at very low rates. For post-emergent applications, sulfometuron-methyl provides the best control when applied to weeds in the early stage of growth. Higher use rates are required when making

applications to established plants. Sufficient soil moisture is required to activate sulfometuron-methyl and move it into the root zone, especially for pre-emergent applications.

Sulfometuron-methyl incorporates into the soil and provides a period of soil residual activity. This period is typically short, only 1 to 2 growing seasons. Because it remains active in the soil for some time, it can be transported away from the treatment site in wind or water erosion. The herbicide label cautions users when making applications to powdery or light, sandy soils.

Sulfometuron-methyl can be applied to seasonally wet areas when no surface water is present. When surface water is present, the label direction requires a 15-foot buffer from the water's edge when making hand-held spot applications. The label specifies this buffer when applying sulfometuron-methyl near water to protect aquatic vegetation and surface water from drift.

Conifer species are generally tolerant of sulfometuron-methyl applied at typical use rates for most graminoid and broadleaf weeds, although seedlings and saplings could be injured or killed by overspray that covers the foliage and stems. Dormant trees are much less likely to be injured. Douglas-fir, lodgepole pine, and ponderosa pine are tolerant of sulfometuron-methyl; it is labeled for weed control in conifer plantations. However, conifer trees or shrubs experiencing physiological stress due to environmental conditions, such as drought or insect or disease outbreaks, may be susceptible to injury from sulfometuron-methyl. The addition of a surfactant increases the risk of injury or mortality.

Overall, deciduous trees and shrubs are less tolerant than conifers. Some deciduous species are tolerant of sulfometuron-methyl, while others are susceptible. Tolerance or susceptibility depends on the species, age class, season of application, use rate, and environmental stress. Seedlings and saplings could be injured or killed by overspray that covers the foliage and stems. Dormant trees are much less likely to be injured. Trees or shrubs growing in acidic soils are more susceptible to sulfometuron-methyl. Trees or shrubs experiencing physiological stress due to environmental conditions, such as drought or insect or disease outbreaks, may be susceptible to injury from sulfometuron-methyl. The addition of a surfactant increases the risk of injury or mortality.

As a broad-spectrum, nonselective herbicide, sulfometuron-methyl is toxic to many annual and perennial graminoid and broadleaf species. Because moisture is necessary for activation of sulfometuron-methyl, this herbicide in arid regions (less than 20 inches of precipitation per year) must be used in seasons when soils are moist and some level of precipitation can be expected. Higher use rates may be required to provide control in arid regions.

Triclopyr

Triclopyr is a selective, systemic herbicide used in the control of aquatic, broadleaf, and woody weed species. Triclopyr works by disrupting plant growth processes. Triclopyr breaks down quickly and does not typically persist in the soil for more than a few weeks to a few months. Triclopyr does persist in plant material until it dies and begins to decay (Tu et al. 2001).

Triclopyr comes in 2 forms (SERA 2011d), but only the amine is used in the salt form, as the ester form volatilizes easily. Both forms degrade rapidly to the parent compound, triclopyr acid, in the soil (Tu et al. 2001). Triclopyr can leach in permeable soils. The amine salt form is more mobile in soil than the ester form; however, leaching is considered minor in a field setting (Tu et al. 2001). Label direction recommends caution when considering triclopyr applications in areas with permeable soils and shallow water tables. Triclopyr is also considered highly mobile in

water, the amine form more so than the ester form, although this is not a problem because triclopyr degrades very quickly to the parent acid in an aquatic environment and does not persist (Tu et al. 2001).

As an aquatic herbicide, triclopyr can be applied directly to water to control aquatic weeds. Triclopyr can also be applied to seasonally dry wetlands (e.g., floodplains) and to transitional areas to control broadleaf and woody weed species.

Triclopyr has very little to no effects on graminoids. Likewise, triclopyr is primarily an herbicide for the control of woody species and controls only a limited number of broadleaf weeds in a few plant families. Triclopyr would seldom be used to control broadleaf weeds.

Triclopyr is a selective herbicide that controls trees and brush and, as such, woody conifer and deciduous species are generally susceptible to triclopyr. The amine form of triclopyr does not readily penetrate woody plant cuticles, so directed foliage sprays with the addition of an effective surfactant or cut surface treatments are needed (Tu et al. 2001). The method of application depends on the presence and type of nontarget woody vegetation. Cut surface application methods provide a high degree of protection to surrounding nontarget vegetation, while directed foliar spray methods may be used when the potential for nontarget damage is not present (SERA 2011d). For example, cut surface treatments on saltcedar would be appropriate when saltcedar occurs mixed in with native trees or shrubs, while directed foliar spray would be appropriate should saltcedar occur in stands unmixed with native trees or shrubs.

3.5.5.2.4. Monitoring and Treatment Effectiveness

Under the action alternatives, both forests would routinely implement a variety of monitoring practices. These include design criteria implementation monitoring, effectiveness monitoring, field observations, photo points, and reports that summarize annual invasive plant management activities. These various types of monitoring would help to assess progress with invasive plant management and comply with Forest Service protocols.

Monitoring informs invasive plant managers of the effectiveness of invasive plant control measures and impacts to nontarget vegetation, and detects the trend of vegetation and soil resources, including Sensitive plant populations. Monitoring performed in Sensitive plant populations would help invasive plant program managers determine the efficacy of the invasive plant control treatments, the response of nontarget vegetation, including Sensitive plants, and the habitat condition. Managers would use the monitoring to make adjustments to IWM, as needed, to achieve the desired condition for the site.

3.5.5.3. Alternative 2—Current Management

The Current Action Alternative (Alternative 2) continues the IWM program as it is currently implemented in the project area. See Chapter 2 for a detailed description of Alternative 2.

3.5.5.3.1. Direct and Indirect Effects

Treatment Methods

Under this alternatives, combinations of herbicides may be the most appropriate treatment where several species of noxious invasive plants occur together, or where the herbicides affect invasive plants differently. For example, a mixture of picloram and imazapic, which are both broadleaf-

selective herbicides, is commonly used to simultaneously treat invasive plants in the sunflower family (picloram) and in the mustard family (imazapic). Herbicide treatment would also be used in conjunction with, or preceding, cultural or mechanical treatments, depending on invasive plant species composition, infestation level, and environmental setting.

Biological Control

The current use of biological treatments is limited to the use of classical biological control techniques, such as the use of predators, parasites, and pathogens. Biological control agents are used to supplement herbicide control in larger infestations where treatment cannot be accomplished regularly due to its cost. The majority of biological control treatment acres in the last three years were to treat spotted knapweed. Releases targeting leafy spurge, Canada thistle, and Dalmatian toadflax also occured. *Cyphocleonus achates*, a root boring/gall weevil for spotted knapweed, and *Aphthona nigriscutis*, a root/defoliating flea beetle for leafy spurge, are the most common agents released within the project area. At least 7 different biological control agents were released during this period; often multiple agents were introduced to a site during a single release. As an example of this, *A. lacertosa*, another root/defoliating flea beetle in the same family, is often released in conjunction with *A. nigriscutis*. Both species are documented as having the potential to provide excellent control on leafy spurge seed production and/or plant density.

Some agents have noticeably affected the target species, such as thistle seed head weevil on nodding plumeless thistle. Others have had little to no apparent effect in reducing plant vigor, seed production, plant density, or any of the other factors associated with successful biological control. Many of these agents were released 10 or more years ago, so the agents have had sufficient time to adapt to local conditions and build population levels high enough to impact target invasive plants. Even those agents that are common and widespread throughout the range of the target species, however, display effects insufficient to provide desirable control levels. Although biological control itself has not produced desired control levels, it is an important component to an IWM approach and can increase control efficacy in conjunction with other treatment methods.

Native Vegetation Communities

There are many reasons why invasive plants are able to overwhelm native plant communities and establish themselves as the dominant plant species even on undisturbed sites in excellent condition. One reason is that most invasive plant species arrived in the United States, often as seeds, without the array of natural enemies that keep their populations in check in their native ranges (Westbrooks 1998). These natural enemies include insect pests, fungi, parasitic organisms, and pathogens, as well as birds and mammals that consume plant material. Native plants are often competitively disadvantaged compared to invasive plants because the native plants still need to contend with natural enemies and foraging animals.

Classical biological control is the introduction of host-specific plant pests and pathogens from their native ranges into new areas across the world where they can be used to control invasive plants (Harris 1991). Many factors influence the success of biological control agents that target invasive plants (Morin et al. 2009, Van Driesche et al. 2010). While some biological agents can fly and readily spread to other invasive plant infestations, others have to crawl from host plant to host plant, which slows their rate of spread. Habitat conditions must be right to establish and reproduce, and some agents cannot survive the annual variations in our climatic regime. Others

are difficult to obtain and are expensive to rear or purchase. Some reproduce, and therefore spread, more slowly, and supplemental releases may be required. The impacts of biological control also appear to be cyclic, meaning that invasive plant populations can vary as the populations of biological control agents wax and wane in response to invasive plant populations, site conditions, and other factors.

As a result, biological control is a slow, long-term process that is often less successful than other forms of invasive plant control, especially where it is the sole form of management. Biological treatment is typically implemented when other treatment methods are not an option.

In some cases, biological control does not provide a long-term solution to invasive plant control objectives. Biological control agents may not be well adapted to an area and may have difficulty becoming established, reproducing, and spreading. The negative impacts to the target plant may be insufficient to have an impact on the larger target plant populations because the biological agents may be unable to substantially reduce seed production or only slightly reduce plant vigor. As a result, the target plants can maintain root reserves and are able to recover from the effects of the biological agent. Treatment efficacy cannot usually be determined at a release site for at least 3 to 5 years; often it may take many more years for agents to establish, spread, and build to population densities sufficient to show impacts to the target invasive plant infestations.

In recent years, a more promising biological control agent for spotted knapweed, a root weevil (*Cyphocleonus achates*), has been introduced. This agent has proven able to successfully establish, overwinter, and spread independently (albeit very slowly) within the project area. However, substantial reductions to spotted knapweed populations have not yet been observed except for a few localized settings. Ongoing field observations elsewhere indicate that it may take 10 to 20 years for this agent to begin to effectively reduce plant density, vigor, and seed production in spotted knapweed infestations (Randall 2014). Additionally, one biological agent used to manage nodding plumeless thistle, the thistle crown weevil (*Trichosirocalus horridus*), has been shown to be successful in reducing nodding plumeless thistle's establishment and spread, both within Idaho and elsewhere (Randall 2014).

Special Status Plant Species

Classical biological control is the introduction of host-specific plant pests and pathogens from their native ranges into new areas across the world where they can be used to control invasive plants (Harris 1991, Sheley and Petroff 1999). Within the project area, biological control agents have no direct effects on nontarget plants. APHIS regulates the approval process for biological control agents, and extensive testing is required to be certain biological control agents demonstrate host species specificity prior to being approved for use. In the past, when standards were not as strict, some agents were found to shift to nontarget plants that were closely related to the host plant species (Simberloff and Stiling 1996). Typically, biological control agents are only approved when they have been shown to be host specific; thus, they do not pose a threat to nontarget species.

The effect of biological control agents on native plant communities is usually expressed indirectly. If agents are successful in reducing seed production, impacting host plant vigor, or slowing the rate of invasive plant spread, then desirable plant communities may be better able to withstand the impacts associated with invasive plant infestation and maintain a viable presence in the altered plant community. However, unless a biological control agent is very successful, this beneficial effect may be minor. The indirect benefits may also be short-lived or cyclical, as

populations of biological control agents naturally fluctuate based on environmental conditions and host plant populations.

Another potential scenario could occur in a Sensitive plant population infested by multiple invasive plant species. A reduction in density of one invasive plant due to an effective biological control agent could result in an increase in density of other invasive plants occupying the site. In such a case, mechanical or herbicide treatment would still be needed.

Another biological control option is targeted grazing, usually involving goats that have been trained to target noxious and invasive species. An example of this treatment occurred along the Wood River Beltway. Though this method does pose more of a threat to nontarget species than does classical biological control, the impacts tend to be incidental (trampling and nipping), and this method provides an overall benefit of less competition from nonnative species for native vegetation, including special status plant species.

Herbicide Control

Native Vegetation Communities and Special Status Plant Species

Herbicides are usually classified based on their chemical structure or mode of action and are taken up by plant roots or through foliage and transported within the plant through the vascular system. Herbicides kill or stress plants by inhibiting enzymes involved in photosynthesis, respiration, and other physiological processes (Bussan and Dyer 1999).

Herbicide application, utilized properly, is an important tool in managing invasive plants. Management of invasive plants that allows desired vegetation to recover from invasive plant infestation and strongly re-establish following herbicide treatment can be accomplished by applying the appropriate herbicides at appropriate rates and by using appropriate application techniques that minimize effects on desirable species. The use of design criteria and application techniques contributes to successful herbicide management by minimizing impacts to desirable plant communities.

The intention of an herbicide application is to eradicate or suppress infestations of invasive plants through direct mortality, decreased plant density, reduced competitiveness, and cessation of seed production or root system expansion (Bussan and Dyer 1999). The intended result is expressed in an increase in desirable plant abundance and vigor, creating more invasive plant-resistant plant communities.

Although herbicides have the potential to affect both invasive plants and desirable plants, there are differences in susceptibility to herbicides among plant species and families (Rice and Toney 1998). Some plants metabolize herbicides, which reduces toxic effects. Some species do not readily absorb herbicides through foliage and roots. For herbicides to be effective, they must be taken into the plant and impair physiological processes (Bussan and Dyer 1999).

Plant species that have similar growth forms and genetic composition often are similarly affected by herbicides; consequently, herbicides have the potential to adversely affect invasive plants and desirable plants possessing similar growth forms, genetic makeup, and life history characteristics (Rice and Toney 1998). In general, most herbicides currently being used (with the exception of glyphosate) have a higher potential to affect broadleaf plants than to affect graminoids (grasses and sedges) (Rice and Toney 1998, Bussan and Dyer 1999). Therefore, desirable broadleaf species have a higher potential to be adversely affected by herbicide application than do desirable graminoids.

A particular herbicide is chosen based on the target invasive plant species, presence of desirable nontarget vegetation, proximity to water, and distribution of desirable species. Site factors and season of use are also considerations. Clopyralid is an example of one of the most selective herbicides currently in use, while glyphosate is a nonselective herbicide that will kill most plant species, including graminoids.

In addition to herbicide selection, technique is also an important decision. The 2 primary types of herbicide application used are spot treatment and broadcast application. Spot treatment is performed by spraying individual plants and the area directly adjacent to them, avoiding the application to nontarget plants as much as possible. On the BNF and SNF under this alternative, most herbicide application would be made as spot treatments.

Broadcast application is only chosen when the number of spot applications necessary to treat an infestation is so large as to make it impractical or where the areas adjacent to the invasive plants overlap. Managers make the decision to spot treat or broadcast spray based primarily on the size and density of the invasive plant population, terrain, and proximity to water. The size of infestations (larger) and the density of invasive plant cover (higher) sometimes result in a need for broadcast applications. Also, on flatter terrain, mechanized equipment may be preferred for broadcast applications due to cost considerations. To keep nontarget impacts to a minimum, applicators maintain application equipment properly functional and calibrated, select herbicides less likely to cause damage, and use the lowest effective application rate.

Spray units may be mounted on vehicles such as trucks or utility vehicles (UTVs). A vehicle-mounted sprayer is not synonymous with broadcast application, since these units are set up to perform spot or broadcast applications. Under this alternative, personnel would perform very little broadcast application on either of the Forests. First, most infestations in the project area are small (less than 1 acre in size) and do not yet consist of monocultures of invasive plants. The invasive plant cover in infestations managed for eradication or control is typically very low, often amounting to only about 10% of the vegetation within the infestation. The areas where large infestations exist are typically not accessible by ground-based equipment and are not treated. Secondly, spot applications are preferred wherever possible to reduce impacts to nontarget plant species to the extent possible. Mechanized equipment is not suitable for finely tuned spot applications, although some target selectivity can be achieved by turning nozzles off and on as needed when invasive plant distribution is patchy. Almost all vehicle-mounted broadcast applications are made along year-round open roads that receive heavy recreational traffic. This traffic greatly increases the number of infestations that establish, necessitating annual invasive plant control. Crews using vehicle-mounted sprayers apply herbicide only where invasive plants are found, creating stretches of broadcast application interspersed with stretches where no herbicide is applied because no invasive plants are found.

Native forbs are important components of many plant communities (Pokorney et al. 2004b), and most native forbs provide food for a variety of insect pollinators. Native forbs are best for native insect pollinators, such as bees or butterflies, for several reasons. Native forbs and their pollinators are well-adapted to one another, with native forbs providing habitat across the landscape at the right time of the year for various populations of pollinators, native forbs provide not only forage in the form of nectar and pollen, but also habitat for resting, mating, or laying eggs, and native plants are adapted to local growing conditions.

Processes such as weed invasion and weed control disrupt plant community composition, structure, and function (Pearson and Ortega 2009). Although some invasive plants, such as spotted knapweed, can provide forage for native pollinators, their overall impacts on an ecosystem far outweigh the possible benefits. In some cases, insect pollinators are even known to contribute to the spread of nonnative invasive plants by increasing the number of pollinated flowers and, therefore, seed production (Barthell et al. 2001).

Likewise, weed control can also impact nontarget forbs. Herbicide application, in particular, has the potential to affect pollinator plants, for example, favoring graminoids over forb species (Crone et al. 2009). Boise and Sawtooth weed program managers have multiple options to reduce the impact of herbicide application on native pollinator plants, including herbicide selection, application technique, lowest effective use rate, season of herbicide application, and using spot applications wherever possible. Researchers note specifically that utilizing spot applications everywhere possible helps to reduce effects to nontarget forbs (Pokorny et al. 2004b, Crone et al. 2009, Pearson and Ortega 2009, Ortega and Pearson 2011). Spot herbicide application is the preferred method wherever possible.

In addition, in the project area, the effects of herbicide application are moderated by the scale at which invasion and herbicide application occurs. About 4% of the project area is infested by noxious weeds and, in general, native plants are still present in invaded areas (USDA Forest Service 2016). A majority of areas treated with herbicide application are small, less than 1 acre in size (USDA Forest Service 2016). The persistence of even low densities of native forb species and seed banks furnish the components to restore pollinator plant species and their pollinators, even in invaded areas. Herbicide application would result in short-term impacts to pollinator plants, but could yield long-term benefits when implemented as part of an IWM strategy.

In addition to plant mortality, several other considerations are associated with herbicide application, including spray drift, herbicide movement in soil and water, and spray adjuvants. Herbicide label direction and design criteria address these considerations. Spray drift is easily managed and design criteria (such as maximum allowable wind speed) address the management of spray drift.

The possibility of herbicide movement in soil depends on a number of factors, including properties of the herbicide selected for use, site-specific conditions (such as topography, soil type, and depth to the water table), and the climatic regime. Motility varies among herbicides; some are highly mobile in soil while others are not (SERA 2011 a-d, 2010, 2007 a-b, 2004 a-f). Picloram, for example, can be highly mobile in soil depending on site conditions, while glyphosate is not mobile. Herbicide is more likely to move in soil on steep slopes and on porous soils, especially soils with little organic matter. Areas with high annual precipitation are usually more prone to the risk of movement than arid climates, as are areas experiencing high intensity rainstorms.

There are 2 primary concerns regarding the movement of herbicide through soil or water, away from the application site. The application cannot perform as intended if the herbicide moves downward in the soil profile below the target invasive plant root zone. Likewise, leaching through the soil could affect nontarget vegetation off site while not accomplishing the purpose of the application.

The other concern is that the herbicide could unintentionally be moved into water, whether through water flow that washes the herbicide away (such as a high-intensity rainstorm) or via

movement of the herbicide into the water table or a water body. Herbicide that enters water unintentionally at high enough concentrations could potentially harm aquatic organisms such as aquatic vegetation, invertebrates, or fish. Although this scenario is unlikely given the type of herbicide applications made, under this alternative, managers would be aware of the possibility of herbicide movement off site and therefore consult herbicide labels with the objective of avoiding movement when making decisions on herbicide selection and use rates.

Herbicides are registered by the EPA and every herbicide, as required by federal law, has a label that provides EPA and manufacturer guidance and instructions on the safe and proper use of the herbicide. Federal law requires compliance with an herbicide label. Adherence to label guidance and instructions are identified as design criteria. Instructions on herbicide labels provide measures to minimize the likelihood of herbicide movement in soil, such as specifications on how close to water an herbicide may be applied. For example, the label for clopyralid notifies the applicator that "clopyralid is a chemical that can travel (seep or leach) through soil." The label instructs the user not to apply clopyralid directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. The label also advises applicators not to apply this herbicide to soils with rapid permeability. The fisheries and soil and water technical reports further discuss the effects of herbicide soil and water motility to these resources.

The term "spray adjuvant" is a catchall phrase for substances added to an herbicide or spray mix to aid in mixing and applying or to improve the efficacy of an herbicide application (Tu et al. 2001). These substances commonly include adjuvants such as water conditioning agents to buffer hard water, surface active agents (surfactants) to reduce the surface tension of water drops (so that spray solution spreads out on plant surfaces and does not run off), or indicator dye (used to show sprayed areas so that applicators do not over-apply or miss patches of invasive plants). Adjuvants may be added to the herbicide formulation at the manufacturing facility or added when applicators are mixing spray at the application site. To be effective, some herbicides, such as imazapic, require the addition of a surfactant-like vegetable or seed oil. Other herbicides, especially when applied to young plants, may need no surfactants. Herbicide labels advise or instruct applicators on the selection and use rates of adjuvants.

Because adjuvants do not contain active ingredients that cause plant mortality, these substances are not subject to same federal laws that govern herbicides. However, this does not mean that all adjuvants are without potential to cause harm to nontarget vegetation. Some, such as indicator dye, do not pose a risk of harm to plants while others, such as some surfactants, are capable of inflicting plant injury. As an example, some surfactants contain acidifying agents which can be useful in damaging the epidermal surface of plants, allowing an herbicide to more easily penetrate the leaf surface of target plants. However, the acidifying agent can have the same effect on the leaves of nontarget plants and increase the potential for injury or mortality to nontarget plants. Under this alternative, weed program managers would routinely consult herbicide label direction when making decision about adjuvant use to select the proper adjuvant for a particular herbicide and to select the lowest effective use rate to reduce nontarget plant damage.

Although herbicides have the potential to affect both invasive and desirable plants, differences in susceptibility to herbicides exist among plant species and families (Rice and Toney 1996). Some plants (both invasive and desirable plants) metabolize herbicides, which reduces toxic effects. Some species do not readily absorb herbicides through foliage and roots. For herbicides to be

effective, they must be taken into the plant and impair physiological processes (Bussan and Dyer 1999).

Plant species that have similar growth forms (e.g., leaf structure and root systems) and genetic composition often are similarly affected by herbicides; consequently, herbicides have the potential to adversely affect invasive plants and desirable plants that have similar growth forms, genetic makeup, and life history characteristics (Rice and Toney 1996). In general, most herbicides currently being used (with the exception of glyphosate) have a higher potential to affect broadleaf plants than graminoids (grasses and sedges) (Rice and Toney 1998, Bussan and Dyer 1999).

The most common direct effect of herbicide to susceptible plants is mortality, since that is the function of an herbicide. Nonlethal effects include reduced plant growth, reduced biomass and vigor, and reduced reproductive success. Indirect adverse effects can be more difficult to observe and ascertain than the direct effects. For example, an impacted plant may have difficulties with photosynthesis and in acquiring and storing nutrients or water (Bussan and Dyer 1999). Its competitive ability may be reduced for a period of time. Detrimental indirect effects on nontarget plants may involve a prolonged period of recovery to restore biomass and regain the root reserves needed to resume seed production or vegetative reproduction.

Nontarget plants can also be affected by residual herbicide activity (Bussan and Dyer 1999). Herbicides that are short-lived and become detoxified in a few days or weeks, such as 2,4-D, have less potential to indirectly affect nontarget plants through soil activity. Other herbicides, such as picloram, can remain active in the soil for more than 1 year. As an example, native plants that were dormant during a late summer herbicide application could be damaged by residual amounts of picloram the following spring when plant growth resumes. Nonlethal damage could include reduced biomass, vigor, and reproductive success. However, studies from western Montana using picloram, clopyralid, and 2,4-D found no evidence of lingering damage from residual herbicide concentrations at the plant community level (Rice et al. 1997, Rice and Toney 1998).

Applications of a nonselective herbicide, such as glyphosate, made during active growth stages would kill or injure individual plants of most of the sensitive plant species most likely to be affected (with the exception of whitebark pine; only foliage that was directly sprayed would be affected). However, glyphosate does not have any soil residual activity and if applied at a time when invasive plants were actively growing, but sensitive plants were dormant, then the application would have no direct or indirect adverse effects.

Due to its growth form as a tree, mature whitebark pine would seldom be exposed directly to herbicide, although seedlings and saplings could be. Although abundant roads and trails increase the susceptibility of the habitat to invasion (Prather 2007), across the forest, whitebark pine habitat is little infested with invasive plants at present.

Herbicide applications to control invasive plants within populations of sensitive plant species would have the potential to adversely affect individual plants and small groups of plants, especially when plants actively grow in the spring and early summer. Herbicide applications made in the late summer or fall, when plants are dormant, would have less potential for direct effects. Other standard operating practices that reduce the impacts of herbicide application to Sensitive plant species include herbicide selection and the lowest effective herbicide use rate.

In addition to herbicide selection and lowest effective application rates, technique is also an important decision. The 2 primary types of herbicide application used are spot treatment and broadcast application. In a broadcast application, herbicide is sprayed over the top of vegetation and is applied to both target and nontarget vegetation. Broadcast application is not used in and directly adjacent to known sensitive plant populations. In contrast, spot treatment is performed by spraying individual invasive plants and the area directly around them, avoiding application to nontarget plants. Only spot herbicide application is made in and directly adjacent to known sensitive plant populations. Spot application of herbicides greatly reduces the risk of mortality to individual Sensitive plants and therefore to sensitive plant populations as well.

Overall, the amount of herbicide applied annually throughout the project area is very low. Invasive plant managers also consider other aspects of herbicide application, such as volatilization, drift, and movement of herbicide through soil or water. Herbicides can move with eroding or windblown soil or with surface or subsurface water. Herbicides can also move through the air as spray drift, which occurs during herbicide application, and volatilization, which could occur after application. Spray drift is dependent on spray equipment parameters such as nozzle orifice size, boom height and pressure, and wind speed (Branham and Hanson 1987). Volatility is dependent on the physical properties of the herbicide, primarily vapor pressure.

Volatilization is the conversion of a liquid or solid chemical to a gas. In the case of an herbicide that volatilizes, the vapor can then move, via air currents, away from the treatment site and affect nontarget plants. The amount of volatilization occurring is dependent upon climactic and microclimactic conditions. Soil moisture is the primary environmental condition that influences the rate at which herbicides volatilize; in general, herbicides volatilize more rapidly from moist soils than from dry soils (Menalled and Dyer 2005). Volatilization also increases with higher air and soil temperatures and increasing wind speed. Ester formulations of herbicides have higher vapor pressures and volatilize more than amine formulations (Nice 2004).

The potential for volatilization can be minimized in a number of ways, some of which are operational and some environmental. Under this alternative, both Forests would only use herbicides with low volatilization potential. The Invasive Plant Management program uses only amine formulations and no ester formulations (which are more likely to volatilize). Only water is used as a carrier. Adherence to label directions, such as the use of specific adjuvants, further reduces the likelihood of volatilization.

The climatic regime in the project area is one of low annual precipitation and soils are naturally dry, which reduces the potential for volatilization from the soil. Application does not occur in areas where rain is expected within hours, based on twice-daily weather forecasts from the National Interagency Fire Center. These conditions further reduce the likelihood of volatilization.

Because weed programs use only herbicide with low volatilization potential and further reduce the risk of volatilization with standard operating practices based on Forest Service risk assessments and herbicide label direction, it is very unlikely that any nontarget vegetation or special status plants would be affected by volatilization.

Spray drift is more likely to have an effect on nontarget vegetation, including Sensitive plants, than is volatilization. Spray drift is the movement of herbicide, generally via spray droplets, away from the target area. Individual plants could come into contact with, and be harmed by,

spray drift. Effects of spray drift to individual plants could include nonlethal damage to vegetation or to reproductive structures, such as flowers or developing seeds. Depending on how much spray drift contacts the plant, damage could be minimal and transient; in this case the plant would quickly recover. Conversely, drift that covered a plant could severely injure it or even kill it. The probability of spray drift affecting an entire population is very low, however; effects would most likely occur to individual plants or to small groups of plants.

