MOUNTAIN PINE BEETLE RESPONSE PROJECT

DRAFT

ENVIRONMENTAL IMPACT STATEMENT

USDA Forest Service
Black Hills National Forest
Custer, South Dakota

Commonly Used Acronyms and Abbreviations

ARC	At-Risk-Community
BA	Basal Area
BF	Board Foot
BHNF	Black Hills National Forest
BMP	Best Management Practices
CCF	Cubic Hundred Feet
CDA	Connected Disturbed Area
CEQ	Council on Environmental Quality
CF	Cubic Feet
CFR	Code of Federal Regulations
CMAI	Culmination of Mean Annual Increment
CPUA	Concentrated Public Use Area
CWD	Coarse Woody Debris
CWPP	Community Wildfire Protection Plan
DBH	Diameter Breast Height
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FRCC	Fire Regime Condition Class
FS	Forest Service
FSH	Forest Service Handbook
FSM	Forest Service Manual
GIS	Geographic Information System
GPS	Global Positioning System
HFRA	Healthy Forests Restoration Act
ID Team	Interdisciplinary Team
MA	Management Area
MBF	Thousand Board Feet
MIS	Management Indicator Species
MMBF	Million Board Feet
MPB	Mountain Pine Beetle
MPBRP	Mountain Pine Beetle Response Project
MVUM	Motorized Vehicle Use Map
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System
NFSR	National Forest System Road
OHV	Off Highway Vehicle
ROD	Record of Decision
S&G	Standard(s) and Guideline(s)
SDGF&P	South Dakota Game, Fish and Parks
SHPO	State Historic Preservation Officer
SOLC	Species of Local Concern
T&E	Threatened and Endangered
TMP	Travel Management Plan
TSI	Timber Stand Improvement
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WUI	Wildland-Urban Interface

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, DC 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Mountain Pine Beetle Response Project
Draft
Environmental Impact Statement
Custer, Fall River, Lawrence, Meade, and Pennington Counties, South Dakota
and Crook and Weston Counties, Wyoming

Lead Agency:	USDA Forest Service
Cooperating Agencies:	None
Responsible Official:	Craig Bobzien, Forest Supervisor 1019 N 5th Street Custer, South Dakota 57730
For Information Contact:	Katie Van Alstyne, Team Leader 8221 South Highway 16 Rapid City, South Dakota 57702 (605) 343-1567

Abstract: The Black Hills National Forest has prepared a Draft Environmental Impact Statement (EIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. The Black Hills National Forest proposes to implement multiple resource management actions within the Mountain Pine Beetle Response Project (MPBRP) as guided by the Black Hills National Forest Land and Resource Management Plan (Forest Plan) as amended, by the Healthy Forests Restoration Act (HFRA) and supported by the National Fire Plan, the President's Healthy Forest Initiative, and by other National level policy. The focus of the actions proposed is to manage the vegetation to reduce the threat to ecosystem components, including forest resources, from the existing insect and disease (mountain pine beetle) epidemic and to reduce hazardous fuels in order to minimize the potential for large-scale severe wildfires. Three alternatives are considered in detail. Alternative A is the No Action Alternative. Alternative B is the proposed action. Integrated Pest Management techniques are proposed for areas at high risk and most susceptible to MPB infestation, with the objective of treating and removing infested trees before beetles can disperse. Alternative C responds to comments received during scoping. It includes treating in advance of MPB, and addresses concerns about safety and access on roadways (ingress/egress). This Draft EIS discloses the direct, indirect, and cumulative environmental impacts resulting from the proposed action and alternatives. At this time, the Forest Service has not identified a preferred alternative.

Reviewers should provide the Forest Service with their comments during the review period of the draft environmental impact statement. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the final environmental impact statement, thus avoiding undue delay in the decision making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to the reviewers' position and contentions. Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 553 (1978).

Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the final environmental impact statement. City of Angoon v. Hodel (9th Circuit, l986) and Wisconsin Heritages, Inc. v. Harris, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the draft environmental impact statement should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3).

Send Comments To:

Craig Bobzien, Forest Supervisor
MPBR Project
1019 N 5th Street
Custer, South Dakota 57730
email: comments-rocky-mountain-black-hills@fs.fed.us

Summary

The Black Hills National Forest proposes to implement multiple resource management actions within the MPBR Project. This proposal is guided by the Black Hills National Forest Land and Resource Management Plan as amended by the Phase II Amendment; the statutory authority and direction provided by the Healthy Forests Restoration Act; and supported by the National Fire Plan; The 10 Year Comprehensive Strategy Implementation Plan agreed to by the Western Governors Association; and The President's Healthy Forest Initiative.

The area affected by the proposal includes portions of stands at high risk for MPB scattered across the roughly 1.2 million acres of NFS lands managed by the Black Hills National Forest, within the proclaimed Forest Boundary. Any vegetation treatment decision(s) on the MPB Response Project would not include project areas that are currently under NEPA analysis, have NEPA Decisions, or are designated as a special area (RNA's, Botanical Areas, etc.). The forest condition is representative of a ponderosa pine fire adaptive ecosystem that has been managed for multiple-use objectives for decades.

The focus of the actions proposed would treat recently infested MPB trees on portions of approximately 242,000 acres of 'High Risk' stands on National Forest System lands in South Dakota and Wyoming to reduce and slow the spread of MPB to reduce the threat to ecosystem components, including forest resources, from the existing insect and disease (mountain pine beetle) epidemic and reduce the potential for severe large-scale wildfire. There is a need to slow or appreciably halt the ongoing development and spread of mountain pine beetle (MPB) in the project area. The implications of continued spread of this epidemic include: increased tree mortality across the landscape; further accumulation of hazardous fuels and increased potential for severe large-scale wildfires threatening the values of the Wildland-Urban Interface (WUI) within the area and beyond; major changes in the scenery; and alteration of wildlife habitat. According to Schmid et al (2007), the most important aspect of managing mature ponderosa pine stands in the Black Hills National Forest is minimizing the MPB-caused mortality. The only effective long-term strategy to minimize MPB-cause mortality is controlling stand conditions through silvicultural means over large landscapes and monitoring areas of beetle buildup (USDA Forest Service, 2010e).

The ongoing MPB epidemic is of foremost concern in the project area. This epidemic is killing mature pine trees, resulting in stand replacement on a landscape scale. Locally (and nationally), the public is demanding action to reduce the risk of MPB affecting their lands, as well as, reducing potential for large-scale wildfires on public lands. The Healthy Forests Restoration Act (HFRA) of 2003, represents the culmination of a number of National level policy documents and efforts developed to address this issue. Guided by the Forest Plan and the HFRA, the MPBR Project proposed action has been developed to treat vegetation on a landscape scale to reduce the threat to ecosystem components from the existing insect and disease (MPB) epidemic and reduce the potential for large-scale severe wildfires. Furthermore, the project intent is to limit effects to the environment from MPB and reduce the potential for loss of property or life due to large-scale wildfire.

The MPBR Project is based on known methods to reduce MPB infested stands using an adaptive approach because it is not possible to determine when or the precise level of MPB activity, but reasonable estimates can be made based on the current extent of the epidemic, the expanding MPB

brood populations available to infest new trees, and the large volume and wide distribution of high risk stands in the project area.

Through varied public involvement and collaboration efforts, comments on the proposed action, potential concerns, and opportunities for managing the MPBR Project were solicited from Forest Service resource specialists, tribal representatives, members of the public, other public agencies, adjacent property owners, and organizations. Methods used to request comments included: Publishing the Notice of Intent (NOI) to prepare and EIS in the *Federal Register* on August 9, 2010; publication of news releases and articles in the Rapid City Journal; mailing a scoping letter that solicited comments to approximately 400 interested parties; conducted public meetings; and meeting with interested individuals and parties.

Comments received during the scoping process were used to help in defining issues, develop alternatives and mitigation measures, and analyze effects. Through review and analysis of the scoping comments and input, the MPBRP Interdisciplinary Team (ID Team) identified three (3) prevailing or key issues related to the proposed activities. The three key issues include: vegetation and wildlife habitat diversity' wildfire and fuels hazard, and social/economics.

These issues led the ID Team to develop alternatives to the proposed action. The alternatives analyzed in detail in this EIS are briefly described as follows:

Alternative A (No Action) – The National Environmental Policy Act (NEPA) requires the study of the no action alternative, and to use it as a basis for comparing the effects of the proposed action and other alternatives. This alternative assumes no implementation of any elements of the proposed action or other action alternatives. However, such things as ongoing fire suppression efforts, noxious weed treatments, and recurring road maintenance on Forest roads would continue as directed by the Forest Plan.

The no action alternative represents no attempt to actively respond to the purpose and need for action or the issues raised during scoping for this project. For example, there would be no effort to modify existing vegetation or related fuels conditions in the project area. The effort to reduce the widespread MPB epidemic and associated fuel loads would not be undertaken.

Alternative B (Proposed Action) – Alternative B was developed in response to the purpose and need and represents the proposed action. Alternative B is designed to treat the vegetation to reduce the potential for Mountain Pine Beetle (MPB) infestations. Integrated Pest Management techniques are proposed for areas at high risk and most susceptible to MPB infestation, with the objective of treating and removing infested trees before beetles can disperse. Techniques such as: cut and chunk, chipping, and cut-pile-burn, and cut-pile-burn with equipment would be scattered across the landscape and generally adjacent to or along private property and roads to remove pockets of infested trees. Insecticide spraying (i.e. carbaryl) would generally occur in developed campgrounds, FS facilities, and on scattered legacy trees and would use chemicals appropriate for a forested environment. Semiochemical use would be limited along the 'leading edge' of the BHNF MPB Strategy. Semiochemical techniques to attract MPB may occur generally southwest of Custer, SD adjacent to Custer State Park and generally west of Spearfish, SD towards the SD-WY State line; north of Sundance in cooperation and coordination with Forest Health entomologists and the States of SD and WY. Cable and Helicopter logging would generally occur in high value areas on slopes greater than 40 percent. Cable units would utilize existing roads. Commercial and non-commercial

thinning to remove recently infested and non-infested trees would generally occur across the landscape on slopes generally less than 40 percent on up to 1,000 contiguous acres.

Vegetative management in this alternative is characterized by a number of treatments. There would be approximately 41,140 acres of commercial and approximately 7,260 acres of non-commercial (products other than logs (POL)) thinning over an approximate five to seven year period to remove MPB infested trees to lower mountain pine beetle risk and wildfire hazard. Commercial treatments would not be authorized in Non-motorized Backcountry (MA 3.32). Commercial and non-commercial thinning would generally occur on slopes less than 40 percent. Sanitation harvest to remove infested trees may be conducted in areas near or adjacent to identified stands in order to limit the expansion of MPB populations. Most harvest would be conducted using whole tree logging methods in order to reduce after-harvest fuel loading.

Alternative C – Alternative C was developed in response to comments received during the scoping period. Under this alternative, approximately 124,000 acres would be treated mechanically (commercial and non-commercial). Alternative C includes all aspects of Alternative B. Integrated Pest Management techniques would occur on portions of approximately 248,000 acres to reduce the spread of MPB across NFS lands to manage and protect ecosystem components. Alternative C includes three additional elements: 1) Landscape level thinning in advance of large beetle infestations to reduce stand densities and the risk of MPB infestation, thereby reducing the wildfire hazard, and creating landscape-scale fuel breaks; 2) Treatments in MA 4.2A Spearfish Canyon and 3) Up to 250 miles of road construction (70 miles new System and 180 temporary).

Alternative C proposes timber harvest via cable logging and use of tractors and skidders, as well as some road construction, in MA4.2A. Due to the high occurrences of Cooper's mountainsnail and SOLC snails in MA4.2A these actions would not be consistent with Standard 3103. Therefore, a Forest Plan amendment is proposed as part of Alternative C, to allow these actions to take place within MA4.2A. This amendment would apply only to actions approved under this project, and would not be an enduring amendment for other decisions, nor would it change the wording of Standard 3103 in the Forest Plan.

Table 0-1 Effects to Key Issues by Alternative on NFS lands using Measurement Indicators

1. Vegetation and Wildlife Habitat Diversity	**Alt A**	**Alt B**	**Alt C**
MPB Risk Rating – Low (acres)	0	48,400	124,000
MPB Risk Rating – High (acres)	248,000	193,600	124,000
2. Wildfire and Fuels Hazard	**Alt A**	**Alt B**	**Alt C**
Fire Hazard Rating (Low) Post Treatment	0	0	0
Fire Hazard Rating (Moderate) Post Treatment	0	48,400	124,000
Fire Hazard Rating (High / Very High) Post Treatment	248,000	199,600	124,000
Wildland Urban Interface (acres)	206,000	200,000	206,000
Level 3-5 System Roads - Ingress/Egress (miles)	177	162	177
3. Social-Economical	**Alt A**	**Alt B**	**Alt C**
Cooperative Efforts with County, State, Other Groups and Individuals (poor to best)	Poor	Better	Best
Total Cost (million)	N/A	-$27.849	-$72.702
Commercial Thinning Treatments (acres)	0	41,140	105,400
Non-Commercial Thinning Treatment	0	7,260	18,600
Volume (over five to seven years)			
Sawtimber CCF	0	403,140	1,032,920
POL CCF	0	14,520	37,200

Structural Stages: In the hardest hit areas, near complete mortality of the larger trees could occur on up to 50 percent of structural stage 4C. This mortality of 4C would result in a mix of structural stage 2 and 3A due to the prolific pine regeneration' that occurs naturally in the Black Hills, thus avoiding the non-stocked structural stage 1. Structural stage 3A stands would result from the advance regeneration presently occurring within the stands. The other 50% of the 4C the mountain pine beetle attack area size could result in a variation of overstory stand densities resulting in mostly a 4A structure with some 4B. As the mountain pine beetle moves across the landscape there is the probability of complete landscapes being killed over time as evident of the on-going epidemic.

The Mountain Pine Beetle Project purpose and need (see Chapter 1) provides the focus and scope of the proposal as related to National and Forest level policy and direction, plus the statutory mandate provided by the Healthy Forests Restoration Act. Given this purpose and need, the Deciding Official (Forest Supervisor) reviews the proposed action, the issues identified during scoping, the alternatives, and the environmental consequences of implementing the proposal and alternatives disclosed in this EIS. This forms the basis for the Deciding Official to make the following determinations:

- Whether or not the proposed activities and alternatives address the issues, are responsive to National policy/guidance/law and Forest Plan direction, and meet the purpose of and need for action in the MPBR Project.
- Whether or not the information in this analysis is sufficient to implement proposed activities.
- Which actions, if any, to approve (decide which alternative or mix of activities to implement).
- Whether there is a need for site-specific amendments to existing Forest Plan direction.