Spray drift is easily managed through standard operating practices. The primary way in which spray drift can be reduced is by increasing droplet size. This can be done by reducing spray pressure, increasing nozzle orifice size, using drift reduction nozzles, and adding adjuvants to the mixture. Design criteria, such as maximum allowable wind speed, help further reduce the potential for spray drift.

The possibility of herbicide movement in soil depends on a number of factors, including properties of the herbicide selected for use, site-specific conditions (such as topography, soil type, and depth to the water table), and the climatic regime (e.g., annual precipitation and season of highest precipitation). Motility varies among herbicides; some are highly mobile in soil, while others are not (Forest Service Risk Assessments). Picloram, for example, can be highly mobile in soil depending on site conditions, while glyphosate is not mobile. Herbicide is more likely to move in soil on steep slopes and on porous soils, especially soils with little organic matter. Areas with high annual precipitation are usually more prone to the risk of movement than arid climates, as are areas that experience high-intensity rainstorms.

Lateral downslope movement of an herbicide through the soil could affect nontarget vegetation off site. While it is conceivable that herbicide movement in soil could affect special status plants, the likelihood is slight. Soils in the project area are not greatly affected by wind erosion, and major movement of soil at a landscape scale is rare. Attention to herbicide label directions, standard operating practices (e.g., herbicide selection), and adherence to design criteria successfully minimize the effects of invasive plant control upon nontarget vegetation and special status plant populations.

In conclusion, though individual plants or small groups of plants may be affected by invasive plant control, the overall distribution of sensitive plants in suitable habitats and their metapopulation structure would not be affected through indirect means (i.e., volatilization, drift, movement in soil or water).

Herbicide application can also have beneficial effects, via indirect improvements in plant community composition, function, and structure, as a result of invasive plant control. The first and most immediately observable indirect effect of invasive plant control is the reduction in cover, density, and vigor of the invasive plant species. This effect results in an increased availability of water and nutrients that were previously claimed by the more competitive, invasive plants (Bussan and Dyer 1999). Through herbicide application, the canopy cover of invasive plants is reduced, allowing native plants greater access to sunlight for photosynthesis. Eventually, native plants are able to regain vigor in the absence of competing invasive plants. Increased biomass and reproductive success are then possible, as is recruitment of new plants into the native plant community.

Vegetation Group

The following sections address specific nontarget vegetation groups and the direct and indirect effects of herbicides to these groupings. Invasive plant species currently present in the project area have the highest potential to invade grasslands, shrublands, and low-elevation conifer cover types, especially sites where the soil and native vegetation have been disturbed. Grasslands and low-elevation mixed evergreen shrub cover types are especially vulnerable to invasive plants, due to lower annual precipitation, longer growing seasons, higher degree of human use, the lack of a forest overstory to inhibit shade-intolerant invasive plants, and the open structure and distribution of plants. For this reason, analysis is directed more toward graminoids and forbs than other vegetation groups.

Coniferous Trees

The frequency of weed invasion and rate of weed expansion in conifer plant communities often depends on disturbance: the type of disturbance, the frequency and severity of disturbance, the scope of the disturbance, and the amount of time it takes an area to recover vegetatively from disturbance (Zouhar et al. 2008).

Conifers as a group are not very susceptible to many herbicides, but they may be variably affected based on species and age as well as the herbicide, the application rate, and the application techniques used. Direct effects are most common on conifer seedlings; they are most likely to experience direct contact with herbicides because they have not yet grown beyond the height of most targeted invasive plant species. Effects may include lethal or nonlethal damage. Older trees (from the sapling stage up) are much less likely to experience any direct or indirect effects, because their foliage is well above the height of understory plants and their bark has thickened.

Within the project area, invasive plant infestations in conifer cover types occur in 2 very different settings. Moist conifer cover types occur at higher elevations with higher annual precipitation, colder night-time temperatures, shorter growing seasons and, often, dense overstory canopies and multiple layers of understory vegetation. Many invasive plants within the project area are shade-intolerant, meaning that the density and vigor of invasive plants are inversely related to shading and competition from overstory trees, saplings/seedlings, and understory vegetation. These characteristics tend to preclude invasion by those invasive plant species that presently infest the 2 forests, except along dispersal corridors and routes where conifer overstory has been cleared within the ROW of the road or trail (Parks et al. 2005, Pollnac and Rew 2013). Invasive plant infestations occur where roads and trail corridors intersect these cover types, but the infestations generally do not extend into the conifer plant communities (USDA Forest Service 2016). Herbicide is applied as needed along the road and trail corridor, with no effects on the moist conifer cover types.

At the other end of this spectrum are the dry conifer cover types. Many of the noxious weed species infesting landscapes within the 2-forest area readily invade ponderosa pine and the lower elevation band of Douglas-fir, particularly where these cover types have been disturbed repeatedly by road construction, timber harvest, and fire. Most noxious weed infestations in the project area occurring within a conifer cover type are located in open forest stands on southerly and westerly aspects, at lower elevations (USDA Forest Service 2016).

As a result of this pattern of infestation, herbicides to control invasive plants may be applied in the understory of these dry conifer cover types, particularly along roads and trails or in logged or burned areas. Seedlings and saplings are most likely to be exposed to herbicides through ground-based broadcast application.

Herbicide application in conifer stands typically involves the use of the same herbicides and application rates as those used in grasslands and shrublands. Weed managers reduce the potential for adverse effects on conifers through herbicide selection and application techniques. For example, clopyralid may be selected over picloram when applying in an understory with numerous seedlings and saplings. Applying at lower pressure and using directional application techniques reduces herbicide contact with conifer foliage. Herbicide labels provide instructions to prevent nontarget damage to trees. Adherence to herbicide label direction and avoidance of direct application to trees reduces adverse effects on individual conifers.

The season of application can also mitigate damage (Gratkowski 1977 and 1978, Radosevich et al. 1980). Ponderosa pine, for example, was found not to be affected when 2,4-D was applied in the late summer after cessation of spring leader growth (Gratkowski 1977 and 1978). Likewise, Radosevich et al. (1980) found that seedlings from a number of pine and fir species and Douglas-fir were tolerant of herbicide applications when not in active growth stages.

Indirectly, the application of herbicides to invasive plants can harm conifers (primarily the youngest age classes) through movement in the soil and root uptake, especially for herbicides that are quite mobile in the soil. This risk can be avoided by herbicide selection (e.g., selecting an herbicide such as clopyralid, which conifers tolerate easily), selecting the lowest effective use rates, following herbicide label directions, and minimizing herbicide application within the foliage zone of trees.

Under this alternative, direct and indirect effects would be limited to individual trees (usually seedlings) or very small site-specific locations (typically <0.01 acre) and have no landscape-level effects because only small acreages in conifer cover types are sprayed and, with the exception of roadsides, spot spraying techniques are used under conifer overstory.

Deciduous Trees and Shrubs

Within the project area, these deciduous tree and shrub cover types are usually located in riparian areas with abundant access to water. They are capable of high site productivity and can support an array of vegetation groups. These habitats are highly preferred by many species of wildlife and are often heavily occupied. Many invasive plant species are able to establish and spread quickly in the riparian environment. Common noxious weed species infesting deciduous plant communities include Canada thistle, leafy spurge, and gypsyflower (hound’s tongue), while newer invaders such as oxeye daisy and saltcedar have been found in more recent years (USDA Forest Service 2016).

Many native deciduous shrub and tree species are not highly susceptible to herbicide damage, but may be variably affected based on species and age as well as the herbicide applied, the application rate, and the application techniques used. Some species, however, may be quite susceptible to the effects of herbicides on foliage and roots. Eliasson (1972) found that aspen was sensitive to the effects of 2,4-D, dicamba, and especially picloram. His study found that aspen was up to 10 times as sensitive to picloram as it was to the other 2 herbicides. Bowes (1976) found that aspen, cottonwood, rose, and western snowberry could all be killed by applications of

2,4-D and picloram. The herbicide label for metsulfuron-methyl lists aspen, cottonwood, hawthorn, wild roses, and willows as all susceptible to lethal effects at moderate to high use rates. In addition, because glyphosate is a nonselective herbicide that can kill or injure living plant foliage, injury is possible when this herbicide is applied directly to deciduous species.

Nontarget deciduous trees and shrubs most likely to be adversely affected by herbicide treatments are seedlings/saplings. Mature plants with actively growing foliage that are over-sprayed with herbicide may also be injured. Direct effects to deciduous species can be mitigated through herbicide selection, use of the lowest effective rate, and application technique.

Indirectly, the unintentional exposure of nontarget vegetation such as deciduous shrubs and trees could result from some herbicides moving through the soil profile or water profile (Anderson 2007). Lethal or nonlethal injuries could result from the movement of herbicide away from the application site. This risk of exposure is reduced by adherence to label directions. For example, the label for metsulfuron-methyl advises that off-target movement in soil or water is possible and provides recommendations to reduce the likelihood of movement.

Direct and indirect effects would be limited to individual plants or very small site-specific locations (typically <0.01 acre) and would have no landscape-level effects.

Evergreen Shrubs

Evergreen shrubs include sagebrush species, rabbit brush, bitterbrush, ceanothus, mountain mahogany, and other shrub species that retain their foliage year round (similar to conifers). Landscapes with an evergreen shrub overstory are referred to as shrublands. Shrublands receive less annual precipitation than conifer cover types and often occur on sites with rocky or gravelly soils. The water table is often located deep underground, so water can be a limited resource. Topography also plays an important role in the distribution of evergreen shrubs (Burke et al. 1989).

Evergreen shrub species are variably susceptible to herbicide damage. Susceptibility depends on species, age, and growth stage as well as on the herbicide, the application rate, and the application techniques used. Researchers and land managers have long known that some species are resistant to the effects of certain herbicides or particular use rates (Evans et al. 1981). Some species, such as mountain mahogany, are highly susceptible to herbicide injury, while many sagebrush species exhibit minor effects to many of the herbicides and use rates commonly applied for invasive plant control. Younger-age classes are more susceptible to the effects of herbicide; mature plants are usually less affected. Species that grow close to the ground are more likely than taller species to experience direct contact with herbicide.

Some of the herbicides in use for invasive plant control have the potential to damage evergreen shrubs. Direct effects range from plant mortality to various kinds of nonlethal stem and foliage damage. Of the herbicides in use, glyphosate and 2,4-D are most likely to impact evergreen shrubs. As a nonselective herbicide, glyphosate can be expected to kill living plant foliage on which it is deposited when applied at rates toxic to evergreen brush species (i.e., at or above 1.5 pints per acre). Likewise, 2,4-D amine applied at rates at or above 4 pints per acre can kill the evergreen foliage on which it is deposited.

The seedling/sapling-age class of evergreen shrubs may be most adversely affected by herbicide treatments; however, mature plants with actively growing foliage that are over-sprayed with herbicide may also be injured. Gratkowski (1977) found that stands of 2 ceanothus species were

susceptible to applications of 2,4-D. Evans and Young (1975) killed green rabbitbrush and big sagebrush stands with an aerially applied tank mix of 2,4-D and picloram.

Direct effects to evergreen shrub species can be managed through the selection of the appropriate herbicide, use rate, and application technique (e.g., minimizing herbicide application over the top of evergreen shrub canopies), along with the timing of herbicide application. Spot herbicide applications are preferred wherever possible to reduce adverse effects to nontarget vegetation.

Indirectly, the application of herbicides to invasive plants can affect evergreen shrubs through movement in the soil and root uptake, especially for herbicides that are quite mobile in the soil (Tu et al. 2001). This risk can be reduced by selecting the lowest effective use rates and following herbicide label directions.

Forbs

Forbs are a diverse group of broadleaf plants that are important components of most cover types. In some cover types, forbs can comprise a major component of the plant community (Pokorny et al. 2004b, Ortega and Pearson 2011) and play a major role in plant community function (Pearson and Ortega 2009). Forbs can be broadly divided into groups based on their reproductive strategies and root systems. Many early spring forbs are annual plants or corm/bulb species that reproduce by dry seed, often in capsules of various kinds. Other forbs reproduce by means of fleshy fruits or spread via rhizomes or stoloniferous root systems (e.g., strawberries). Yet other forbs are taprooted, often with very large roots that grow deep underground (e.g., lupine or balsamroot species).

Forbs are typically the most impacted group of nontarget vegetation in any herbicide application. Because most invasive plant species in the project area are forbs, broadleaf-selective herbicides are used, inevitably resulting in some degree of damage or mortality to nontarget forbs as well. All herbicides used have the potential to kill or damage native or desirable forb species. Once an invasive plant infestation has been established long enough to out-compete native forbs and become a monoculture, nontarget damage to forbs is no longer a concern. In the earlier stages of invasion, however, invasive plants and native or desirable forb plants are intermixed, and nontarget damage to forbs occurs.

Herbicides with short periods of toxicity and little residual activity, such as glyphosate and 2,4-D, generally have few direct or indirect effects on spring- and early summer-flowering species when applied during the species' dormant periods, such as in mid to late summer and fall (Rice et al. 1997b). These species often include corm and bulb species, such as death camas, or rhizomatous species with fleshy roots, such as wild iris. Annual forbs that have completed their life cycle by the time herbicides like glyphosate and 2,4-D are applied are also unlikely to be affected. Jacobs and Sheley (1999) found forb density unaffected after 2,4-D applications in early June and early July on a study site in the early stages of invasive plant invasion.

Forb species are most likely to be adversely affected when exposed to herbicides while in an active growth stage (e.g., young plants or plants that are initiating growth in the spring), since plants are most susceptible to herbicide effects when they are rapidly developing (Rice et al. 1997b). Many native broadleaf plants flower and set seeds in spring and summer and are dormant in fall. When plants are dormant, they are not as susceptible to herbicides (Rice and Toney 1996). Application of herbicides during the summer and fall when annual forbs have completed their life cycles and many perennial native forbs are dormant or at low levels of

physiological activity can substantially reduce adverse effects of herbicide application (Rice et al. 1997b).

Herbicide applications must be made to invasive plant infestations, however, when the invasive plants are most susceptible to the herbicide's active ingredient. Many noxious weeds, for instance, have vigorous periods of growth in spring and again in the fall when temperatures begin to cool and precipitation increases.

Spring and early- to mid-summer herbicide applications typically result in some degree of adverse effects to nontarget forbs, particularly when using herbicides with residual activity (Rice 1992, Rice et al. 1997b, Rice and Toney 1998, Rice 2000). Adverse effects have also been noted with some fall applications (Crone et al. 2009, Ortega and Pearson 2011). Picloram is a very effective herbicide commonly used to control highly aggressive noxious weed species like leafy spurge and spotted knapweed, and it can remain active in the soil for 1 or more years (Tu et al. 2001). Other herbicides used, such as clopyralid, have lesser degrees of soil residual activity (Dow AgroSciences 1997), but are also capable of producing adverse effects on nontarget vegetation while the herbicide remains active in the soil.

The effects to forbs from herbicides with residual activity are often reported by researchers to be short term with regard to cover or leaf area, although demographic effects (fecundity) of longer but unknown durations may be present. In multiple-year studies from adjacent Montana, Rice and colleagues (Rice et al. 1992, Rice et al. 1997, Rice and Toney 1998, Rice 2000) found short-term effects on native forb species with applications of picloram, clopyralid, or a mixture of clopyralid and 2,4-D. Picloram had the greatest impacts on forbs, while clopyralid alone had the fewest. These studies showed that initial decreases in native forb cover recovered to pre-spraying levels within 3 years. Without continued control, however, spotted knapweed recovered to pre-treatment levels. Follow-up treatments showed that spotted knapweed control could be maintained without permanent adverse impacts to the forb component.

Arrowleaf balsamroot, a common dominant forb species in bunchgrass and sagebrush plant communities, has been used in a number of studies as a good representative of a native perennial forb. A recent study by Crone et al. (2009) investigated the effects to flowering, seed production, and seedling recruitment in western Montana. Crone et al. (2009) found that a single application of picloram did not reduce the leaf area of arrowleaf balsamroot in the short term; however, it did reduce flowering and seed set, an effect that lasted for a period of 4 years. The application also greatly reduced the recruitment of new arrowleaf balsamroot plants. The picloram application in this study was broadcast via ATV in the fall, while arrowleaf balsamroot was dormant.

Ortega and Pearson (2010, 2011) had much the same results while also studying the effects of picloram on spotted knapweed and arrowleaf balsamroot on the Lolo National Forest over a 6-year period of time. Pearson and Ortega, however, also looked specifically at the initial levels of spotted knapweed infestation, finding (at moderate and high levels of spotted knapweed invasion) that arrowleaf balsamroot cover was already depressed by spotted knapweed prior to treatment with the herbicide. Ortega and Pearson also noted a reduction in arrowleaf balsamroot from broadcast applications made in the fall.

Research from an ongoing study in the Great Basin south of the project area (Davis 2013, 2014) has found that imazapic applications suppress native annual forb species in terms of percent cover in the short term. Similar to the results by researchers studying the effects of picloram and clopyralid, by year 3 to year 4 post-application, forb species recovered in the study areas.

Graminoids

Graminoids (grasses and grass-like plants such as sedges) are a component of all cover types and constitute an important plant life form in some cover types (Mueggler and Stewart 1981). The vigor, density, and seed production of graminoids play an important role in the ability of plant communities to recover from weed invasion (Sheley and Petroff 1999).

Some of the most common perennial native graminoids on rangeland are bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), Sandberg bluegrass (*Poa secunda*), and needle and thread grass (*Hesperostipa comata*). In forest cover types, pinegrass (*Calamagrostis rubescens*) and elk sedge (*Carex geyeri*) are often common components of the plant community.

The effects of herbicides used on perennial graminoids are much less variable than the effects on nontarget forbs. Most herbicides used are selective herbicides that target broadleaf invasive plants and do not affect graminoids. At the application rates used, chlorsulfuron, clopyralid, metsulfuron-methyl, dicamba, imazapyr, picloram, and 2,4-D have little or no adverse effects on perennial graminoids. For example, Jacobs and Sheley (1999) found that perennial graminoids were unaffected by 2,4-D and that, on their study site, bluebunch wheatgrass and Idaho fescue increased in density with 2,4-D control of spotted knapweed.

The major exception to this lack of negative effects is glyphosate (NuFarm 2011a). Glyphosate is a nonselective herbicide that can kill or damage graminoids, sometimes even at low use rates.

Other herbicides used that affect graminoids are imazapic and sulfometuron-methyl. Imazapic is an herbicide often used in restoration efforts where the establishment of graminoids is an important component of restoration and can often be applied to control broadleaf invasive plants simultaneously with the seeding of many native grasses. However, imazapic also provides control of some annual grasses, such as cheatgrass, and some cool season, perennial grasses, such as Kentucky bluegrass (BASF 2011). Both of these grasses are nonnative invasive species, of which control may be a management objective in some settings.

Imazapic may injure some native grasses. One species, Sandberg bluegrass (a perennial, shallow-rooted grass), is native to the Rocky Mountain Ecoregion, and is a highly desirable grass for niche occupation. Weed managers consider it important to retain Sandberg bluegrass where it occurs when considering herbicide applications. Davis (2014) reports that recent research in the Great Basin has found that although imazapic applications may cause a slight initial suppression of Sandberg bluegrass, plants recover within 3 to 4 years post-treatment.

In contrast to imazapic, sulfometuron-methyl controls many annual and perennial grasses. Cheatgrass and Kentucky bluegrass are common examples of nonnative invasive graminoids susceptible to sulfometuron-methyl. Fescues and bromes, both of which occur as native grasses, are also susceptible to this herbicide. Due to the use of imazapic, however, sulfometuron-methyl has not been applied in recent years.

Persistent herbicides are more likely to affect graminoids in the seedling stage than when mature. Sheley et al. (2000) found that effects to the establishment of grass seedlings from clopyralid and picloram applications depended on the application rate and the timing of the application relative to the time since the grass had germinated. Herbicide applications implemented 2 or more weeks after the grass was seeded, even at higher use rates, allowed successful grass establishment.

Spring applications are more likely to cause short-term damage to mature graminoids than fall applications, by temporarily reducing vigor and seed production of some grass species (Rice et al. 1997b, Rice and Toney 1998). In addition, mature grasses may be atypically affected by herbicides when physiologically stressed, such as during a drought period or insect outbreak. The effects of herbicides on nonsusceptible graminoids is generally short term (often no more than 1 or 2 growing seasons) and does not alter long-term species diversity or overall biomass (Rice and Toney 1998).

With the exceptions noted above, herbicide applications in general are beneficial to nonsusceptible graminoids (Rice and Toney 1998, Ortega and Pearson 2011). As an example, native grasses such as bluebunch wheatgrass are vulnerable to the impacts of weed invasion (Ortega and Pearson 2011) and usually respond very positively to herbicide treatments that reduce weed density and cover. There are a number of reasons why graminoids respond so positively. They are not physiologically impacted by broadleaf herbicides, so they can respond rapidly to re-allocations of site resources (Rice and Toney 1998, Ortega and Pearson 2011). Soil and water resources are more available without competition from weeds. Allelopathic effects decline as weed density decreases. In addition, more growing spaces are made available for graminoid recruitment as weed density decreases (Rice and Toney 1998, Ortega and Pearson 2011). In this example, because bluebunch wheatgrass is a community dominant in grassland and shrubland cover types, grass recovery in response to weed control measures assists in plant community recovery.

Grasslands are often impacted by a high degree of human uses (Parks et al. 2005). Historically, these sites were often settled early during westward expansion and continued on into the homesteading era. Land clearing for raising crops and livestock introduced early and widespread soil and vegetation disturbance. Many nonnative plant species were introduced deliberately or accidentally, setting the stage for weed establishment and spread more than a century ago (Rice 2000, Parks et al. 2005).

Areas denoted as “grasslands” usually host a wide variety of native forb species, some of which codominate with grasses (Pokorny et al. 2004b). In these plant communities, the effects of herbicide vary between vegetation groups, some of which are beneficial and some adverse, depending on the vegetation group. Researchers have found that herbicide applications can cause depressions in forb species richness, cover, and fecundity (Rice and Toney 1996, Ortega and Pearson 2011). Conversely, herbicide applications that control broadleaf invasive plants allow graminoid species to increase cover and biomass, as a result of decreased competition. In long-term studies, Rice and his colleagues have found that this effect tends to balance out over time. Nonetheless, it is important to recognize and ameliorate the effect.

Mechanical Control

Mechanical control methods include hand pulling, grubbing, hoeing, cutting and mowing, burning, and torching. The BNF and the SNF do not currently use or propose to use mechanical methods such as chaining and disking as methods for controlling invasive plants.

Various methods of mechanical control have been shown to be quite effective in controlling or partially controlling some invasive plant species (Sheley 1994). Mechanical control methods are generally more effective in controlling taprooted species or those with shallow root systems. Mechanical control is seldom an effective means of controlling species with rhizomatous or stoloniferous root systems or those that can sprout from deep underground roots.

Mechanical control methods are very expensive and labor intensive (Duncan et al. 2004, Beck 2013) and are generally implemented only under these circumstances: a) on small, high-priority sites, such as campgrounds or picnic areas, where reducing the threat of spread justifies the expense, b) on invasive plant species prioritized for high levels of control, such as new invaders identified for early detection efforts, c) only during seed production stages of plant growth, or d) in conjunction with other control methods. For example, mechanical removal of seed heads is commonly practiced on small infestations of gypsyflower (hound's tongue) from mid-summer through fall, when viable seeds are present on mature plants.

Mechanical control is expensive for 2 reasons: 1) treatments are physically very demanding and time consuming, so daily output is very low; hard rocky soils and high invasive plant densities further slow the work, and (2) treatments must be repeated frequently to be effective, sometimes as often as every 2 to 3 weeks, depending on the target species. This means that although mechanical control can be effective at a very small scale, it is not effective at the landscape level.

Mechanical control is a very labor intensive and expensive method of treating invasive plants and is best suited to small sites. Various methods of mechanical control have been shown to be quite effective in controlling or partially controlling some invasive plant species (Sheley 1994). Mechanical control methods are generally more effective in controlling taprooted species or those with shallow root systems. Mechanical control is seldom an effective means of controlling species with rhizomatous or stoloniferous root systems or those that can sprout from deep underground roots.

Mechanical control as the sole method of eradicating an invasive plant infestation is often ineffective because of the long-term viability of invasive plant seeds in the soil. In addition, mechanical treatments are often less effective than herbicide applications. There is only a narrow seasonal window for implementation. Pulling, grubbing, and hoeing are usually effective only in the spring and early summer when the soil is moist enough to effectively remove the entire root crown or root masses of target plants. Pulling leaves and stems but not removing the root crown does not kill the plant and usually results in prompt regrowth.

Additionally, once plants have dropped seed for the year, mechanical treatment can become ineffectual because of seeds remaining in the soil, which ensures a fresh crop of invasive plants the following year. Most invasive plant species are prolific seed producers and have the ability to regenerate and produce seed following removal of top growth, so mechanical methods can even prompt rebloom.

Mechanical treatments can kill many, but not all, taprooted species (some invaders, such as rush skeletonweed, are able to resprout from segments of taproot left in the ground). Mechanical treatments of invasive plants with rhizomatous or stoloniferous root systems (such as leafy spurge or invasive hawkweeds) do not kill plants, but reduce seed production only for the season in which they are treated.

Removal of seed heads can improve treatment efficacy by reducing the potential for viable seeds to be spread by people, domestic livestock, or wildlife. Very small infestations are often pulled or grubbed to remove viable seeds on existing plants, then treated with herbicide. If the infestation consists of many mature plants in seed set, however, mechanical removal is too time consuming and expensive to be a practical control method. For that reason, mechanical control methods are often combined with herbicide applications, especially for Dalmatian toadflax, gypsyflower (hound's tongue), leafy spurge, rush skeletonweed, and saltcedar. Once herbicide

application has reduced the size and density of the infestation, integration of mechanical control helps to reduce the risk of further spread. Mechanical treatments are also effective when combined with reseeding or other restoration efforts.

Type of Mechanical Control

Hand Pulling, Grubbing, Hoeing

Hand pulling target invasive plants has very little direct effect on native vegetation, for several reasons: 1) only extremely limited areas can be effectively treated by this method, 2) there is limited soil disturbance with hand pulling, and 3) only target invasive plants are removed.

Hand pulling, grubbing, and hoeing do create small areas of bare soil that, without additional control measures, would be promptly recolonized if residual viable seeds exist in the soil.

A minimal amount of soil disturbance may result from hand pulling, grubbing, and hoeing. The impacts of soil disturbance are limited to the immediate area around the plants being removed by hand pulling, grubbing, or hoeing.

Grubbing and hoeing target invasive plants may also affect adjacent nontarget plants, due to the increased soil disturbance and the fact that some nontarget plants are injured or killed, since these methods are less selective than hand pulling.

Cutting and Mowing

Cutting, mowing, and other similar methods using hand or power tools have minimal potential to disturb the soil. The goal of cutting and mowing methods is to reduce the vigor and reproductive ability of targeted plants. Depending on the target species, intermixed nontarget plants could also be affected by these treatments. Timing the treatments when possible to avoid interfering with seed production phases on nontarget vegetation can be used to reduce the impacts to desirable species.

Cutting of some invasive plant species, such as saltcedar, which grows in a large shrub to small tree form, is a treatment that removes only stems of the target species. Unless mistakes are made in correctly identifying the target species, cutting generally has no direct nontarget effects.

Torching

Torching is only used in focused circumstances, due to the possibility of fire escaping and burning areas not intended for treatment. An example of torching would be using a propane torch at dispersed, undeveloped campsites to destroy viable puncturevine seeds. Soil at these sites is compacted and hardened, due to frequent use, and little vegetation is present. Due to the site setting, effects are generally limited to changes in soil morphology from the application of fire.

Native Vegetation Communities

Special Status Plant Species

The effects of mechanical control may be variably beneficial or detrimental to Sensitive plants. Mechanical control can be an effective choice for some Sensitive plant populations when used as part of IWM. For example, invasive plants can be mechanically removed within the Sensitive plant population and then herbicides can be sprayed outside the population to provide a buffer against re-invasion.

Removal of seed heads from invasive plants in and around a Sensitive plant population can prevent the input of fresh seeds to the seedbank, helping to reduce the density of invasive plants within a Sensitive plant population and allowing more growing space for Sensitive plants.

However, mistakes can be made in plant identification when performing mechanical control and some individual Sensitive plants could be killed. This incidental mortality could be due to proximity to target invasive plants or to occasional misidentifications, especially at the seedling stage, which can be more difficult to see than adult plants. Incidental mortality is more likely to occur when working with hand tools or power tools, as compared to hand pulling.

One of the effects of mechanical control includes soil disturbance. Churning of the seed bed turns up viable seeds that have been buried in the soil and can create a germination event from soil-banked seed. Soil disturbance can also potentially increase the risk of erosion. The scale of soil disturbance effects occurs only at a localized level, since mechanical control is confined to small areas.

Mechanical invasive plant control may also increase the amount of bare ground. This can be detrimental, beneficial, or a combination of both. Increased amounts of bare ground could result in a temporary increase in soil erosion, for example, during a high-intensity rain event. The bare ground also provides a seed bed for the deposition of freshly produced seeds, whether from desirable species or from invasive species. This bare ground effect is usually confined to very small areas, since mechanical control is practiced on only a small scale.

Rehabilitation and Restoration Practices

FSM and FSH direction provide guidance on rehabilitation and restoration. *Rehabilitation* is defined as repairing ecosystem processes, productivity, and services, while *restoration* is defined as more actively assisting the recovery of an ecosystem that has been degraded to the point it no longer has biotic integrity in terms of species composition and community structure (FSM 2070). Rehabilitation may require little more than invasive plant control measures and removal of disturbances (e.g., foot or vehicle traffic) for a time to allow a site to recover naturally on its own. Some sites that have been highly degraded by invasive plants may require more intervention in addition to invasive plant control, such as seedbed preparation, seeding, planting plugs, or mulching.

Invasive plant control is a rehabilitative and restorative practice in itself, aimed at reducing or removing invasive plants and corresponding banks of viable seeds stored in the soil to promote the establishment and maintenance of desirable plant species (FSM 2900). An upward vegetative trend of desired plant species helps meet the desired conditions of plant communities. Healthy, functional plant communities containing desirable species are resilient to disturbances such as fire and are more resistant to invasive plant invasion.

Some degraded sites require additional intervention to achieve a desired plant community that is stable, self-sustaining, resilient to disturbances, and resistant to weed invasion (Masters and Sheley 2001). Sites may be so impacted by invasive plants that rapid recovery of desired plant species is limited by 1 or more factors (Goodwin et al. 2006). For example, there may not be enough native seed left in the soil, the soil may have been affected by allelopathic compounds from the invasive plants, or there may have been changes in pollinator population levels or species diversity. In these cases, when desirable plant species—whether native graminoids and forbs or as part of a mix of nonnative plants suited to the site (e.g., a pasture grass mix at an

administrative site)—are no longer present on the site, then revegetation must be considered. From a natural resource management perspective, post-treatment plant communities are considerably more desirable than untreated, invasive-plant-dominated communities.

For recovery to proceed, whether natural recovery or human-assisted restoration, invasive plants must be controlled (Kardol and Wardle 2010), sources of disturbance and vector pathways need to be managed, and microsite niches must be available to receive and shelter desirable vegetation, whether seeds, plugs, or transplants (Goodwin et al. 2006, Sheley and Half 2006, Brown et al. 2008).

The Forest Service prefers to rely on natural regeneration as part of rehabilitative measures to restore ecosystem structure, function, and productivity on sites degraded by invasive plants. Passive or natural regeneration is preferred during and after control treatments for sites that still contain sufficient cover and density of desirable plant species. There are a number of advantages to natural site recovery. Sufficient native or desirable vegetation or seed sources may still be available onsite or nearby, making assisted recovery unnecessary. Where some or many components of a native plant community are still present, unassisted natural recovery may readily occur, although some vegetation groups may take longer to recover than others (Goodwin et al. 2006). In addition, a few researchers have suggested that relict vegetation on a heavily invaded site may possess some adaptions to cope with the invading plant species (Callaway and Ridenour 2004). If so, allowing this relict vegetation to re-establish could confer some degree of resistance to re-invasion.

Typically, site restoration involves supporting the re-establishment or return of desirable vegetation to a degraded site because necessary components of the plant community are no longer present or are too few in number. When assisted restoration must be used, native species are preferred in most situations. If possible (where and when available), locally sourced seed or plants are also preferred. When locally sourced plant materials are not available, the Forest Service uses seed and plants produced commercially from nurseries whose parent stock comes from locations on which site conditions are similar to the area requiring restoration.

Assisted restoration is used at very high priority sites (e.g., where no native seed sources are available or in areas with high human uses). Often, the best assistance is simply to reduce human disturbance and allow an area time to slowly recover. As an example, fencing to prevent human or animal access is often a very useful strategy, although it is not effective over large areas.

Natural regeneration may be slower, but it is the more desirable outcome. However, there are also drawbacks to natural regeneration. Although natural regeneration reduces the risk of introducing a new invasive plant, it could occur so slowly that invasive plants could re-establish in the area before desirable vegetation, negating the benefits of control. Natural regeneration may not compete well against invasive plants. For example, most invasive plant species have persistent seed banks that can make it harder for desirable plants to re-establish. Following treatment of a monoculture or near-monoculture of invasive plants, desirable species may need to be seeded to re-establish desirable native or nonnative vegetation and prevent re-invasion. As another example, areas with active soil erosion may recover too slowly to protect the soil, resulting in yet more soil erosion and increased site instability.

Site environmental properties are important to consider when developing an implementation plan for assisted restoration (Goodwin et al. 2006). Topographical features such as elevation, aspect, and slope need to be assessed, as do soil attributes and local climatic conditions.

Soil-related factors such as compacted or shallow topsoil, poor soil fertility, lack of soil microorganisms, or insufficient microsites to harbor seeds can strongly influence the outcome of assisted restoration actions (Goodwin et al. 2006).

Weather also plays a large role in the success or failure of assisted restoration actions. Lack of adequate moisture when seeds are germinating and developing root systems may yield poor establishment or even complete failure to establish (Goodwin et al. 2006). Conversely, too much precipitation can wash soil away from germinating plants before their root systems develop sufficiently to hold soil in place. The 2 most common reasons a restoration activity fails are lack of moisture during the seedling phase, and intense competition with nonnative invasive plants for growing spaces and site resources (Sheley and Petroff 1999).

Although natural regeneration is usually considered the best method of re-establishing desirable species, if invasive plant invasion and site disturbance has caused local extinctions of native or desirable plant species and left behind few, if any, relict plants, and if no seed bank is present, then assisted recovery becomes necessary. The decision to implement rehabilitation or restoration includes factors such as low native species diversity, low plant cover, lack of seed sources from nearby areas, the need to establish desirable vegetation to compete with invasive species, and stabilization of eroding soil. When desirable plant cover or density is too low for a site to recover on its own in a timely manner, then assistance in the form of interseeding may be needed to achieve management objectives for the site. When assisted recovery actions are determined to be the best choice, the Forest Service has established practices to guide managers in site recovery. Based on the cost of implementation and site limitations, such as access or topography, weed managers may have to rely on natural regeneration at some sites because they cannot otherwise effectively regenerate all the sites.

Invasive plant control is a rehabilitative/restorative practice in itself, aimed at reducing or removing invasive plants and the banks of viable invasive plant seeds stored in the soil, to promote the establishment and maintenance of native plants (FSM 2900). An upward vegetative trend of native plants, including Sensitive plant species, helps meet the desired condition of plant communities.

After invasive plant control, both Forests prefer to rely on natural recovery to restore ecosystem structure, function, and productivity on sites degraded by invasive plants. In the case of Sensitive plant species, which often have adaptions to highly specific habitat conditions, allowing site recovery to proceed naturally is preferred. Therefore, there would be no direct or indirect effects to Sensitive plants since there would be no active restoration implemented in Sensitive plant populations.

3.5.5.3.2. Cumulative Effects of Alternative 2

City, state, and county governments have ongoing weed spraying programs, some with less-stringent measures to prevent water contamination. Unknown amounts of herbicides are sprayed annually along road ROWs by state and county transportation departments, sometimes several times a year. Private landholders also spray unknown chemicals in unknown amounts.

Habitat quality for sensitive plant species addressed in this document has likely declined since pre-settlement conditions. Past, ongoing, and foreseeable Forest management activities have resulted in changes to forested, nonforested, dry meadow, wet meadow, and riparian habitats associated with these species. These activities include road construction and maintenance and

off-road vehicle use. Decades of domestic livestock grazing directly altered species compositions and cover densities in upland and riparian habitats' plant species. Fire suppression altered natural fire regimes, reducing the frequency of low-intensity fires in habitats that evolved with fire to high-intensity, infrequent fires, which directly alters species compositions and cover densities. Timber management activities have altered the landscape, along with associated actions such as slash pile burning, logging decks and landings, roads, and public firewood-gathering programs. Recreation activities occur associated with developed and dispersed uses such as OHV use, horseback riding and pack animal use, bicycling, hiking, backpacking, and utilization of developed camp areas). All these activities have the potential to displace native species, introduce and spread nonnative plant species, and shift plant community composition, altering resource availability and successional pathways.

The actions described in this document have and would contribute to cumulatively affecting sensitive plant species, as noted above. The introduction and spread of nonnative plant species in remote locations would likely continue, and the effects on sensitive plants would likely increase on remote sites. Ground-based herbicide application has helped the Forest control noxious plant species populations along roadways; however, nonnative plant species infestations in inaccessible areas such as remote burned areas, decommissioned roads, roadless areas, and backcountry areas are mainly untreated due to economic and physical infeasibility. The result has been that species such as rush skeletonweed and leafy spurge are expanding into inaccessible areas.

Every mile of road has an associated area of vulnerability to nonnative plant species invasion due to use and maintenances as well as to the associated herbicide treatments that occur in known areas of noxious plant species. These activities have created positive and negative impacts on sensitive species that prefer disturbed habitats, such as species in the genus *Botrychium*. The potential negative impacts depend on the nonnative plant species and the type of herbicide applied.

Fire, both wildfire and prescribed fire of high and moderate severity, have contributed to a high risk for nonnative plant species invasion that could impact sensitive plant species. It is likely that the unchecked spread of nonnative plant species populations in the future would potentially add to the cumulative effects to sensitive plant species in inaccessible areas.

The definitive cumulative effects from nonnative plant species competition and the related treatments are unknown. Past, ongoing, and foreseeable Forest management activities mentioned above and public use of forest lands have contributed, and would continue to contribute, to the introduction and spread of nonnative plant species and resulting treatments.

Biological Control

Few cumulative effects to native vegetation and sensitive plant populations result from the use of biological control agents. However, in an IWM program, multiple invasive plant control techniques are used in combination. One potentially beneficial cumulative effect of biological control agents, used in conjunction with other invasive plant control measures, could be a more rapid reduction of invasive plant density and distribution in sensitive plant populations. This would result in a reduced need for other invasive plant control treatments, such as mechanical or herbicide treatments.

There is little likelihood of adverse cumulative effects arising from the use of biological control agents. One potential adverse effect could be the natural movement of biological control agents dispersing naturally across national boundaries from countries where requirements regarding host specificity are less stringent. There is one such case from Canada, where a biological control agent intended to control gypsyflower (hound's tongue; *Cynoglossum officinale*) was found to cross over from the gypsyflower and feed on native members of the borage plant family. There is usually no way to remove biological control agents from natural settings once they have been released, have established, and are naturally dispersing. In this case, however, no sensitive plant species in the borage family exist within the project area.

Herbicide Control

Much private land is under agricultural production and no longer supports native plant communities. Sensitive plant species are not federally protected and, while private landowners may be encouraged to conserve native plants, they are neither required to do so nor to alter land-use practices that support their businesses.

The same is largely true of county lands. County land is often dedicated to supporting county uses and infrastructure. It has often been converted from native vegetation to serve county needs. For example, county material sources are managed to provide materials needed for county road maintenance. Another example involves the airports that serve each county.

Other federal land management agencies, such as the BLM, may apply herbicides within or near populations of Sensitive plant species that occur on BLM lands. The BLM follows much the same standards for protecting rare plants and maintaining or restoring rare plant habitat as does the Forest Service. Likewise, BLM operational practices for invasive plant control are similar to those practiced by the Forest Service. Given this, it is unlikely that federal invasive plant management activity within or near Sensitive plant populations would contribute to downward trends in population numbers.

Within the project area, the BNF and SNF's invasive plant management programs carry responsibility for herbicide applications, with the one exception of herbicide application along state highway rights-of-way. Herbicide applications, including those made by contractors and partners, are conducted using standard operating practices that provide protection to native vegetation and sensitive plants while accomplishing invasive plant management objectives.

Mechanical Control

There is little likelihood of cumulative effects arising from mechanical invasive plant control in native vegetation and sensitive plant populations. Sensitive plant populations are mapped and made known to invasive plant management crews, who plan invasive plant control treatments, including mechanical control, to protect Sensitive plants. Likewise, when other ground-disturbing land-use activities are planned (for example, mineral exploration), program managers check the NRIS database for the presence of known populations of sensitive plant species.

Rehabilitation and Restoration Practices

Cumulatively, any projects, especially those at the landscape level, could contribute to improved habitat conditions for native vegetation and Sensitive plants.

3.5.5.3.3. Alternative 2 Summary

No irreversible or irretrievable uses of resources are associated with Alternative 2, which is a continuation of the present invasive plant management program. To date, success in prevention, early detection, and control and management elements of invasive plant management has been achieved. Overall, however, the presence and influence of invasive plant species throughout the project area is increasing due to lack of appropriate tools and technology. In time, implementation of this alternative could impact Sensitive plants in terms of plant vigor, productivity, and habitat suitability.

Native vegetation and special status plant species may be impacted by herbicide and mechanical invasive plant control measures; individual plants or small groups could be damaged or killed, especially young plants that are difficult to detect. However, adverse effects to populations would be negligible. Continued implementation of the Current Action would not contribute to a downward trend in populations or habitat quality for any Sensitive plant species, nor would it lead to listing under the ESA. Table 3-66 displays the determination of effects to habitat and Sensitive plant populations as a result of implementing Alternative 2.

Table 3-66. Determination of effects to sensitive plant habitat and plants resulting from Alternatives 2 through 5

Sensitive Plant Species	Effects to Habitat	Effects to Plants	Effects Determination
Endangered Species Act List			
Whitebark Pine (candidate)	Short-term adverse impacts Long-term beneficial impacts (SAI-LBI)	Short-term adverse impacts Long-term beneficial impacts (SAI-LBI)	May impact individuals and habitat (MIIH), but not likely to cause a trend toward federal listing or loss of viability
Forest Service Region 4 Sensitive List			
Tolmie's Onion	SAI-LBI	SAI-LBI	MIIH
Scalloped Moonwort	SAI-LBI	SAI-LBI	MIIH
Bryum Moss	SAI-LBI	SAI-LBI	MIIH
Christ's Indian Paintbrush	SAI-LBI	SAI-LBI	MIIH
Davis' Wavewing	SAI-LBI	SAI-LBI	MIIH
Idaho Douglasia	SAI-LBI	SAI-LBI	MIIH
Stanley's Whitlow-grass	SAI-LBI	SAI-LBI	MIIH
Guardian Buckwheat	SAI-LBI	SAI-LBI	MIIH
Sacajawea's Bitterroot	SAI-LBI	SAI-LBI	MIIH
Idaho Penstemon	SAI-LBI	SAI-LBI	MIIH
Cottam Cinquefoil	SAI-LBI	SAI-LBI	MIIH
Bugleg Goldenweed	SAI-LBI	SAI-LBI	MIIH
Forest Watch List			
Tall Swamp Onion	SAI-LBI	SAI-LBI	MIIH
Grouse Creek Rockcress	SAI-LBI	SAI-LBI	MIIH
Challis Milkvetch	SAI-LBI	SAI-LBI	MIIH
Park Milkvetch	SAI-LBI	SAI-LBI	MIIH
Pale Sedge	SAI-LBI	SAI-LBI	MIIH
Mt. Shasta Sedge	SAI-LBI	SAI-LBI	MIIH
Spoonleaf Sundew	SAI-LBI	SAI-LBI	MIIH
Giant Helleborine Orchid	SAI-LBI	SAI-LBI	MIIH
Blandow's Helodium Moss	SAI-LBI	SAI-LBI	MIIH
Simpson's Hedgehog Cactus	SAI-LBI	SAI-LBI	MIIH
Kruckeberg's Hollyfern	SAI-LBI	SAI-LBI	MIIH
Silvery Primrose	SAI-LBI	SAI-LBI	MIIH
Farr's Willow	SAI-LBI	SAI-LBI	MIIH
Wedgeleaf Saxifrage	SAI-LBI	SAI-LBI	MIIH
Rannoch-rush	SAI-LBI	SAI-LBI	MIIH

3.5.5.4. Alternative 3—Proposed Action

The third alternative (Proposed Action) brings forward all the treatment actions presently available under the Current Action, as well as providing for the use of 3 additional herbicides: fluroxypyr, imazapyr, and imazamox. See Chapter 2 for a complete description of Alternative 3.

3.5.5.4.1. Direct and Indirect Effects

Biological Control

The direct, indirect, and cumulative effects of biological control under Alternative 3 would be the same as those described under Alternative 2.

Herbicide Control

Alternative 3 would implement design criteria to help minimize the impacts of herbicide application to native vegetation and special status plants while still achieving invasive plant control objectives.

The direct and indirect effects of herbicide application as implemented by Alternative 3 would be the same as those disclosed under Alternative 2, with 3 exceptions. These exceptions include 1) the subtraction of 1 herbicide (diflufenzopyr) and addition of 3 herbicides as approved herbicides, 2) the use of helicopter aerial application, and 3) aquatic application of herbicides.

Additional Herbicides

Alternative 3 proposes the use of 3 herbicides in addition to those currently in use: fluroxypyr, imazapyr, and imazamox. Table 3-67 displays the application rates and methods for these herbicides that would be used to implement Alternative 3.

Table 3-67. New herbicides proposed for use under Alternative 3 (Proposed Action)

Herbicide/Active Ingredient (AI)	Maximum Label Application Rate (lbs AI/acre)	Proposed Typical Application Rate (lbs AI/acre)	General Application
Fluroxypyr	1.5 lbs/acre	0.5–1.0 lb/acre	Upland
Imazapyr	1.5 lbs/acre	0.5–1.0 lb/acre	Upland, Riparian, Aquatic
Imazamox	0.5 lb/acre	0.25–0.5 lb/acre	Riparian, Aquatic

<u>Fluroxypyr</u>

Fluroxypyr is a selective post-emergent systemic herbicide. It is registered for the control of broadleaf weeds in rangeland, noncrop areas, and grazed areas and for the control of woody brush. Fluroxypyr is structurally similar to several other herbicides—aminopyralid, clopyralid, picloram, and triclopyr—and, like these other herbicides, fluroxypyr acts by mimicking indoleacetic acid, a plant growth hormone (SERA 2009a).

Fluroxypyr is a selective herbicide that controls broadleaf species; therefore, it poses a risk to nontarget forbs, as well as desirable woody species in treatment areas. Because fluroxypyr is often tank-mixed with other active ingredients, its risk for nontarget effects should be considered in conjunction with those of the other active ingredients.

The risk assessment for fluroxypyr indicates that this active ingredient poses a high risk to nontarget terrestrial plants through direct-spray scenarios. It is assumed that direct spray of some nontarget vegetation within the treatment area (if present) would occur, particularly if fluroxypyr is broadcast-sprayed over a large area where desirable broadleaf species are present and are susceptible at the time of treatment.

Risks to terrestrial plants from off-site drift are generally low and would be greatest for aerial applications of fluroxypyr. Suitable buffer distances to protect nontarget terrestrial plants range from 100 feet for ground applications with a low boom, to 300 feet for certain aerial applications. No risks to terrestrial plants were predicted for surface runoff exposure scenarios. No risks to nontarget aquatic plants were predicted for exposures involving off-site drift, surface runoff, or root-zone groundwater flow, under a variety of site conditions.

Additional effects to certain nontarget plant species could occur if populations of pollinators were harmed by herbicide spraying. Based on the risk assessments, fluroxypyr poses a low risk to pollinators under direct-spray scenarios.

Imazamox

Imazamox is labeled for aquatic applications (SERA 2010), and the use of imazamox is proposed to treat aquatic invasive plant species in or at the margins of water bodies. Imazamox is active on submersed, emerged, and floating monocot aquatic plants (BASF 2009). It works by inhibiting a plant enzyme called ALS, which regulates the production of essential amino acids in plants. When ALS is inhibited, plants die. The efficacy and selectivity of imazamox on aquatic vegetation is determined by the use rate and by the method of application.

There would be no effects to conifers, deciduous trees and shrubs, evergreen shrubs, and terrestrial grasses and forbs resulting from imazamox applications. Imazamox would be used only for applications to water and at the water's edge.

Native macrophytes could be severely injured or killed by imazamox, if present and growing interspersed with target aquatic invasive plants (SERA 2010). Because the emphasis for aquatic invasive plants is one of EDRR, direct and indirect effects would be limited to very small, site-specific locations. New infestations of aquatic invasive plants would likely be less than 0.1 acre in size. At this scale, applications of imazamox would have no landscape-level effects to populations of native macrophytes.

Imazapyr

Imazapyr is labeled for aquatic applications (SERA 2011b), and Alternative 3 proposes the use of imazapyr primarily for treating emergent aquatic invasive plant species in and around water. Imazapyr is recognized as being a very effective herbicide for an array of emergent aquatic invasive plants and weed species growing right along the water's edge, often with their roots in the water (Tu et al. 2001). These include species such as saltcedar and knotweeds that invade riparian areas. Imazapyr is toxic to susceptible plants at low concentrations (Trevathan 2002c).

Imazapyr is a broad-spectrum herbicide similar to glyphosate in terms of its nonselectivity. In addition to aquatic macrophytes, it is toxic to many annual and perennial grass species and broadleaf species, as well as many brush and vine species (BASF 2012). Those plant species resistant to imazapyr apparently metabolize it to an immobile form that cannot be translocated to the meristematic tissues. In addition, when imazapyr is applied at high rates, it can result in season-long soil activity, providing residual control of germinating seeds.

Conifers are one of the few vegetation groups that exhibit some degree of tolerance to imazapyr. Imazapyr is commonly used for forestry site preparation and weeding in conifer plantations (BASF 2012). As with most herbicides, seedlings and saplings are more likely to be affected than mature trees. Trees that are under stress from drought, disease, or injury are more likely to be affected by imazapyr. Some imazapyr injuries to tolerant conifers may be transient, followed by rapid recovery, while injuries to less tolerant species could be severe. Imazapyr labels provide instructions such as application method, the use of surfactants, season of application, and use rates to minimize the risk of injury to conifers from imazapyr. The applications of imazapyr would be intended for aquatic applications and waterline applications made to weed species that grow with their roots in the water. The likelihood of direct or indirect effects to conifers resulting from the use of imazapyr is very low.

Many deciduous tree and shrub species can be harmed by imazapyr, particularly at medium- to high-use rates. Herbicide labels instruct applicators to avoid contact with foliage of nontarget trees and shrubs, as well as the soil in which these species are rooted. Because the root zone of trees and shrubs can extend well beyond the drip line, applications made along the margins of water bodies must be undertaken with care in areas where deciduous trees and shrubs are present (BASF 2012). Indirectly, however, shoreline plants with roots extending into water bodies and treated with imazapyr would generally not be affected (BASF 2012). Applications of imazapyr would be intended for aquatic applications and waterline applications made to weed species that grow with their roots in the water. For example, imazapyr could be applied to invasive knotweeds and milfoils. Therefore, individual native deciduous trees and shrubs could be affected by imazapyr applications made along the margins of water bodies (although not when aquatic applications are made). Impacts can largely be eliminated by adherence to label directions, applying the lowest effective rate, and choosing the proper application method. Application by wicking or rolling, rather than spraying, provides for very precise applications of imazapyr to target plant foliage only. This avoids unintentional overspray on to nontarget vegetation and soil. These measures would manage the risk of effects on deciduous trees and shrubs.

In general, evergreen shrub species are tolerant of imazapyr. Applications of imazapyr would be intended for aquatic applications and waterline applications made to weed species that grow with their roots in the water. Evergreen shrub species do not grow in the settings intended for imazapyr applications. The likelihood of direct or indirect effects to evergreen shrubs resulting from the use of imazapyr is very low.

Imazapyr is toxic to many graminoid species and, in general, should be considered injurious or potentially lethal to desirable and native grass species. The use rate, season of application, type of surfactant used, and use of imazapyr in tank mixes with other herbicides all affect the degree of injury to graminoids (BASF 2012). Graminoid plants under stress from drought, disease, insects, or temperature extremes are more likely to experience mortality or injury (BASF 2012). Nonlethal effects may include chlorosis, stunting, loss of vigor, and loss of seed production. Applications of imazapyr would be intended for aquatic applications and waterline applications made to invasive plant species that grow with their roots in the water. The risk of damage to nontarget graminoids can be managed by adherence to label direction, applying with the lowest effective use rate, and using wicking or rolling techniques to provide very precise applications of imazapyr to target plant foliage only.

Imazapyr should be considered injurious or lethal to desired and native broadleaf forb species. Applications of imazapyr would predominantly be used for aquatic applications and waterline applications made to invasive plant species that grow with their roots in the water. Therefore, individual plants and small groups of nontarget forbs could be damaged or killed by imazapyr applications made along the margins of water bodies.

In aquatic settings, imazapyr has little or no toxicity to submersed aquatic plants (BASF 2012). It must be applied to emergent vegetation. Native macrophytes that grow submersed in water would not be affected by imazapyr. Native macrophytes that grow emerged from the water, however, could be affected by imazapyr applications made to nonnative invasive aquatic plants. At infested sites, native macrophytic plants could be severely injured or killed by imazapyr, if present and growing interspersed with target invasive plants. Because the emphasis for aquatic invasive plants is one of EDRR, direct and indirect effects would be limited to very small, site-specific locations. New infestations of aquatic invasive plants would likely be less than 0.1 acre in size. At this scale, applications of imazapyr would have no landscape-level effects to populations of native macrophytes.

Aerial Application

The ability to use aerial application of herbicides would help improve invasive plant control efforts for currently uncontrolled or poorly controlled infestations in the project area. Treatment limitations (e.g., topography, slope, lack of water, remote sites, and associated high treatment costs) would be easier to manage with aerial application as an approved tool. Aerial application would provide IWM on sites where no or few invasive plant control options currently exist due to these treatment limitations. This is a particularly important consideration for invasive plant species for which there are no biological control agents available or for which available agents have not been effective in providing weed control. Aerial application would greatly reduce treatment costs on areas that are currently prohibitively expensive due to site location, topography, and long distances to water.

Aircraft have been widely used as a land management tool for decades. Aerial application of herbicides started primarily in agriculture, but as aircraft and application equipment improved, its use expanded into natural resource management. The use of aircraft in natural resource management includes many activities, such as the control of detrimental insects, weeds, and diseases or in restoration projects requiring fertilization and seeding. The need to reach large expanses of remote, inaccessible terrain and the high cost of manual, ground-based labor dictate that many of these activities be conducted from the air (Kilroy et al. 2003).

Currently, ground-based application of herbicides is performed utilizing both spot and broadcast application techniques, with design criteria incorporated to manage the risks associated with the application of herbicides. The aerial application of herbicides is no different. Helicopters would be used to perform broadcast applications of herbicides with design criteria developed to minimize the risks associated with the application of herbicides by air, in addition to those for general herbicide application.

Although aviation is an inherently dangerous activity, risks can be minimized by following operating and safety guidelines. In addition to safety concerns, the other aspects of herbicide application, such as volatilization, drift, and movement of herbicide through soil or water are considered. Herbicides can move with eroding or windblown soil or with surface or subsurface water. Herbicides can also move through the air as spray drift, which occurs during herbicide

application, and via volatilization, which could occur after application. Spray drift is dependent on spray equipment parameters such as nozzle orifice size, boom height and pressure, and wind speed (Branham and Hanson 1987). Volatility is dependent on the physical properties of the herbicide, primarily vapor pressure.

Table 3-68 displays the volatilization potential of herbicides being considered for aerial application under Alternative 3. No ester formulations are proposed for use during aerial application.