Table of Contents

Summary iv
CHAPTER 1 PROPOSED ACTION and PURPOSE AND NEED FOR ACTION 13
Document Structure 13
Background 14
Management Direction 17
Forest Plan Direction 18
Management Areas 18
Forest Plan Goals and Objectives 19
Management Area Specific Goals and Objectives 21
Other Direction 24
Purpose Of and Need for Action 25
Proposed Action 26
Decision Framework 27
Public Involvement and Collaboration 28
Issues 29
1. Vegetation and Wildlife Habitat Diversity 29
2. Wildfire and Fuels Hazard 30
3. Social 30
CHAPTER 2 ALTERNATIVES, INCLUDING THE PROPOSED ACTION 33
INTRODUCTION 33
ALTERNATIVES CONSIDERED IN DETAIL 33
Alternative A – No Action 34
Alternative B – Proposed Action 35
Alternative C 36
ACTIVITIES COMMON TO ALL ACTION ALTERNATIVES 38
DESIGN CRITERIA 39
MONITORING 39
ALTERNATIVES CONSIDERED but ELIMINATED FROM DETAILED STUDY 41
COMPARISON OF ALTERNATIVES 44
1. Vegetation and Wildlife Habitat Diversity Issue 44
2. Wildfire and Fuel Hazard Issue 45
3. Social 46
CHAPTER 3 AFFECTED ENVIRONMENT and ENVIRONMENTAL CONSEQUENCES 49
INTRODUCTION 49
PHYSICAL ENVIRONMENT 50
WATERSHED 50
SOILS 82
TRANSPORTATION 102
BIOLOGICAL ENVIRONMENT 111
VEGETATION 111
FIRE and FUELS 129
RANGE 148
NOXIOUS and INVASIVE WEEDS 151
WILDLIFE 155
Management Indicator Species (MIS): 156

Region 2 (R2) Sensitive Species 161
Species of Local Concern (SOLC) 173
Summary of Determinations 190
FISHERIES 219
BOTANY 226
Region 2 Sensitive Plant Species 227
Species of Local Concern (SOLC) 228
SOCIAL ENVIRONMENT 243
TRAVEL MANAGEMENT 243
SCENIC QUALITY 243
RECREATION USE 265
HERITAGE 274
SOCIAL 284
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES 292
SHORT-TERM USES AND LONG-TERM PRODUCTIVITY 293
UNAVOIDABLE ADVERSE EFFECTS 293
CHAPTER 4 BIBLIOGRAPY/REFERENCES 295
CHAPTER 5 GLOSSARY 347
CHAPTER 6 LIST OF PREPARERS 369
CHAPTER 7 INDEX 371

List of Tables

Table 0-1 Effects to Key Issues by Alternative on NFS lands using Measurement Indicators vi
Table 1-1 Management Area Designations and Acreage in the Project Area 19
Table 2-1 Effects to Key Issues by Alternative 47
Table 2-2 Treatments by Alternative 48
Table 3-1 Beneficial Uses and Impaired Streams 52
Table 3-2 Wetland within Potential Treatment Areas 53
Table 3-3 Watersheds with an Impaired Stream or Lake 56
Table 3-4 Watersheds and Associated Watershed Condition Class 58
Table 3-5 Acres of Treatment within WIZ 61
Table 3-6 Temperature Impaired Watersheds and WIZ Proposed Treatment Areas 64
Table 3-7 Upper Cold Brook Watershed Cumulative Effects Summary 73
Table 3-8 Upper Beaver Creek Watershed Cumulative Effects Summary 74
Table 3-9 Silver Creek-Rapid Creek Watershed Cumulative Effects Summary 75
Table 3-10 South Fork Castle Creek Watershed Cumulative Effects Summary 77
Table 3-11 Park Creek Watershed Cumulative Effects Summary 78
Table 3-12 Boulder Creek Watershed Cumulative Effects Summary 79
Table 3-13 Little Spearfish Creek Watershed Cumulative Effects Summary 80
Table 3-14 Miles of Roads/Routes 103
Table 3-15 Open Road/Trail Density in the MPBR PTAs for Alternatives B and C. 103
Table 3-16 Activity in Miles and Estimated Cost for Alternatives B and C 105
Table 3-17 Summary of proposed transportation miles for the existing District Landscape projects. 108
Table 3-18 Summary of Road Miles 111
Table 3-19 Forest-wide Structural Stages and Management Areas 114

Table 3-20 Structural Stage Distribution 114
Table 3-21 Alternative B Management Areas 120
Table 3-22 Alternative C Structural Stages Distribution Post Treatment..... 126
Table 3-23 Fire Regimes in the Black Hills..... 130
Table 3-24 Fire Regime Condition Class (FRCC)..... 131
Table 3-25 Fire history Occurrence and Size of Fires from 1970 to Present. 132
Table 3-26 Area of Large Fire (1970-2011) Within the Project Area (Alternative B)..... 133
Table 3-27 Area of Large Fires (1970-2011) Within the Project Area (Alternative C) 133
Table 3-28 Existing and Alternative B Post Treatment Structural Stage and Fire Hazard Rating 141
Table 3-29 Existing and Alternative C Post Treatment Structural Stage and Fire Hazard Rating 144
Table 3-30 Fire Hazard Rating Summary..... 147
Table 3-31 Grazing Allotments and Developments within the MPBR Project Area 148
Table 3-32 Invasive and Noxious Weeds in the MPBR Project Area 152
Table 3-33 Habitat Descriptions for SOLC occurring within the Project Area..... 173
Table 3-34 Region 2 Sensitive Plant Species Having Suitable Habitat within the Project Area.228
Table 3-35 Plant Species of Local Concern with Respect to the Project Area..... 229
Table 3-36 Comparison of Potential Treatment Impacts on Acres of Known and Assumed Occurrences of R2 Sensitive Plant Species 241
Table 3-37 ROS Classification Acres and Percent 267
Table 3-38 Historic Properties Identified To-Date within Project Area..... 278
Table 3-39 Population by Race..... 285
Table 3-40 Demographics Indicators for Low-Income Populations for the Project Area..... 287
Table 3-41 Household Earnings..... 287
Table 3-42 Employment by Industry 288
Table 3-43 Employment by Wood Product Industries 288
Table 3-44 Financial Efficiency Measures for Alternative B and C (2011 Dollars)..... 291

List of Figures

Figure 1-1 MPBR Project Vicinity 14
Figure 1-2 Estimated Acres Affected by MPB 16
Figure 2-1 The Adaptive Management Cycle..... 40
Figure 2-2 Selection of IPM 41
Figure 3-1 Comparison of Potential Activities and Potential Ground Disturbance on Soils..... 89
Figure 3-2 Alternative A Structural Stages..... 118
Figure 3-3 Alternative A Structural Stages in Five Years: 118
Figure 3-4 Alternative A Predicted Changes vs. Alternative B Post Treatment 124
Figure 3-5 Alternative A Predicted Changes vs. Alternative C Post Treatment 128
Figure 3-6 Typical Stand Structure for each Fire Regime Condition Class 131
Figure 3-7 Point Fire History Within and Adjacent to the Project Area 132
Figure 3-8 Large Fire History (100 Acres or larger) Within and Adjacent to the Project Area. 133
Figure 3-9 Structures within 3 Miles of Project Area..... 135
Figure 3-10 Alternative A Fire Hazard Rating 140
Figure 3-11 Alternative B Fire Hazard Rating 142
Figure 3-12 Alternative C Fire Hazard Rating 144

Figure 3-13 MPB Activity Middleground 247
Figure 3-14 MPB No Treatment Middleground 247
Figure 3-15 Before Treatment of MPB Stand..... 250
Figure 3-16 Post Treatment of MPB Stand..... 250
Figure 3-17 MPB Activity Before Thinning..... 251
Figure 3-18 Thinning Recently Infested Trees 251
Figure 3-19 Percent Change in Population 2000-2010..... 285

Appendices

Appendix A - Public Involvement and Collaboration...……..... A-1
Appendix B - Design Criteria, Mitigation, and Monitoring…….. B-1
Appendix C - Past, Present, Foreseeable Activities……..…….....C-1
Appendix D - Maps……... ……... D-1
Map 1 – Vicinity
Map 2 – Management Areas
Map 3 – Alternative B Treatments
Map 4 – Alternative C Treatments
Map 5 – Travel Management
Map 6 – Alternative B Transportation
Map 7 – Alternative C Transportation

CHAPTER 1 PROPOSED ACTION and PURPOSE AND NEED FOR ACTION

Document Structure

The Black Hills National Forest has prepared this Environmental Impact Statement in compliance with the National Environmental Policy Act (NEPA), the Healthy Forests Restoration Act (HFRA), and other relevant Federal and State laws and regulations. This Environmental Impact Statement discloses the direct, indirect, and cumulative environmental impacts that would result from two action alternatives and No Action alternative. The document is organized into seven chapters followed by Appendices A – E.

Chapter 1. Proposed Action and Purpose of and Need for Action: The chapter includes information related to background of the project proposal, issues, the purpose of and need for the project, and a description of the agency's proposal for addressing that purpose and need. This section also details how the Forest Service involved the public, how the public responded and what issues were generated regarding the proposal.

Chapter 2. Alternatives, including the Proposed Action: This chapter provides a more detailed description of the proposed action as well as alternative methods for achieving the stated purpose. The proposed action (Alternative B) was developed based on addressing the purpose and need. Alternative C was developed based on comments raised by the public, other agencies, and internally. This chapter also provides a discussion of design criteria and monitoring required. Finally, this section includes summary tables of the environmental consequences and a comparison of effects associated with each alternative.

Chapter 3. Affected Environment and Environmental Consequences: This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis documentation is organized by resource area, e.g., Fire and Fuels, Wildlife Habitat, Watershed, etc.

Chapter 4. Bibliography/References: The bibliography provides a list of references supporting the documentation in the EIS.

Chapter 5. Glossary: The glossary provides a list and explanation of key words, acronyms, and terminology used throughout the EIS.

Chapter 6. List of Preparers: This chapter provides a list of preparers involved during the development of the environmental impact statement.

Chapter 7. Index: The index references page numbers for many key document topics and words.

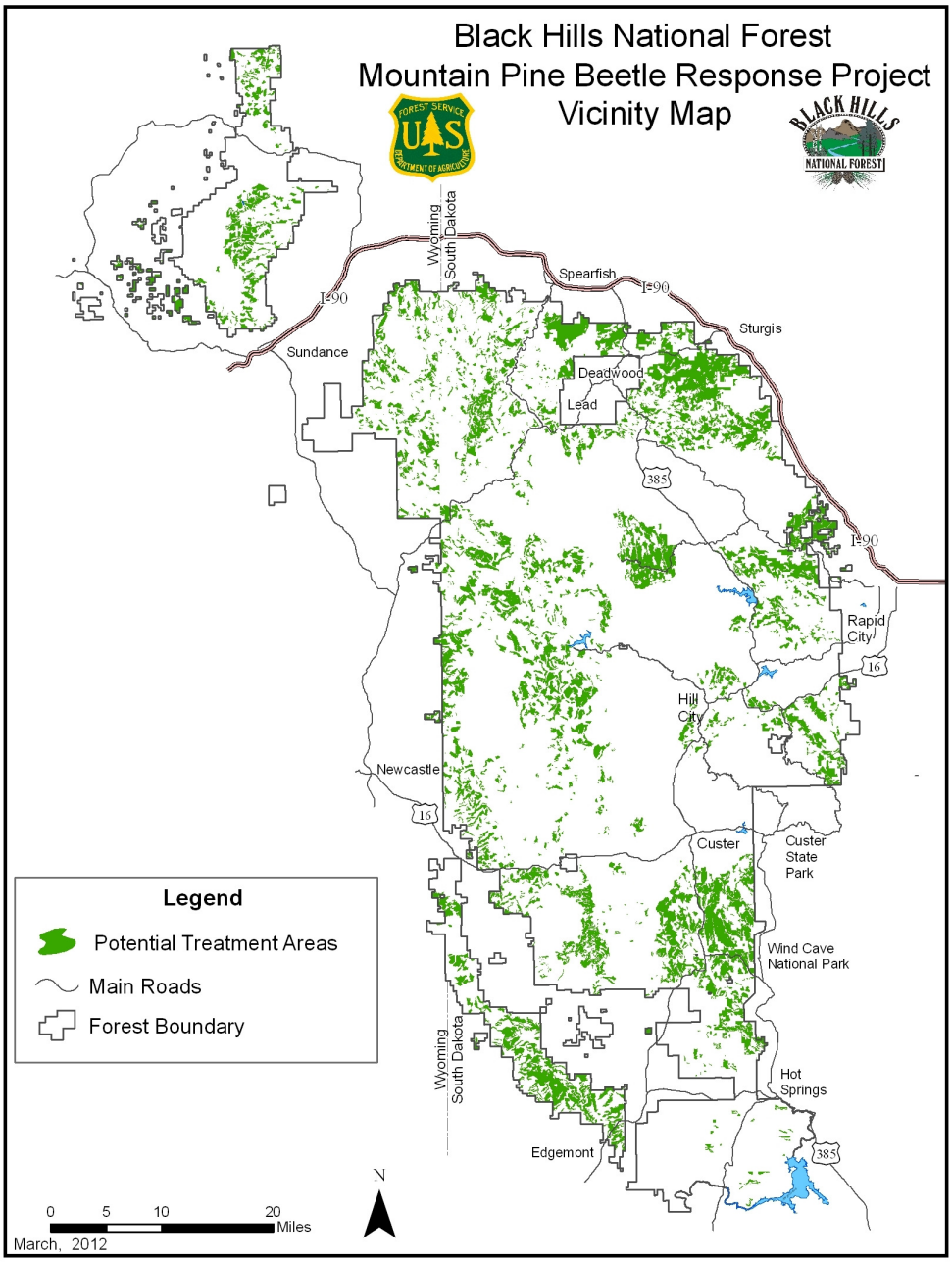
Appendices: The appendices provide more detailed information to support the documentation and analysis presented in the EIS.

Additional documentation, including more detailed analyses of project-area resources, may be found in the Project File located at Forest Supervisor's Office in Custer, South Dakota.

Background

The project area includes portions of ponderosa pine stands at high risk for mountain pine beetle (MPB) scattered across the roughly 1.2 million acres of NFS lands managed by the Black Hills National Forest, within the proclaimed Forest Boundary. Any vegetation treatment decision(s) on the Mountain Pine Beetle Response (MPBR) Project would not include project areas that are currently under NEPA analysis, have NEPA Decisions, or are designated as a special area (RNA's, Botanical Areas, etc.). Figure 1-1 displays the location of the MPBR Project Area.

Figure 1-1 MPBR Project Vicinity



Historic Perspective:
Sporadic use of the Black Hills by Euro-Americans began in the early 1800s and consisted mainly of fur trappers and traders (Sundstrom 1989). The western half of South Dakota, including the Black Hills, portions of southern North Dakota, and nearly the entire area of the Powder River Basin in Wyoming and Montana, were recognized as unceded Indian Territory by the 1868 treaty between the United States and the Sioux and Arapaho. More intense Euro-American occupation in the Black Hills began shortly after gold was discovered in the Black Hills in 1874. It was this discovery that brought a full-scale influx of Euro-American prospectors and miners to the Black Hills.

In addition to gold, several other minerals began to be extracted from the Black Hills in the late 19th and early 20th centuries. These minerals were largely contained in the pegmatite dikes exposed throughout the Black Hills which frequently form resistant ridges and were mined from the surface. Typically, the rock was blasted from the pegmatite dikes using dynamite placed in either hand- or machine-drilled holes. The blasted rock was then sorted by hand and transferred to other locations for processing. After mining was complete, the extraction of rock typically left small open pits or cuts where the pegmatite dikes were once present.

Historic settlement in the Black Hills by Euro-Americans is generally auxiliary to this history of the mining industry. Homestead patents are common from the late 1800s through the 1920s. Industries such as ranching and logging became common in the early 1900s; however, much of the land was not patented and remained public land.

As a result of the gold rush-era settlement, the Black Hills of South Dakota and Wyoming is a heavily settled area. There are numerous communities scattered throughout the Black Hills, along with a complex pattern of private land interspersed with National Forest System land. Many of these private lands have housing developments or isolated houses or structures. Others are rapidly becoming residential developments. This poses unique challenges to the management of National Forest System lands, as the effects of such management greatly affect our neighbors, and vice versa.

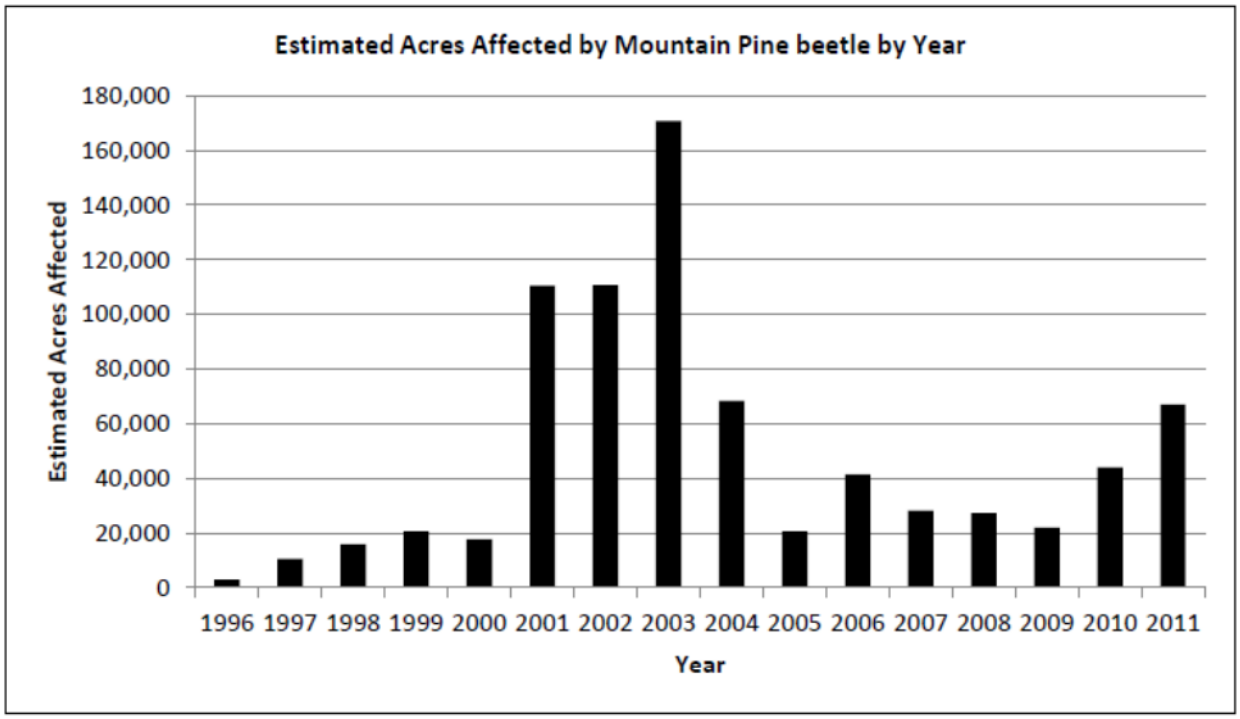
Mountain Pine Beetle and Wildfire
The composition of today's vegetation is more the result of a combination of aggressive fire suppression and past management activities than from natural events. Photographs and records from the late 1800s and early 1900s indicate that today's forest is more continuous, uniform and dense than what has historically occurred. There are more pine trees in this area than existed under natural conditions, and less meadows/grasslands and hardwoods due to pine tree encroachment. Historically, insects and fire were a major force in shaping and contributing to the structure and composition of the ponderosa pine forests of the western United States, including the Black Hills. Insect infestations, especially mountain pine beetle, have played a role in thinning dense stands.