Table 3-68. Volatilization potential of herbicides considered for aerial application

Herbicide	Volatilization Potential
2,4-D amine	Much less volatile than ester formulations [a]
Chlorsulfuron	Volatilization plays minor role in disappearance [b]
Clopyralid	Does not volatize readily in the field [a]
Dicamba	Volatilization not significant from soil surfaces, some may occur from plant surfaces [c]
Glyphosate	Does not volatize readily in the field [a]
Imazapic	Not volatile [a]
Metsulfuron-methyl	Does not volatize readily in the field [d]
Picloram	Does not volatize readily in the field [a]
Sulfometuron-methyl	Not volatile [e]
Triclopyr TEA (triethylamine salt)	Ester formulations are highly volatile (the Forest Service uses amine) [a]

[a] Tu et al. 2001.
[b] PMEP 1985.
[c] EXTONET 1996
[d] Information Ventures 2002
[e] BPA 2000.

The potential for volatilization can be minimized in a number of ways, some of which are operational and some environmental. Using water as a carrier and the use of specific adjuvants reduces the likelihood of volatilization. The climatic regime for the project area is one of low annual precipitation and the soils are naturally dry, which reduces the potential for volatilization from soil. Aerial applications would be made primarily during morning hours when air and soil temperatures are lower and winds are calm or light. These conditions further reduce the likelihood of volatilization.

Spray drift is the movement of herbicide, generally via spray droplets, away from the target area. Spray drift can be reduced by increasing droplet size. This can be done by reducing spray pressure, increasing nozzle orifice size, using drift reduction nozzles, rearward nozzle orientation during aerial applications, and the addition of drift reduction adjuvants to the spray mix. Other factors influencing spray drift are the method of application (drift is generally greater from mist blower and aerial applications than ground application); the distance between the nozzle and target (less distance will reduce drift); wind direction and wind speed; air stability; and temperature and humidity (low humidity and high temperatures cause rapid evaporation, which reduces the size of droplets). The influence of humidity and temperature is not always predictable, however (Dexter 1993). Spray drift cannot be completely eliminated; however, with proper management, drift levels can be minimized to levels that do not cause harm (Felsot 2001). General methods to reduce drift potential of herbicides considered for aerial application are discussed below.

Under Alternative 3, aerial application of herbicides could occur on up to 10,000 acres per forest annually. This amounts to approximately 11% of inventoried invasive plant infestations and 0.5% of the project area. For the purpose of this analysis, it is assumed that an aerial application is a broadcast application.

The broadcast nature of aerial application would, in the short term, affect nontarget vegetation across larger areas, as compared to ground-based broadcast or spot applications. For this reason, the Forests would apply design criteria to reduce the effects of aerial application to nontarget vegetation. These include measures such as herbicide selection, applying more selective and less toxic herbicides such as aminopyralid and clopyralid, and using the lowest effective use rate. For example, since glyphosate is a nonselective herbicide, it would not be used for aerial application. Only upland sites would be treated with aerial application, to reduce effects to nontarget deciduous trees and shrubs. Conifer cover types with more than 30% overstory canopy cover would not be treated using aerial application. Aerial application of herbicides would be limited to lands greater than 300 feet from special status plant populations and 300 feet from live water; therefore, the potential impacts to nontarget riparian vegetation would remain the same as those for ground-based applications.

The direct and indirect effects of these herbicides on nontarget vegetation are the same regardless of the application method—whether the herbicide is applied using a ground-based broadcast application system, like a spray truck, or applied using a helicopter with strict adherence to design criteria and herbicide label direction. The potential for drift during aerial application is slightly higher than for ground-based applications, but standard operational practices successfully manage drift concerns, such as drift control agents, appropriate type and size of nozzle, appropriate boom length and application pressure, application at the lowest safe elevation, and application in optimal weather conditions (Wolf 2000). The number of acres treated annually would increase in years in which herbicides were applied aerially. Necessarily, this would also increase the amount of broadcast acreage, creating a concurrent increase in the adverse effects of herbicide application to nontarget vegetation in the areas treated aerially.

The potential effects at the site level would be the same as for a ground-based broadcast application. The difference is one of scale, in that more acreage would be treated aerially than could be treated using ground-based equipment. However, from a project area perspective, even though aerial application has the potential to apply herbicides over larger areas, implementation of Alternative 3 would only aerially treat 10,000 acres per forest annually. At a landscape scale, the potential short-term impacts to nontarget vegetation in the project area would be minor, and offset by the long-term benefit of reduced invasive plant cover contributing to increased density of desirable vegetation with improved productivity and vigor.

Beneficially, areas that are presently not infested but “at risk” to invasive plant invasion would be more protected by aerially applying herbicides to infestations that are currently uncontrolled, thus establishing containment boundaries. Additionally, aerial application would provide for landscape-level restoration efforts to manage invasive plants and maintain or improve ecosystem resilience.

Special status plant species would potentially be impacted by aerial herbicide applications, but design features have been put in place to greatly minimize the risk. Aerial application would not be done within 300 feet of known special status plant populations. There remains a risk of impact to unknown special status plant individuals and populations. Another design criteria is that no

aerial applications of herbicides would be made in whitebark pine stands. No direct or indirect adverse effects to any known populations of special status species would result from aerial application of herbicides.

Aquatic Applications

Two known species of littoral weeds (i.e., weeds that grow with their roots in or very near the water and with their foliage well above the surface of the water) infest lands within the project area. These are Japanese knotweed and saltcedar; both species occur in riparian areas or grow adjacent to water, but do not grow beneath the surface of the water. Both of these species have the ability to grow beyond the immediate vicinity of water, but at this time they are only found growing immediately adjacent to water. To date, they have been managed for eradication as riparian weeds and utilizing treatment techniques, herbicides, and design criteria associated with terrestrial plants. A hybrid Eurasian watermilfoil (*Myriophyllum spicatum*) is known to occur within the project area at one location. It is a submerged invasive that grows in the water and would require aquatic application of herbicides to treat. Implementation of Alternative 3 would allow quick response to aquatic invasive plants. Early detection and treatment would minimize the impacts of treatment and would reduce the impacts of invasion to native aquatic vegetation.

The State of Idaho has 2 invasive species management plans that provide direction toward the management of aquatic invasive plants within the project area. The first of these plans is the Idaho Invasive Species Strategic Plan 2012–2016 (IDA 2012); the second of these plans is the Idaho Aquatic Nuisance Species Plan of 2007 (Idaho Invasive Species Council Technical Committee 2007). In particular, the Idaho Aquatic Nuisance Species Plan of 2007 outlines a rapid response strategy that the Forests propose to implement if an aquatic invasive species is found to occupy waters within the Forests.

In many ways, aquatic invasive plants are similar to terrestrial invasive plants. There are annuals and perennials. Many flower and produce seed, others propagate only asexually. Some produce tubers or winter buds, some are more shade-tolerant than others, and nearly all respond to fertilization. Therefore, the management and control of these pests is similar, in many respects, to that of terrestrial invasive plants (Morgan and Patten 2012).

Herbicide treatment options are generally associated with 3 broad categories of aquatic invasive plants: emergent, submersed, and floating. Emergent plants (sometimes called bank or marginal plants) are those rooted or anchored in the substratum, with most of the leaf stem tissue above the water surface. They do not rise and fall with the water level. Examples include purple loosestrife (*Lythrum salicaria*), Japanese knotweed (*Polygonum cuspidatum*), and saltcedar (*Tamarix ramosissima*). Submersed plants are adapted to grow with all or most of their vegetative tissue below the water surface. Examples of submersed plants include pondweeds (*Potamogeton* spp.), Eurasian watermilfoil, and Brazilian waterweed (*Egeria densa*). Floating plants are those that are either free-floating or anchored to the substratum. They produce most of their leaf stem tissue, or thalli, at or above the water surface. Leaves or thalli of floating plants rise and fall with the water level. An example of a floating plant is the water hyacinth (*Eichhornia* spp.), although other aquatic invasive plants on the Idaho noxious weed list can survive in a free-floating form; an example of this is Carolina fanwort (*Cabomba* spp.).

Alternative 3 proposes to use 4 herbicides for the treatment of aquatic invasive plants. Of these, 2 herbicides (glyphosate and triclopyr TEA) are already authorized for use in the treatment of terrestrial invasive plants. The 2 herbicides that are proposed to be added to the toolbox are

imazamox and imazapyr. Table 3-69 displays these 4 herbicides as proposed for use by plant growth form.

Table 3-69. Herbicide treatment options, by growth form

Growth Form	Aquatic Use Herbicides			
	Glyphosate	Imazamox	Imazapyr	Triclopyr TEA
Submersed Invasive Plants		X		X
Emergent Invasive Plants	X	X	X	X
Broadleaf; Floating and Emergent	X	X	X	X
Floating Invasive Plants	X			

Application techniques for the treatment of aquatic invasive plants fall into 2 basic types, foliar application and submersed aquatic. In a foliar application, the herbicide is mixed with water and sprayed on the foliage of floating or emergent plants in a given area. The goal during foliar application of an aquatic herbicide is to obtain good coverage and ensure that the maximum amount of herbicide is taken up by the target weed. The foliar application of herbicides to emergent and floating-leaved plants is generally well understood by homeowners because this is common practice on ornamental lawn and garden plants.

The application of herbicides for submersed weed control, however, is often more complicated and thus more difficult to understand. In an application for submersed aquatic invasive plants, herbicide is applied into the water and the target plant uptakes the active ingredient through the water. The control of submersed aquatic weeds is much more difficult than the control of emergent aquatic plants, for the following reasons:

- Fewer herbicides are registered for submersed treatments
- The dilution effect of water depends on the depth of the water
- Wind, waves, and currents dilute herbicides
- It takes more time to treat and cover submersed plants
- Submersed weeds are generally much more expensive to treat
- The growth stage and area covered by the plants are important
- Use of treated water for irrigation and drinking may be restricted

These general factors, along with additional site-specific factors, would be used to determine which herbicides and application techniques should be used to control submersed aquatic invasive plants. When making aquatic herbicide applications, all the design criteria for general herbicide applications apply, as well as design criteria specific to aquatic herbicide applications.

There are no special status plant species that grow in aquatic settings. Aquatic applications would have no effects, direct, indirect, or cumulative to special status plants.

Mechanical Control

The direct and indirect effects of mechanical control under Alternative 3 would be the same as those described under Alternative 2.

Rehabilitation and Restoration Practices

The direct and indirect effects of rehabilitation and restoration measures under Alternative 3 would be the same as those described under Alternative 2.

3.5.5.4.2. Cumulative Effects of Alternative 3

Biological Control

The cumulative effects of biological control as implemented by Alternative 3 would be the same as those disclosed under Alternative 2 (Current Action).

Herbicide Control

The cumulative effects of herbicide application to native vegetation communities and special status plant species are the same as those described under Alternative 2, with the exception of including aerial application and aquatic application as approved application methods. Note that there would be no cumulative effects to special status plant species resulting from aquatic applications.

Beneficial effects of weed control accrue at both the site level and at the plant community and landscape level. These include improved plant community composition and ecosystem resilience. The potential increase in acres treated could result in short-term impacts to nontarget vegetation, but could provide for long-term benefits in terms of plant community composition and ecosystem resilience. These beneficial effects would not only be realized within the project area, but would also benefit lands beyond the project area by reducing the movement of invasive plant reproductive propagules or seeds from NFS lands.

The CWMAs are all using herbicides. IWM programs on adjacent non-NFS lands could be more effective since both forests work cooperatively with these entities. IWM in the project area would continue to identify infestations as high priorities for treatment. Herbicide application at these sites would continue to be very low, although the products used would shift to new, less toxic herbicides with lesser effects on nontarget vegetation. No increase in cumulative effects would occur from the shift to newer herbicides.

Mechanical Control

The direct, indirect, and cumulative effects of mechanical control under Alternative 3 would be the same as those described under Alternative 2.

Rehabilitation and Restoration Practices

The direct, indirect, and cumulative effects of rehabilitation/restoration measures under Alternative 3 would be the same as those described under Alternative 2.

3.5.5.4.3. Alternative 3 Summary

No irreversible or irretrievable uses of resources are associated with Alternative 3. Implementation of Alternative 3 would contribute to restoration of native or desirable vegetation in areas where nonnative, invasive plant species have established. Invasive plant treatments as described in accordance with Alternative 3 would have relatively short-lived detrimental effects and long-term beneficial effects. Detrimental effects to Sensitive plants would be minimized through the implementation of the design criteria.

Implementation of Alternative 3 would be beneficial overall since it (a) would permit the use of new, less toxic and more selective herbicides and (b) would permit the use of aerial application on invasive plant infestations that are uncontrolled or poorly controlled. In the long term, preventing invasive plants from spreading into currently uninfested areas, slowing the rate of spread of existing infestations, and reducing the density of invasive plants in existing infestations would prove beneficial to native vegetation communities and Sensitive plants.

Native vegetation communities and sensitive plant species may be impacted by herbicide and mechanical invasive plant control measures; individual plants or small groups could be damaged or killed, especially young plants that are difficult to detect. However, adverse effects on communities and populations would be negligible, even with the addition of aerial application. Implementation of Alternative 3 would not contribute to a downward trend in populations, habitat quality, or native vegetation communities nor would it lead to listing under the ESA. Table 3-66 (above) displays the determination of effects to habitat and Sensitive plant populations (by sensitive plant species) as a result of implementing Alternative 3.

3.5.5.5. Alternative 4—No Aerial Herbicide Application

Alternative 4 is a subset of Alternative 3 (Proposed Action). Alternative 4 excludes aerial application of herbicide for the treatment of invasive and noxious plant species.

3.5.5.5.1. Direct and Indirect Effects

The direct and indirect effects as implemented by Alternative 4 would be the same as those disclosed under Alternative 3, the Proposed Action, with the exception that there would be no helicopter aerial application of herbicide. Without aerial application of herbicide, the ability to improve invasive plant control efforts for currently uncontrolled or poorly controlled infestations in the project area would not improve. Treatment limitations (e.g., topography, slope, lack of water, remote sites, and associated high treatment costs) would be more difficult to manage without aerial application as an approved tool compared to Alternative 3. Without aerial application, some infested areas would not be treated due to prohibitively expensive costs based on site location, topography, and long distances to water.

No irreversible or irretrievable uses of resources are associated with Alternative 4. Implementation of Alternative 4 would contribute to restoration of native or desirable vegetation in areas where nonnative, invasive plant species have established. Invasive plant treatments, as described in accordance with Alternative 4, could have relatively short-lived detrimental effects and long-term beneficial effects, however, potential detrimental effects to native vegetation communities and sensitive plant species would be minimized through the implementation of the design criteria.

Implementation of Alternative 4 would be beneficial overall since it would permit the use of new, less toxic, and more selective herbicides. In the long term, preventing invasive plants from spreading into currently uninfested areas, slowing the rate of spread of existing infestations, and reducing the density of invasive plants in existing infestations would prove beneficial to native vegetation communities and sensitive plants.

Native vegetation communities and sensitive plant species may be impacted by herbicide and mechanical invasive plant control measures; individual plants or small groups could be damaged or killed, especially young plants that are difficult to detect. However, adverse effects on populations and communities would be negligible. Implementation of Alternative 4 would not contribute to a downward trend in populations or habitat quality for any sensitive plant species nor would it lead to listing under the ESA. Table 3-66 (above) displays the determination of effects to habitat and Sensitive plant populations (by sensitive plant species) as a result of implementing Alternative 4.

3.5.5.5.2. Cumulative Effects

Cumulative effects as implemented by Alternative 4 (the No Aerial Herbicide Application Alternative) would be the same as those disclosed under Alternative 3 (Proposed Action).

3.5.5.6. Alternative 5—No Aquatic Herbicide Application

Alternative 5 is a subset of Alternative 3 (Proposed Action). Alternative 5 excludes aquatic application of herbicide for the treatment of aquatic invasive noxious plants species.

3.5.5.6.1. Direct and Indirect Effects

The direct and indirect effects as implemented by Alternative 5 would be the same as those disclosed under Alternative 3, the Proposed Action, with the exception that there would be no herbicide treatment of aquatic invasive plants. There would be no difference in environmental consequences to Sensitive plant populations between Alternative 3 and Alternative 5 as there are no aquatic Sensitive plant species listed for the BNF or the SNF. However, this alternative eliminates a tool to be used to implement a rapid response strategy if an aquatic invasive species is found to occupy waters within the Forests, therefore subjecting the Forests to potential aquatic invasive species invasion.

No irreversible or irretrievable uses of resources are associated with Alternative 5. Implementation of Alternative 5 would contribute to restoration of native or desirable vegetation in areas where nonnative, invasive plant species have established. Invasive plant treatments as described in accordance with Alternative 5 could have relatively short-lived detrimental effects and long-term beneficial effects. Detrimental effects to Sensitive plants would be minimized through the implementation of the design criteria.

Implementation of Alternative 5 would be beneficial overall since it a) would permit the use of new, less toxic, and more selective herbicides, and b) would permit the use of aerial application on invasive plant infestations that are at present uncontrolled or poorly controlled. In the long term, preventing invasive plants from spreading into presently uninfested areas, slowing the rate of spread of existing infestations, and reducing the density of invasive plants in existing infestations would prove beneficial to sensitive plants.

Sensitive plant species may be impacted by herbicide and mechanical invasive plant control measures: individual plants or small groups could be damaged or killed, especially young plants that are difficult to detect. However, adverse effects on populations would be negligible. Implementation of Alternative 5 would not contribute to a downward trend in populations or habitat quality for any sensitive plant species nor would it lead to listing under the ESA. Table 3-66 (above) displays the determination of effects to habitat and sensitive plant populations (by Sensitive plant species) as a result of implementing Alternative 5.

3.5.5.6.2. Cumulative Effects

The direct, indirect, and cumulative effects as implemented by Alternative 5 (the No Aquatic Herbicide Application Alternative) would be the same as those disclosed under Alternative 3 (Proposed Action).

3.5.5.7. Conclusions about Alternative Effects and Forest Plan Consistency

The No Action Alternative would result in the expansion of noxious weeds across 5% to 24% of the project area over the next 10 years. This could affect as many as 1.03 million acres, reducing native vegetation vigor and increasing the risk of extirpation to special status plants from the project area.

The No Action Alternative moves forest health, diversity, and resiliency away from Forest Plan desired conditions. It does not comply with laws, regulation, and Forest Service policy. By choosing no action, the Forest Service would lose the benefit from past-year treatments. At any time if weed management was to be reinstated into the project area, a more aggressive and ambitious use of weed control would be required to get back to the current condition, as described in section 3.5.4, for native vegetation and special status plants. This would require a large expenditure of money and resources and may not ever be achievable due to resource scarcity.

Implementation of Alternative 1 would reduce pollinator habitat, degrade native vegetation, and potentially impact individual special status plants and their habitats. This would occur both in the short term and in the long term.

The action alternatives (Alternatives 2 through 5) comply with laws, regulations, and policy. These alternatives adhere to Forest Plan standards and guidelines and would aid forest health, diversity, and resiliency in moving toward desired conditions. Alternative 3 provides the greatest advantage in treating noxious weeds, as it has the largest toolbox by allowing for aerial and aquatic herbicide applications. Alternative 2 would be the most limiting of the action alternatives, as it proposes the use of fewer herbicides and fewer acres of treatment by biocontrols, herbicides, and mechanical. Alternative 5 would be more beneficial than Alternative 4, as aerial application of herbicide allows for treating large and remote areas more effectively than through ground-based application methods; however, with this increase in benefit, the risk to nontarget species also increases.

The impacts to special status plants and native vegetation from the action alternatives (Alternatives 2, 3, 4, and 5) would be negative in the short term but beneficial in the long term. However, design criteria have been put in place to reduce risk and protect individual special status plants and their habitats. In general, all action alternatives may impact individuals and habitat in the short term but would have beneficial impacts to special status plant populations and

their habitats in the long run (Table 3-70). This is due to the risk of individual mortality to special status plants and nontarget plants in their habitats.

Based on information in the risk assessments, herbicides would pose risks to terrestrial special status plant species under direct spray and off-site drift scenarios. The greatest risks to terrestrial special status plants from off-site drift would be associated with aerial applications (Alternatives 3 and 5).

Accidental direct spray or spill could result in harm to aquatic special status plant species. Off-site drift would not be expected to harm sensitive aquatic plants, assuming the design feature buffers around aquatic habitats are followed. Adverse effects to terrestrial special status plant species should not occur as a result of surface runoff.

Low risks to pollinators were predicted under scenarios involving direct spray. Design features used to protect rare plants would also help prevent harm to insects in the vicinity. Effects to pollinators would be short term, and population-level effects are not anticipated when these types of management practices are incorporated into the project design when rare plants are present.

Of the 3 proposed control methods, herbicide application poses the greatest risk to individuals and nontarget individuals. However, design criteria have been put in place to reduce risk and protect individual special status plants and their habitats.

Table 3-70. Treatment method effect on Region 4 sensitive plants

Measurement Indicator	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
No Action	MIIH	N/A	N/A	N/A	N/A
Biological Control	N/A	NII	NII	NII	NII
Herbicide Application	N/A	MIIH/BIH	MIIH/BIH	MIIH/BIH	MIIH/BIH
Mechanical Control	N/A	MIIH	MIIH	MIIH	MIIH
Cumulative Impacts	MIIH	MIIH/BIH	MIIH/BIH	MIIH/BIH	MIIH/BIH

Note: NII: No impact to individuals; BIH: Beneficially impact habitat; MIIH: May impact individuals and habitat.

3.6. Human Health

Human Health Summary: Alternative 1 would pose no human health risk from exposure to herbicides or other treatment methods because no invasive plant control activities would be initiated. Under this alternative, invasive plants would continue to spread on both Forests, which could impact individuals sensitive to invasive plant allergens. Because no invasive plant treatments would occur, no need exists for design criteria to protect human health.

Of the 14 herbicides proposed for use in the action alternatives, 9 did not have any scenarios involving workers that exceeded the LOC. Out of the 5 herbicides with scenarios exceeding the HQ LOC for workers at some rate of application, 4—chlorsulfuron, dicamba, sulfometuron-methyl, and triclopyr—did not exceed any LOC at typical application rates. However, 1—2,4-D amine—exceeded the chronic exposure LOC at typical application rates.

Design criteria minimize all worker exposure scenarios by following safe work practices and label advisories. The general public would not be exposed to harmful levels of any herbicides used in the implementation of this project. Few plausible scenarios exist that exceed even the most conservative threshold of concern for public health and safety.

3.6.1. Introduction

This section analyzes the potential for adverse health effects to workers and members of the public resulting from implementation of the alternatives from both the impacts of invasive plants and the impacts of invasive plant control on humans. This includes treatment of invasive plants using herbicides, mechanical methods, and biological control agents.

During scoping, commenters brought up concerns about the effects of herbicides on human health. While herbicides can be associated with human health hazards, the likelihood of harmful exposures under this project is very low. Workers and the public may be exposed to herbicides used to treat invasive plants under the proposed action alternative in this project; however, no exposure scenarios exceeding a threshold of concern are anticipated.

Design criteria were developed to minimize or eliminate exposures of concern to workers and the public. The design criteria include aspects such as stringent safety measures, use of personal protective equipment, selective application methods, and public notification of treatment activities which are planned to avoid exposures at levels that could be of concern to workers and the public.

3.6.2. Methodology for Analysis

Risk assessments are a qualitative evaluation of the probability that the use of an herbicide may pose a risk to human health or the environment (FSM 2150.5). The ForestService used the SERA risk assessments to evaluate human health and ecological effects of herbicides using EPA studies and other peer-reviewed articles from the open scientific literature. The risk assessments contain:

- Hazard Characterization—What are the dangers inherent with the active ingredient?
- Exposure Assessment—Who could come into contact and how much?

- Dose Response Assessment—How much is too much?
- Risk Characterization—Indicates whether or not there is a plausible basis for concern.

In addition to the analysis of potential hazards to human health from the active ingredients in the herbicides, SERA risk assessments evaluated available scientific studies of potential hazards of other substances associated with herbicide applications: impurities, metabolites, inert ingredients, and adjuvants. There is usually less toxicity data available for these substances (compared to the herbicide active ingredient) because they are not subject to the extensive testing that is required for the herbicide active ingredients under the FIFRA.

The risk assessments considered worst-case scenarios, including accidental exposures and applications at maximum label rates. Although these risk assessments have limitations (see discussion below), they represent the best science available. The risk assessment methodologies and detailed analyses are incorporated into conclusions about herbicide toxicity in this document.

3.6.2.1. Exposure Scenarios

For each human health assessment in a risk assessment, researchers analyze a set of general exposure scenarios based on the low, typical, and maximum label rates of the herbicides. For workers, exposure analyses are based on application method, application rate, and acres treated. For the public, general exposure scenarios include coming into contact with sprayed vegetation and consumption of contaminated fruit, fish, or water.

Accidental exposure scenarios were designed to be intentionally extreme. The worker exposure scenarios involved immersion of the hands for a 1-minute period and the wearing of contaminated gloves for an hour, at varying application rates; however, for all herbicides and surfactants, the amount of plausible worker exposure was below the LOC, for all application methods.

For the general public, accidental exposures are evaluated in 3 scenarios: a naked child is sprayed directly with an herbicide as it is applied and no steps are taken to remove the pesticide from the child for 1 hour; a woman of childbearing age is accidentally sprayed on her feet and legs and no attempt is made to remove the pesticide for 1 hour; and an accidental spill into a small pond occurs, where a young child consumes 1 liter of contaminated water soon after. The plausibility of these scenarios is very low; ideally, trained applicators practice proper hygiene and would never spray a person (e.g., the naked child and woman’s legs) and, in the event of a pond spill, precautions would be taken to prevent public access following the spill, thus reducing the chances of, for example, water consumption and fishing.

The estimates of longer-term general exposure via consumption of contaminated water are based on estimated application rates and monitoring studies that can be used to relate levels in ambient water to treatment rates in a watershed. In most herbicide applications, however, substantial proportions of a watershed are not likely to be treated.

The exposure scenarios based on longer-term consumption of contaminated vegetation assume that an area of edible plants is inadvertently sprayed and these plants are consumed by an individual over a 90-day period. Wild foods commonly gathered by the public, such as huckleberries, occur incidentally on some portions of the Forest in areas that do not tend to have high densities of invasive plants. Several exposure scenarios for recreational and

subsistence fish consumption were considered in the SERA risk assessments; none are near any herbicide exposure LOC (SERA 2009b).

In 2007, the EPA released a draft list of 73 pesticides, based on the high potential for human exposure, to be tested for the potential to cause endocrine disruption. Glyphosate is the only herbicide included in the EPA draft list that is considered for use within the project area; glyphosate was studied by SERA in 2011 (SERA 2011a).

The quantitative risk characterization for human health and ecological effects is expressed as the HQ. For workers and members of the general public, the RfD of 2 milligrams acid equivalent (mg a.e.)/kilogram body weight (kg bw)/day is used to characterize risks associated with acute and longer-term exposure levels. All exposure assessments are based on the unit application rate of 1 pound a.e./acre. Based on the HQ method, concern for workers is minimal. At the highest labeled application rate for terrestrial applications (about 8 pounds a.e./acre), the highest HQ is 0.6, which is the upper bound of the HQ for workers involved in ground broadcast applications.

3.6.2.2. Primary Sources Informing the Analysis

The Forest Service contracted with SERA to evaluate human health and ecological effects of herbicides using EPA studies and other peer-reviewed articles from the open scientific literature. Laboratory and field studies surrounding herbicide toxicity, exposure, and environmental fate were used to estimate the risk of adverse effects to nontarget terrestrial and aquatic organisms, human, water, and soil.

3.6.2.3. Analysis Area

The analysis area for direct and indirect effects is the nonwilderness portion of the BNF and the entire SNF. Cumulative effects will be addressed at a District-wide level in order to include Cooperative Weed Management Area (CWMA) activities.

3.6.2.4. Measurement Indicators

Issue: Exposure to herbicides may affect human health due to herbicide toxicity.

Measurement Indicators:

- Toxicity potential of herbicides being used
- Adequacy of design criteria to protect human health

3.6.3. Compliance with Forest Plan and Other Relevant Direction

Safety standards for herbicide use are set by the U.S. EPA, Occupational Health and Safety Administration, Code of Federal Regulations (40 CFR, Part 170), and individual States.

The FIFRA established the U.S. system of pesticide regulation to protect applicators, consumers, and the environment. The Forest Service is authorized by FIFRA and by the Cooperative Forestry Assistance Act to use pesticides for multiple-use resource management and maintenance of the quality of the environment, as long as the actions comply with the NEPA and the CEQ regulations. In addition, several sections of the FSM and Forest Service

Handbook (FSH) (FSM 2150; FSM 2150, R4 supplement; FSH 2109.14; FSM 6709.11) provide guidance to the safe handling and application of herbicides.