Mountain pine beetle (*Dendroctonus ponderosae*) is the number one insect killer of pines throughout the western United States. The beetle is a native species to the West and attacks most pine species including ponderosa pine in the Black Hills.

During the mid-1990s, beetle mortality was light and scattered throughout the Black Hills. In 1997, there was a noticeable increase in mortality detected. The 1999 survey showed another sharp increase from 1998, with much of the heaviest damage concentrated into a few areas. The aerial survey from 1999 detected a total of 25,562 trees killed throughout the Black Hills. This is

an increase from the 10,726 trees killed on National Forest System lands in 1998. In 2000, the amount of mortality increased again to 38,262 trees. In all cases, much of the damage was concentrated in groups of 25 trees or more in a few areas. More than 60% of the total tree mortality recorded in the 1999 and 2000 aerial surveys was found in the Beaver Park area. Other areas sustaining concentrated pockets of tree mortality included Bear Mountain, Steamboat Rock and areas west and south of Deerfield Lake. In 2001 there was a tremendous increase in the number of trees killed. From 2002 through 2005 an increase in beetle mortality was beginning to concentrate in the central Hills, with smaller spots elsewhere. From 2006 through 2010 epidemics intensified and continued on about 25,000-40,000 acres per year in the central Hills and intensified with new areas beginning to appear in the northern and southern Hills. In 2011 the acres affected with new attacks was approximately 67,000 acres. Since 1996, approximately 405,000 acres of NFS lands have been affected by MPB.

Figure 1-2 Estimated Acres Affected by MPB



The MPB epidemic is continuing to expand within and adjacent to the MPBR Project potential treatment areas (PTA's). This current epidemic is killing large numbers of mature pine trees. The vegetation structure and wildlife habitat is changing on a landscape scale. As trees are killed they fall to the ground adding dead, dry fuels within an area already rated as having high wildfire hazard. The rate of infestation is increasing and is likely to spread over a large area over the next three to five years. MPB prefer stands of dense, mature pine trees, which is abundant and continuous throughout the area. The primary management tool for reducing MPB-caused mortality is to remove the infested trees and to reduce the density of the remaining trees through mechanical thinning.

Fires occurring since 1970, approximately 3,781 are known lightning-caused, 161 equipment-caused, 574 campfire-caused, 131 smoking-caused, 147 debris burning-caused, 68 railroad-caused, 133 arson-

caused, 83 children-caused and 246 miscellaneous. The number of fires on National Forest System (NFS) lands has remained fairly constant at 65-130 starts per year.

Recent wildfires, including but not limited to the Jasper Fire, Roger's Shack, Elk Mountain II, Battle Creek, Grizzly Gulch, Red Point, Ricco, Cement, East Ridge, and Alabaugh Fires have burned over approximately 296,000 acres. Large wildfires (fires greater than 300 acres) burned about 312,000 acres during the period from 1970 to 2011 in the Black Hills. Since 1980, a dramatic increase in acreage burned has occurred. These intense fires covered large areas, moving as far as eleven miles in one day and as fast as five miles in three hours.

Although wildland fires are natural occurrences, they can conflict with land management objectives by impacting soil productivity, increasing conditions for soil erosion, expanding noxious weeds, harming some plant and animal species, reducing visual quality and recreation values, and destroying valuable timber resources. In addition, large wildfires threaten the lives of residents and firefighters, destroy houses and other private property, and contribute to substantial impact to the local economy and private landowners.

The project area contains wildland-urban interface, as defined by the Community Wildfire Protection Plans (CWPPs) for Crook, Custer, Fall River, Lawrence, Meade, Pennington, and Weston counties. This project would help accomplish goals of those plans by developing an accelerated program on certain Federal lands to combat insect infestations (Crook County); reduce the risk, and help restore, recover, and mitigate the damage caused by fire, insects, invasive species, and damaging weather (Meade, Lawrence County); and reduce fire and forest health risks within and around Wildland Urban Interface (WUI) areas and At-Risk Communities (ARC) (All Counties). The threat of wildfire is a major concern for those living, working, and recreating in this area, and for the communities that depend on the Forest watersheds for a portion of their domestic water supply.

The potential treatment areas identified in the MPBR Project are rated as having a high to very high wildfire hazard. This rating is based mainly on crown fire hazard. The ongoing MPB epidemic is making this situation worse by replacing live, green standing fuels with large amounts of dead and dry fuels. These dead fuels are slow to decompose in this dry environment and would be a fire hazard for the next several decades. Fires burning in these heavy fuels would be difficult and dangerous to suppress. The primary management tools to reduce fuel loads and wildfire hazards are to mechanically thin dense stands with high wildfire hazard, remove MPB infested trees, and remove activity fuels from the forest floor.

The MPBR Project is based on known methods to reduce MPB infested stands using an adaptive approach because it is not possible to determine when or the precise level of MPB activity, but reasonable estimates can be made based on the current extent of the epidemic, the expanding MPB brood populations available to infest new trees, and the large volume and wide distribution of high risk stands in the project area.

Management Direction

The following sections provide an overview of the management direction applicable to the MPBR Project.

Forest Plan Direction

The Black Hills National Forest programmatic management direction is the 1997 Revised Land and Resource Management Plan (LRMP or Forest Plan), as amended by the Phase II Amendment (October 2005), and supported by the Final Environmental Impact Statement (FEIS) for the Phase II Amendment to the 1997 LRMP. The Forest Plan is required by the rules implementing the Forest and Rangeland Renewable Resources Act of 1974 (RPA), as amended by the National Forest Management Act of 1976 (NFMA).

The Forest Plan as amended, provides revised and new goals, objectives, and standards and guidelines focused on protecting communities, property, and forest values by reducing severe insect infestations and fire hazards; conserving viable plant and animal species and habitats for the long term supported by the best available science; designating research natural areas; and providing for the continuing viability of the existing forest products industry and infrastructure essential to cost effectively managing vegetation on the Black Hills National Forest. Moreover, the Forest Plan provides overall management allocations, goals and objectives (FP Chapter I), as well as associated standard and guidelines (FP Chapter II) for management.

Forest Plan Standard 3103 directs to manage colonies of sensitive species of snails and snail species of local concern to retain important habitat features, by avoiding burning and heavy equipment use and other activities that may compact soils or alter vegetation composition and ground cover. A listed sensitive species, Cooper's mountainsnail, *Oreohelix strigosa cooperi*, is known to occur on the Black Hills, and is protected by this standard. Numerous colonies of this species are known to occur in Spearfish Canyon, Management Area 4.2A. Four snail Species of Local Concern (SOLC) - Callused vertigo (Vertigo arthuri), frigid ambersnail (Catinella gelida), mystery vertigo (Vertigo paradoxa) and striate disc (Discus shemekii) - also occur in Spearfish Canyon, though not as abundantly as Cooper's mountainsnail.

Alternative B proposes no activities in MA4.2A. However, Alternative C proposes timber harvest via cable logging and use of tractors and skidders, as well as some road construction, in MA 4.2A. Due to the high occurrences of Cooper's mountainsnail and SOLC snails in MA4.2A these actions would not be consistent with Standard 3103. Therefore, a Forest Plan amendment is proposed as part of Alternative C, to allow these actions to take place within MA4.2A. This amendment would apply only to any actions approved under this project, and would not be an enduring amendment for other decisions, nor would it change the wording of Standard 3103 in the Forest Plan.

Management Areas

The Forest Plan sets management allocations for specific uses of land (Management Areas) within the Forest to meet multiple use objectives (FP Chapter III). The MPBR Project Interdisciplinary (ID) Team reviewed Management Area (MA) direction and confirmed that no new information existed that would require reconsideration of Forest Plan resource allocations. The MAs designated in the Forest Plan for the MPBR Project Area are listed in Table 1-1.

Table 1-1 Management Area Designations and Acreage in the Project Area

MANAGEMENT AREA	ACRES	NFS %
3.31 - Backcountry Motorized	4,411	2%
3.32 - Backcountry Non-Motorized	3,120	1%
4.1 - Limited Motorized Use and Forest Product Emphasis	4,184	2%
4.2A - Spearfish Canyon (Alternative C only)	5,583	2%
5.1 - Resource Production Emphasis	102,979	41%
5.1A - Southern Hills	21,360	9%
5.2A - Fort Meade VA Hospital Watershed	2,604	1%
5.4 - Big Game Winter Range Emphasis	91,691	37%
5.43 - Big Game and Resource Production	4,642	2%
5.6 - Forest Products, Recreation Big Game Emphasis	7,085	3%
8.2 - Developed Recreation Complexes	339	0%
Total NFS	248,984	100.00%

Forest Plan Goals and Objectives

The Forest Plan establishes eleven multiple use goals and associated objectives for management of the Forest. Goals 1-4, 10 and 11 are directed toward natural resource objectives for multiple use management of the Forest. Goal 3 and 5-9 provide socio-economic emphasis for management of the Forest. The goals and objectives, applicable to specific resource management issues needing resolution, provide the basic direction for defining the purpose and need and subsequently developing the project proposal. The eleven Forest Plan goals are discussed in Chapter I of the Forest Plan. The Responsible Official for the MPBR Project has chosen to propose resource management actions that respond to Forest Plan Goals 7, and 10.

> **Goal 7. Emphasize cooperation with individuals, organizations and other agencies while coordinating planning and project implementation.**
> **Goal 10. Establish and maintain a mosaic of vegetation conditions to reduce occurrences of catastrophic fire, insect, and disease events, and facilitate insect and disease management and firefighting capability.**

Associated with these goals are specific resource objectives. Comparing objectives to current conditions is integral to defining the purpose and need and developing the proposed action. Objectives providing management emphasis for this project are summarized below. Note that other Forest Plan goals and numerous objectives not mentioned in detail also provide guidance and are achieved to varying degrees as a function of project implementation and effect.

Goal 7 - Emphasize cooperation with individuals, organizations and other agencies while coordinating planning and project implementation.

Objective 701. "Continue to cooperate with interested parties and organizations in the development of plans and projects."

- *There is an opportunity to work with the Counties, State, and private landowners to generate a broad base of support and/or a well-informed public regarding project plan/design and project actions proposed and taken.*

- *There is an opportunity with the adaptive process of this Project to be more efficient in coordinating with partners and cooperators based on MPB populations rapidly changing the landscape.*

Objective 702. "Encourage cost sharing as part of cooperative efforts."

- *There is an opportunity to work with the Counties, State, and private landowners on cost sharing in an "All Lands" approach to MPB in the Project Area.*

Objective 703. "Seek partnerships with other service providers – federal, state, county, local and private sector – to define complementary roles that best meet customer needs."

- *There is an opportunity to coordinate with the Counties, State, and private landowners to partner and possibly cost-share in vegetation treatment and fuel reduction actions adjacent to and/or across mutual boundaries.*

Objective 704. "Consult with tribal governments, traditional practitioners, and other knowledgeable individuals to identify important areas of American Indian religious significance."

- *There is an opportunity to utilize the ongoing BHNF process and project-specific consultation to provide mutually beneficial information exchange, cooperative and open relations, and maintains trust and credibility between the agency and tribal representatives.*

Goal 10 - Establish and maintain a mosaic of vegetative conditions to reduce the occurrences of catastrophic fire, insect, and disease events, and facilitate insect and disease management and firefighting capability.

Objective 10-01. "Manage for 50 to 75 percent moderate-to-low fire hazard in the wildland-urban interface and reduce fire hazard within proximity of structures… Manage the remainder of the Forest for 50 percent moderate-to-low fire hazard…"

- *There is an opportunity to reduce existing fire hazard that currently exceeds objectives on NFS lands in the project area.*

Objective 10-04. "Reduce or otherwise treat fuels commensurate with risks (fire occurrence), hazard (fuel flammability), and land and resource values common to the area, using the criteria in Forest-wide Guideline 4110."

- *There is an opportunity to treat fuels and reduce hazards in the area.*

Objective 10-05. "Manage wildfires using the appropriate response based management area emphasis, existing values, risk of ignition, and fuel hazards within a given area."

- *There is an opportunity to reduce existing and activity fuels to a manageable level thereby facilitating a proactive and effective response to wildfire.*

Objective 10-06. "Develop fuel management and protection strategies for intermixed land ownerships in partnership with private, state, and other federal agencies."

- *There is an opportunity to coordinate with the State and Counties based on goals established in the CWPP's to reduce fuels on both public and private lands in order to reduce the potential for large wildfires that could affect homes, infrastructure, visual quality, timber and forest ecosystem values, and wildlife (including sensitive species) habitat in the area.*

Objective 10-07. "Where outbreaks of mountain pine beetle could present risks to management objectives for ponderosa pine, reduce acreage of ponderosa-pine stands that are in medium or high risk for infestation."

- *Although it is not possible to determine exactly which stands would become infested and the precise level of MPB activity, there is an opportunity to respond to MPB infestations by removing infested trees and thinning pine trees to reduce the amount of high risk stands.*

Objective 10-08. Using analyses of insect and disease occurrences, prioritize suppression strategies to meet management objectives and minimize value loss of tree vegetation affected by outbreaks of insect and disease pests.

- *There is an opportunity to use Integrated Pest Management techniques to prioritize treatments by using an adaptive approach - allowing flexibility and efficiency to treat areas that are changing considerably across the landscape.*

Management Area Specific Goals and Objectives

Management Area 3.31 – Backcountry Motorized

Guideline 3.31-2101. "Vegetative management practices are available…Timber harvest may also be used to prevent or respond to epidemic insect conditions…"

- *An opportunity exists to maintain and promote the recreation, wildlife, and forest appearance by treating stand infested with MPB.*

Management Area 3.32 – Backcountry Non-Motorized

The MPBR Project Area contains 3,120 acres in MA 3.32. Commercial harvest activities would not be authorized under Alternative B.

Guideline 3.32-2102. "Vegetative management practices are available…Timber harvest may also be used to prevent or respond to epidemic insect conditions…"

- *An opportunity exists to maintain and promote the recreation, wildlife, and forest appearance by treating stand infested with MPB.*

Management Area 4.1 – Limited Motorized Use and Forest Products Emphasis

Goal 4.1-201. "Emphasize wood-fiber production, wildlife habitat, and visual quality".

- *There is an opportunity to manage vegetation focused on reducing insect, fire and fuels hazards designed to be fully compatible with the objective of providing wildlife habitat and visual quality.*

Management 4.2A – Spearfish Canyon.

The MPBR Project Area contains 5,583 acres in MA 4.2A. Activities proposed would not be authorized under Alternative B.

Standard 4.2A-4101. "Manage Fire and fuels through various methods to protect the biological and scenic values, but in the wildland-urban interface the priority will be fuel reduction."

- *An opportunity exists to enhance the biological and scenic values by thinning and treating stands infested with MPB.*

Management Area 5.1 - Resource Production Emphasis.

Goal 5.1-201. "Manage tree stands to emphasize timber products, forage production, and water yield."

- *There is an opportunity to manage vegetation for insect, fuels and fire hazard reduction while concurrently providing timber products, forage production, and contributing to increased water yield.*

Objective 5.1-202. "While meeting other objectives for this management area, provide variety in stand sizes, shape, crown closure, age structure and interspersion."

- *There is an opportunity to manage vegetation focused on reducing insect, fire and fuels hazards designed to be fully compatible with the objective of providing variety in the forested setting.*

Objective 5.1-203. "Maintain or enhance hardwood shrub communities where biologically feasible, and within management objectives."