Although several standards and guidelines exist addressing public health relative to facilities, recreation activities, roads, wildfire, and so forth, both the BNF Forest Plan (USDA Forest Service 2010a) and the Sawtooth Forest Plan (USDA Forest Service 2012a) are silent regarding human health standards and guidelines specific to herbicide use.

The action alternatives comply with standards and guidelines specific to nonnative plant management; Alternative 1 does not comply with the Forest Plans. The design criteria developed for all treatment methods, the herbicides analyzed, and the application methods proposed under all action alternatives comply with FSM and FSH (FSM 2150; FSM 2150, R4 supplement; FSH 2109.14; FSM 6709.11) and FIFRA safety standard guidelines.

3.6.4. Affected Environment

3.6.4.1. Potential Human Health Effects from Invasive Plants

Some invasive plants found in the project area contain compounds that can cause allergic reactions; others have spines, prickles, or sharp leaf margins that can cause scrapes, cuts, or skin irritation. Individuals who are allergic to plants may suffer symptoms ranging from mild congestion, rashes, and localized itching to severe breathing difficulty or even anaphylaxis.

Approximately 18% to 20% of the U.S. population exhibits symptoms of allergic rhinitis or hay fever. Knapweed pollen is a common but powerful allergen that peaks in late July to early August. It can trigger severe reactions in sensitive individuals (Duncan and Clark 2005).

Leafy spurge contains a toxic compound in its milky latex which can cause primary chemical irritation, resulting in dermatitis and causing blisters and inflammation (Webster 1986). If leafy spurge sap gets into the eye, it can cause inflammation of the cornea and result in sight-threatening complications (Eke 1997). The sap of spotted knapweed may also cause skin irritation. People coming into contact with weeds (generally from pulling them) are advised to wear gloves to protect against injury and reduce contact with compounds in the plants.

3.6.4.2. Potential Human Health Effects from Biological Treatments

Biological treatments would result in no known risks to human health.

3.6.4.3. Potential Human Health Effects from Chemical Treatments

Toxicity tests required by the EPA for pesticide registration include acute (short-term) or chronic (longer-term) exposures. Herbicides are subjected to long-term animal studies that test for effects and compliance with federal safety standards for human health. Table 3-71 displays EPA toxicity categories.

Table 3-71. Environmental Protection Agency toxicity categories

Toxicity Category	Signal Word	Toxicity Classification	Oral (mg/kg)	Dermal (mg/kg)	Inhalation (mg/L)	Eye Irritation	Skin Irritation
I	DANGER Poison	High	0–50	0–200	0–0.2	Corrosive: corneal opacity not reversible within 7 days	Corrosive
II	WARNING	Moderate	>50–500	>200–2,000	>0.2–2.0	Corneal opacity reversible within 7 days; irritation persisting for 7 days	Severe irritation at 72 hours
III	CAUTION	Low	>500–5,000	>2,000–20,000	>2.0–20	No corneal opacity; irritation reversible within 7 days	Moderate irritation at 72 hours
IV	NONE	Very Low	>5,000	>20,000	>20	No irritation	Mild or slight irritation at 72 hours

Source: EPA 2012a

During the herbicide registration process, the EPA evaluates carcinogenicity, teratology (birth defects), endocrine-system disruption, and mutagenicity studies of herbicide effects to animals. The study data are used to make inferences relative to human health. Table 3-72 displays the categories under human hazards based on acute toxicity for assessed herbicides, while Table 3-73 displays human hazards based on chronic toxicity for assessed herbicides. Data are from the respective SERA reports, NPIC (2002), Gervais et al. (2008), Henderson et al. (2010), and Bunch et al. (2012).

Table 3-72. Human hazards based on acute toxicity categories

Herbicide	Acute Oral Toxicity	Acute Dermal Toxicity	Acute Inhalation Toxicity	Primary Eye Irritation	Primary Skin Irritation
2,4-D amine	Moderate	Moderate	Low	High	Very Low
Aminopyralid	Very Low	Very Low	Very Low	Very Low	Very Low
Chlorsulfuron	Very Low	Low	Low	Low	Very Low
Clopyralid	Low[a]	Low	Low	Moderate	Very Low
Dicamba	Low	Low	Very Low	Moderate	Moderate
Fluroxypyr	Low	Low	Very Low	Moderate	Low
Glyphosate	Low	Low	Low	Low	Very Low
Imazamox	Very Low	Very Low	Very Low	Moderate/ Very Low[b]	Very Low
Imazapic	Very Low	Very Low	Low	Low	Very Low
Imazapyr	Very Low	Very Low	Low	Low	Very Low
Metsulfuron-methyl	Very Low	Low	Moderate	Low	Low
Picloram	Low	Low	High	Low	Very Low
Sulfometuron-methyl	Very Low	Very Low	Low	Low	Low
Triclopyr TEA	Low	Low	Low	High	Low

[a] Low for technical grade, which is not used by the Forest Service; very low for formulation used by the Forest Service.
[b] Moderate for technical grade; very low for formulation used by the Forest Service.

Table 3-73. Human hazards based on chronic toxicity categories

Herbicide	Carcinogen	Teratogen	Reproductive	Mutagen	Endocrine Disruptor
2,4-D amine	Not Classifiable	Unlikely	Unlikely	Unlikely	Unknown
Aminopyralid	Not Likely to Be Carcinogenic	No Effects	No Effects	No Effects	No Evidence
Chlorsulfuron	Evidence of Noncarcinogenicity	No Effects	No Evidence	No Effects	No Evidence
Clopyralid	Evidence of Noncarcinogenicity	No Effects	No Effects	No Effects	No Evidence
Dicamba	Not Classifiable	Unlikely	No Effects	No Effects	No Information
Fluroxypyr	Not Likely to Be Carcinogenic	No Effects	No Effects	No Effects	No Evidence
Glyphosate	Evidence of Noncarcinogenicity	Unlikely	Unlikely	No Effects	Unlikely
Imazamox	Not Likely to Be Carcinogenic	No Effects	No Effects	No Effects	No Evidence
Imazapic	Evidence of Noncarcinogenicity	No Effects	No Effects	No Effects	No Evidence
Imazapyr	Evidence of Noncarcinogenicity	No Effects	No Effects	No Effects	No Evidence
Metsulfuron-methyl	Not Likely to Be Carcinogenic	No Effects	No Effects	No Effects	No Evidence
Picloram	Evidence of Noncarcinogenicity	No Effects	No Effects	No Effects	No Effects
Sulfometuron-methyl	No Evidence of Carcinogenic Activity	Unlikely	Unlikely	No Effects	No Evidence
Triclopyr TEA	Not Classifiable	No Effects	No Effects	No Effects	No Evidence

Note: Not Classifiable = Inadequate evidence of carcinogenicity or for which no data are available; Unlikely = Inconsistent or isolated effects have been shown in laboratory tests; not considered a hazard to humans at expected exposure levels; Unknown = Laboratory tests are inconclusive or further testing is required; No Effects = No effects have been shown in laboratory tests; not considered a hazard to humans.

All herbicide applicators must follow the label directions for application rate and usage. The herbicide label is the primary communication for safe handling and use of the product. The label reflects the numerous scientific studies and regulatory reviews generated by the EPA registration process, which provides reasonable assurance that the potential benefits of use outweigh any potential risks—that, when used according to label directions, the herbicide will not cause unreasonably adverse effects on humans, fish, and wildlife, or on the environment. The law requires herbicide users to read and follow label specifications. FIFRA, as currently amended, allows use of an herbicide at rates up to those approved on the label.

In addition to following label directions, the Forest Service requires an additional level of risk assessment. The inherent hazard (toxicity) of the herbicide, an estimate of exposure, and the response of the individual organism under consideration to that exposure (dose–response) are modeled to generate an estimate of risk (HQ) for each scenario. The herbicides in this analysis are evaluated based on the HQ, which is the ratio between the estimated dose (the amount of herbicide received from a particular exposure scenario) and the RfD. When a predicted dose is less than the RfD, and the HQ (estimated dose/RfD) is less than 1.0, which is below the LOC, then significant toxic effects are unlikely for that specific herbicide application. Table 3-74 displays where HQs were exceeded.

Table 3-74. Scenarios in which hazard quotients were exceeded

Herbicide	Workers—Acute	Workers—Chronic	Public—Acute	Public—Chronic
2,4-D amine	Yes	Yes	Yes	Yes
Aminopyralid	No	No	No	No
Chlorsulfuron	No	Yes	Yes	No
Clopyralid	No	No	Yes	No
Dicamba	Yes	No	Yes	Yes
Fluroxypyr	No	No	No	No
Glyphosate	No	No	Yes	No
Imazamox	No	No	No	No
Imazapic	No	No	Yes	No
Imazapyr	No	No	No	No
Metsulfuron-methyl	No	No	No	No
Picloram	No	No	No	Yes
Sulfometuron-methyl	No	Yes	No	No
Triclopyr TEA	Yes	Yes	No	Yes

In the 3 instances where the Worker exposure exceeded the HQ, the typical application rates were exceeded. As previously described for the general public scenario, they are designed to be extreme and are implausible. In all cases, the HQ was exceeded under these scenarios: a naked child is sprayed directly with an herbicide as it is applied and no steps are taken to remove the pesticide from the child for 1 hour; a woman of childbearing age is accidentally sprayed on her feet and legs and no attempt is made to remove the pesticide for 1 hour; and an accidental spill into a small pond occurs, where a young child consumes 1 liter of contaminated water soon after.

Potential techniques for minimizing human exposures to herbicides include selecting herbicides with low toxicity and using them at the lowest effective application rate to achieve the project's objective; using application methods that minimize off-target movement and nontarget exposures; for streams, using buffer areas for certain herbicides; providing personal protective equipment for applicators; and posting signs at treated areas to inform the public. Under all alternatives, treatments would be accomplished according to strict safety and health standards as required by EPA pesticide regulations, which are rendered on herbicide labels through the instructions for appropriate use.

Chronic toxicity results from repeated exposures or prolonged or continuous exposure to a chemical, typically at levels lower than those causing acute toxicity. Chronic toxicity often demonstrates a delayed response. Public concerns toward herbicides generally focus on potential chronic toxicity. Sublethal poisoning or exposure may be expressed by any of the

following: skin/eye irritations; nervous system disorders; reproduction system disorders; damage to other organ systems (e.g., liver, kidney, lungs); birth defects; mutations; and cancer.

3.6.4.3.1. Active Ingredients

2,4-D Amine

2,4-D, the common name for 2,4-dichlorophenoxyacetic acid, is a selective systemic herbicide used to control broadleaf weeds. In the risk assessment, 2 acute RfDs were used—one for reproductive-age females derived from the basis of maternal toxicity (0.025 mg/kg/day), and one for male workers (0.067 mg/kg/day). The chronic RfD was the same for female and male workers (0.005 mg/kg/day). For workers, HQs could be exceeded in both acute and chronic scenarios (Table 3-74) potentially resulting in adverse health outcomes. For chronic exposure, at the typical application rate of 1 pound a.e./acre, HQs for backpack and aerial spray methods would be 16 and ground broadcast would be 30. The acute accidental scenarios of wearing contaminated gloves for 1 hour at all application rates and wearing contaminated gloves for 1 minute at the highest application rate resulted in HQ exceedances of 15 to 94. The accidental spill on the lower legs at a high application rate (4 pounds a.e./acre) also exceeded the HQ, by 1.8 (i.e., the HQ was 2.8). The magnitude of the HQ is linearly related to the application rate.

For scenarios involving the public, HQs for both chronic and acute scenarios were exceeded (Table 3-74). For acute accidental exposures, researchers projected that the naked child scenario HQ would be exceeded, by 3 at the lowest application rate (0.5 pound a.e./acre) to 28 at the highest application rate. For consumption of contaminated water by a child, HQs were exceeded by 41, 82, and 328 for the lowest, typical, and highest application rates. The other acute scenarios that exceeded HQs were those of an adult female eating contaminated fruit (4, 7, and 30 at the lowest, typical, and highest application rates) and vegetation (27, 54, and 216, respectively). Regarding chronic exposure, the scenario for consumption of vegetation over the long term showed plausible adverse health effects: the HQ exceedances would be 19, 38, and 152 at the lowest, typical, and highest application rates (USDA Forest Service 2006).

Subgroups sensitive to 2,4-D amine exposure are children, especially those who are malnourished; women who are pregnant or who could become pregnant; immune-compromised individuals; and individuals with diseases affecting the integrity of the cell membrane. In addition, sunscreens can increase the absorption of 2,4-D into the skin (USDA Forest Service 2006).

Aminopyralid

No exposure scenarios for workers, neither acute nor chronic, exceeded the RfD (Table 3-74). The HQs for all application methods were below the LOC, by factors of 33 to 200.

For chronic public exposure scenarios, HQs at the highest application rates were below the LOC, by factors of 100 to 125,000. Acute exposures for consumption of contaminated produce were below the LOC by factors of 10 to 50, and nonaccidental exposures involving contaminated water were below the LOC by factors of 50 to 500. The accidental exposure

scenario of a child consuming contaminated water resulted in an HQ of 0.6, which is below the LOC.

No information suggests any specific groups or individuals may be sensitive to the systemic effects of aminopyralid. Aminopyralid is a relatively new herbicide, and available information is limited to studies required for pesticide registration. However, nothing has raised substantial concern. Risks to the public or workers are not anticipated resulting from the application of aminopyralid (SERA 2007a).

Chlorsulfuron

Regarding chronic exposure for workers, the upper range of the HQs was below the LOC for all backpack and aerial applications, although it was somewhat above the LOC for ground broadcast at the maximum label application rate. No acute accidental scenarios resulted in an HQ exceeding the LOC (Table 3-74).

As for public exposure, the only scenario to slightly exceed the LOC was water consumption after an accidental spill of a large amount of chlorsulfuron into a small pond. This scenario assumes that an adult consumes contaminated ambient water from a contaminated pond for a lifetime which is not a plausible scenario. No other scenario, neither acute nor chronic, exceeded the HQs (Table 3-74). For both workers and members of the general public, typical exposures to chlorsulfuron do not lead to estimated doses that exceed a LOC. (SERA 2004)

No information exists to suggest that specific subgroups or individuals may be sensitive to this chemical. In addition, no data exist to assess if chlorsulfuron would interact synergistically or antagonistically with any other herbicide. No additives in chlorsulfuron formulations are classified as toxic. There is no indication that repeated exposures would exceed a toxicity threshold (SERA 2004a).

Clopyralid

For workers, none of the acute or chronic exposure scenarios exceeded the HQ LOC at any application rate (Table 3-74).

Regarding public exposure, the only scenario to slightly exceed the LOC was the consumption of water by a small child after an accidental spill of a large amount of clopyralid into a small pond. No other scenario, acute or chronic, exceeded the HQs (Table 3-74). All of the anticipated exposures for workers are below the acute RfD for acute exposures and below the chronic RfD for chronic exposures. For members of the general public, none of the longer-term exposure scenarios approach a LOC and none of the acute/accidental scenarios exceed a LOC, based on central estimates of exposure (with the exception of the contaminated water consumption). The use of clopyralid does not appear to pose any risk of systemic toxic effects to workers (or to the general public) in Forest Service programs.

No information suggests specific subgroups or individuals may be sensitive to this chemical. It is unclear as to whether individuals with preexisting diseases of the kidney, liver, or blood would be particularly sensitive to clopyralid exposure; however, individuals with any severe disease may be considered more sensitive to any chemical exposure. No data exist for assessing whether or not clopyralid would interact synergistically or antagonistically with

any other herbicide. No additives in clopyralid formulations are classified as toxic. There is no indication that repeated exposures would exceed a toxicity threshold (SERA 2004b).

Dicamba

At the typical application rate for ground-based broadcast applications (0.3 pound a.e./acre), the upper range of the HQ for chronic exposure was reached, but not exceeded. For backpack and aerial applications, the LOC was exceeded at application rates over 0.6 pound/acre. At typical application rates, no accidental acute exposure exceeded the LOC; however, at the maximum application rate (2 pounds/acre), workers would be exposed to levels of dicamba considered unacceptable, although it is uncertain as to whether noticeable effects would occur.

Regarding the acute accidental exposure scenarios for the public, at typical and above application rates, the naked child scenario and the consumption of contaminated water after a spill exceeded the LOC for the HQs (Table 3-74). At the highest application rate, the acute scenarios of the sprayed lower legs of the woman, the consumption of fruit, and the consumption of fish by subsistence populations all exceeded the LOC. None of the chronic exposure scenarios at the typical application rate exceeded the LOC (Table 3-74). At the highest application rate, the LOC was exceeded for the consumption of contaminated vegetation.

The only sensitive subgroup identified for dicamba was children. The scenarios analyzed included effects on children. No evidence exists that dicamba interacts with other compounds (SERA 2004c).

Fluroxypyr

All exposure assessments were based on the application of Vista XRT at the maximum application rate of 0.5 pound a.e./acre. For workers, in terms of general exposures—i.e., daily exposure levels anticipated during a prolonged application program—the HQs ranged from 0.0001 (aerial spray) to 0.08 (ground broadcast spray), which are below the LOC (1.0) by factors ranging from 12.5 to 10,000. Thus, under normal conditions and even at the highest application rate, exposure levels of fluroxypyr (which is formulated as fluroxypyr-MHE) were substantially below the LOC (Table 3-74).

The risk characterizations for all nonaccidental exposure scenarios were easily interpreted and no basis found for assuming plausible risks to the general public (Table 3-74). The upper bound of the highest HQ for longer-term exposure scenarios was 0.06 (the longer-term consumption of contaminated vegetation), which is below the LOC by a factor of about 16. The upper-bound HQ values for the other longer-term exposure scenarios were associated with upper-bound HQs of 0.00002 to 0.009, which are below the LOC by factors of about 100 to 50,000.

Under normal conditions of use, fluroxypyr is not expected to cause adverse human health effects. All of the accidental exposure scenarios were intentionally extreme. Nonetheless, only 2 exposure scenarios resulted in upper-bound HQ values exceeding the LOC—i.e., the consumption of contaminated water by a child after an accidental spill, with HQ values of 0.3 (0.02–1.7), and the consumption of fish by subsistence populations after an accidental spill, with HQ values of 1.0 (0.1–3.0). In the event of an accidental spill of a fluroxypyr

formulation into a small pond, measures should be taken to limit or mitigate potential exposures to members of the general public. Such mitigation measures would be standard practice in any properly conducted pesticide application (SERA 2009a).

Glyphosate

For workers, the accidental acute exposure scenario was below the HQ LOC by a factor greater than 300; for chronic exposures, all HQs were below the LOC (Table 3-74). To reach the LOC (HQ = 1.0) for aquatic applications, a worker would have to treat more than 250 acres in a single day (nonaerial), which is not plausible.

For the public, the acute exposure scenario of eating contaminated produce applied at the rate of 8 pounds/acre would result in an HQ of 5.6 (Table 3-74). No basis exists for asserting the dose related to that exposure level would result in gross signs of toxicity or lethality, but the level may raise concerns for adverse health effects in pregnant women. This is not a plausible exposure scenario for the applications being analyzed, however, since food crops are not being treated. Aquatic applications all saw HQs below the LOC, by a factor of 100.

Glyphosate breaks down into a metabolite and impurities. The metabolite present in the formulations used by the Forest Service is aminomethylphosphonic acid (AMPA). Existing glyphosate toxicity data encompass mammalian exposures to this metabolite. As far as concerns of AMPA as an environmental metabolite, it has been determined by the EPA that it is of no toxicological concern. Glyphosate contains N-nitrosoglyphosate (NGN) as an impurity. The EPA has concluded that the NNG present in glyphosate is not toxicologically significant (SERA 2011a).

Glyphosate inhibits some cytochrome P450 isozymes (aromatase). Inhibiting these enzymes could enhance or diminish the toxicity of other compounds, depending on whether metabolism increases or decreases toxicity of those compounds (SERA 2011a). The impact of an added surfactant for aquatic applications is directly proportional to the surfactant's toxicity and concentration. Using lower application rates while keeping the concentration of the surfactant constant would decrease the impact of the surfactant relative to high application volumes (SERA 2011a).

The International Agency for Research on Cancer (IARC) determined glyphosate should be classified as "possibly carcinogenic to humans" based on reviews of existing studies rather than new research (Guyton et al. 2015). In 1991, the EPA concluded that glyphosate had "evidence of non-carcinogenicity" (Table 3-73), based on a lack of evidence to the contrary and on the criteria used by the EPA for classifying a carcinogen. The Forest Service defers to the EPA in cases such as this. A new risk assessment is expected later this year; if the EPA adopts the IARC recommendation and reclassifies glyphosate, then the Forest Service would consider updating their risk assessments, and the reclassification would be considered "new information" for the purposes of NEPA (Bakke 2015).

Imazamox

No exposure scenarios for workers or the public resulted in an HQ that exceeded or approached a LOC (Table 3-74). The use of imazamox is not likely to possess any identifiable risks to humans (SERA 2010).

In terms of the human health risk assessment imazamox does not appear to cause detectable signs of toxicity in mammals even at very high doses. No remarkable signs of toxicity are reported in standard toxicity studies involving dermal, ocular, or inhalation exposure. Most of the occupational exposure scenarios and many of the exposure scenarios for the general public involve the dermal route of exposure. For some compounds, acute dermal and oral LD50 values can be used to assess the plausibility of the estimated dermal absorption rates relative to oral absorption rates. This is not possible for imazamox due to its low toxicity which resulted in a lack of definitive LD50 values in the acute oral toxicity studies and acute dermal toxicity studies.

Imazapic

The worker exposure scenarios, both acute and chronic, did not result in HQs exceeding a LOC (Table 3-74). A LOC could, however, be reached by wearing contaminated gloves at the maximum application rate for a longer period of time than the scenarios called for. Imazapic is also mildly irritating to the eyes. These effects are mitigated by wearing proper personal protective equipment and following proper handling practices. For the public, none of the long-term exposure scenarios resulted in an HQ exceeding the LOC (Table 3-74). For acute accidental scenarios, the only one reaching a LOC was the drinking of contaminated water by a small child after a spill into a small pond. No information suggests that specific groups or individuals may be especially sensitive to systemic effects of imazapic (SERA 2004d).

Imazapyr

No exposure scenarios for workers or the public resulted in an HQ that exceeded or approached a LOC (Table 3-74). The use of imazapyr is not likely to possess any identifiable risks to humans (SERA 2011b).

Metsulfuron-methyl

No exposure scenarios for workers or the public resulted in an HQ that exceeded or approached a LOC (Table 3-74). No information suggests that specific groups or individuals may be especially sensitive to systemic effects of metsulfuron-methyl (SERA 2004e).

Picloram

For workers, none of the acute or chronic exposure scenarios exceeded the HQ LOC at any application rate (Table 3-74).

Regarding public exposure, the only scenario resulting in an HQ greater than 1.0 was the long-term consumption of contaminated vegetation at the maximum application rate of 1 pound a.e./acre (Table 3-74). This scenario is unlikely, especially since vegetation would exhibit visible damage after being sprayed with picloram.

No information suggests that specific subgroups or individuals may be sensitive to this chemical. One study implicated 2,4-D in combination with picloram; this combination may cause reproductive impairment in mice. Another study indicated a commercial mixture of picloram and 2,4-D might negatively affect immune function in rats; however, the study did not allow for an evaluation of any potential interactions between picloram and 2,4-D

(SERA 2011c). It should be noted that a formulation of 2, 4-D in combination with picloram is not used in Forest Service programs.

Sulfometuron-methyl

At the typical application rate (0.045 pound/acre), no acute or chronic scenarios exceeded the LOC for workers (Table 3-74). At the maximum label application rate, backpack, ground broadcast, and aerial application methods all slightly exceeded the LOC for chronic exposure (Table 3-74). If the assumptions (i.e., highest application rate, highest number of acres treated per day, and hygiene practices utilized) had been changed, there still would be no indication of workers at risk of sustaining systemic toxic effects. No accidental acute scenarios exceeded the LOC at the highest application rate.

None of the acute or chronic scenarios involving the public resulted in an exceedance of the LOC at any application rate (Table 3-74).

No sensitive subgroups have been identified; however, speculation exists that individuals with existing thyroid dysfunction could be at increased risk. No evidence indicates sulfometuron-methyl would interact synergistically or antagonistically with any other herbicide (SERA 2004f).

Triclopyr TEA

For workers, none of the acute exposure scenarios exceeded the HQ LOC at the typical application rate (1 pound a.e./acre) (Table 3-74). At the application rate of 1 pound a.e./acre and typical conditions of application, no indication existed that workers would be subjected to hazardous levels of triclopyr TEA at central estimates of exposure. At the upper ranges of exposure, however, the LOC was exceeded. At the application rate of 6 pounds a.e./acre, the LOC for chronic exposure was exceeded for all terrestrial application methods (Table 3-74). None of the accidental exposure scenarios exceeded the LOC at the typical application (1 pound a.e./acre) or the high application (6 pounds a.e./acre) rates. At the maximum label application rate (9 pounds a.e./acre), a rate that is rarely (if ever) used by the Forest Service, the accidental exposure scenario of wearing contaminated gloves for 1 hour would exceed the HQ LOC for female workers. No accidental exposure scenarios would exceed the LOC for male workers.

For the public exposure scenarios, the only acute scenario resulting in an exceedance (HQ = 27) of the LOC was a female of childbearing age eating contaminated vegetation after an application rate of 1 pound a.e./acre. Aquatic applications of triclopyr do not present identifiable risks to workers or the public. Identified sensitive subgroups are women of childbearing age; a risk of potential adverse reproductive outcomes exists in women exposed to amounts of triclopyr above the LOC. Individuals with kidney disease or those with multiple chemical sensitivity syndrome may be at higher risk; however, no literature supports this conclusion.

A major metabolite of triclopyr is 3,5,6-trichloro-2-pyridinol (TCP), which is toxic to mammals and other species. The HQs for TCP are similar to those for triclopyr: the exposure scenario of a female of childbearing age eating contaminated vegetation at the application rate of 1 pound a.e./acre would exceed the LOC, with the upper-bound acute HQs ranging from 2 to 15 (SERA 2011d).

Triclopyr is a relatively typical, weak-acid auxin herbicide. Aminopyralid, clopyralid, and picloram are similar in structure and in the way each chemical is absorbed, distributed, metabolized, and eliminated (as well as in toxicity); therefore, it is reasonably anticipated that exposure to triclopyr along with the aforementioned other weak-acid herbicides may result in additive risks (SERA 2011d).

3.6.4.3.2. Drift and Volatilization

Herbicides can move through the atmosphere via spray drift, which occurs during herbicide application, and by volatilization, which occurs after application. Volatility depends on the physical properties of the herbicide, primarily vapor pressure, while spray drift depends on the sprayer parameters, such as nozzle orifice size, boom height and pressure, and wind speed (Branham and Hanson 1987).

Volatilization is the conversion of a liquid or solid chemical to a gas. The amount of volatilization occurring depends on climactic and microclimatic conditions. Soil moisture is the primary environmental condition influencing the rate at which herbicides volatilize; in general, herbicides volatilize more rapidly from moist soils than from dry soils (Menalled and Dyer 2005). Volatilization also increases with higher air and soil temperatures and greater wind speed. Using surfactants can change the volatility of an herbicide (Lincoln County Weed Board unk.). Ester formulations of herbicides possess higher vapor pressures and volatilize more than amine formulations (Nice 2004). No ester formulations are proposed for use in this analysis.

Studies examining the risk to the public from pesticide volatilization have been conducted in residential areas near agricultural areas. The chemicals addressed in these studies do not include any that are reviewed in this analysis (Kegley et al. 2009).

Spray drift is the movement of the herbicide, generally via spray droplets, from the target area to an unintended area. Spray drift can be reduced by increasing droplet size. Droplet size can be reduced by reducing spray pressure, increasing nozzle orifice size, using drift reduction nozzles, utilizing rearward nozzle orientation during aerial applications, and adding adjuvants to the mixture. Other factors influencing spray drift are the method of application (drift is generally greater from mist blowers and aerial applications than from ground applications), the distance between the nozzle and the target (less distance reduces drift), wind direction and wind speed, air stability, and temperature and humidity (low humidity and high temperatures causes rapid evaporation, which reduces the size of droplets and increases drift). The influence of humidity and temperature is not always predictable, however (Dexter 1993).

Spray drift cannot be completely eliminated; however, with proper management, drift levels can be minimized to levels that do not cause harm (Felsot 2001). The methods to reduce drift potentials of herbicides considered for aerial application are discussed below.