- *There is an opportunity to manage vegetation geared to improve hardwoods and also contribute to the fuel break benefits that hardwoods naturally provide.*

Objective 5.1-204. "Manage for the following percentages of structural stages in ponderosa pine across the management area in a variety of sizes and shapes." (Reference structural stage table, LRMP, Phase II Amendment, Page III-67)

- *See opportunity statement (italics) under Objective 5.1-202 above.*

Guideline 5.1-4101. "Utilize appropriate fuel treatment practices, including prescribed fire, to meet management objectives."

- *There is an opportunity to utilize a full complement of fuel treatment tools in accomplishing insect, fuels and fire hazard reduction objectives.*

Management Area 5.1A – Southern Hills.

Objective 5.1A-202. "Vary tree densities (0-140 basal area) within stands to create small-scale diversity…"

- *There is an opportunity to manage vegetation focused on reducing insect, fire and fuels hazard to be compatible with other habitat objectives.*

Guideline 5.1A-2101. "Timber harvest may be used to achieve management objectives".

- *There is an opportunity to manage vegetation for insect, fuels and fire hazard reduction while concurrently benefiting wildlife habitat and vegetative diversity.*

Management Area 5.2A – Fort Meade VA Hospital Watershed.

Goal 5.2A-101. "Vegetation will be managed to provide optimum water quality while meeting state water quality standards".

- *There is an opportunity to manage vegetation for insect, fuels and fire hazard reduction while concurrently providing optimum water quality and contributing to increased water yield.*

Standard 5.2A-4101. "Manage fire and fuels through control practices and a full array of fuel treatment options which will provide the greatest measure of protection or improvement to the quality and quantity of municipal water supplies".

- *See Goal 5.2A-101 above.*

Management Area 5.4 - Big Game Winter Range Emphasis.

Goal 5.4-201. "Manage tree stands for wildlife habitat and vegetative diversity."

- *There is an opportunity to manage vegetation for insect, fuels and fire hazard reduction while concurrently benefiting wildlife habitat and vegetative diversity.*

Objective 5.4-206. "Manage for the following percentages of structural stages in ponderosa pine across the management area in a variety of sizes and shapes." (Reference structural stage table, LRMP, Phase II Amendment, Page III-92)

- *There is an opportunity to manage vegetation focused on reducing insect, fire and fuels hazard to be compatible with structural stage objectives.*

Guideline 5.4-4101. "Utilize appropriate fuel treatment practices, including prescribed fire, to achieve resource management objectives."

- *There is an opportunity to utilize a full complement of fuel treatment tools in accomplishing wildlife habitat improvement objectives while concurrently contributing to fuel and fire hazard reduction objectives.*

Management Area 5.43 - Big Game and Resource Production.

Goal 5.43-201. "Emphasize wildlife habitat and wood-fiber production".

- *There is an opportunity to manage vegetation focused on reducing insect, fire and fuels hazards designed to be fully compatible with the objective of providing wildlife habitat and wood-fiber.*

Objective 5.43-204-FC. "Manage for the following percentages of structural stages in ponderosa pine across the management area in a variety of sizes and shapes." (Reference structural stage table, LRMP, Phase II Amendment, Page III-108)

- *There is an opportunity to manage vegetation focused on reducing insect, fire and fuels hazard to be compatible with structural stage objectives.*

Management Area 5.6 – Forest Products, Recreation, Big Game Emphasis.

Goal 5.6-202. "Manage forest cover types to provide variety in stand sizes, shape, crown closure, age structure and interspersion".

- *There is an opportunity to manage vegetation for insect, fuels and fire hazard reduction while concurrently providing variety of stand structure.*

Objective 5.6-204-FC. "Manage for the following percentages of structural stages in ponderosa pine across the management area in a variety of sizes and shapes." (Reference structural stage table, LRMP, Phase II Amendment, Page III-114)

- *There is an opportunity to manage vegetation focused on reducing insect, fire and fuels hazard to be compatible with structural stage objectives.*

Management 8.2 - Developed Recreation Complexes.

Goal 8.2-201. "Manage vegetation in high-use recreation areas to provide for public safety, to improve forest condition…"

- *There is an opportunity to reduce existing and activity fuels to a reasonable and manageable level for effective response to visuals and public safety concerns.*

Goal 8.2-204. "Manage fuels to retain a natural forest appearance and to reduce the threat of wildfire damage to forest resources."

- *There is an opportunity to reduce the threat of wildfire damage to the infrastructure and natural setting of the Developed Recreation Complexes.*

Goal 8.2-206. "Control insect-and-disease pest populations in and adjacent to the area through active monitoring while reducing pest-population potential through vegetative management…"

- *There is an opportunity to manage vegetation by reducing mountain pine beetle infestations and lower the risk/hazard in the project area.*

Other Direction

While fires have always helped shape the landscape, today's fires are not simply those of the past; they are often hotter, more destructive, and more dangerous to suppress. The increase in large-scale wildfire nation-wide has led to considerable new and/or revised National level initiatives, policy, and law regarding fire and fuels management. These initiatives, policy, and law also apply to insect and disease epidemics.

The Healthy Forests Restoration Act (HFRA) of 2003 (H.R. 1904) provides improved statutory processes for hazardous fuel (including insect/disease) reduction projects and healthy forest restoration on National Forest System lands. Other supporting policy includes the Healthy Forest Initiative, intended to reduce administrative process delays related to implementation of fuels (and insect/disease) reduction projects; National Fire Plan, and The Federal Wildland Fire Management Policy. The main focus of this National guidance is an emphasis on reducing the probability and occurrence of large-scale wildfire in fire adapted ecosystems, especially near at-risk communities and the wildland-urban interface (WUI); and to reduce the levels of insect infestations and disease.

HFRA contains a variety of provisions to expedite hazardous fuel reductions on specific types of National Forest land. The MPBR Project is an authorized hazardous fuel reduction project under Section 102(a)(4) of the Healthy Forests Restoration Act of 2003. The area qualifies under section 102(a)(4) because there is an existing mountain pine beetle epidemic occurring within and adjacent to the project area which poses a significant risk to resource values on National Forest and private lands (see Determination of Insect Epidemic letter held in the Project File).

The HFRA provides expedited procedures for complying with National Environmental Policy Act (NEPA) requirements. Section 104 of HFRA provides guidance on the range of alternatives studied and disclosed in the NEPA document. All authorized hazardous fuel reduction projects must be consistent with applicable Forest Plan direction or, if not, it includes an amendment to the Forest Plan.

Another provision of the HFRA regards the encouragement of communities to prepare a Community Wildfire Protection Plan (CWPP), which identifies areas of wildland-urban interface (WUI) and recommends the types and methods of treatments on Federal and non-Federal land. The project area contains wildland-urban interface, as defined by the Community Wildfire Protection Plans for Crook, Custer, Fall River, Lawrence, Meade, Pennington, and Weston counties. This project would help accomplish goals of those plans by developing an accelerated program on certain Federal lands to combat insect infestations (Crook County); reduce the risk, and help restore, recover, and mitigate the damage caused by fire, insects, invasive species, and damaging weather (Meade, Lawrence County); and reduce fire and forest health risks within and around Wildland Urban Interface (WUI) areas and At-Risk Communities (ARC) (All Counties).

The MPB Response Project also integrates goals and objectives established in the July 2011 'The Western Bark Beetle Strategy (WBBS) for Human Safety, Recovery, and Resiliency.' The Western Bark Beetle Strategy identifies how the Forest Service is responding to and will respond to the western bark beetle epidemic over the next five years. The extent of the epidemic requires prioritization of treatments, first providing for human safety in areas threatened by standing dead hazard trees, and second, addressing dead and down trees that create hazardous fuels conditions adjacent to high value areas. After the priority of safety, forested areas with severe mortality will be reforested with the appropriate species (Recovery). Forests will also be thinned to reduce the number of trees per acre and create more diverse stand structures to minimize extensive epidemic bark beetle areas (resiliency).

The Black Hills National Forest MPB Strategy incorporates the WBBS, the current understanding of available scientific research, and presents a science-based path forward. The strategy will be achieved through well-defined goals, objectives, and action items, to address each of the three prongs of the bark beetle problem: human safety, forest recovery, and long-term forest resiliency. The action alternatives in Mountain Pine Beetle Response Project address, to varying degrees, the safety, recovery, and resiliency presented in the WBBS and the Forest Strategy.

Purpose Of and Need for Action

The Purpose and Need provides the basis for development of the Proposed Action and any alternatives generated. The Purpose and Need is based on direction provided by the Black Hills National Forest, Land and Resource Management Plan (Forest Plan) and National level policy and law. The Purpose and Need provides fundamental rationale for the project and it provides guidance to the MPBR Interdisciplinary Team during environmental analysis for the MPBR Project Area.

Purpose and Need. The management focus is to develop a vegetation condition in the project area that:

- Reduces the threat to ecosystem components, including forest resources, from the existing mountain pine beetle epidemic.
- Help protect local communities and resources from large scale wildfire by reducing hazardous fuels.

The MPB Response Project is designed to reduce the threat to ecosystem components from the existing insect and disease (MPB) epidemic; help protect forested areas on adjacent private and state lands; and to alleviate potential adverse effects of the beetle epidemic on Forest resources. The Project is based on known methods to reduce MPB infested stands using an adaptive approach because it is not possible to determine when or exactly which stands would become infested with MPB and/or the precise level of MPB activity, but reasonable estimates can be made based on the current extent of the epidemic, the expanding MPB brood populations available to infest new trees, and the large volume and wide distribution of high risk stands in the project area.

There is a need to be more efficient and timely in treating newly infested areas of MPB across the Forest. As an adaptive project, provides a more timely and effective response as well as allowing the Forest more flexibility in responding to MPB outbreaks by allowing the use of a suite of tools to reduce or blunt MPB. Secondly, there is a need to manage hazardous fuel loading associated with the MPB epidemic and conduct sanitation/salvage operations to minimize the potential for large high intensity/high severity wildfires.

There is a need to maintain or improve forest health and vigor on a landscape scale with the objective of maintaining a healthy forest that is less susceptible to forest insects and diseases, and can better withstand events such as wildfire, wind, snow, drought, or other weather related impacts.

There is a need to appreciably slow or halt the ongoing development and spread of mountain pine beetle (MPB) in the project area. The implications of continued spread of this epidemic include: increased tree mortality across the landscape; further accumulation of hazardous fuels and increased potential for severe large-scale wildfires threatening forest resources and values of the WUI within the area and beyond; major changes in the scenery; alteration of wildlife habitat; and impacts to soil and water resources.

Associated with the need to address the MPB epidemic is the need to reduce the potential for severe large-scale wildfire. This can be accomplished by breaking up the continuity and implementing a variety of vegetation management treatments to thin and reinvigorate pine stands, reduce forest fuels, and to facilitate effective wildfire suppression/protection in the area – much of which is WUI.

In association with the focus on improving forest health in the project area, stemming the advance of MPB, and reducing fuels/fire hazard, there is an opportunity to address other Forest Plan objectives. These include maintaining or improving wildlife/plant habitat, providing forest products to local industry, and providing for other resource amenities and uses.

Proposed Action

The proposed action was introduced to the public during the scoping period (see Public Involvement and Collaboration section discussed later in Chapter 1). This proposal was based on addressing the purpose and need described in the previous section. Comments received during the comment period and at the public meetings were used to refine the proposed action and to develop alternatives to the proposed action.

The proposed action is presented in detail in Chapter 2 of this EIS. It would treat recently infested MPB trees on portions of approximately 242,000 acres of 'High Risk' stands on National Forest System lands in South Dakota and Wyoming to reduce and slow the spread of MPB. The proposed action uses Integrated Pest Management techniques to reduce the spread of MPB across NFS lands to manage and protect ecosystem components. Integrated Pest Management techniques are proposed for areas at high risk and most susceptible to MPB infestation, with the objective of treating and removing infested trees before beetles can disperse. Techniques such as: cut and chunk, chipping, and cut-pile-burn, and cut-pile-burn with equipment would be scattered across the landscape and generally adjacent to or along private property and roads. Insecticide spraying (i.e. carbaryl) would generally occur in developed campgrounds, FS facilities, and on scattered legacy trees and would use chemicals appropriate for a forested environment. Semiochemical use would be limited along the 'leading edge' of the BHNF MPB Strategy. Semiochemical techniques to attract MPB may occur generally southwest of Custer, SD adjacent to Custer State Park and generally west of Spearfish, SD towards the SD-WY State line; north of Sundance in cooperation and coordination with Forest Health entomologists and the States of SD and WY. Helicopter and cable logging would occur in areas of high value and generally on slopes greater than 40 percent. Cable units would utilize existing roads. Generally, commercial and non-commercial treatments to remove infested trees with associated thinning to remove recently infested and non-infested trees would occur across the landscape on slopes less than 40 percent on up to 1,000 contiguous acres.

The proposed action includes approximately 41,140 acres of commercial and approximately 7,260 acres of non-commercial (products other than logs (POL)) thinning over an approximate five to seven year period to remove MPB infested trees to lower mountain pine beetle risk and wildfire hazard. Commercial treatments would not be authorized in Non-Motorized Backcountry (MA 3.32). Commercial and non-commercial thinning would generally occur on slopes less than 40 percent. This focused forest thinning serves to reduce MPB habitat and fuel loads.

Decision Framework

The Mountain Pine Beetle Response Project purpose and need (see Chapter 1) provides the focus and scope of the proposal as related to National and Forest level policy and direction, plus the statutory mandate provided by the Healthy Forests Restoration Act. Given this purpose and need, the Deciding Official (Forest Supervisor) reviews the proposed action, the issues identified during scoping, the alternatives, and the environmental consequences of implementing the proposal and alternatives disclosed in this EIS. This forms the basis for the Deciding Official to make the following determinations:

- Whether or not the proposed activities and alternatives address the issues, are responsive to National policy/guidance/law and Forest Plan direction, and meet the purpose of and need for action in the MPBR Project.
- Whether or not the information in this analysis is sufficient to implement proposed activities.
- Which actions, if any, to approve (decide which alternative or mix of activities to implement).
- Whether there is a need for site-specific amendments to existing Forest Plan direction.

If any action alternative is selected, project implementation could begin in the Fall 2012. The initial focus would be to remove MPB infested trees and thin stands in the areas of highest infestation.

Public Involvement and Collaboration

During the project development and analysis period, efforts were made to collaborate with individuals and groups interested in the MPBR Project. Part of this effort included public scoping (see Appendix A).

Scoping is the process of soliciting and reviewing public comments about proposed federal actions to determine the breadth of issues to be addressed. Comments on the proposed action, potential concerns, and opportunities for managing the MPBR Project Area were solicited from members of the public, American Indian Tribes, other public agencies, adjacent property owners, organizations, and Forest Service specialists.

The Notice of Intent (NOI) to prepare an EIS was published in the *Federal Register* on Monday, August 8, 2011. This provided official notification that the public comment period for the MPBR Project Area would last for 30-days concluding September 7, 2011. A corrected NOI was published in the *Federal Register* on Thursday, February 23, 2012 to update the Deciding Official determinations.

A scoping letter was mailed to approximately 333 potentially interested parties, including adjacent landowners, Tribes, and State and local governments, beginning on August 2, 2011. This letter included a description of the project area, an overview of the NEPA process, a general explanation of the actions proposed and the reasons for the proposal, and an invitation to comment. Three public meetings were held to explain the proposal to the public, and to take comment. A total of 268 members of the public attended these meetings, which were held in Sundance, WY; Hill City, SD; and Spearfish, SD.

The project was entered into the Schedule of Proposed Actions (SOPA) in October 2011. SOPA contains a list of Forest Service proposed actions that will soon begin or are undergoing environmental analysis and documentation. It provides information so the public can become aware of and indicate interest on specific proposals (located on-line at www.fs.fed.us/sopa).

The Forest received 164 emails and letters during the scoping period, and 581 individual comments were identified. There was considerable public response supporting the proposal and rationale for action. Many responders urged more and faster actions to address the beetle epidemic. Several responses were also received that questioned the need for the project, suggested other approaches, or expressed concern about the possible effects of the proposal on natural resources and other factors.

Some key interest groups consulted with and/or involved in the planning process were the South Dakota Department of Agriculture - Division of Resource Conservation and Forestry and Division of Wildlife Fire Suppression, Conservation Leaders, Chamber of Commerce for Rapid City and County Supervisors for Pennington and Lawrence Counties, Rapid City Optimist Club and National Forest Advisory Board. A concerted effort was made to engage in consultation regarding the project with Tribal contacts known to have interest in management of the National Forest. Tribal authorities have been invited to participate in the development of a programmatic agreement for this project (see Heritage Section).

Issues

This section provides a summary of issues identified during the public and internal scoping period for the MPBR Project. Comments received during scoping were used to help in defining issues, develop alternatives and mitigation measures, and analyze effects. A total of 164 comments were received via letters, faxes, public meeting transcripts, personal-delivery, or email during the formal scoping process. The majority of responses were supportive of the overall project, a few were not. Through review and analysis of scoping comments and input, the MPBR Project Core ID Team identified three prevailing or key issues related to the proposed activities. Comments received and the agency 'response to comments' are summarized in the MPBR Project File located at the Forest Supervisor's Office, Custer, South Dakota.

The ID Team reviewed input submitted during the scoping period and separated the issues into significant [as directed by the Council on Environmental Quality (CEQ) regulations (40 CFR 1500.4(g) and 1501.7)] and non-significant issues. Significant issues are 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 Council on Environmental Quality (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 (Sec. 1506.3)…." Non-significant issues and rationale regarding their categorization as non-significant may be found in the project record. A brief description of the three key issues and measurement indicators follows below:

1. Vegetation and Wildlife Habitat Diversity

The ongoing MPB epidemic is of foremost concern in the project area. The epidemic is killing mature pine trees, resulting in stand replacement on a landscape scale. The 250,000 acres of pine trees are rated as high risk for MPB infestation. A high level of mortality is expected throughout the area as a result of the ongoing epidemic. This would increase fuel loads and wildfire hazard, and poses a (significant) threat to ecosystem components and forest resources.

The proposed action seeks to maintain and enhance vegetation and wildlife diversity by removing infested pine trees to limit MPB spread locally. Reducing the amount of MPB caused mortality and maintaining mature pine trees within stands would reduce the potential for wildfire that could impact large areas of the forested ecosystem.

Most respondents commented on their support to limit the spread of MPB and reduce wildfire hazard. A few respondents commented directly on vegetation and wildlife habitat diversity. Generally, the emphasis of these comments was to leave the maximum amount of mature pine on the landscape. A concern was raised that efforts to suppress and prevent a potential insect infestation would result in reduced snag densities, tree diameters and longevity across the landscape.

Measurement indicators are listed below for the varied aspects of the vegetative and wildlife habitat diversity issue. These indicators are represented by vegetative diversity and wildlife habitat components applicable to the Black Hills NF as specified in the Forest Plan or other direction. Thus, as measurement indicators, these components can provide the public and

decision maker a basis for making a relative comparison between alternative resolutions regarding vegetative and wildlife habitat diversity. A comparison between alternatives is displayed in table format at the end of chapter 2. Also, a written description of the comparative differences in effects is presented in the Comparison of Alternatives section in Chapter 2 and in the Vegetation and Wildlife Habitat section in Chapter 3 of this EIS.

Measurement Indicators:
- MPB Hazard Rating (Acres Low / High)
- Structural Stages

2. Wildfire and Fuels Hazard

The need to reduce fuels, and the potential for large-scale wildfire are currently of foremost concern with the public and the agency in this area. The seven Community Wildfire Protection Plan's designate most of the proposed treatment areas as wildland-urban interface. There are 56 at-risk-communities and these issues have understandably been elevated to a higher level of concern with the local public, given the massive MPB epidemic and wildfires that have been experienced recently throughout the West and certainly within the Black Hills.

Comments from local, State, and Federal elected officials indicated that the Forest Service needs to be proactive and do more to address the ongoing MPB epidemic and wildfire and fuels hazard on National Forest lands with emphasis focused on the wildland-urban interface areas and private property boundaries.

The proposed action includes removing recently infested MPB trees. Many of the stands with a high/very high wildfire hazard also have a high risk for MPB. The proposed action recognizes that wildfire in this setting cannot be eliminated, but by managing vegetation and fuels, fire severity and intensities may be reduced.

The parameters listed below are measurement indicators for the multiple aspects of the fire and fuel hazard reduction issue in the MPB Response Project Area. These indicators are representative of a number of variables associated with fuels and fire hazard reduction. These measurement indicators are intended to provide the public and decision maker a basis for making a relative comparison between alternative resolutions regarding fuels and fire hazard reduction. A comparison between alternatives is displayed in table format at the end of Chapter 2 (see Table 2-1and Table 2-2). A narrative description of the comparative differences in effects is presented briefly in the Comparison of Alternatives section in Chapter 2 and in more detail under the Fire and Fuels section in Chapter 3 of this EIS.

Measurement Indicators:
- Fire Hazard Rating (Acres Low/Moderate/High/Very High)
- Wildland Urban Interface (Acres)
- Miles of Roads – Ingress/Egress (Levels 3-5)

3. Social

The Project area lies within the wildland-urban interface (WUI) and contains numerous at-risk communities. The many people who live within and adjacent to the area strongly value its

forested setting and the experiences and lifestyle associated with this environment. Landowners are concerned about property values and their health and safety as related to the ongoing MPB epidemic and the potential threat of large-scale wildfire. Values at risk on the approximately 300,000 acres of private land within the project are characterized by: extensive structure and subdivision development, 56 at-risk-communities, utility infrastructure, businesses, highways, roads, fences, outbuildings, recreation sites, and community watersheds.

The MPB Response project area contains many distinctive features that visitors look for when visiting National Forest System lands – solitude, fishing, hunting, camping, hiking, and motorized and non-motorized travel within a short distance of their communities.

The local public strongly supports using multiple management tools (including commercial timber harvest) to reduce the potential for insect/disease infestations and reducing the potential for large-scale wildfire. Public comments also support commercial harvest because it utilizes a renewable resource and provides a needed commodity, employs local residents, adds favorably to the local and State economy, is environmentally acceptable, and can make an important difference in quickly and effectively reducing insect/disease infestations and wildfire potential.

There were comments about the need to preserve the scenic beauty of the area, and to maintain the balance of the need for insect/fuel treatment with the amount of development/use within the area. Some respondents question whether the proposed thinning to reduce stand density would actually reduce mountain pine beetle risk. These respondents prefer an approach of either no active management or the use of prescribed burning as the way to naturally thin stands.

There was a remarkable expression of urgency and expectation by locals participating during the public involvement period. They clearly felt that the agency should act quickly and do something significant and effective to safeguard their well-being and the resource amenities from the MPB epidemic and potential impacts of large-scale wildfire.

The parameters listed below are measurement indicators for the various aspects of this social issue. These indicators are intended to provide the public and decision maker a basis for making a relative comparison between alternative resolutions regarding the social and economic concerns as related to the proposal, MPB, and fuel/fire hazard conditions in the area. A comparison between alternatives is displayed in table format at the end of Chapter 2. Also, a written description of the comparative differences in effects is presented in the Comparison of Alternatives section in Chapter 2 and in the Socio-economic section in Chapter 3 of this EIS.

Measurement Indicators:

- Fire Hazard Rating (Acres Low/ High)
- At-Risk Communities – Cooperative efforts with County, State, other Groups/Individuals (subjective estimate of cooperation and involvement with interested entities)
- Cost (millions)
- Commercial Timber Harvest (Volume)
- Non-Commercial Thinning (Volume)

CHAPTER 2 ALTERNATIVES, INCLUDING THE PROPOSED ACTION

INTRODUCTION

This Chapter provides a detailed description of the proposed action (Alternative B), Alternative C, as well as a No Action alternative (Alternative A) for the MPBR Project Area. Maps of the proposed action and alternatives are located in Appendix D of this EIS. The Agency has not identified a preferred alternative at this time.

This chapter presents the alternatives comparatively by both describing and displaying the quantitative and qualitative differences between each alternative. The intent is to provide the public and decision maker a basis for choice among management options when considering the environmental consequences (effects) of implementing each alternative as disclosed in Chapter 3 of this EIS.

A brief overview is presented toward the end of this chapter regarding those alternatives that were considered by the Core ID Team but eliminated from detailed development and study. The last section of the chapter contains two comparative tabular summaries that describe each alternative and display the quantitative and/or qualitative effects of implementing each alternative relative to the three key issues presented in Chapter 1.

ALTERNATIVES CONSIDERED IN DETAIL

This section provides a summary of activities that are planned to occur during implementation of any of the alternatives. *It is important to note that the amount (e.g. acres, miles, etc.) of a certain activity in any alternative is approximate (based on inventory and survey estimates).* Actual figures may increase or decrease somewhat during "on-the-ground" preparation of the project actions based on such things as non-uniform fuels regime or stand structure, small inclusions of inoperable terrain, refinement of length or standard of road needed or eliminated, etc.

The MPBR Project qualifies as an "authorized fuel hazard reduction project" pursuant to HFRA Sec. 102(a)(4). This determination is set forth in a project memo entitled "Authorized Hazardous Fuel Reduction Projects per HFRA" held in the MPBR Project file.

Pursuant to HFRA, authorized projects cannot take place in wilderness areas, wilderness study areas or areas where removal of vegetation is prohibited by an act of Congress or Presidential proclamation. None of these restrictions apply to the MPBR Project (Sec. 102 (d)). Also, HFRA requires that projects, such as the MPBR Project, be consistent with the LRMP (Sec. 102 (b)).

The MPBR Project Core ID Team recommended (with Deciding Official concurrence) that the No Action, Proposed Action, and one additional action alternative would be considered in detail. Section 104 of HFRA provides guidance on the range of alternatives studied in detail and disclosed in the NEPA document.

The MPBR Project Action Alternatives are based on known methods to reduce MPB infested stands using an adaptive approach because it is not possible to determine when or the precise level of MPB activity, but reasonable estimates can be made based on the current extent of the epidemic, the

expanding MPB brood populations available to infest new trees, and the large volume and wide distribution of high risk stands in the project area.

Alternative A would take no action to address the purpose and need. Alternatives B and C are action alternatives that focus to varying degrees on meeting the purpose and need. Alternative B is the proposed action and includes commercial and non-commercial thinning. Alternative C was developed in response to public comments received during the scoping period. Specifically, it responds to concerns about not treating more 'high risk' stands on a landscape basis, treating in advance of MPB, and addresses concerns about safety and access on roadways (ingress/egress).

The HFRA (Sec. 101(3)) also encourages the development of Community Wildfire Protection Plans (CWPP), which identify areas of WUI and recommends the types and methods of treatments on Federal and non-Federal land. The project area contains wildland-urban interface, as defined by the Community Wildfire Protection Plans for Crook, Custer, Fall River, Lawrence, Meade, Pennington, and Weston counties. This project would help accomplish goals of those plans by developing an accelerated program on certain Federal lands to combat insect infestations (Crook County); reduce the risk, and help restore, recover, and mitigate the damage caused by fire, insects, invasive species, and damaging weather (Meade, Lawrence County); and reduce fire and forest health risks within and around Wildland Urban Interface (WUI) areas and At-Risk Communities (ARC) (All Counties). The plans designate most of the MPBR Project Area as WUI for the purposes "covered" by HFRA (Sec. 102(a)(1)).

Alternative A – No Action

The National Environmental Policy Act (NEPA) requires the study of the No Action Alternative and to use it as a basis for comparing the effects of the Proposed Action and other alternatives.

The No Action Alternative assumes that no implementation of any elements of the proposed action or other action alternative would take place within the MPB Response Project Area. This alternative represents no attempt to actively respond to the purpose and need for action, the issues, or concerns identified during scoping for this project. There would be no effort to modify existing vegetation and related fuels conditions in the project area. Vegetation structure would change over time through natural growth and mortality and events such as wildfires, storms, and insect and disease outbreaks. None of the actions associated with this EIS would occur.

It is important to note that the absence of management actions does not mean that conditions in the area would remain static over time. In fact, there would likely be dramatic changes. This is related to the actions of nature and to the actions of people. Natural processes are likely to result in the large-scale mortality of mature pine trees due to the ongoing mountain pine beetle epidemic. Dead pine trees would add to the accumulation of ground and ladder fuels and increase the potential for large-scale wildfires with associated negative effects on the land, values, wildlife, and people. Human caused changes include a further increase in development on private land, expanded dispersed recreation use, and increased traffic on the newly designated road and trail system in the project area.

Actions such as ongoing Forest protection efforts, fire suppression, noxious weed treatment, and recurring road maintenance on system roads would continue as directed by the Forest Plan.

Vegetative management would not take place unless authorized by other decisions (see cumulative effects actions in Chapter 3).

Alternative B – Proposed Action

Alternative B is designed to reduce the threat from recently detected infestations of MPB in high risk stands. Infested trees would be treated before the beetles disperse to other trees (stands). Some surrounding (non-infested) trees at risk of infestation may also be thinned to reduce stand densities and the associated threat to ecosystem components, including forest resources, from the existing (mountain pine beetle) epidemic and reduce the potential for large-scale wildfire. The alternative was developed as a response to the purpose and need for action and it represents the Forest Service proposed action (see description of the purpose and need plus the proposed action in Chapter 1 of this EIS).

Vegetative management in this alternative uses Integrated Pest Management techniques on portions of approximately 242,000 acres to reduce the spread of MPB across NFS lands to manage and protect ecosystem components. Integrated Pest Management techniques are proposed for areas at high risk and most susceptible to MPB infestation, with the objective of treating and removing infested trees before beetles can disperse. Techniques such as:

- Cut and chunk, chipping, cut-hand pile-burn, and cut-equipment pile-burn would be scattered across the landscape. Generally chipping and cut-equipment pile-burn would be in areas with good access adjacent to or along private property and roads. Cut and chunk and cut-hand pile-burn would be scattered along roads, private property and hillsides to remove pockets of infested trees.
- Insecticide spraying (i.e. carbaryl) would generally occur in developed campgrounds, FS facilities, and on scattered legacy trees. Semiochemical use would be limited along the 'leading edge' of the BHNF MPB Strategy. Semiochemical techniques to attract MPB may occur generally southwest of Custer, SD adjacent to Custer State Park and generally west of Spearfish, SD towards the SD-WY State line; north of Sundance in cooperation and coordination with Forest Health entomologists and the States of SD and WY.
- Cable and Helicopter logging would generally occur in high value areas on slopes greater than 40 percent. Cable units would utilize existing roads.
- Commercial and non-commercial thinning to remove recently infested and non-infested trees would generally occur across the landscape on slopes generally less than 40 percent on up to 1,000 contiguous acres.

Alternative B proposes approximately 41,140 acres of commercial and approximately 7,260 acres of non-commercial (POL) thinning over an approximate five to seven year period to remove MPB infested trees and associated trees to lower mountain pine beetle risk and wildfire hazard. Commercial treatments would not be authorized in Non-motorized Backcountry (MA 3.32). Commercial and non-commercial thinning would generally occur on slopes less than 40 percent. Cable logging is proposed in areas with existing roads. This focused forest thinning serves to reduce MPB habitat and fuel loads.

Adhering to project design criteria, all trees infested by MPB would be targeted for treatment. Some surrounding (non-infested) trees at risk of infestation may also be considered for treatment.

Prospective treatment and methods used at any specific locations would be reviewed prior to implementation by resource specialists to ensure compliance with the Decision(s) of this EIS.

Most forest thinning would be accomplished using a variety of contracting methods (commercial timber harvest, service contracts, stewardship contracts) or Forest Service work crews or cooperators to a lesser extent would be used to thin trees and reduce fuels in areas where contracting is not feasible. The amounts of commercial and non-commercial acres are based on estimates at this time. The result, however, would be to maximize the economic efficiency of the overall operations through contracting and agreements. Sanitation harvest to remove infested pine trees may be conducted in areas near or adjacent to identified stands in order to limit the expansion of MPB population.

Alternative B would utilize existing roads and routes. No new roads would be constructed. Reconstruction of existing NFSRs could include improvements, restoration or realignment. Some existing unauthorized routes may be converted to Level 1 System Roads and closed following management activities. Some System Trails may be temporarily changed to roads and then returned to trails after vegetation management activities are completed.

See Table 2-1 and Table 2-2 at the end of this chapter for a comparison of alternatives. Appendix D contains maps that display the location of vegetation treatments activity and existing roads/routes. Design criteria, mitigation, and monitoring specific to this alternative are described in Appendix B. Integrated Pest Management methods and treatment activities in Alternative B would occur over an approximate five to seven year period and include:

Commercial Harvest Treatments

- 41,140 acres

Non-commercial (POL) Treatments

- 7,260 acres

Total estimated area of mechanical harvest treatments:

- 48,400 acres

Total estimated volume of timber and other products removed

- Volume of saw timber removed – up to 403,172 CCF over an approximate five year period
- Volume of products other than logs removed – up to 14,520 CCF over an approximate five year period

Alternative C

Alternative C was developed in response to public comments received during the scoping period. The alternative is a more proactive response to the purpose and need for action. Specifically, it responds to concerns about not treating more 'high risk' stands on a landscape basis, treating in advance of MPB, and addresses concerns about safety and access on roadways (ingress/egress).