Aminopyralid

For aerial applications, liquid formulations of aminopyralid are applied using specially designed spray nozzles and booms designed to reduce turbulence and maintain large droplet size to reduce drift (SERA 2007a). Applications may only be performed under favorable weather conditions, which include wind speeds between 2 and 10 mph and not during

temperature inversions. Aminopyralid should be applied at rates of no less than 2 gallons (mixed) per acre; 5 gallons or greater are recommended. If electrostatic spray systems are used, then aminopyralid can be applied at a rate of 1 gallon per acre (Dow AgroSciences 2007).

No worker or public exposure scenarios in the risk assessment exceeded the RfD; all were below the LOC, by factors of 33 to 200 (SERA 2007a).

Clopyralid

Clopyralid has been shown to have little potential for drift during aerial applications (DiTomaso et al. 2004). To reduce any possible drift, the label recommends using straight stream nozzles, spray booms no longer than three-fourths the length of the rotor, drift control systems, and drift control additives. Aerial applications should be conducted when wind velocity is low and not during temperature inversions (Dow AgroSciences 2011).

The only scenario found to slightly exceed the LOC was the consumption of water after an accidental spill of a large amount of clopyralid into a small pond. No other acute or chronic scenario, whether for workers or for the public, exceeded the HQs (SERA 2004b).

Imazapic

For Forest Service purposes, aerial applications for imazapic are to be conducted only by helicopter. Approximately 40 to 100 acres per hour may be treated. Liquid formulations are applied through specially designed spray nozzles and booms designed to reduce turbulence and maintain large droplet size to reduce drift (SERA 2004d). To additionally reduce or prevent drift, applications should not be performed in windy or gusty conditions (applications should occur when wind speeds are between 3 and 10 mph), high temperatures, low humidity, or temperature inversions (BASF 2011).

No worker or public exposure scenarios in the risk assessment exceeded the RfD; all were below the LOC, by a factor of at least 25 (SERA 2004d).

Picloram

For Forest Service purposes, aerial applications for picloram are to be conducted only by helicopter. Approximately 40 to 100 acres per hour may be treated. Liquid formulations are applied through specially designed spray nozzles and booms designed to reduce turbulence and maintain large droplet size to reduce drift (SERA 2011c).

One exposure scenario exceeded the HQ—that of a person eating contaminated vegetation over the long term. Aerial applications have the same exposure potential as backpack applications.

A study was done in the Missoula Valley modeling the buffer zones necessary to ensure that potential exposure to the public (and specifically children) would be well below any harmful levels. The simulation assumed a 10-mph wind for ground applications and a 6-mph wind for aerial applications. Table 3-75 illustrates the modeling results, which indicate that buffer zones resulting in no potential harm to a child were not substantial (Felsot 2001).

Table 3-75. Ground and aerial applications of clopyralid, 2,4-D amine, and picloram—recommended minimum buffer zones (feet)

Application Method	1 Spray Swath			20 Spray Swaths		
	Clopyralid	2,4-D Amine	Picloram	Clopyralid	2,4-D Amine	Picloram
Ground spray, low boom	0	5	0	0	5	0
Ground spray, high boom	0	15	0	0	30	0
Aerial spray, 10-ft release	—	—	—	0	N/A	0
Aerial spray, 25-ft release	—	—	—	0	N/A	0

Source: Felsot (2001)

3.6.4.3.3. Other Ingredients and Adjuvants

Inert (or "other") ingredients and adjuvants comprise ingredients in an herbicide formulation other than the active ingredient. By law, the active ingredient must be identified on a product's label and the percentage by weight disclosed. Inert ingredients and adjuvants are substances that are intentionally added to an herbicide either in the commercial formulation or in the tank mixture. Their purpose is to influence the effectiveness of the active ingredient by, for instance, preventing caking or foaming, extending the shelf life, acting as surfactants, or assisting with the mixing and/or application of the herbicide. The law does not require disclosure of the name or percentage of the "other" ingredients on the label or Material Safety Data Sheet, because the identity is considered proprietary information of the manufacturer (EPA 2012b).

Some formulations of glyphosate contain the surfactant polyethoxylated tallow amine (POEA). The toxicity of formulations containing this surfactant is greater than the toxicity of formulations that do not contain it. The POEA adjuvant (e.g. Roundup Pro) will only be used in uplands where there is no potential for movement into aquatic systems. Within or near aquatic systems, only products labelled for aquatic application would be used.

The EPA reviews inert ingredients prior to registration. The lack of disclosure on the label of "other" ingredients in a formulation indicates none of the inert ingredients that are present at a concentration of 0.1% or greater are classified as hazardous or toxic (US EPA 2012b, 2013). The inclusion of certain ingredients in adjuvant formulations is regulated by the EPA, but the testing, the oversight of manufacture, and the use of adjuvants is not regulated consistently.

During the SERA risk assessments, data on inert ingredients in the confidential business information files or obtained under a Freedom of Information Act (FOIA) request were reviewed, with the exception of 2,4-D, whose study predates FOIA availability (USDA Forest Service 2006). The herbicide formulations whose proprietary information was released included inert ingredients on the EPA Inert List 4A (minimal-risk ingredients, whether of low toxicity or nontoxic); List 4B, which comprises "other" ingredients for which the EPA has sufficient information to reasonably conclude that the current use will not adversely affect public health; or List 3, which delineates inert ingredients for which available toxicity data are insufficient to classify the compound as one of toxicologic concern

(List 1), one of possible toxicologic concern (List 2), or one of minimal concern (List 4). For purposes of this study, no toxic substances were identified as being included in any herbicide formulations.

The list of adjuvants commonly used on both Forests is identified in the project record (Brown 2015).

3.6.4.4. Potential Human Health Effects from Manual and Mechanical Treatments

Potential risks to human health can result from manual and mechanical invasive plant control methods. Adverse weather and terrain can cause unfavorable working conditions. Heat and cold-related illness can be hazardous. Steep and uneven terrain could increase the risk of tripping and falling, resulting in strains, sprains, breaks, cuts, abrasions, or loss of control of equipment. Tools and equipment possess inherent dangers such as sharp edges of blades, emissions from gasoline or diesel powered equipment, flying debris, and loud noises that could damage hearing. Ergonomic hazards resulting in musculoskeletal injuries could occur from carrying equipment and pulling invasive plants.

Although some potential for adverse health effects is associated with mechanical treatment of invasive plants, required personal protective equipment such as gloves, long-sleeved shirts, boots, and safety glasses, along with good personal hygiene and appropriate and adequate training and supervision, could prevent injuries or decrease exposure risks. Such hazards are mitigated through worker compliance with occupational health and safety standards.

3.6.4.5. Potential Human Health Effects from Rehabilitation and Restoration Treatments

Potential human health risks associated with cultural control[15] methods include exposure to dust and chaff during seeding operations. Allergic reactions can result from the exposure of seed chaff when handling seeds; however, gloves, long-sleeved shirts, boots, and other personal protective equipment (as needed) would mitigate injuries or irritations.

3.6.5. Environmental Consequences

3.6.5.1. Direct and Indirect Effects

3.6.5.1.1. Effects Common to All Action Alternatives

Potential Human Health Effects from Biological Treatments

No human health effects are anticipated from biological treatments of invasive plants.

Potential Human Health Effects from Manual and Mechanical Treatments

Potential risks to human health from mechanical invasive plant control methods are very low and include emissions from gasoline or diesel powered equipment, burns, allergies, back

[15] Cultural weed control refers to any technique that involves maintaining field conditions such that weeds are less likely to become established and/or increase in number. Examples of cultural weed control would be crop rotation, avoiding overgrazing of pastures or rangeland, using well-adapted competitive forage species, and maintaining good soil fertility.

injuries, injuries from tools and equipment, and skin irritation from direct contact with plants by individuals performing the work.

In a few individuals, some invasive plant species can cause allergies and minor skin irritations. Some species of invasive plants, such as thistles, cause minor scrapes and irritations. Other, more serious, complications may result from hand pulling. For example, leafy spurge contains a latex-bearing sap that irritates human skin and, rarely, causes blindness in humans upon contact with the eye (Webster 1986, Eke 1997). Highly allergic individuals can have serious complications when exposed to allergens (weeds or pollen), including constriction of the airway and anaphylactic shock, which can be especially hazardous because forest workers generally work some distance from medical assistance.

Although some potential for adverse health effects is associated with mechanical treatment of invasive plants, required personal protective equipment such as gloves, long-sleeved shirts, boots, and safety glasses, along with good personal hygiene, would mitigate injuries or irritation. *Therefore, no human health effects are anticipated by manual or mechanical removal of invasive plants.*

Potential Human Health Effects from Rehabilitation and Restoration Treatments

Potential human health risks associated with cultural control methods include exposure to dust and chaff during seeding operations. Allergic reactions can result from exposure of seed and chaff when handling seeds; however, gloves, long-sleeved shirts, boots, and other personal protective equipment (as needed) would mitigate injuries or irritations. *Therefore, no human health effects are anticipated by cultural control methods.*

3.6.5.1.2. Alternative 1—No Action

Alternative 1 would pose no human health risk from exposure to herbicides or other treatment methods because no invasive plant control activities would be initiated. Under this alternative, invasive plants would continue to spread on both Forests, which could impact individuals sensitive to invasive plant allergens. Because no invasive plant treatments would occur, no need exists for design criteria to protect human health.

3.6.5.1.3. Alternatives 2, 3, 4, and 5

Indicator 1—Toxicity Potential

Worker Exposure

Worker exposure to herbicides is affected by the application rate of the herbicide, the number of hours per day the herbicide is applied, the number of acres treated per hour, hygiene used, and personal protective equipment worn. During broadcast and spot treatments, workers can come into contact with herbicides primarily through exposed skin, but also through the mouth, nose, and lungs. Contact with herbicides may result in irritation to the skin and eyes.

The worker exposure scenarios involved immersing the hands for 1-minute and wearing contaminated gloves for 1 hour, at varying application rates. Of the 14 herbicides proposed for use, 9 did not have any scenarios involving workers that exceeded the LOC (Table 3-74). Out of the 5 herbicides with scenarios exceeding the HQ LOC for workers at some rate of application, 4—chlorsulfuron, dicamba, sulfometuron-methyl, and triclopyr—did not exceed

any LOC at typical application rates. However, 1—2,4-D amine—exceeded the chronic exposure LOC at typical application rates (Table 3-74).

Design criteria minimize all worker exposure scenarios by following safe work practices and label advisories.

Public Exposure

Exposure scenarios assume a person has contact with the herbicide from direct spray, from skin contact with sprayed vegetation, or from consumption of contaminated fruit, water, or fish. Scenarios in risk assessments were modeled for both acute and chronic exposures.

Of the 14 herbicides proposed for use, 7 did not have any scenarios involving the public that exceeded the LOC; however, 7 herbicides exhibited scenarios exceeding the HQ LOC at some rate of application (Table 3-74). One herbicide, picloram, had no scenarios that exceeded the LOC at the typical application rate. Both chlorsulfuron and clopyralid slightly exceeded the LOC, but only under the scenario where a large amount of chemical is spilled in a pond and water from the pond is consumed soon after. Dicamba exhibited 2 acute scenarios, consumption of water after a spill and the spraying of a child, that exceeded the LOC at a typical application rate. Triclopyr exhibited a chronic scenario exceeding the LOC for a female who eats vegetation sprayed at a typical application rate. Glyphosate exceeded a LOC for one acute scenario, that of consuming contaminated produce applied at the maximum rate. One herbicide, 2,4-D amine, had acute and chronic exposure scenarios where the HQ LOC was exceeded at typical, and lower, application rates.

The public exposure scenarios evaluated in the risk assessments were purposefully extreme; for instance, there is virtually no chance of a child or a woman of childbearing age to be directly sprayed during herbicide applications. Three herbicides—2,4-D amine, glyphosate, and triclopyr—revealed exposure scenarios exceeding a LOC if fruits or vegetation containing herbicide residue were consumed shortly after application; 2,4-D amine also exceeded the LOC for vegetation consumed over the long term. Some edible forest product collection occurs on both Forests, but collection is not extensive. People who harvest and consume edible forest products may be exposed through directly handling contaminated plant material, then chewing or eating it. Such doses are unlikely to exceed a threshold of concern. All herbicides applied on both Forests also have a dye added to the tank mixture so that chemically treated plants are visually identifiable, which makes avoidance of those plants possible. The general public would not be exposed to substantial levels of any herbicides used in the implementation of this project. Few plausible scenarios exist that exceed even the most conservative threshold of concern for public health and safety.

Indicator 2—Adequacy of Design Criteria

Design criteria would minimize public exposure by increasing notification of the public regarding areas with herbicide applications. The general public would not be exposed to harmful levels of any herbicides used in the implementation of this project.

The risk assessment evaluated 2 hypothetical drinking water sources: 1) a stream contaminated with herbicide residues via runoff or leaching from an adjacent herbicide application; and 2) a pond, into which a large amount of herbicide solution is spilled. The only herbicide scenarios of concern would involve a child drinking from a pond contaminated by the spill of a large tank of herbicide solution. The risk of a major accidental

spill is not linked in a cause-and-effect relationship to how much treatment of invasive plants is projected for a particular herbicide; a spill is a random event. A spill could happen whenever a vehicle carrying herbicide passes a body of water. The potential risk of human health effects from large herbicide spills into drinking water is alleviated by design criteria requiring all aspects of the Spill Plan to be implemented.

3.6.5.2. Cumulative Effects

Human activities are known to have influenced the spread of invasive plants into North America, the Pacific Northwest, and specific sites within the project area. A complete list of past actions is not necessary to understand how land uses have contributed to the current distribution of invasive plants. The baseline for cumulative effects analysis is the current condition.

A list of ongoing activities and foreseeable future projects is available in the project record. Many of these activities have the potential to introduce or spread noxious invasive plants. Permitted activities have stipulations, such as prevention measures included in grazing allotment annual operating instructions, timber sale contracts, and mineral material plans of operation. The recent update of travel management plans for both Forests eliminated cross-country motorized travel, which eliminated a substantial potential for introducing or spreading noxious invasive plants. The maximum number of acres that would be treated—which are identified in the alternatives—would not change based upon these activities. The potential for cumulative effects resulting from treatment activities is discussed below.

3.6.5.2.1. Alternative 1—No Action

No cumulative effects from treatment activities would occur because no treatment activities would be undertaken in this alternative.

3.6.5.2.2. Alternatives 2–5

Potential Human Health Effects from Biological Treatments

No direct or indirect human health effects are anticipated to occur as a result of biological treatments; therefore, no cumulative effects are anticipated to occur.

Potential Human Health Effects from Chemical Treatments

Because of the manner in which the State of Idaho collects data regarding pesticide use, tracking which herbicides are used (or in what quantity) on private land is not possible; however, CWMA partners do track that information for their activities, to varying degrees. The County CWMAs treat private, State, County, and federally managed lands and provide herbicide to landowners. CWMA partners are licensed pesticide applicators; therefore, herbicides have been applied in compliance with label directions.

In addition, 2 nearby National Forests, the Payette and Salmon-Challis National Forests, treat weeds adjacent to the project area, as does the Boise and Twin Falls Districts of the BLM. These invasive plant treatment programs are very similar to the Current or Proposed Action Alternatives.

The extent of herbicide applications for invasive plant management on lands adjacent to or near the Forests cannot be quantified in all instances; only some of these activities are known to the Forest Service, and no reporting to State or other government agencies is required. Because other governmental invasive plant management entities do not collect usage data to the extent that the Forests do (nor in the same manner), comparison can, in some instances, be difficult. Moreover, the State of Idaho does not require private applicators to collect application data to the same degree as professional applicators.

Additionally, management of these areas may change over the 10 to 15-year timeframe of this project. County road rights-of-way (ROWs) and State highway ROWs are treated with herbicides. The BLM, the IDFG, the Idaho Department of Transportation, and all project area Counties engage in invasive plant control measures, as do many private landowners, particularly ranchers and other agricultural producers. It is expected that invasive plant control efforts, including aerial and ground applications of herbicides, will continue on State-owned, privately owned, and public lands surrounding the Forests.

The SERA risk assessments identified connected actions and cumulative effects for each of the herbicides reviewed. In the risk assessments, connected actions include actions or the use of other chemicals that are both necessary and in close association with the use of the analyzed herbicide. Cumulative effects are analyzed within the context of the Food Quality Protection Act, which requires the assessment of chemicals with similar modes of action. It is beyond the scope of the risk assessments to identify and consider all agents that might interact with, or cause cumulative effects in conjunction with, each analyzed herbicide.

2,4-D Amine

Some studies suggest that 2,4-D in combination with other herbicides may cause synergistic effects. One study implicated 2,4-D in combination with picloram; this combination may cause reproductive impairment in mice. No evidence exists that inert compounds or impurities found in 2,4-D formulations would constitute significant health risks (USDA Forest Service 2006).

The herbicide 2,4-D is a member of the alkylphenoxy herbicide class of pesticides. Regarding human exposure, the EPA has not yet determined which compounds (if any) exhibit common modes of toxicity. Interactions are likely to occur between 2,4-D and other chemicals that affect cell membranes and cell metabolism. The risk assessment for long-term exposure (which addresses the potential impacts of cumulative effects) identified the potential for adverse health effects for workers and people consuming contaminated vegetation (USDA Forest Service 2006).

Aminopyralid

No basis exists to assert that impurities in, or metabolites of, aminopyralid are likely to result in effects not already included in the HQs for human exposure scenarios.

The EPA has not made a common mechanism of toxicity finding for aminopyralid interacting with other substances. The risk assessment specifically considered the effects of repeated and long-term exposure, which addressed the potential impact of cumulative effects and concluded no basis existed for asserting that cumulative adverse effects were plausible (SERA 2007a).

Chlorsulfuron

No data exist to assess whether chlorsulfuron would interact, either synergistically or antagonistically, with 2,4-D or any other herbicide.

The risk assessment specifically considered the effects of repeated and long-term exposure, which addressed the potential impact of cumulative effects and concluded there was no indication that a threshold for toxicity would be exceeded or that cumulative adverse effects would occur (SERA 2004a).

Clopyralid

No data in the literature suggest that clopyralid would interact, either synergistically or antagonistically, with other compounds.

The risk assessment specifically considered the effects of repeated and long-term exposure. All long-term exposure scenarios were substantially below the LOC and should not be associated with cumulative adverse effects (SERA 2004b).

Dicamba

No substantial evidence exists that dicamba will interact with other compounds.

The risk assessment specifically considered the effects of repeated and long-term exposure. Long-term exposure scenarios were below the LOC and should not be associated with cumulative adverse effects (SERA 2004c).

Fluroxypyr

Fluroxypyr formulations contain inert components, and the metabolism of fluroxypyr may involve the formation of other compounds. Given the low HQ values associated with nonaccidental exposure scenarios and the generally conservative assumptions on which these HQ values are based, no plausible basis exists for suggesting that inert ingredients, impurities, or metabolites would have an impact on the risk characterization for potential human health effects. The risk assessment did consider the effect of repeated exposures to fluroxypyr for both workers and members of the general public. As discussed above, only one HQ exceeded (modestly) the LOC—the upper-bound HQ of the scenario regarding subsistence populations' consumption of fish after an accidental large spill in a small pond (SERA 2009a).

Glyphosate

The most important connected action in the use of glyphosate is the use of surfactants. The POEA adjuvant (e.g. Roundup Pro) will only be used in uplands where there is no potential for movement into aquatic systems. Within or near aquatic systems, only products labelled for aquatic application would be used.

People could be exposed to multiple sources of glyphosate; however, the exposure scenarios indicate that multiple exposures do not exceed the LOC. The EPA possesses no data at this time to determine whether glyphosate has a common mechanism of toxicity with other substances or how to include glyphosate in a cumulative risk assessment (SERA 2011a).

Imazamox

Imazamox formulations contain inert components, and its metabolism involves the formation of other compounds. Based on the low HQs derived from the exposure scenarios, no plausible basis exists for suggesting that inert ingredients, impurities, or metabolites would impact the risk characterization for human health effects.

Because imazamox and metabolic degradates possess low toxicity, no concern exists regarding the potential for cumulative adverse effects with other substances with a common mode of action (SERA 2010).

Imazapic

The manufacturer recommends tank mixes with glyphosate and 2,4-D. No data are available for the combined toxicity with glyphosate and, although the combination with 2,4-D is more toxic than imazapic alone, that is likely due to the properties of 2,4-D.

The risk assessment specifically considered the effects of repeated and long-term exposure. Long-term exposure scenarios were below the LOC and should not be associated with cumulative adverse effects (SERA 2004d).

Imazapyr

Imazapyr formulations contain inert components, and its metabolism involves the formation of other compounds. Based on the low HQs derived from the exposure scenarios, no plausible basis exists for suggesting that inert ingredients, impurities, or metabolites will impact the risk characterization for human health effects.

Even though imazapyr is structurally similar to other imidazolinone herbicides (imazamox and imazapic), data do not support the conclusion that they share a common mechanism of toxicity and that the combined effect would result in cumulative adverse effects. Because imazapyr exhibits low toxicity, there is no basis for enhanced concern for the potential for cumulative adverse effects (SERA 2011b).

Metsulfuron-methyl

No data in the literature suggest that metsulfuron-methyl would interact, either synergistically or antagonistically, with other herbicides.

The risk assessment specifically considered the effects of repeated and long-term exposure, which addressed the potential impact of cumulative effects and concluded there was no indication that a threshold for toxicity would be exceeded or that cumulative adverse effects would occur (SERA 2004e).

Picloram

Although the technical grade formulation of picloram contains hexachlorobenzene, the exposure scenarios determined the potential carcinogenic risk was below the LOC. The use of technical grade picloram is not considered in this analysis.

Picloram does not appear to produce a toxic metabolite. For the purposes of this analysis, picloram is assumed to have no common mechanism of toxicity with other substances. The risk assessment specifically considered the effects of repeated and long-term exposure, which should not be associated with cumulative adverse effects (SERA 2011c).

Sulfometuron-methyl

No data in the literature suggest that sulfometuron-methyl would interact, either synergistically or antagonistically, with other herbicides.

The risk assessment specifically considered the effects of repeated and long-term exposure, which addressed the potential impact of cumulative effects, and concluded there was no indication that a threshold for toxicity would be exceeded or that cumulative adverse effects would occur (SERA 2004f).

Triclopyr TEA

Triclopyr TEA may metabolize into 3,5,6-trichloro-2-pyridinol, or TCP, which is toxic to mammals and other species. The exposure scenario of a female of childbearing age eating contaminated vegetation at the application rate of 1 pound a.e./acre would exceed the LOC (SERA 2011d).

Triclopyr is a relatively typical, weak-acid auxin herbicide. Aminopyralid, clopyralid, and picloram are similar in structure and in the way each chemical is absorbed, distributed, metabolized, and eliminated (as well as in toxicity); therefore, it is reasonably anticipated that exposure to triclopyr along with the aforementioned other weak-acid herbicides may result in additive risks (SERA 2011d).

The exposure scenarios in the risk assessment specifically addressed and encompassed the potential impact of the cumulative effects of repeated exposures to triclopyr for workers at high application rates and for women of childbearing age who eat contaminated produce (SERA 2011d).

Potential Human Health Effects from Manual and Mechanical Treatments

No data exist that identify the level of manual and mechanical treatments conducted in the lands adjacent to the Forests that encompass the proposed project area. No direct or indirect human health effects are anticipated to occur; therefore, no cumulative effects are anticipated to occur.

Potential Human Health Effects from Rehabilitation and Restoration Treatments

No data exist that identify the level of rehabilitation and restoration treatments conducted in the lands adjacent to the Forests that encompass the proposed project area. No direct or indirect human health effects are anticipated to occur; therefore, no cumulative effects are anticipated to occur.

3.6.5.2.3. Conclusions about Cumulative Effects of Alternatives

The total land mass of the 13 counties in the project area is 21,084,536 acres. Private land comprises 6,227,906 acres, or 28%, of the counties (Table 3-76). Even without knowing how much herbicide is applied to private land, the proportion of private land in relation to the 13-countywide area is low. In addition, the applications of these herbicides are spatially distinct. None of the herbicides analyzed exhibit obvious cumulative adverse effects when used in combination with other herbicides. Effects from repeated exposures are discussed earlier in this report and can be largely mitigated by proper use of personal protective equipment and good hygiene practices. Given the relatively small proportion of treatment

across the landscape, the implementation of design criteria designed and utilized to protect workers and the public, and the use of label guidelines for proper application, cumulative adverse effects to human health are not expected from the implementation of any of the action alternatives.

Table 3-76. Project area ownership by county (acres)

County	Private	State	Bureau of Land Management	National Park System	Forest Service	Other	Total Acres
Ada	334,436	45,692	282,889	0	3,929	11,273	678,219
Boise	232,685	87,524	30,890	0	835,147	33,393	1,219,639
Gem	205,498	19,506	70,116	0	61,592	5,069	361,781
Valley	264,396	67,559	2,211	0	2,027,359	26,475	2,388,000
Blaine	331,092	60,168	589,892	222,564	490,656	9,698	1,704,070
Camas	218,565	27,885	124,226	0	319,707	134	690,517
Cassia	713,401	53,205	464,201	8,113	387,280	26,714	1,652,914
Custer	179,894	54,801	803,733	0	2,117,317	5,410	3,161,155
Elmore	466,249	120,194	580,601	0	766,019	50,610	1,983,673
Oneida	351,424	13,016	201,949	0	94,573	109,937	770,899
Power	448,254	26,713	204,212	35,617	36,002	174,417	925,215
Twin Falls	582,258	29,704	522,006	4,309	92,857	3,090	1,234,224
Box Elder	1,899,754	932,645	1,079,120	2,222	103,884	296,605	4,314,230
Total Acres	6,227,906	1,538,612	4,956,046	272,825	7,336,322	752,825	21,084,536

3.6.5.3. Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitment of resources associated with the implementation of any action alternatives would be anticipated. In general, the implementation of invasive plant treatments would result in short term impacts followed by long term improvements; for example in groundcover, resulting in improved soil condition and water quality; and restores native vegetation in areas where nonnative plants have been introduced. Design criteria would minimize the magnitude and duration of any short term effects.

3.6.5.4. Forest Plan Consistency

Both the Boise and Sawtooth Forest Plans are silent regarding Forest Plan human health standards and guidelines specific to herbicide use. Several standards and guidelines address public health relative to facilities, recreation activities, roads, wildfire, etc., but none address the use of herbicides on human health.

The action alternatives comply with the standards and guidelines specific to the Forest Plans' nonnative plant management.

The No Action Alternative does not comply with the Forest Plans' nonnative plant management direction, specifically with respect to NPGO01, which states: "Manage noxious weeds with an IWM approach that uses prevention, education, eradication, containment, and control treatment strategies in a coordinated effort that includes potentially affected resources, users, funding sources, and activities."

3.7. Wilderness

Wilderness Summary: Alternative 1 would negatively affect the natural quality of wilderness by unintended consequences of modern civilization on the ecological systems through the expansion and/or establishment of invasive plants. Alternative 1 would have no effect on the untrammeled quality of wilderness character. Consciously refraining from manipulating vegetation would help preserve the untrammeled quality.

Alternative 2 would negatively affect the natural quality of wilderness character because controlling invasive plants on a broad landscape-scale would not be addressed. Alternatives 3, 4, and 5 would preserve the natural quality of the wilderness areas. The variety of treatment methods available, excluding aerial or motorized application, would allow some measure of controlling existing invasive plant populations with respect to density and spread and could eliminate new infestations if identified early enough (EDRR). There would be a short-term effect on the natural quality of wilderness with the use of chemicals and biological controls but the long-term effect would be positive. Alternative 3 would best preserve the natural characteristics because of the variety of treatment methods available, excluding aerial or motorized application. Alternatives 2, 3, 4, and 5 would negatively affect the untrammeled quality by consciously manipulating vegetation where the “earth and its community of life” are essentially unhindered and free from modern human control or manipulation.

3.7.1. Introduction

This section describes the affected environment and analyzes the effects of the proposed project and alternatives on wilderness located on the SNF and BNF. Effects on the wilderness character of the Hemingway-Boulders Wilderness, Sawtooth Wilderness, and White Clouds Wilderness located within the Sawtooth NRA are evaluated. BNF lands within the Frank Church-River of No Return Wilderness are not covered in this analysis as treating invasive species within this wilderness was covered under a separate decision issued in 2007, nor is the 459 acres of BLM managed land located within the White Clouds Wilderness covered by this analysis.