Alternative C includes all aspects of Alternative B (Proposed Action). Integrated Pest Management techniques would occur on portions of approximately 248,000 acres to reduce the spread of MPB

across NFS lands to manage and protect ecosystem components. As stated for Alternative B, the following techniques could be used:

- Cut and chunk, chipping, cut-hand pile-burn, and cut-equipment pile-burn would be scattered across the landscape. Generally chipping and cut-equipment pile-burn would be in areas with good access adjacent to or along private property and roads. Cut and chunk and cut-hand pile-burn would be scattered along roads, private property and hillsides to remove pockets of infested trees.
- Insecticide spraying (i.e. carbaryl) would generally occur in developed campgrounds, FS facilities, and on scattered legacy trees and would use chemicals appropriate for forested environments.
- Semiochemical use would be limited along the 'leading edge' of the BHNF MPB Strategy. Semiochemical techniques to attract MPB may occur generally southwest of Custer, SD adjacent to Custer State Park and generally west of Spearfish, SD towards the SD-WY State line; north of Sundance in cooperation and coordination with Forest Health entomologists and the States of SD and WY.
- Helicopter logging would generally occur in high value areas on slopes greater than 40 percent.
- Commercial and non-commercial thinning to remove recently infested and non-infested trees would occur across the landscape on slopes generally less than 40 percent.

Alternative C proposes approximately 105,400 acres of commercial and approximately 18,600 acres of non-commercial (POL) thinning over an approximate five to seven year period to remove MPB infested trees to lower mountain pine beetle risk and wildfire hazard.

Alternative C includes three additional elements:

- Landscape level thinning in advance of large beetle infestations to reduce stand densities and the risk of MPB infestation, thereby reducing the wildfire hazard, and creating landscape-scale fuel breaks.
- Treatments in MA 4.2A Spearfish Canyon
- Up to 70 miles of new System and/or 180 miles temporary road construction

Alternative C would utilize existing roads and construct new System and/or Temporary Roads. Reconstruction of existing NFSRs could include improvements, restoration or realignment. Construction of new temporary roads would not be converted to System Roads. Some existing unauthorized routes (approximately 46 miles) may be converted to Level 1 System Roads and closed following management activities. Some System Trails may be temporarily changed to roads and then returned to trails after vegetation management activities are completed.

See Table 2-1 and Table 2-2 at the end of this chapter for a comparison of alternatives. Appendix D contains maps that display the location of vegetation treatments activity and new road construction. Design criteria, mitigation, and monitoring specific to this alternative are described in Appendix B. Integrated Pest Management methods and treatment activities in Alternative C would occur over an approximate five to seven year period and include:

Commercial Harvest Treatments

- 105,400 acres

Non-commercial (POL) Treatments

- 18,600 acres

Total estimated area of mechanical harvest treatments:

- 124,000 acres

Total estimated volume of timber and other products removed

- Volume of saw timber removed – up to 1,032,920 CCF over an approximate five year period
- Volume of products other than logs removed – up to 37,200 CCF over an approximate five year period

During analysis, the ID Team identified the need for a site-specific Forest Plan amendment to fully implement this alternative. Effects of implementing each alternative, including an amendment, are presented in Chapter 3. The following is a brief description that would require an amendment.

Forest Plan Standard 3103 directs to manage colonies of sensitive species of snails and snail species of local concern to retain important habitat features, by avoiding burning and heavy equipment use and other activities that may compact soils or alter vegetation composition and ground cover. A listed sensitive species, Cooper's mountainsnail, *Oreohelix strigosa cooperi*, is known to occur on the Black Hills, and is protected by this standard. Numerous colonies of this species are known to occur in Spearfish Canyon, Management Area 4.2A. Four snail Species of Local Concern (SOLC) - Callused vertigo (Vertigo arthuri), frigid ambersnail (Catinella gelida), mystery vertigo (Vertigo paradoxa) and striate disc (Discus shemekii) - also occur in Spearfish Canyon, though not as abundantly as Cooper's mountainsnail.

Alternative C proposes timber harvest via cable logging and use of tractors and skidders, as well as some road construction, in MA 4.2A. Due to the high occurrences of Cooper's mountainsnail and SOLC snails in MA4.2A these actions would not be consistent with Standard 3103. Therefore, a Forest Plan amendment is proposed as part of Alternative C, to allow these actions to take place within MA4.2A. This amendment would apply only to any actions approved under this project, and would not be an enduring amendment for other decisions, nor would it change the wording of Standard 3103 in the Forest Plan.

ACTIVITIES COMMON TO ALL ACTION ALTERNATIVES

Post-sale Activities: The Knutson Vandenburg (KV) Act authorizes the Forest Service to collect money from timber sales for resource enhancement, protection, and improvement work in the timber sale area. Actions proposed as KV activities for the MPBR Project area are listed below:

- **Vegetation monitoring:** Post treatment data collection for use in monitoring and evaluation of activities. Follows standard stand exam protocols for complete condition evaluation.
- **Noxious weed treatment and monitoring:** Spray and monitor noxious weeds following all ground disturbing activities.
- **Road closure:** All new roads constructed or converted under the MPBR Project would be closed upon the completion of management activities. Closure methods would be

determined at the time of closure depending on site conditions. Possible methods include: locked gates, boulders, dirt berms, downed trees, fences, and re-contouring.

The following is a description of specific actions planned that are common to both action alternatives (with some exceptions as noted) both in terms of type of action, amount, or size.

Fuels Management Collaboration and Cooperation
Under all Action Alternatives strong emphasis would be given to further current efforts at working collaboratively with the State Wildland Fire and Forestry Divisions, Volunteer Fire Departments, Crook, Custer, Fall River, Lawrence, Meade, Pennington, and Weston counties, landowners, and others regarding insect and fuels hazard reduction and management concerns including:

- Implementing the management recommendations and guidance set forth in the Community Wildfire Protection Plans;
- Working collaboratively with State, local jurisdictions, and private landowners to treat hazardous fuels in a coordinated effort along adjoining NFS/private land boundaries;
- Advocating the use of appropriate building materials, landscaping techniques, appropriate fuel break construction methods like those recommended by the "*Firewise*" program on adjoining lands; and

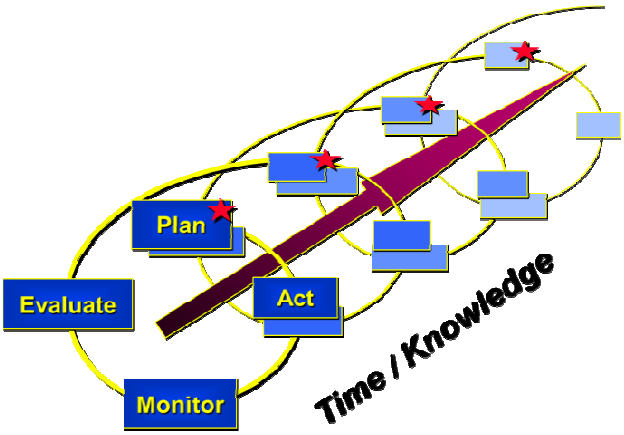
DESIGN CRITERIA

Design criteria include standard practices such as Forest Plan Standards and Guidelines (S&Gs), Best Management Practices, and others. They are actions that are applicable and expected to be implemented as a matter of standard operating procedures consistent with the theme of a given alternative. Design criteria are applied in order to protect resources and forest users, as well as minimize impacts resulting from implementing action alternatives (see Appendix B).

MONITORING

The MPB Response Project is an adaptive management project. As such, monitoring plays an important role in providing feedback on which design features were implemented, which were effective, and whether adaptations are needed to treatment design to make them more effective (Figure 2-1).

Figure 2-1 The Adaptive Management Cycle.



Monitoring MPB Response Project activities would consist of two types of monitoring – implementation monitoring and effectiveness monitoring. Implementation monitoring would measure whether applicable design criteria, BMPs and Forest Plan standard and guidelines are correctly implemented. This allows managers to adjust management if certain items are being missed during the implementation process. Effectiveness monitoring measures whether the treatments implemented with the design criteria, BMPs and Forest Plan standard and guidelines are achieving the desired out comes. Effectiveness monitoring would measure how implemented treatments are effective at protecting resources as well as reducing MPB risk. If monitoring finds resource protection objectives are not being achieved, then:

- Reduce or modify vegetation treatment operations <u>and/or</u>
- Increase resource protection measure
- Increase monitoring to determine the source of impact and apply appropriate mitigation

A sample of the each type of treatments in the MPB Response Project would be selected each year for monitoring and evaluation. Monitoring would occur through pre-field review and field visits. The pre-field review would include reviewing implementation notes and applicable standards, guidelines, design criteria and BMPs. Field visits would be accomplished in an interdisciplinary fashion to facilitate cross-sharing of effectiveness and identification of needed changes to project activities. The monitoring information collected would be evaluated and documented along with any recommended changes in an annual report. The annual report would be completed and provided to the Forest Supervisor within two months of the end of the fiscal year (January 31 of each year).

Project and contract administrators would perform much of the project monitoring during project implementation. Other resource specialists would monitor specific progress including application of design criteria and mitigation measures related to their resource of concern.

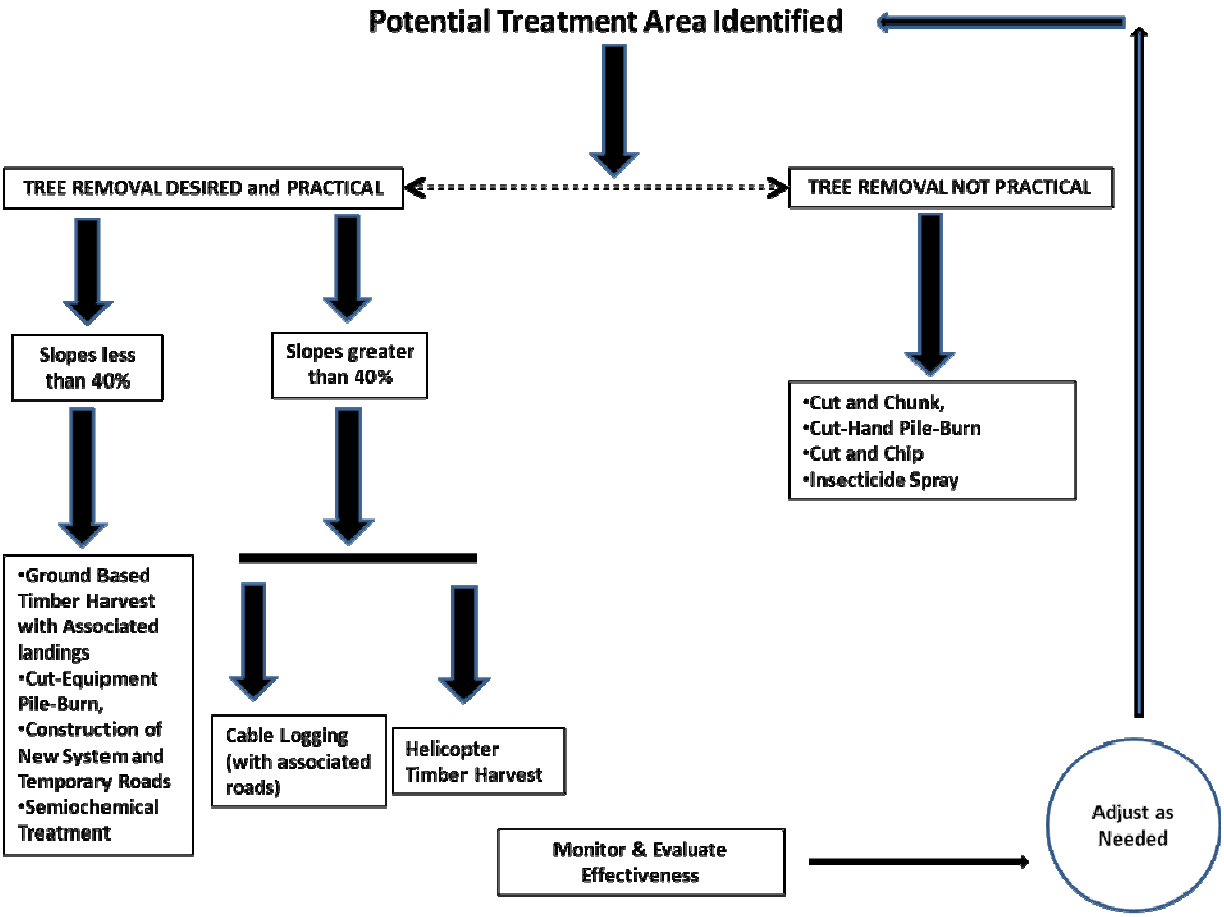
Selection of Integrated Pest Management Techniques

Black Hills National Forest resource specialists use professional judgment along with collaborating with researchers and others to use the best available science to address the on-going MPB epidemic. The Project is based on known methods to reduce MPB infested stands

using an adaptive approach because it is not possible to determine when or the precise level of MPB activity, but reasonable estimates can be made based on the current extent of the epidemic, the expanding MPB brood populations available to infest new trees, and the large volume and wide distribution of high risk stands in the project area.

The guide in figure 2-2 will help determine, which, if any, integrated pest management techique and design criterias would be utilized in the MPBR Project potential treatment areas.

Figure 2-2 Selection of IPM



Utilizing local wood products industries would be the most economical and normally the best choice in meeting the purpose and need: removing the infested tree(s) from the forest reduces MPB risk and the fire hazard.

ALTERNATIVES CONSIDERED but ELIMINATED FROM DETAILED STUDY

Additional alternatives to the Proposed Action were considered based on issues and concerns expressed during the scoping period. Most scoping comments were supportive of the Proposed Action, but some had recommendations to consider alternative actions as part of the NEPA analysis. The HFRA Section 104(c)(1)(C)(i)(ii) specifies consideration of additional alternative(s) meets the purpose and need of the project. Some of the comments recommended actions that were

outside the scope of the purpose and need, some were actions that could be incorporated into design and mitigation measures included in the proposed action, and some were incorporated into an additional alternative (Alternative C) for detailed study. The following provides an overview of alternatives that were considered, but eliminated from detailed study.

District landscape Projects. Since 1997, the Black Hills has seen a noticeable increase in pine tree mortality due to MPB. The four ranger districts that comprise the Black Hills National Forest have also increased the scale and scope of District level projects to manage the Forest in response to the ongoing MPB epidemic. From the early 2000's these landscape projects have thinned the Forest in areas most prone to MBP.

However, many areas of the Forest are more continuous, uniform and denser than what has historically occurred. The MPB epidemic is rapidly expanding across the Forest. The epidemic is changing vegetation structure and wildlife habitat on a landscape scale. The rate of infestation is increasing and the epidemic is likely to continue over the next three to five years (Allen, 2011).

The potential treatment areas identified are 'High Risk' stands on National Forest System lands to reduce and slow the spread of MPB, and reduce wildfire hazard on the Forest. The current approach is beyond the scale of District level projects to effectively respond to the ongoing MPB epidemic. Alternatives B and C propose to reduce MPB risk and fire hazard by treating recently infested MPB areas in a timely and effective manner. Alternative C proposes to thin in advance of MPB to lessen the susceptibility of MBP and reduce fire hazard across a larger landscape on the premise of anticipating MPB entering the potential treatment areas. None of these proposed treatments associated with the Mountain Pine Beetle Response Project would occur within current or foreseeable District planning areas. District landscape projects, at this time, was considered but eliminated from detail study primarily because it does not provide the flexibility, timing, scale, and efficacy to respond to the MPB epidemic and associated fire hazard.

An alternative was proposed that would limit commercial treatments to within one-quarter mile of structures. This proposal is intended to provide defensible space from wildfires around private property. The Healthy Forests Restoration Act encourages the development of Community Wildfire Protection Plans. Crook, Custer, Fall River, Lawrence, Meade, Pennington, and Weston counties have CWPP's and define WUI buffers and treatments within one-half mile, one and one-half mile, and three mile buffer zones. This project would help accomplish goals of those plans by developing an accelerated program on certain Federal lands to combat insect infestations (Crook County); reduce the risk, and help restore, recover, and mitigate the damage caused by fire, insects, invasive species, and damaging weather (Meade, Lawrence County); and reduce fire and forest health risks within and around Wildland Urban Interface (WUI) areas and At-Risk Communities (ARC) (All Counties). The threat of wildfire is a major concern for those living, working, and recreating in this area, and for the communities that depend on the Forest watersheds for a portion of their domestic water supply.

An alternative that only treats within one-quarter mile of structures was considered but eliminated from detail study for several reasons. First, limiting treatments to one-quarter mile does not address the need to treat stands that are infested with MPB. Second, wildfires in the Black Hills have been observed lofting embers and starting spot fires up to one-half mile in front of a fast moving fire front. Third, the potential treatment areas are rated as high or very high fire

hazard rating. The potential for a fast moving stand replacing fire is relatively high. Furthermore, it does not address the threat to ecosystem components from large-scale wildfire over the larger project area.

An alternative was proposed to exclude certain management areas from treatments (i.e. Backcountry Non-Motorized, Southern Hills, and Big Game Winter Range). The ID Team determined that excluding these MA's from the project would not meet the purpose and need or Forest Plan direction. Both Alternatives A and B address a portion of this proposed alternative – Alternative B would not authorize commercial treatments in Backcountry Non-Motorized (MA 3.32). Therefore, excluding certain management areas from treatments was considered but eliminated from detail study.

An alternative was proposed to include 'special areas' for treatment (i.e. Inyan Kara Mountain and Sand Creek Inventoried Roadless Area, Crow Peak, Lookout Mountain). Inyan Kara and Sand Creek Inventoried Roadless Areas (IRA's) were not included in the MPBR Project due to agency policy on management of roadless areas and Forest Plan direction regarding management activities and opportunities. These 'special' Management Areas have specific Forest Plan direction on management activities and would require a time consuming amendment to the Forest Plan to be included in the MPBRP. Focusing on Management Areas with objectives to actively treat MPB, the MPBRP would provide for a more timely and effective response as well as allowing the Forest more flexibility in responding to MPB outbreaks by allowing the use of a suite of tools to reduce or blunt MPB. Other areas (i.e. Spearfish Canyon was incorporated into Alternative C) and Lookout Peak is on private property. For the reasons cited above, a separate alternative designed to include additional 'special areas' was considered but eliminated from detail study.

An alternative was proposed that would not allow any new road construction or reconstruction or convert any 'non-system' roads. Alternative A (No Action) and Alternative B address a portion of this proposed alternative – no new road construction. The Forest-wide Travel Management EIS/ROD designates motorized routes/areas within the project area.

The Transportation System for the Proposed Action (Alternative B) proposes to convert up to 15 miles of existing non-system roads and converts up to 46 miles in Alternative C. Alternatives B and C propose to reconstruct approximately 87 and 223 miles of system roads to improve drainage, protect road beds from damage, and ensure safe ingress/egress. An Alternative that does not treat MPB infested stands by precluding reconstruction would not meet the purpose and need for the project.

Any impacts associated with road activities are likely to be minimal in intensity of effects. The new road construction proposed in Alternative C (70 miles System and 180 miles temporary) would be field reviewed prior to construction. All road work would comply with Region 2 Watershed Conservation Practices (WCP). The HFRA, under which the project is proposed, is intended to streamline the NEPA process, limit the number of alternatives analyzed (see HFRA Sec. 104(c)(1) and (2)), and focus on meeting the purpose and need for the project (HFRA Sec. 104(c)(1)(C)(i)(ii)). Analyzing a separate alternative that constructs no new roads or converts no existing non-system roads is well within the range of alternatives considered in detail in this EIS.

Therefore, an alternative that does not allow new construction, conversion of existing non-system roads, or reconstruction of existing roads was considered and eliminated from detail study for the reasons cited above.

An alternative was proposed that would reduce MPB effects through non-commercial treatments only, use prescribed fire, and convert stands to aspen or birch. The ID Team determined that the use of non-commercial thinning only would focus on limiting tree removal to those smaller than 9-inch diameter is neither warranted nor prudent relative to the on-going MPB epidemic and reducing hazardous fuels within the potential treatment areas. This proposed alternative would be very costly with little to no offsetting revenues. Promoting diversity in forest types is a Forest Plan objective that would continue under any alternative.

Many of the stand boundaries identified in the project are mid-slope and do not lend to a safe and effective prescribe broadcast burn unit. There is abundant intermix of private land, 56 at risk communities, WUI, FRCC 3, and the potential treatment areas rated as high or very high fire hazard. This increases the burning complexity (in both igniting and holding) therefore, prescribed broadcast burning, utilizing only non-commercial treatments and converting stands was considered by eliminated from detail study.

An alternative was proposed that would maximize commercial and non-commercial treatments and broad scale MPB baiting. The ID Team considered fully maximizing treatments on all possible acres needing treatment. Developing and analyzing such an alternative would certainly take the range of alternatives to the fullest extent being analyzed. This could entail amending the Forest Plan to permit treatment at the expense of other Forest Plan objectives, standards, or guidelines.

This proposal, which is within the scope of the purpose and need, would most likely have the greatest positive impact on reducing MPB and hazardous fuels. The use of broad scale baiting has not been implemented and monitored for results across large landscapes (See Vegetation Section in Chapter 3). However, when balancing the needs of other resources relative to Forest Plan direction and HFRA, the ID Team determined that a maximal approach would not be practical primarily because of the costs associated.

COMPARISON OF ALTERNATIVES

This section presents a brief comparative discussion of the three alternatives given detailed study in this EIS. The alternatives are described and compared in terms of the effects each alternative has on the key issues described in Chapter 1. A comparative overview of vegetation treatment activities is also provided. Table 2-1 and 2-2, display comparative summaries of the effects of each alternative and their respective treatment activities. The environmental consequences of the alternatives to the resources affected in the MPBR Project Area are more completely described in Chapter 3 of this EIS and information contained in the Project File.

1. Vegetation and Wildlife Habitat Diversity Issue

Changes in vegetation and associated wildlife habitat would occur in the project area regardless of which alternative is selected, including the No Action Alternative. The ongoing MPB

epidemic is expected to continue to greatly affect the vegetation and wildlife habitats in the project area. Open forest conditions are expected to increase in all alternatives while dense forest conditions are expected to decline due to MPB activities. Increased fuel loading caused by dead and dying pine trees would increase the potential for even more dramatic changes from potential wildfire, up to the complete removal of the existing forest over large portions of area. Stand-replacing fire would create Black-backed and Lewis's woodpecker habitat while removing habitat for other sensitive species.

In the short term, Alternative A is expected to favor wildlife species that prefer dense mature pine stands with large amounts of standing dead trees (snags). Many of these habitats are expected to change in the long term with the ongoing MPB epidemic and greater potential for large-scale wildfire. MPB activities are expected to reduce mature ponderosa pine trees. Some of the mature pine trees are large trees that serve as raptor roost trees, bat roosts, foraging habitat for brown creepers and pygmy nuthatches, and provide future large snags for woodpeckers and flying squirrels.

Alternatives B and C are expected to directly reduce, but not eliminate the amount of dense pine habitat, and favor wildlife species that thrive in more open stands. Open forest conditions are used by peregrine falcons and goshawks for foraging, Lewis's woodpeckers, and bighorn sheep. Habitat for other species (e.g., flammulated owls, Black-backed woodpeckers, broad-winged, sharp-shinned and Cooper's hawks) that use dense, mature forest conditions is expected to decline. Some species use both dense and open forests (e.g., goshawks, northern flying squirrels, saw-whet owls, pygmy nuthatches and deer). These species may decline until the forest recovers from MPB and treatments. Forested stands with lower basal areas would improve growth and vigor and increase the size of the remaining trees. These conditions are expected to conserve habitat for woodpeckers, brown creepers, and pygmy nuthatch, and bats by promoting the development of larger-diameter trees, which may eventually provide large-diameter snags. These alternatives also would have a lower but sufficient amount of snags as compared to Alternative A. Alternatives B and C would reduce mountain pine beetle hazard and tree mortality. Some of stands would be treated thereby fuel loading would be managed and overall wildfire hazard reduced.

The removal of the pine overstory in Alternatives B and C would release the established understory from competition for light, water, and nutrients. The effect would be an increase in early successional, younger structural stage pine directed at meeting Forest structural stage objectives. Species associated with early seral pine habitats would benefit from treatments proposed in Alternatives B and C.

Deciduous trees such as aspen and oak may increase under all alternatives if MPB areas and treatment areas have a deciduous component. This could improve foraging habitat for ruffed grouse, redbelly snakes, broad-winged hawks, Cooper's hawks, goshawks and other species that use hardwoods or prey on animals that use hardwood habitat. The potential for hardwood to increase is greatest in Alternative C, followed by Alternative B and A, respectively.

2. Wildfire and Fuel Hazard Issue

Forest vegetative and fuels conditions in the Mountain Pine Beetle Response project area would continue to deviate from their historic range under Alternative A (No Action). With the expanding

MPB epidemic, large amounts of dead, dry fuels will be added to an already serious wildfire hazard. Currently 100% of the project area is rated at a high or very high wildfire hazard and this hazard will continue to increase if no action is taken to modify or treat the fuels. The end result could be high intensity wildfire over much of the project area that would remove much of the existing forest cover. This could cause significant negative effects to the ecosystem; area infrastructures, public and private lands, and threaten the lives of residents and firefighters. There are approximately 206,000 acres of WUI, which would not be treated under the No Action Alternative. Alternative B contains 200,000 acres and Alternative C 206,000 acres of WUI, which could potentially be treated.

Treatments planned in Alternatives B and C would help reduce the potential for a severe wildfire by moving the forest closer to a Condition Class 1 or 2 - i.e., conditions more closely approaching the natural (historical) range of variability of vegetation characteristics; fuel composition; wildfire frequency, severity and pattern; and other associated disturbances. This would be accomplished by thinning the ponderosa pine forest, removing or treating some of the surface fuels by pile burning.

Alternative C, followed by Alternative B, would have the greatest effect on reducing fire hazards. Both alternatives would treat the forest and manage the forest to a lower stand density. Treatments would be implemented on a landscape basis and designed so that they would complement existing or natural fuelbreak features such as hardwood stands, meadows, private land pastures, and moister habitats.

Fire Hazard is expected to be reduced substantially with Alternatives B and C, but conditions change quickly in a Fire Regime I forest, and fire hazard will eventually escalate post-treatment as the vegetation grows and the detritus once again accumulates. However, the fire hazard in twenty years is expected to be much lower with Alternative C or B than the No Action Alternative.

All action alternatives would meet the Forest Plan Goal 10 of establishing and maintaining a mosaic of vegetative conditions to reduce occurrences of large-scale fire, insect, and disease events, and facilitate insect and disease management and firefighting capabilities, and Standard 4103, utilizing prescribed fire to achieve management objectives.

It is not possible to eliminate fire from a short interval fire regime based on past history of fire events in the Black Hills. Wildfires would continue to occur within or adjacent to the project area. Most of these fires are of low intensity and are too small to have a significant effect upon the environment. It is the large, severe wildfires that have the most impact upon the ecosystem, the public, and private lands conditions and values. The alternatives for the MPBR Project have been evaluated on their effectiveness in reducing the potential for large, severe wildfires.

3. Social

The ongoing MPB epidemic and subsequent wildfire hazard is of foremost concern in the project area. This epidemic is killing mature pine trees, resulting in stand replacement on a landscape scale.

There would be no direct costs associated with Alternative A. Although potential costs associated with No Action (Alternative A) is not integrated into the cost/benefit analysis, the actual cost of no action could potentially be much higher than the action alternatives in economic, social and environmental terms. Recent wildfires on the Black Hills and in the

western USA have experienced costs in the millions of dollars for suppression alone. For example suppression costs for the recent Battle Creek Fire are estimated at $6.5 million and the Jasper Fire around $11.5 million. Costs of rehabilitation, economic loss of resources and property values are significant additional costs of these wildfires.

The financial analysis illustrates that commercial harvest revenues offset costs of alternative implementation in proportion to the value and amount of merchantable timber removed. Revenues from Alternative B offset implementation costs to a lesser degree than Alternative C. Because of the greater revenues generated more activities critical to meeting the purpose and need can be accomplished under Alternative C relative to Alternative B. Costs associated with non-commercial thinning acres planned (7,260 acres in Alternative B and 18,600 acres in Alternative C) contribute to the high cost and revenue factors which influence the differences in the financial outcomes.

Mountain Pine Beetle and wildfire hazard reduction is an indirect indicator of how effectively the alternatives contribute to safeguarding the health, values and lifestyles of local residents and Forest users by reducing insect and severe wildfire hazard. This is a qualitative indicator; however, this measure is supported by the effects to MBP and wildfire hazard resulting from the level of vegetative treatment to reduce potential for insects / disease and large-scale wildfire as disclosed in the analysis. The No Action alternative does nothing to address this issue and the potential for insect infestations and large-scale wildfire continues to increase. Alternative B has a moderately effective impact to address these social concerns. Alternative C, with its landscape approach to treat in advance of MPB is the most effective at reducing the potential for insect infestations and probability of large-scale wildfire.

Table 2-1 Effects to Key Issues by Alternative

1. Vegetation and Wildlife Habitat Diversity	**Alt A**	**Alt B**	**Alt C**
MPB Risk Rating – Low (acres)	0	48,400	124,000
MPB Risk Rating – High (acres)	248,000	193,600	124,000
2. Wildfire and Fuels Hazard	**Alt A**	**Alt B**	**Alt C**
Fire Hazard Rating (Low) Post Treatment	0	0	0
Fire Hazard Rating (Moderate) Post Treatment	0	48,400	124,000
Fire Hazard Rating (High / Very High) Post Treatment	248,000	199,600	124,000
Wildland Urban Interface (acres)	206,000	200,000	206,000
Level 3-5 System Roads - Ingress/Egress (miles)	177	162	177
3. Social-Economical	**Alt A**	**Alt B**	**Alt C**
Cooperative Efforts with County, State, Other Groups and Individuals (poor to best)	Poor	Better	Best
Total Cost (million)	N/A	-$27.849	-$72.702
Commercial Thinning Treatments (acres)	0	41,140	105,400
Non-Commercial Thinning Treatment	0	7,260	18,600
Volume (over five to seven years)			
Sawtimber CCF	0	403,140	1,032,920
POL CCF	0	14,520	37,200

Structural Stages: In the hardest hit areas, near complete mortality of the larger trees could occur on up to 50 percent of structural stage 4C. This mortality of 4C would result in a mix of structural

stage 2 and 3A due to the prolific pine regeneration' that occurs naturally in the Black Hills, thus avoiding the non-stocked structural stage 1. Structural stage 3A stands would result from the advance regeneration presently occurring within the stands. The other 50% of the 4C the mountain pine beetle attack area size could result in a variation of overstory stand densities resulting in mostly a 4A structure with some 4B. As the mountain pine beetle moves across the landscape there is the probability of complete landscapes being killed over time as evident of the on-going epidemic.

Table 2-2 Treatments by Alternative

Activity	Alternative A	Alternative B	Alternative C
Cut and Chunk*	0	All Acres (242,000)	All Acres (248,000)
Cut and Chip*	0	All Acres	All Acres
Cut-hand pile-Burn*	0	All Acres	All Acres
Cut-Equipment Pile-Burn*	0	Generally slopes less than 40 percent	Generally slopes less than 40 percent
Insecticide Spray	0	Campgrounds/Admin Sites/Legacy Trees	Campgrounds/Admin Sites/Legacy Trees
Semiochemical**	0	Synthetic attractants would be used on a limited basis based on entomologist recommendations.	Same as Alternative B
Commercial/Non-commercial Timber Harvest***	0	48,400 acres over five to seven years	124,000 acres over five to seven years
Ground Based	0	Generally less than 40 % slopes	Generally less than 40 % slopes
Cable	0	Cable Harvest utilize existing roads/routes; generally greater than 40% slopes	Cable Harvest; generally greater than 40% slopes
Helicopter	0	Generally areas greater than40% slopes	Generally areas greater than 40% slopes
Construct New System Roads	0	0	70 Miles
Construct Temporary Roads	0	0	180 Miles
Convert to System Roads	0	15 Miles	46 Miles
Volume CCF (over five years) Sawtimber Product other than Logs (POL)	 0 0	 403,172 14,520	 1,032,920 37,200

*MPB infested trees would be cut/chunked/chipped/burned in all areas based on the Forest MPB Strategy
**Use of semiochemicals, such as Attractants, is a method which would be utilized in coordination with Forest Health and the States of SD and WY entomologists.
***MPB infested trees removed using conventional harvest methods. Alternative B would remove infested trees as well as an adequate buffer surrounding the infested trees. Alternative C would focus more on the resiliency area of the Forest Strategy.

CHAPTER 3 AFFECTED ENVIRONMENT and ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter describes the affected environment for each resource analyzed. Subsequently, the environmental consequences of the alternatives on the resource components of the physical, biological, and social environment in the MPBR Project Area are disclosed. Environmental consequences are described in terms of the beneficial/adverse, short and long-term direct/indirect and cumulative effects. Effects are quantified where possible, although qualitative discussion is often necessary. Elements that are not affected or minimally affected by the alternatives such as climate, noise, and topography are not discussed. This chapter provides the scientific and analytical basis for the comparison of alternatives presented in Chapter 2.