3.7.2. Methodology for Analysis

Effects from controlling invasive plants were determined by utilizing the MRDG for designated wilderness. The MRDG is derived from Section 4(c) of the Wilderness Act and involves two steps. The first step is to determine whether action is necessary; the second step is to determine the minimum activity to treat invasive plants in designated wilderness areas. To determine if treatment was necessary, the analysis focused on total acres of nonnative species in designated wilderness, the effectiveness of current management strategies of EDRR, if action could be taken outside of designated wilderness, if action was necessary to satisfy valid existing rights or a special provision in wilderness legislation or to meet the requirements of other federal laws, and to preserve one or more qualities of wilderness character.

Wilderness designation is intended to preserve and protect certain lands in their natural state. The Wilderness Act of 1964 identifies wilderness uses and prohibited activities. The Wilderness Act’s Statement of Policy, Section 2(c) states that wilderness should be managed

"…in such manner as will leave them unimpaired for future use as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character…" The statutory language of the Wilderness Act is used to identify five qualities of wilderness character: Untrammeled, Undeveloped, Natural, Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation, and Other Features of Value, defined below (Laudres et al. 2015).

- Untrammeled: Area is unhindered and free from intentional actions of modern human control or manipulation.
- Natural: Area appears to have been primarily affected by the forces of nature and are substantially free from the effects of modern civilization.
- Undeveloped: Area is essentially without permanent improvements or the sights and sounds of modern human occupation, and it retains its primeval character.
- Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation: Area provides outstanding opportunities for people to experience solitude or primeval and unrestricted recreation including the values associated with physical and mental inspiration, challenge, self- reliance, self-discovery, and freedon.
- Other Features of Value: Area may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value. Though not required of any wilderness, where they are present they are part of that area's wilderness character and must be protected as rigorously as any of the other four required qualities.

Invasive plants have spread aggressively in similar ecotypes; however, the majority of the inventoried infestations within the Sawtooth Wilderness are relatively small and isolated. A comprehensive survey of the White Clouds and Hemingway-Boulders Wilderness will likely identify additional species and infested acres. The inventoried infestations for the White Clouds and Hemingway-Boulders Wilderness areas were surveyed prior to designation as wilderness.

Federal law does not specifically require management action in wilderness to address invasive plants. Some type of action was determined necessary through the MRDG process to address the threat of invasive plants within the Sawtooth, White Clouds, and Hemingway-Boulders Wilderness areas. Invasive plants have the potential to irreversibly affect native plant communities and natural conditions and scenic values in the wilderness. Because of spread vectors, such as wildlife and wind, limiting actions to outside of wilderness to address infestations would not be effective in minimizing the spread of invasive plants.

The second step in the MRDG process determines the minimum activity to treat invasive plants in designated wilderness areas. This step requires analyzing other legislative direction, time constraints, various components of the treatment action, and a comparison of the action alternatives.

3.7.2.1. Primary Sources Informing the Analysis

Data for the quantitative analysis were developed using software from ESRI. Three types of operations were used—attribute queries, spatial queries, and generation of new datasets from

the original Forest Service GIS corporate data. The degree of spatial analysis ranges from simple queries about the spatial events to more complicated combinations of attribute queries, spatial queries, and alterations of corporate data to create new layers for the purpose of this analysis. ArcMap 10.1 was used to accomplish all spatial analysis and cartographic display.

The collective knowledge of the project by IDT members and SNF wilderness specialists through integration of science with local conditions was also utilized.

3.7.2.2. Analysis Area

The analysis area includes the approximately 2.2 million acres of the BNF and 2.1 million acres of the SNF, including the Sawtooth NRA, Hemingway-Boulders Wilderness, Sawtooth Wilderness, and White Clouds Wilderness. This area is used as the analysis area for direct, indirect, and cumulative effects. BLM lands within the White Clouds Wilderness are not covered in this analysis. BNF lands within the Frank Church-River of No Return Wilderness are not covered by this project as treatment of invasive species within this wilderness was covered under a separate decision issued in 2007.

3.7.2.3. Measurement Indicators

The Wilderness Act, Section 2(c) defines wilderness as "an area where the earth and its community of life are untrammeled by man…protected and managed so as to preserve its natural conditions." Furthermore, the Section 4(b) of the Act mandates "…each agency administering wilderness...shall be responsible for preserving the wilderness character of the area..." While treating invasive plants may affect the natural quality of wilderness character by maintaining a naturally functioning ecosystem, the intentional control or manipulation of the components or processes or ecological systems (i.e., treatment of plant species) may also affect the untrammeled quality of wilderness character.

3.7.2.4. Measurement Indicators:

- Untrammeled Quality Measure: Number of actions to manage plants
- Natural Quality Measure: Acres[16] of nonnative species

3.7.3. Compliance with Forest Plan and Other Relevant Direction

The BNF Forest Plan (USDA Forest Service 2010a) and the SNF Forest Plan (USDA Forest Service 2012a) collectively describe the framework for managing the BNF and SNF.

The Sawtooth National Recreation Area Act (P.L. 92-400), which includes the Sawtooth Wilderness, states that the standard will be to "manage both federal and private lands to ensure the preservation and protection of the natural, scenic, historic, pastoral, and fish and wildlife values and to provide for the enhancement of the associated recreational values."

The Sawtooth Wilderness Management Plan (USDA Forest Service 20003a, 2012a) details management direction for the wilderness area, including the following guideline for invasive plants: "Human activities are managed to prevent the introduction of non-native species;

[16] Infested acres surveyed between 2010-2015

existing populations will be identified and eradicated in a manner to minimize negative impacts on the wilderness resource."

The Hemingway-Boulders Wilderness, Sawtooth Wilderness, and White Clouds Wilderness are located mostly within the Sawtooth NRA. The Hemingway-Boulders Wilderness and White Clouds Wilderness were designated on August 7, 2015 (P.L. 114-46); no management plan has been developed at this time. However, these areas were managed as recommended wilderness—where protecting wilderness values was paramount. Any standards not in conflict with the Wilderness Act of 1964 still apply under interim direction.

The Wilderness Act of 1964 (P.L. 88-577) defines wilderness, allowable uses, prohibited uses, and special provisions for congressionally designated wilderness areas. Section 4.(d)(1) states, "In addition, such measures may be taken as may be necessary in the control of fire, insects, and diseases, subject to such conditions as the Secretary deems desirable."

FSM 2300 describes the Forest Service Authority, Objectives, Policy, and Responsibility for recreation management. Pertinent federal laws are the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the NFMA.

This Wilderness Resource section and the accompanying technical report in the project record comply with the BNF final environmental impact statement and SNF final environmental assessment for their Forest Plans (USDA Forest Service 2010b, 2012b) and all associated amendments. Forest-wide desired conditions, goals, objectives, and standards and guidelines for invasive plants relevant to the resource issues analyzed in this report are found under Nonnative Plants and Wilderness.

The Forest Plan (USDA Forest Service 2010a, 2012a) outlines the following goals, objectives, and guidelines.

3.7.3.1.1. Nonnative Plants:

Objectives

NPOB07—Emphasize prevention of noxious weed establishment through education and cooperation with recreation user groups such as ATV, motorcycle, and stock user groups.

3.7.3.1.2. Wilderness:

Goals

WRGO01—Protect wilderness values as defined in the 1964 Wilderness Act. Improve opportunities and experiences through the development of individual wilderness management plans, partnerships with permittees and user groups, and interpretive and educational opportunities.

Objectives

WROB02—Manage high mountain lakes within designated wilderness to be consistent with policies for fish and wildlife management in National Forest and BLM wilderness (Forest Service, BLM, and AFWA, June 2006 CORRECTION). Jointly develop management agreements with the Idaho State Fish and Game Department for such areas.

Guidelines

WRGU01—Use public education and interpretation programs to foster wilderness values, and to maintain environmental qualities and primitive recreation experiences.

3.7.4. Affected Environment

3.7.4.1. Wilderness

The Sawtooth Wilderness was designated by Congress on August 22, 1972, through the passage of the Sawtooth National Recreation Area Act (P.L. 92-400). The 217,088-acre area lies in Boise, Custer, Elmore, and Blaine counties and is comprised of lands within the Sawtooth, Boise, and Salmon-Challis National Forests. Administered by the Sawtooth NRA, the Sawtooth Wilderness offers outstanding primitive recreation opportunities in an environment characterized by high-quality air and water, spectacular scenery, unique geologic features, and protected fish and wildlife habitats. It includes 14 streams eligible for Wild and Scenic River designation.

The Hemingway-Boulders Wilderness and White Clouds Wilderness areas were designated on August 7, 2015, through the passage of the Sawtooth NRA and Jerry Peak Wilderness Additions Act (P.L. 114-46). The 67,998-acre Hemingway-Boulders Wilderness lies within Blaine and Custer counties. The 90,769-acre White Clouds Wilderness lies within Custer County. The majority of these acres are administered by the SNF; approximately 450 acres on the eastern wilderness boundary along the East Fork Salmon River are managed by the BLM and will not be analyzed. Both wilderness areas lie within the Sawtooth and Salmon-Challis National Forests. The Hemingway-Boulders Wilderness includes 5 streams eligible for Wild and Scenic River designation; 4 streams in the White Clouds Wilderness are eligible. Because these wilderness areas were recently designated, no current management area direction is provided. However, these areas have been managed as recommended wilderness—where protecting wilderness values was paramount. Any standards not in conflict with the Wilderness Act of 1964 still apply under interim direction.

There are 36 acres of inventoried invasive plants in the Hemingway-Boulders Wilderness, 1,567 acres in the Sawtooth Wilderness, and 264 acres in the White Clouds Wilderness for a total of 1,867 acres of inventoried invasive plants (Table 3-77).

Table 3-77. Designated wilderness areas with acres of invasive plant infestations

Name of Invasive Plant Species		Acres of Invasive Plants per Wilderness Area		
Common Name	Scientific Name	Hemingway-Boulders	Sawtooth	White Clouds
Black henbane	*Hyposcyamus niger*	0.09 (1)	0	0
Bull thistle	*Cirsium vulgare*	0	0	30 (1)
Yellow toadflax	*Linaria vulgaris*	0	4 (2)	259 (4)
Canada thistle	*Cirsium arvense*	0.17 (4)	740 (68)	31 (2)
Common mullein	*Verbascum thapsus*	12 (3)	0	1 (1)
Dalmatian toadflax	*Linaria dalmatica*	0	1,021 (84)	0
Diffuse knapweed	*Centaurea diffusa*	0	251 (8)	0
Dyer's woad	*Isatis tinctoria*	0	8 (1)	0
Hoary alyssum	*Berteroa incana*	0	0.16 (1)	0
Nodding plumeless thistle	*Carduus nutans*	0.02 (1)	0	30 (1)
Orange hawkweed	*Hieracium aurantiacum*	0	2 (1)	0
Pitseed goosefoot	*Lythrum salicaria*	0	49 (4)	0.30 (3)
Rush skeletonweed	*Chondrilla juncea*	0.01 (1)	337 (41)	0
Spotted knapweed	*Centaurea stoebe ssp. micranthos*	27 (15)	373 (40)	33 (2)

Note: ( ) = Number of infestations

The BNF and SNF have been treating invasive plants in designated wilderness areas. A treated acre is an area infested with invasive plants that has been treated or retreated by an acceptable method (herbicide, biological, mechanical, cultural, or manual) for the specific objective of controlling the invasive plant's spread and/or reducing its density. The stem-mining weevil (Mecinus janthiniformis) is one of the most common biological treatments used by the BNF to control Dalmatian toadflax (*Linaria dalmatica*) on the edge of the wilderness and to prevent infestations in the Sawtooth Wilderness. The weevil larvae feed within the stems and impede the plant's ability to transport nutrients, resulting in reduced flower formation and premature wilting of shoots. Adult weevils feed heavily on leaves, flowers, and stems.

Table 3-78 displays the total treated acres in designated wilderness areas for 2010 to 2015. During the past 5 years, 25 invasive plant infestations were treated a total of 40 times within the Sawtooth Wilderness. Within the area that became the Hemingway-Boulders Wilderness, 5 invasive plant infestations were treated a total of 21 times. Within the area that became White Clouds Wilderness, 1 invasive plant infestation was treated 4 times (Table 3-78).

The total acres treated were calculated in GIS based on those areas with a common area in the attribute table. Many areas were treated multiple times, and the acres are counted for each treatment, so if a 10-acre area was treated 5 times, the total treated acres would be 50. For this reason, the number of treated acres is higher than the total number of infested acres in the wilderness.

Table 3-78. Designated wilderness with acres of treated invasive plant infestations over 5 years

Number of Treated Sites	Number of Times Treated	Total Acres Treated
Hemingway-Boulders Wilderness (pre wilderness designation)		
2	1	14.31
1	2	52.56
1	5	0.44
1	13	44.46
5	21	111.77
Sawtooth Wilderness		
17	1	661.01
4	2	26.8
1	3	72.78
1	4	1086.02
1	6	628.92
1	7	1512.02
1	17	4262.4
26	40	8249.95
White Clouds Wilderness (pre wilderness designation)		
1	4	33.59
32	65	8395.31

3.7.5. Environmental Consequences

3.7.5.1. Direct and Indirect Effects

While treating invasive plants would affect the natural quality of wilderness character by maintaining a naturally functioning ecosystem, the intentional control or manipulation of the components or processes or ecological systems (e.g., treatment of invasive plants) would degrade the untrammeled quality. (Table 3-79). “In essence, the untrammeled quality monitors actions that intentionally manipulate or control ecological systems, whereas the natural quality monitors the intentional and unintentional effects from actions taken inside wilderness as well as from external forces on these systems” (Landres et al. 2008).

The Wilderness Act of 1964 requires preserving natural conditions while providing provisions for actions to be taken to address infestations. The Act also requires preserving the untrammeled quality of wilderness character. The threat from invasive plants is a long-term and likely irreversible threat to the natural quality of wilderness character, while taking necessary action is a negative impact to the untrammeled quality.

Table 3-79. Wilderness comparison of issue by alternative

Measurement Indicator	Alternative 1: No Action	Alternative 2: Current Management	Alternative 3: Proposed Action	Alternative 4: No Aerial Herbicide	Alternative 5: No Aquatic Herbicide
Untrammeled	No change	Negative	Negative	Negative	Negative
Natural	Long term negative	Short term negative; generally positive	Short term negative; generally positive	Short term negative; generally positive	Short term negative; generally positive

3.7.5.1.1. Alternative 1: No Action

No identified direct effects would occur under Alternative 1 with respect to the wilderness resource.

The long-term indirect effects of Alternative 1 would be that existing populations of invasive plants would be expected to increase in density. Some species which have not yet been identified on the Forests could become established and increase in frequency and cover. Invasive plants already established would be expected to opportunistically expand their range and compete with native plants. Due to the propensity of invasive plants to benefit from human disturbance, the absence of treatment associated with human vectors, generally trails, campsites or stocktie areas, could lead to an accelerated rate of spread. An accelerated rate of spread, combined with the ability of invasive plants to outcompete native plants, would affect the natural quality of the wilderness character.

Effects to designated wilderness areas are evaluated based on the alternative's effects on the following qualities of wilderness character:

- Untrammeled: Alternative 1 would have no effect on the untrammeled quality of wilderness character. Consciously refraining from manipulating vegetation would help preserve the untrammeled quality.
- Natural: Alternative 1 would affect the natural quality of wilderness character by unintended consequences of modern civilization on the ecological systems through the expansion and/or establishment of invasive plants. If invasive plants are left untreated, they could reduce the amount of native plants, altering the integrity of the ecosystem. Invasive plants can displace or hybridize with native plants and may change important natural processes. Invasive plants can also change the character of the landscape. Large infestations of invasive plants would have a negative effect on the natural quality of wilderness. Early eradication can prevent these effects from occurring; but without treatment, the natural quality would be threatened.

While none of the identified alternatives would provide a permanent control option for invasive plants, implementing Alternative 1 would likely lead to more rapid colonization and population increases of invasive plants.

3.7.5.1.2. Alternative 2: Current Management

Direct effects from Alternative 2 would negatively affect the untrammeled quality of wilderness character by consciously manipulating vegetation where the "earth and its community of life" are essentially unhindered and free from modern human control or manipulation. The indirect effects of Alternative 2 would be that existing populations of

invasive plants would be expected to increase in density at a slower rate than Alternative 1. Some species which have not yet been identified on the Forests could become established and increase in frequency and cover. Invasive plants already established would be expected to opportunistically expand their range and compete with native plants. There would be a short-term effect on the natural quality of wilderness with the use of chemicals and biological controls, but the long-term effect would be positive.

Effects to designated wilderness areas were evaluated based on the alternative's effects on the following quality of wilderness character:

- Untrammeled: Alternative 2 would negatively affect the untrammeled quality of wilderness character as it is degraded by active manipulation of ecological processes despite the fact that the plants are invasive and regardless of the method used to eradicate them.
- Natural: Alternative 2 would affect the natural quality of wilderness character because controlling invasive plants on a broad landscape-scale would not be addressed. Current management's relative success rate is not enough to rapidly address any new or existing infestations of invasive plants within the wilderness to keep them from proliferating.

While none of the identified action alternatives would provide a permanent control option for invasive plants, implementing Alternative 2 would lead to more effective control than Alternative 1, but not as effective as the other action alternatives.

3.7.5.1.3. Alternative 3: Proposed Action

Treatment methods for Alternative 3 include aerial application of herbicides. Aerial herbicide application is not permitted within wilderness. Direct effects from Alternative 3 would negatively affect the untrammeled quality of wilderness character by consciously manipulating vegetation where the "earth and its community of life" are essentially unhindered and free from modern human control or manipulation. Rehabilitation and restoration of treated sites, depending on the scope and scale, would be considered manipulation of the land, degrading the untrammeled quality of wilderness character.

Over time, the indirect effects of Alternative 3, with all appropriate design criteria in place, would be an increase in cover and spread of invasive plant species, but at a slower rate than under Alternative 1 and Alternative 2. Each of the various control measures would have the indirect effect of slowing the rate of overall spread. Due to the propensity of invasive plants to benefit from human disturbance, the absence of treatment associated with human vectors, generally trails, campsites or stocktie areas, could lead to an accelerated rate of spread. An accelerated rate of spread, combined with the ability of invasive plants to outcompete native plants, would degrade the natural quality of wilderness character. There would be a short-term effect on the natural quality of wilderness with the use of chemicals and biological controls, but the long-term effect would be positive.

Effects to designated wilderness areas were evaluated based on the alternative's effects on the following qualities of wilderness character:

- Untrammeled: Alternative 3 would affect the untrammeled quality of wilderness character as it is degraded by active manipulation of ecological processes despite the

fact that the plants are invasive and regardless of the method used to eradicate them. Rehabilitation and restoration of native plants and site closure would also be considered manipulating "the earth and its community of life", degrading the untrammeled quality of wilderness character.

- Natural: Alternative 3 would best preserve the natural quality of wilderness character. The variety of treatment methods available, excluding aerial or motorized application, would allow some measure of controlling existing populations with respect to density and spread and could eliminate new infestations if identified early enough through the use of ERDD. The 1964 Wilderness Act states wilderness is, "protected and managed so as to preserve its natural conditions." The treatment would have a positive long-term impact to the natural quality, whereas using the actual treatment would have a negative short-term effect. Rehabilitation and restoration would ensure native species, patterns, and ecological processes are protected.

While none of the identified alternatives would provide a permanent control option for invasive plants, implementing Alternative 3 would likely lead to more effective control than each of the other action alternatives and a greatly reduced rate of spread compared to Alternative 1. It would also lead to a reduced incidence of newly established populations.

3.7.5.1.4. Alternative 4: No Aerial Herbicide Application and Alternative 5: No Aquatic Herbicide Application

Aerial herbicide application is not permitted within wilderness. Effects under Alternative 4 and Alternative 5 would be the same as those described under Alternative 3.

3.7.5.2. Cumulative Effects

Human activities are known to have influenced the spread of invasive plants into North America and into the project area. A complete list of past actions is not necessary to understand how land uses have contributed to the current distribution of invasive plants. The baseline for cumulative effects analysis is the current condition. Future actions are those within the bounds of the existing Forest Plans. Herbicide treatments occur on landownerships adjacent to NFS lands. Because consistent and complete information about herbicides being used adjacent to the Forests is unavailable, certain assumptions were made for this analysis and are discussed in Appendix B.

3.7.5.2.1. Alternative 1: No Action

This alternative proposes no long-term control strategy to address treating newly discovered invasive plant populations or to arrest the spread of established invasive plant populations, which could have a lasting impact on wilderness character. The fundamental effects of not having a long-term control strategy would be the same as those addressed above under "Alternative 1: No Action". Differences may occur with respect to the rate at which the effects occur over time and would be a function of the number and span of ground-disturbing activities and the effectiveness of preventative control measures taken at the time of implementation.

3.7.5.2.2. Alternative 2: Current Management

It is anticipated that all future ground-disturbing activities would be developed with project-specific preventative control measures, which should allow the Forests to minimize the impact of future management actions on the introduction or spread of invasive weeds.

Reducing the introduction or spread of invasive plants would minimize the effect of future activities to designated wilderness areas. Overall, cumulative effects would not vary from the indirect effects described in “Alternative 2: Current Management”.

3.7.5.2.3. Alternative 3: Proposed Action, Alternative 4: No Aerial Herbicide Application, and Alternative 5: No Aquatic Herbicide Application

It is anticipated that all future ground disturbing activities would be developed with project-specific preventative control measures, which, when combined with EDRR and ground-based treatment options, should allow the Forests to minimize the impact of future management actions on the introduction or spread of invasive plants. Reducing the introduction or spread of invasive plants would minimize the effect of future activities, including effects to designated wilderness areas. Overall, cumulative effects would not vary from the direct and indirect effects described for Alternatives 3, 4, and 5 above.

3.7.5.3. Irreversible and Irretrievable Commitment of Resources

Permanent facilities or associated wilderness resources are not modified to an extent that loss of wilderness opportunity occurs from any of the identified actions. There would be no irreversible loss of wilderness resource and/or opportunity or an irretrievable commitment of resources during implementation of any of the defined action alternatives.

3.7.5.4. Forest Plan Consistency

Each of the action alternatives analyzed, along with their specific design criteria, comply with the management direction for wilderness provided in the respective Forest Plans for the BNF and SNF.

The design criteria developed for all treatment methods, the herbicides analyzed, and the application methods in all the action alternatives comply with FSM 2150, 2320; FSH 2109, 2300; the EPA, OSHA, the Code of Federal Regulations (40 CFR part 170), and FIFRA safety standard guidelines

3.8. Cultural Resources

Cultural Resources Summary: No direct effects to archaeological sites would occur under Alternative 1, as no weed treatments are proposed. However, indirectly, weed infestations may alter an area's fire ecology, making it more prone to fire potentially causing historic buildings and pictograph sites to be at greater risk of loss to fire.

Under Alternative 2, design criteria, including consulting an archaeologist prior to ground disturbing work, preclude any adverse effects to cultural resources from proposed activities.

For Alternatives 3, 4, and 5, all proposed weed control actions using targeted grazing or manual or mechanical methods or actions involving site preparation and seeding would be analyzed as individual federal actions and would be reviewed in accordance with NHPA Section 106, and any final treatment plan would be crafted so that no adverse effects to the sites would occur. Because these design criteria would be followed, no adverse effects to cultural resources are anticipated from implementation of these alternatives.

3.8.1. Introduction

The BNF and SNF contain numerous archaeological sites eligible for listing on the National Register of Historic Places (NRHP). Invasive weed infestations and some of the methods used to control weeds may negatively impact these archaeological sites. Any planned weed control activity with the potential to cause ground disturbance will be treated as a federal action and will follow the National Historic Preservation Act of 1966 (NHPA) Section 106 process.

Incidental weed pulling would not trigger a Section 106 review, as a very low probability exists that it would have an adverse effect on an archaeological site. Incidental weed pulling is defined as 1) occurring during the chance discovery of weeds (i.e. seeing a weed while walking down a trail), and 2) removing individual weeds by hand, without the aid of a tool. Incidental weed pulling can be used anytime as an unplanned and expedient control method. A planned weed control project incorporating pulling as part of its control methods will be subject to Section 106 review as a federal action.

3.8.2. Methodology for Analysis

3.8.2.1. Analysis Area and Measurement Indicators

The project area is the analysis area for effects to cultural resources. The source of information for the affected environment includes archeological resource surveys that have been conducted on the BNF and SNF. This analysis examines the potential of each of the 5 alternatives to affect archaeological sites on the BNF and SNF.

3.8.3. Compliance with Forest Plan and Other Relevant Direction

The primary legislation governing heritage management is the NHPA of 1966 (amended in 1976, 1980, and 1992). All other heritage resource management laws and regulations support, clarify, or expand on the NHPA. The Federal Code of Regulations at 36 CFR 800 (Protection of Historic Properties), 36 CFR 63 (Determination of Eligibility to the NRHP, and 36 CFR 296 (Protection of Archaeological Resources) and FSM 2360 provide the basis for specific Forest Service

heritage resource management practices. These laws and regulations guide the BNF and SNF in identifying, evaluating, and protecting heritage resources.

Under NHPA Section 106, the Forest Service is required to evaluate effects of proposed management actions on historic properties (archaeological sites and ethnographic resources, including traditional cultural properties). The BNF and SNF follow the standards and guidelines in their respective Land and Resource Management Plans (Forest Plans) for protecting heritage resources and consulting with Native American tribes (USDA Forest Service 2010a, pp. III-71 through III-74; USDA Forest Service 2012a, pp. III-74 through III-77).

This document analyzes proposed weed treatment activities in accordance with the NEPA and the NHPA Section 106.

3.8.4. Affected Environment

3.8.4.1. Existing Conditions

3.8.4.1.1. Boise National Forest

On the BNF, 1,054 archaeological sites occur within the analysis area that are either NRHP listed or NRHP eligible (n = 446), or have not yet been evaluated (n = 608).

Of the 1,054 sites, 248 (24%) are located in mapped invasive plant locations. More unrecorded sites likely occur in the analysis area and in mapped invasive plant locations, as much of the area has not been surveyed for archaeological sites.

Of the 1,054 sites, 258 are prehistoric, 723 are historic, 71 are multicomponent, and 2 need to be evaluated. The prehistoric sites consist primarily of campsites. The historic sites include, but are not limited to, cabins; mines; refuse dumps; Forest Service guard stations and lookouts; and landscape features such as mining and irrigation ditches, roads, and trails.

3.8.4.1.2. Sawtooth National Forest

On the SNF, 1,806 archaeological sites have been recorded. Of these 1,806 sites, 462 sites (26%) are located in mapped invasive plant locations. More unrecorded sites are likely in the analysis area and in mapped invasive plant locations, as much of the area has not been surveyed for archaeological sites.

Approximately 50% of the SNF sites are prehistoric, 47% are historic, and 3% are multicomponent. Prehistoric sites include house-pit villages, lithic sites, pictograph sites, rock shelters, and talus pit sites. Historic sites include cabins, ditches, dumps, graves, guard stations, lookouts, mines, ranches, roads, ruins, and trails.

3.8.5. Environmental Consequences

3.8.5.1. Alternative 1—No Action

3.8.5.1.1. Direct Effects

No direct effects to archaeological sites would occur under this alternative as no weed treatments are proposed.

3.8.5.1.2. Indirect Effects

Weed infestations may alter an area's fire ecology, making it more prone to fire (Whisenant 1989; Billings 1992; Brooks and Pyke 2001). Historic buildings located in such an area would be at greater risk of loss to fire. Fire can damage pictograph sites by altering the pigments or causing the rock medium to spall. Greater fire frequency caused by weed infestations can increase exposure to this risk.

3.8.5.1.3. Cumulative Effects

Because this alternative would have no direct effects, no cumulative effects would occur under this alternative.

3.8.5.2. Alternative 2—Current Management

3.8.5.2.1. Direct Effects

Alternative 2 is the current management alternative which utilizes biological, herbicide, manual, and mechanical methods for controlling weeds, as well as rehabilitation and restoration methods such as site preparation and seeding. These actions have the potential to directly effect archaeological resources through chemical contamination from herbicide appilication and destroying archaeological artifacts, features, and sites through manual and mechanical control, rehabilitation, site preparation, and seeding operations. An archaeologist would be consulted prior to initiation of work when the method to be used has the potential to disturb the ground deep enough to affect archaeological resources. If a known archaeological site is in the area, the site would be avoided. Because these design criteria would be followed, no adverse effects are anticipated from this alternative.

3.8.5.2.2. Indirect Effects

No indirect effects would occur under this alternative.

3.8.5.2.3. Cumulative Effects

This alternative would have no cumulative effects when combined with other ongoing or reasonably foreseeable project.

3.8.5.3. Alternatives 3–5

3.8.5.3.1. Direct Effects

Alternatives 3–5 propose actions that utilize biological, herbicide, manual, and mechanical methods for controlling weeds, as well as rehabilitation and restoration methods such as site preparation and seeding. Targeted grazing, manual and mechanical methods, and site preparation and seeding may adversely affect archaeological sites in the treatment area.

All proposed weed control actions using targeted grazing or manual or mechanical methods or actions involving site preparation and seeding would be analyzed as individual federal actions and would be reviewed in accordance with NHPA Section 106. The BNF and SNF would conduct an archaeological survey of all areas where these methods are proposed if they have the

potential to disturb the ground and if they occur in areas with a high probability of finding archaeological sites.

No archaeological survey would be necessary if the treatment area has:

- Been previously disturbed to the degree that there is no possibility of it containing an intact archaeological site; or
- Had an adequate archaeological survey conducted in the past.

If an NRHP eligible site is found within a weed treatment area, the final treatment plan would be crafted so that no adverse effect to the site would occur. If artifacts or archaeological features are discovered during the application of mechanical and/or cultural methods, work would stop in that location and a Forest Service archaeologist would be notified. Because these design criteria would be followed, no adverse effects to cultural resources are anticipated from implementation of these alternatives.

3.8.5.3.2. Indirect Effects

No indirect effects would occur under this alternative.

3.8.5.3.3. Cumulative Effects

No cumulative effects would be expected under this alternative.

3.8.5.4. Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable uses of heritage resources are associated with the actionable proposals of this project.

3.8.5.5. Forest Plan Consistency

All alternatives are consistent with the Forest Plan regarding cultural resources.

3.9. Air Quality

Air Quality Summary: For all action alternatives, the dust generated and overall fuel consumption required to implement the alternatives as described would not likely have measurable impacts on air quality in any Class I or Class II Airsheds or at monitoring sites. Volatilization is not expected to be an issue; dicamba is the only herbicide proposed for use with the potential for volatilization. Dicamba slowly breaks down in sunlight - volatilization from soil surfaces is not significant, but some volatilization may occur from plant surfaces (Extoxnet 1993). Design criteria limits broadcast spraying of dicamba to less than 0.5 contiguous acres per application. All action alternatives comply with direction for air quality found in the Forest Plans for the BNF and SNF (USDA Forest Service 2010a, 2012a) and the Clean Air Act (PL 101-549).

Under Alternative 1, no effects to air quality would occur.

3.9.1. Introduction

This section describes the characteristics and relevant rules, regulations, and laws related to air quality, and discloses the effects the various alternatives would have on air quality.

3.9.2. Methodology for Analysis

3.9.2.1. Analysis Area

The analysis area for effects to air quality from the BNF and FNS Invasive Plant Species Treatment Project includes a 100-kilometer radius around the project area located within the Montana/Idaho Airshed Group's monitoring area.

3.9.2.2. Measurement Indicators

Analysis was completed using emissions data from the Montana/Idaho Airshed Group, which measures National Ambient Air Quality Standards (NAAQS). Particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide, and sulfur dioxide were used as air quality indicators.

3.9.3. Compliance with Forest Plan and Other Relevant Direction

The basic framework for controlling air pollutants is the 1970 Clean Air Act, as amended in 1990. The primary means by which regulation is accomplished is through the implementation of the NAAQS. In addition to the NAAQS, other sections or provisions of the Clean Air Act, as amended, address general conformity, prevention of significant deterioration, and visibility (e.g., regional haze). Within the project area, one mandatory Class I Airshed exists—the Sawtooth Wilderness. The remainder of the analysis area and most of those lands immediately adjacent to the project area contain Class II Airsheds (permitted moderate deterioration).

Under the 1977 Clean Air Act amendments, Congress defined mandatory Class I Airsheds for wilderness areas as greater than 5,000 acres; however, the White Clouds, Hemingway-Boulders, and Frank Church–River of No Return (FC–RONR) Wilderness areas were designated following the 1977 effort and have not since been included as Class I Airsheds.

The goals of the BNF and SNF's Forest Plans with respect to air quality are two-fold: to meet state air quality standards and to manage smoke, while achieving land management objectives. People visiting the National Forests have the opportunity to experience clean air and spectacular vistas in a natural setting while recognizing those vistas may be affected periodically by smoke from management actions or wildfires (USDA Forest Service 2010a, p. III-16 to III-17; USDA Forest Service 2012a, p. III-16).

3.9.4. Affected Environment

3.9.4.1. Air Pollutants

The Montana/Idaho Airshed Group, of which the BNF and SNF are members, was formed in 1998 and releases annual operating guidelines for public and private land managers within Idaho. The objective of those guidelines is to coordinate prescribed burning between members to minimize smoke-related impacts to air quality; however, the group also functions as a source of data for particulate emissions in general. The Montana/Idaho Airshed Group monitors daily emissions, burning activities, and PM levels with established monitoring units and certified meteorologists.

Currently, the predominate sources of emissions affecting visibility in the project area are outside the local area and comprise regional emission sources due to summer fires and coal-fired plants. Local sources in the immediate area are limited and generally restricted to vehicle exhaust, smoke, and dust. Particulates from dust and smoke adversely affect visibility, but these are generally short-term emission sources associated with disturbed areas related to fires and traffic on dirt roads. Although generally a drier environment, the standard visual ranges at Craters of the Moon averaged 162 miles from 2000 to 2010. Within the Sawtooth NRA, standard visual range averaged 155 miles from 2000 to 2010. Within the FC-RONR, standard visual range median values were 108 miles and 133 miles in summer and fall, respectively, from 1989 through 1993; the poorest visibility (tenth percentile) ranged from 55 miles to 75 miles in the summer and fall, respectively, during that same time period (Jackson 2001).

The EPA has established NAAQS for 6 air pollutants: carbon monoxide, ozone, nitrogen dioxide, sulfur dioxide, lead, and PM (Table 3-80; EPA 2012). As it relates to this project, PM associated with dust and emissions from unpaved roads, vehicles, and equipment represent the pollutants of most concern because of potential impacts on human health and visibility.

For this analysis, $PM_{2.5}$, PM_{10}, nitrogen dioxide, and sulfur dioxide were used as indicators. The NAAQS for PM_{10} (PM less than 10 micrometers in aerodynamic diameter) was established in 1987 and updated in December 2006. The NAAQS for $PM_{2.5}$ (PM less than 2.5 micrometers in aerodynamic diameter) was established in 1997 and updated in December 2012. Although $PM_{2.5}$ causes more severe health effects and impacts visibility than PM_{10}, the PM_{10} standards were retained because they also have the potential to cause significant health effects. Nitrogen dioxide and sulfur dioxide standards were established in 1971 and have since been amended. According to the NAAQS, PM_{10} cannot exceed 150 micrograms/cubic meter (ug/m^3) within a 24-hour period, and $PM_{2.5}$ cannot exceed 35 ug/m^3 within a 24-hour period (Table 3-80), either alone or in combination with existing pollution sources. $PM_{2.5}$ has additional annual standards—a primary limit of 12 ug/m^3 and a secondary limit of 15 ug/m^3, based on a 3-year average. Nitrogen dioxide cannot exceed 100 parts per billion (ppb) in a 1-hour period averaged over 3 years, and sulfur dioxide cannot exceed 75 ppb in a 1-hour period averaged over 3 years (Table 3-80).

An area violating the NAAQS is designated as "nonattainment." For the purposes of regulating ambient air quality, the IDEQ does not possess baseline data for the affected environment. Air quality in the project area, however, is generally good to excellent due to the lack of urban and industrial sources and a minimum of other activities (e.g., vehicle dust and emissions) in the area that would generate pollutants. Existing sites near Idaho City, Salmon, Garden Valley, Twin Falls, Rexburg, Missoula, and McCall monitor $PM_{2.5}$ levels. A review of air quality monitors since 2013 revealed that on a 24-hour average, all monitors except Rexburg did record a few days where average air quality exceeded a $PM_{2.5}$ level of 35 (USDA Forest Service 2016). For days with available data in Idaho, a total of 18 days exceeded standards, and these were almost exclusively recorded in the summer, winter, and spring—most probably associated with wood burning, wildland/prescribed fires, and stagnant air masses (IDEQ 2015).

Table 3-80. National Ambient Air Quality Standards (NAAQS) as established by the Environmental Protection Agency

Pollutant	Primary/ Secondary	Averaging Time	Level[a]	Form
Carbon Monoxide	Primary	8 hour	9 ppm	Not to be exceeded more than once per year
		1 hour	35 ppm	
Lead	Primary and Secondary	Rolling 3-month average	0.15 ug/m^3	Not to be exceeded
Nitrogen Dioxide	Primary	1 hour	100 ppb	98th percentile, averaged over 3 years
	Primary and Secondary	Annual	53 ppb	Annual mean
Ozone	Primary and Secondary	8 hour	0.075 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particulate Matter Pollution, $PM_{2.5}$	Primary	Annual	12 ug/m^3	Annual mean, averaged over 3 years
	Secondary	Annual	15 ug/m^3	Annual mean, averaged over 3 years
	Primary and Secondary	24 hour	35 ug/m^3	98th percentile, averaged over 3 years
Particulate Matter Pollution, PM_{10}	Primary and Secondary	24 hour	150 ug/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide	Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3 hour	0.5 ppm	Not to be exceeded more than once per year

Source: EPA 2012
[a]ppm = parts per million; ug/m^3 = micrograms per cubic meter

3.9.4.2. Class I Airsheds

Class I Airsheds are subject to the most stringent restrictions relative to additional air pollution. The Clean Air Act established the national visibility goals of preventing any future, and the remedying any existing, impairment of visibility in mandatory Class I Airsheds where impairment results from manmade air pollutants. The EPA's regional haze regulations (July 1, 1999) require all States to develop visibility plans to address regional haze impairment of Class I Airsheds within their state, as well as Class I Airsheds outside their state that may be affected by

emissions from within their state. Table 3-81 lists the Class I Airsheds and population centers within a 100-kilometer radius of the project area where effects may occur. Table 3-81 also discloses the approximate distances and general direction from the project area. Figure 3-2 displays the sensitive areas surrounding the project area.

Table 3-81. Class I and Class II wilderness areas, nonattainable areas, impact areas, cities (sensitive areas), and other interested areas, in and near the project area on the Boise National Forest (BNF) and Sawtooth National Forest (SNF)

Site	Approximate Distance from Project Area (kilometers [km])	Direction from Project Area
Class I and Class II Wilderness Areas		
Sawtooth Wilderness (Class I)	0 km	Within project area (SNF)
Hells Canyon Wilderness (Class I)	76 km	North and west
Jarbidge Wilderness (Class I)	80 km	South and west
Craters of the Moon (Class I)	36 km	South and east
Selway–Bitterroot Wilderness (Class I)	86 km	North and east
Frank Church–River of No Return Wilderness (Class II)	0 km	Within project area (SNF)
Hemingway–Boulders Wilderness (Class II)	0 km	Within project area (SNF)
White Clouds Wilderness (Class II)	0 km	Within project area (SNF)
Nonattainable Areas		
Boise	0 km	Within project area (BNF)
Cache Valley	87 km	East
Fort Hall	20 km	North and east
Impact Areas		
Boise	0 km	Within project area (BNF)
Sun Valley	0 km	Within project area (SNF)
Twin Falls	25 km	North
Pocatello	65 km	North and east
McCall	20 km	North and west

Site	Approximate Distance from Project Area (kilometers [km])	Direction from Project Area
Cities (Sensitive Areas)		
Atlanta	0 km	Within project area (BNF)
Banks	0 km	Within project area (BNF)
Bellevue	0 km	Within project area (SNF)
Cascade	0 km	Within project area (BNF)
Clayton	0 km	Within project area (SNF)
Featherville	0 km	Within project area (BNF)
Hailey	0 km	Within project area (SNF)
Idaho City	0 km	Within project area (BNF)
Ketchum	0 km	Within project area (SNF)
Lowman	0 km	Within project area (BNF)
Ola	0 km	Within project area (BNF)
Pine	0 km	Within project area (BNF)
Placerville	0 km	Within project area (BNF)
Smith's Ferry	0 km	Within project area (BNF)
Stanley	0 km	Within project area (SNF)
Sun Valley	0 km	Within project area (SNF)
Arco	51 km	North and east
Bliss	50 km	South and east
Challis	35 km	North and east
Elba	5 km	East
Emmett	40 km	West
Fairfield	17 km	South
Mackay	65 km	North and east
Mountain Home	27 km	South
Oakley	5 km	East
Pocatello	60 km	North and east
Shoshone	65 km	North
Twin Falls	28 km	North

Site	Approximate Distance from Project Area (kilometers [km])	Direction from Project Area
Other Interested Areas Outside the 100-kilometer Radius		
Eagle Cap Wilderness (Class I), Oregon	21 km	West
Strawberry Mountain Wilderness (Class I), Oregon	80 km	West
Yellowstone National Park (Class I), Wyoming/Montana	130 km	North and east
Red Rock Lakes National Wildlife Refuge (Class I), Montana	100 km	North and east
Anaconda–Pintler Wilderness (Class I), Montana	74 km	North
Grand Teton National Park (Class I), Wyoming	164 km	North and east
Teton Wilderness (Class I), Wyoming	215 km	North and east
Washakie Wilderness (Class I), Wyoming	265 km	North and east
Fitzpatrick Wilderness (Class I), Wyoming	213 km	East
Bridger Wilderness (Class I), Wyoming	210 km	East
North Absaroka Wilderness (Class I), Wyoming	263 km	North and east
Duck Valley Reservation (Sensitive Area)	32 km	West
City of Salmon (Impact Area)	16 km	East
City of Idaho Falls (Impact Area)	32 km	North

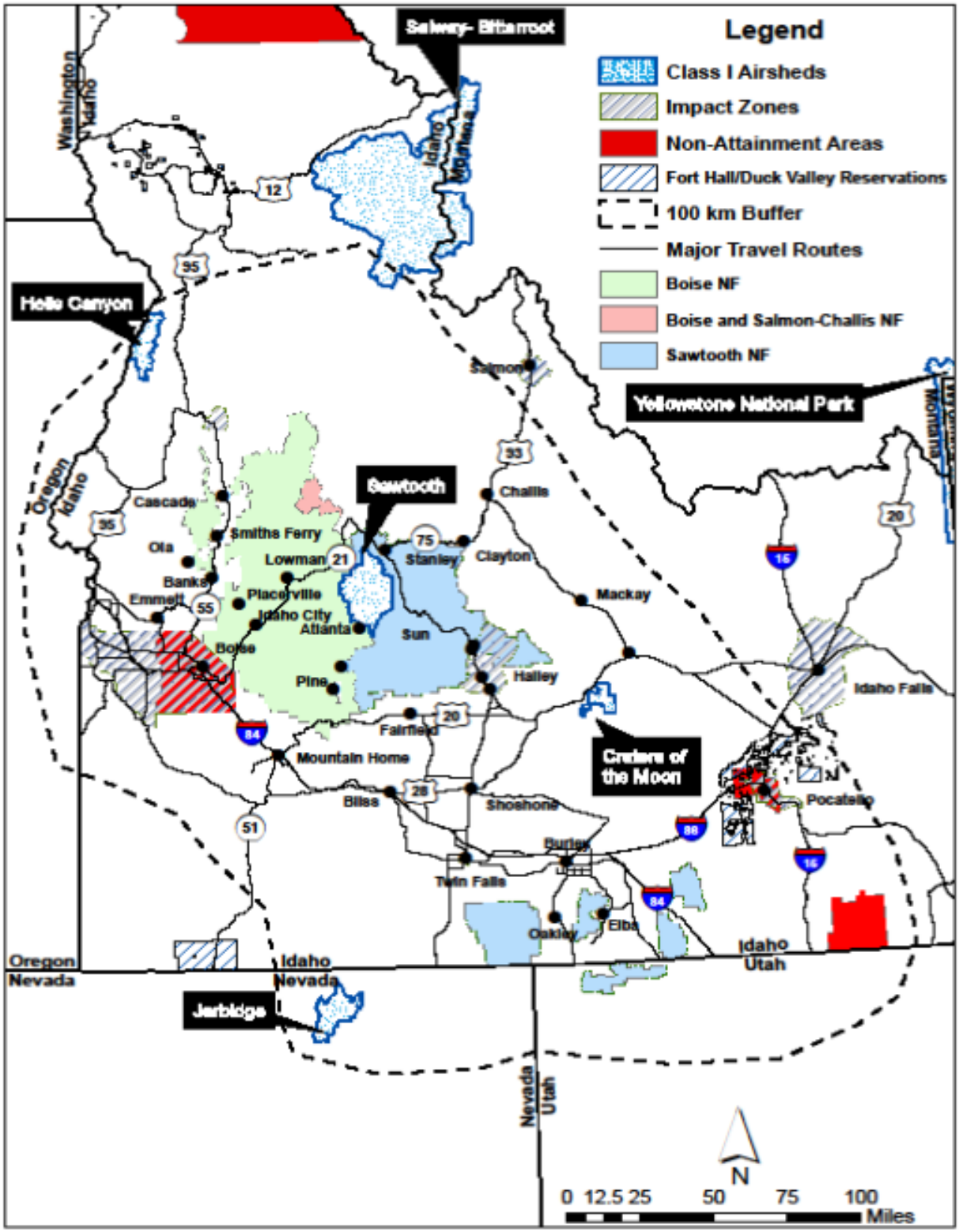

Figure 3-2. Project area with 100-kilometer radius

3.9.5. Environmental Consequences

3.9.5.1. Alternative 1—No Action

Direct and Indirect Effects

No activities are proposed under this alternative, therefore, no direct or indirect effects on air quality are expected. Impacts from dust and vehicle/other emissions in the area associated with recreational/other activities would not change appreciably from the existing condition and would continue to contribute PM based on the conditions present at the time of travel. Depending on actual usage of the analysis area, activities would continue to produce dust, nitrogen dioxide, and sulfur dioxide.

3.9.5.2. Alternative 2—Current Management *and* Alternative 4—No Aerial Herbicide Application

Direct and Indirect Effects

Under Alternatives 2 and 4, exhaust pollutants would be generated by project vehicles for the duration of the project. When road moisture levels are low enough, project vehicles would generate dust. Access to the treatment sites and transport of equipment and supplies would use fuel and generate exhaust. In relation to national and global fuel use, the fuel consumption and associated emissions from Alternatives 2 and 4 would be negligible. Fugitive dust and particulate emissions may occur during the following activities associated with Alternatives 2 and 4:

- Operating OHVs
- Driving vehicles on paved and unpaved roads

Although Alternatives 2 and 4 could increase particulates from dust and vehicle emissions in the area, they would not likely have measurable impacts on air quality in any Class I or II Airsheds identified above or at monitoring sites, given the distance and dilution that would occur as particles and air mix over distance. Very minimal amounts of mixing and overall air volume would be needed to dilute dust and vehicle emissions to levels below the air quality standards identified in Table 3-80. Potential impacts to the wilderness user, along with users of other NFS lands, would be limited to localized impacts from dust prior to dispersal. Dust would be generated and dispersed to no perceptible level outside the wilderness, but could be perceived by wilderness users on high vistas looking outside the wilderness at the project area. After dispersal, the dust would no longer be perceived by the user. Suspended particles would likely not have a measureable impact on overall visibility in the project area, nor would any deposition likely have measurable impacts on the water quality of surface water.

Volatilization should not be an issue; dicamba is the only herbicide proposed for use with potential for volatilization, which may occur from plant surfaces (Extoxnet 1993), but design criteria limits broadcast spraying of dicamba to less than 0.5 contiguous acres per application which limits potential volztilization.

Under Alternative 2, the Forests propose treating around 600 acres using bio-control, approximately 15,000 acres using ground applied herbicide, and approximately 200 acres using mechanical/manual removal for both Forests combined. Under Alternative 4, the Forests propose treating around 4,000 acres using bio-control, approximately 12,000 acres using ground applied herbicide, and approximately 4,000 acres using mechanical/manual removal for both Forests

combined. The overall fuel consumption and dust generated by vehicles required to implement these alternatives would not likely have measurable impacts on air quality in any Class I or II Airsheds.

3.9.5.3. Alternative 3—Proposed Action *and* Alternative 5—No Aquatic Herbicide Application

Direct and Indirect Effects

Under Alternatives 3 and 5, exhaust pollutants would be generated by project vehicles for the duration of the project. When road moisture levels are low enough, project vehicles could generate dust. Access to the treatment sites and transport of equipment and supplies would use fuel and generate exhaust. Helicopters would also be used to spray treatment areas. Though application rates vary, several hundred acres can be accomplished in a few hours when conditions are favorable, and application volumes of approximately 2 gallons (water carrier diluted with herbicide) per acre can be achieved. In relation to national and global fuel use, the fuel consumption and associated emissions from Alternatives 3 and 5 would be negligible. Fugitive dust and particulate emissions would occur during the following activities associated with these alternatives:

- Operating OHVs
- Driving vehicles on paved and unpaved roads
- Landing and operating helicopters

Although Alternatives 3 and 5 would increase particulates from dust and vehicle/helicopter emissions in the area, they would not likely have measurable impacts on air quality in any Class I or II Airsheds identified above or at monitoring sites, given the distance and dilution that would occur as particles and air mix over distance. Very minimal amounts of mixing and overall air volume would be needed to dilute dust and vehicle/helicopter emissions to levels below the air quality standards identified in Table 3-80. Potential impacts to the wilderness user (and users of other NFS lands) would be limited to localized impacts from dust prior to dispersal. Dust would be generated and dispersed to no perceptible level outside the wilderness, but could be perceived by wilderness users on high vistas looking outside the wilderness at the project area. After dispersal, the dust would no longer be perceived by the user. Suspended particles would likely not have a measureable impact on overall visibility in the project area, nor would any deposition likely have measurable impacts on the water quality of surface water.

Volatilization is not expected to be an issue; dicamba is the only herbicide proposed for use with the potential for volatilization, which may occur from plant surfaces (Extoxnet 1993), but design criteria limits broadcast spraying of dicamba to less than 0.5 contiguous acres per application.

Under Alternatives 3 and 5, the Forests propose treating up to 4,000 acres using bio-control, approximately 12,000 acres using ground applied herbicide, approximately 20,000 acres using aerial applied herbicide, and approximately 4,000 acres using mechanical/manual removal for both Forests combined. The overall fuel consumption and dust generated by vehicles required to implement these alternatives would not likely have measurable impacts on air quality in any Class I or II Airsheds.

Aerially applied herbicide would have a greater dispersal distance than ground applied herbicide, generally due in part to the height of the helicopter's boom over foliage. Aerial herbicide application would not occur when sustained wind speeds exceed 5 mph or label recommendations, whichever is less. Actual dispersal distances can vary and depend on many factors such as wind, air stability, nozzle size/angle, and spray pressure (Dexter 1995). Large droplet sizes would be employed to reduce drift. A 100-micron droplet could travel up to 44 feet in a 3-mph wind before falling 10 feet, while a 240-micron droplet would only travel 28 feet in the same wind (Dexter 1995). Given the expected short distances of herbicide dispersal with project design features included for sustained wind and the use of large droplets, there is no potential for herbicides to have measureable impacts on air quality on any Class I or II Airsheds identified above or at monitoring sites.

3.9.5.4. Cumulative Effects for All Alternatives

The area used to assess this project's cumulative effects on air quality consists of a 100-kilometer radius around the project area. No known past activities when combined with proposed activities would result in a noticeable incremental effect on air quality. Present/ongoing and foreseeable future actions considered in this cumulative effects analysis involve numerous activities over a very wide area and include, but are not limited to, prescribed fires, wildfires, wood stoves, logging/mining/industrial activities, road construction/maintenance, vehicle emissions, recreation uses, and/or other sources of pollutants on adjacent NFS, State, and private lands.

Alternative 1 (No Action Alternative) does not propose any activities and, therefore, would have no direct, indirect, or cumulative effects on air quality.

Dust, vehicle, and other emissions resulting from the alternatives could combine with air pollutants from other projects, including but not limited to prescribed fires, wildfires, wood stoves, logging/mining/industrial activities, road construction/maintenance, vehicle emissions, recreation uses, and/or other sources of pollutants on the BNF and SNF, adjacent NFS, State, and private lands. Many of these activities are largely driven by seasonal opportunities or requirements that present parameters on resource managers, landowners, and users to conduct their activities simultaneously. Even though the impacts of these activities are widely spaced over vast, complex terrain, degradation of air quality could occur at localized sites from cumulative effects.

Due principally to the increase in number of acres treated for the various alternatives, a reasonable correlation likely exists between acres treated and overall emissions of each alternative, although this is not a direct correlation. Alternatives 3 and 5 would likely contribute more dust and emissions than Alternative 4, based on acres treated. The fewest emissions of the action alternatives are likely to be seen with Alternative 2, based on acres treated. Alternatives with more acres treated, therefore, have the potential to contribute more pollutants cumulatively.

Air quality would continue to be monitored at sites throughout the state for daily and annual standards. Organizations such as the Montana/Idaho Airshed Group would continue to work with agencies to manage inputs such as smoke impacts.

With relation to national and global petroleum reserves, the energy consumption associated with individual alternatives, as well as the differences between alternatives, is insignificant. Additionally, at a global scale, the energy consumption (and thus the associated minor

emissions) would likely have unmeasurable and insignificant effects on emissions and greenhouse gases.

3.9.5.5. Irreversible and Irretrievable Commitment of Resources

Due to a projected increase in acres occupied by nonnative species, Alternative 1 could result in an irreversible change in plant communities that could, in turn, result in a degradation of soil condition.

No irreversible or irretrievable commitment of resources associated with the implementation of any action alternatives would be anticipated. In general, the implementation of invasive plant treatments would result in short term impacts followed by long term improvements, for example in groundcover, resulting in improved soil condition and water quality; and restores native vegetation in areas where nonnative plants have been introduced. Design criteria would minimize the magnitude and duration of any short term effects.

3.9.5.6. Forest Plan Consistency

All action alternatives comply with direction for air quality found in the BNF and SNF Forest Plans and the Clean Air Act, as amended (PL 101-549) (Table 3-82).

Table 3-82. Forest Plan direction for air quality. Boise and Sawtooth National Forests

Standard or Guideline Number		Standard or Guideline	Project Compliance with Standard or Guideline
Standards	ASST01	Prescribed fire operations shall be conducted consistent with the state's smoke management program.	No prescribed burning is proposed.
	ASST02	Adhere to the operations and procedures of the Montana/Idaho Airshed Group and the Utah Interagency Smoke Management Program to limit potential unacceptable smoke impacts. Further restrict burning activities if local conditions indicate potential unacceptable smoke impacts to ambient air quality and/or visibility.	No prescribed burning is proposed.
	ASST03	Apply control measures as directed by the appropriate DEQ during air pollution episodes (e.g., no new ignitions during declared episodes).	No prescribed burning is proposed.
Guidelines	ASGU01	In addition to identifying applicable regulations, plans, and policies important to project design of prescribed fire activities, air quality and visibility impact evaluations should also consider other sources of emissions; identify sensitive areas; include descriptions of planned measures to reduce smoke impacts as appropriate; identify the potential risk for smoke intrusions into sensitive areas; and describe ambient air monitoring plans, when appropriate.	No prescribed burning is proposed.
	ASGU02	Consider and evaluate the impacts of smoke on sensitive areas (e.g., Class I, non-attainment or maintenance areas, population centers, etc.) within an appropriate area of consideration. A 100-kilometer (approximately 62 miles) distance surrounding the project area should be the initial area of consideration. Air quality modeling should be used to support evaluations when possible. Particulate matter is currently the primary pollutant of concern for air quality evaluations related to Forest management activities for compliance with National Ambient Air Quality Standards (NAAQS).	No prescribed burning is proposed.
	ASGU03	Fire Management Plans should outline a process to consider smoke impacts resulting from fire management activities, particularly prescribed fire.	No prescribed burning is proposed.
	ASGU04	Annually and/or seasonally communicate with the public regarding planned amounts of prescribed burning and potential smoke impacts. Especially near population centers, communication should be aimed at minimizing concerns about health and safety related to smoke.	No prescribed burning is proposed.

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