Direct and indirect effects of the proposed action and its alternatives were analyzed over the planning period (10-15 years). Cumulative effects take into account past, present, and reasonably foreseeable activities from actions other than the MPBR Project, in addition to direct and indirect effects of the MPBR Project. The area analyzed for cumulative effects is the project area for all resources unless otherwise noted. Cumulative effects are disclosed under each resource topic.

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of the past action. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

This cumulative effects analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. There are several reasons for taking this approach. First, a catalog and analysis of all past actions would be impractical to compile and unduly costly to obtain. Current conditions have been impacted by innumerable actions over the last century (and beyond), and trying to isolate the individual actions that continue to have residual impacts would be nearly impossible. Second, providing the details of past actions on an individual basis would not be useful to predict the cumulative effects of the proposed action or alternatives. In fact, focusing on individual actions would be less accurate than looking at existing conditions, because there is limited information on the environmental impacts of individual past actions, and one cannot reasonably identify each and every action over the last century that has contributed to current conditions. Additionally, focusing on the impacts of past human actions risks ignoring the important residual effects of past natural events, which may contribute to cumulative effects just as much as human actions. By looking at current conditions, we are sure to capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects. Finally, the Council of Environmental Quality issued an interpretive memorandum on June 24, 2005, regarding analysis of past actions. The memorandum states, “agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions.”

The cumulative effects analysis in this EIS is also consistent with Forest Service National Environmental Policy Act (NEPA) Regulations (36 CFR 220.4 (f)) (July 24, 2008), which state, in part:

CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives would add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonably foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making (40 CFR 1508.7).

The resource components described in this chapter are arranged in three sections:

Physical Environment
Biological Environment
Social Environment

PHYSICAL ENVIRONMENT

This section will describe the affected environment and environmental consequences for each resource of the Physical Environment (Watershed, Soils; and Transportation).

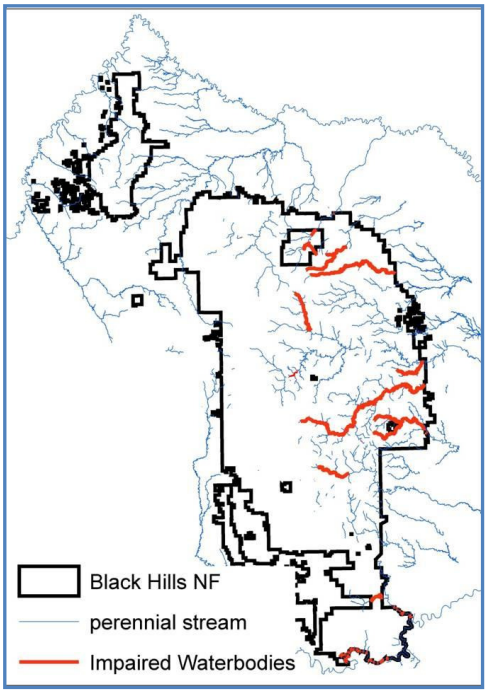
WATERSHED

Affected Environment
The 1996 Final Environmental Impact Statement (FEIS) for the Black Hills National Forest Land and Resources Management Plan (USDA Forest Service 1996b) and the 2005 Final EIS for the Phase II Amendment to the 1997 Revised Forest Plan (USDA Forest Service 2005a) disclosed information on water resources including groundwater, water yield, watershed condition class, stream flow regimes and wetlands. The 2010 Black Hills National Forest Travel Management Plan FEIS (USDA Forest Service, 2010d) disclosed information on the road network in relation to aquatic resources. This information is incorporated by reference and summarized for this analysis area. New information is also presented below.

Watershed Condition Class
The Black Hills National Forest reclassified watershed condition class as part of a 2011 national effort. The process is outlined in the *Watershed Condition Framework and Technical Guide* (http://www.fs.fed.us/publications/watershed/). Watershed condition was based on a 12-indicator model that considered both aquatic and terrestrial physical and biological indicators. Specific

indicators included; water quality, water quantity, aquatic habitat, aquatic biota, riparian/wetland vegetation, roads and trails, soils, fire regime, forest cover, rangeland vegetation, terrestrial invasive species and forest health. Indicators were individually rated, then summed based on a weighting factor to give a rating of Class 1 (functioning properly), Class 2 (functioning at risk) or Class 3 (impaired function) was assigned. A watershed that is rated between a score of 1.0 and 1.6 is a Class 1 watershed. A watershed that is rated between a score of 1.7 and 2.2 is a Class 2 watershed. A watershed that is rated between a 2.3 and 3.0; it is a Class 3 watershed (USDA Forest Service, 2011c).

The Black Hills National Forest has 44 Class 1 watersheds, 51 Class 2 watersheds and zero Class 3 watersheds. The results can be viewed online at: http://apps.fs.usda.gov/WCFmapviewer/. Ten watersheds were excluded from this process because Forest Service activities were not likely to affect the condition class based on the small acreage (usually less than 10%), location or ownership pattern of National Forest System land in the watershed.



Surface Water

The Black Hill's stream network is characterized by geology, climate, and constructed reservoirs that influence stream permanence, volume, temperature, etc. The Black Hills region traditionally has some of the best surface water quality in the state (SD DENR 2010). This is due in a large part to a cooler climate, higher precipitation and less erosive bedrock than the surrounding plains.

The geology of the Black Hills results in very little surface water on the Limestone Plateau and on the southwest portion of the Forest. These limestone formations also create a "loss zone" along some of the Forest periphery where stream flow goes into groundwater aquifers. During periods of base flow, some` streams lose their entire flow when crossing these outcrops.

Approximately 50% of the annual precipitation occurs during May, June, and July, and almost 75% during the 5-month period between April and August, in the form of rain associated with high-intensity, short-duration thunderstorms. The smallest amounts of precipitation typically occur during the winter months, November through February, as snow. Most of the total annual snow fall occurs in the late spring months of March and April.

There are no natural lakes on the Forest (Stewart et al, 1964); all standing waters are manmade impoundments. Approximately 2,000 surface acres of reservoirs occur on the Black Hills National Forest (USDA-Forest Service 1996). The largest three reservoirs on the Forest include Pactola (785 acres), Deerfield (415 acres) and Sheridan (385 acres). The Forest Service has jurisdiction of water levels in and releases from Sheridan Reservoir whereas the U.S. Bureau of Reclamation has jurisdiction of Pactola and Deerfield reservoirs. Eleven other Forest Service

impoundments, ranging in size from less than 1 acre (Strawberry Pond) up to 30 surface acres (Cook Lake), provide fishing and other water recreation activities.

Beneficial Uses and Impaired waters

The Clean Water Act requires states to adopt water quality standards to protect the nation's waters. These standards define how much of a pollutant can be in a surface and/or groundwater while still allowing it to meet its designated uses, such as for drinking water, fisheries, swimming, irrigation or industrial purposes. Every two years States must publish an updated list of streams and lakes that are not meeting their designated uses (impaired waters) because of excess pollutants.

South Dakota impaired streams are listed in the South Dakota Department of Environment and Natural Resource's *2010 Integrated Report for Surface Water Quality Assessment* (SD DENR 2010). Impaired streams within the analysis area include Battle, Bear Butte, Elk, French, Grizzly Bear, North Fork Rapid, Spring, Strawberry, Victoria, West Strawberry and Whitewood creeks. Impaired lakes include Iron Creek, Deerfield, Horsethief and Sheridan lakes. No impaired waters are identified on the Wyoming portion of the Black Hills National Forest (WY DEQ 2010).

Table 3-1 Beneficial Uses and Impaired Streams

Waterbody	Beneficial Use	Impairment	Source
Battle Creek	Coldwater Permanent Fish Life	Temperature	Natural sources
Bear Butte Creek	Coldwater Permanent Fish Life	Temperature	Natural sources
Deerfield Lake	Coldwater Permanent Fish Life	Temperature	
Elk Creek	Coldwater Permanent Fish Life	Temperature	
French Creek	Coldwater Marginal Fish Life	Dissolved oxygen temperature	Natural sources Drought-related impacts
Grizzly Bear Creek	Coldwater Permanent Fish Life	Temperature	
Horsethief Lake	Coldwater Permanent Fish Life	Ph (high) temperature	Natural sources
Iron Creek Lake	Coldwater Permanent Fish Life	Temperature	
North Fork Rapid	Coldwater Permanent Fish Life	Temperature	
Sheridan Lake	Coldwater Permanent Fish Life	Dissolved oxygen temperature	
Spring Creek (↑Sheridan Lake)	Coldwater Permanent Fish Life Immersion Recreation	Temperature Fecal coliform	Natural sources Urban runoff Livestock On-site treatment systems Wildlife
Spring Creek (↓Sheridan Lake)	Coldwater Marginal Fish Life	Temperature	Natural sources
Strawberry Creek	Fish/Wildlife Propagation, Recreation, Stockwater	Cadmium	Acid mine drainage Impacts from abandoned mines
Victoria Creek	Coldwater Permanent Fish Life	Temperature	Natural sources
West Strawberry Creek	Limited Contact Recreation	Fecal coliform	
Whitewood Creek	Immersion Recreation	Escherichia coli Fecal coliform	Wildlife other than waterfowl Grazing in riparian/shoreline zones Combined sewer overflows

Source: SD DENR 2010

Stream Connectivity and CDA's
Dams associated with manmade impoundments affect stream connectivity and aquatic organism passage. Other small dams on non-NFS land and instream structures, such as "perched" culverts at road-stream crossings, also exist and fragment the stream network and block fish passage.

Unpaved road surfaces are a long-term source of sediment input into waterbodies, resulting in connected disturbed areas (CDA's). The proximity of a road to a waterbody increases the potential for sediment input. Road-stream crossings are typically CDA's. There are approximately 280 road crossings on perennial streams in the analysis area. This number includes all management jurisdictions (Forest Service, State, county, etc.) and roads both open and closed to motorized use.

Water Yield
Water yield is a concern for communities in and around the Black Hills. The water provided by streams that flow from the Black Hills is an important resource utilized for drinking water supplies, irrigation, stock watering, fisheries, and recreation in the surrounding area.

Forested landscapes intercept rain and snow, evapo-transpiring the moisture back to the atmosphere. As a result, forests can lower the quantity of water that reaches the ground surface. In the Black Hills, over 92% of the total annual precipitation is lost to evapo-transpiration associated with the dense forests of the area (Driscoll et al, 2002). However, forests also help conserve moisture by providing shade and cooler temperatures which provide for less overall evaporation. The transpiration of moisture back to the atmosphere contributes to rain and snow development in the area. Thus, the annual water yield depends upon the density or coverage of the forest, the type of forest vegetation, as well as many other factors including climate, weather patterns, geology, slope, soils, stream channel conditions and riparian area conditions.

Floodplains, Wetlands and Riparian Areas
Floodplains are natural inundation areas for floods that reduce flood stages and velocities. Every stream has a floodplain. Floodplains store water, serve as natural sponges to moderate the release of high waters and act as filters to trap sediment and pollutants. They are important because the loss of floodplain function can change the timing and peak of stream flows. There are 705 acres of mapped floodplains within the project area.

Wetlands control runoff and water quality, recharge ground water and provide special habitats. Actions that may alter their ground cover, soil structure, water budgets, drainage patterns and long-term plant composition can impair these values.

The wetlands classification system identified by Cowardin et al. (1979) is the national standard for mapping, monitoring and reporting on wetlands. The National Wetland Inventory completed by the U. S. Fish and Wildlife Service mapped wetlands. The type, number and acres of wetlands present in the potential treatment areas are shown in table 3-2.

Table 3-2 Wetland within Potential Treatment Areas

Wetland Type	Number Present	Acres
Freshwater Emergent Wetland	44	31.1
Freshwater Forested/Shrub Wetland	11	30.9
Freshwater Pond	125	32.7
Other	16	5.1

Source: U.S. Fish and Wildlife Service National Wetland Inventory

Springs are defined as *"place where ground water flows naturally from a rock or the soil onto the land surface or into a body of surface water."* (Glossary of Hydrology, 1998). Springs are managed as a subset of wetlands due their unique characteristics. Also, springs are a primary factor for determination of a groundwater dependent ecosystem (subset of wetlands) (USDA Forest Service, 2010f). Watershed Conservation Practices Handbook states "avoid any loss of rare wetland such as fens and springs," (p. 14, USDA Forest Service, 2006c). For discussion of fens see the Botany Specialist Report (Vollmer, 2012). For this report, springs are discussed with wetlands. There are 134 springs within the affected environment.

Riparian areas are those lands that interface between water and drier uplands. Riparian areas are some of the most ecologically diverse habitat types and provide bank stability, sediment filtering, streamside shading and nutrient input into streams and lakes.

Watershed Effects
The discussion of watershed effects addresses watershed condition class, hydrologic functionality, riparian areas, wetlands, springs, and floodplains present within the Pine Beetle Project Area. *"Hydrologic functionality relates primarily to flow, sediment, and water-quality attributes,"* (p. 3, USDA Forest Service, 2011). Direct and indirect effects for these topics are discussed below.

Methodology

Indicators
The following indicator measures will be used to measure the effect to the water resource across the range of alternatives:

- Watershed Condition Class, change in classification
- Acres of proposed treatment areas within watershed influence zones (WIZ)
- Acres of proposed treatment areas within watershed

Assumptions
The analysis presented here is based on the following assumptions:

- Implementation will be evenly distributed across the forest/watersheds for the two alternatives
- Forest Plan Standards and Guidelines (FPS&G) will be followed (USDA Forest Service, 2006)
- Watershed Conservation Practices (FSH2509.25) will be followed (USDA Forest Service, 2006b)
- Design criteria would be implemented and adequate funding would be provided for implementation and monitoring
- Project will follow state and federal laws; especially regarding construction in or near waterways and wetlands to control erosion

Cumulative Effects Bounds
The spatial boundaries of the cumulative effects analysis are the HUC 12 watershed boundaries and the time frame for the cumulative effects discussion is from year 2002 through 2022, ten years before and ten years after. These dates include impacts from recent timber harvesting in

the past and extend forward to include the estimated completion of activities proposed in this project. A list documenting known past, present and planned future activities for this planning area is included in the project record.

Design Criteria
Design criteria are presented Appendix B and were developed to conserve and protect the hydrologic resources during the implementation of the Pine Beetle Response Project. Majority of the design criteria are from the FPS&G, WCP Handbook, and Best Management Practices developed by the states of South Dakota and Wyoming.

Watershed Condition Class
There are 12 indicators that are used to determining watershed condition class. Indicators that could potentially be altered within this project area are: riparian/wetland vegetation, fire regime or wildfire, forest cover, and forest health. Riparian areas and wetlands are discussed specifically below. Riparian and wetland vegetation only constitutes for 15% of the rating for the watershed condition class rating (USDA Forest Service, 2011k). Fire regime or wildfire, forest cover, and forest health all individually account for 2.5% of the ranking for the watershed condition class. Collectively, these three indicators account for 7.5% of the watershed condition. For more information about fire regime, see the Fire and Fuels report (Pechota, 2012), forest cover and forest health in the Silviculture report (Cook, 2012).

Indicators that could have minor changes but not substantial are: water quality, water quantity, and soils. Water quality and water quantity (flow regimes) are discussed below. Soils are discussed more specifically under the Soils resource report (Reyher, 2012).

Alternative A - Direct/Indirect Effects
Implementation of Alternative A should not change the Watershed Condition Class Rating for the 95 watersheds; because no treatments are proposed.

There are 11 streams and 4 lakes that are listed as impaired within the State of South Dakota (SDDENR, 2010) and no listed streams within the State of Wyoming (WYDEQ, 2010). Alternative A would not cause these streams and lakes to improve or degrade their existing condition. This is because no activities are proposed under Alternative A.

Alternative A - Cumulative Effects
There are no proposed activities under Alternative A; thus no change to Watershed Condition Class or impaired stream reaches. Therefore; no cumulative effects would be expected under this alternative.

Alternatives B and C - Direct/Indirect Effects
There are 15 watersheds that are rated as a Class 1 watershed, but on the cusp of transitioning to a Class 2 watershed. Implementation of the design criteria, FPS&Gs, WCPs, and state BMPs would not cause these 15 watersheds to transition from a Class 1 watershed to a Class 2 watershed. Implementing the PBR project should not cause these 15 watershed score to change due to the implementation of the design criteria, FPS&Gs, and WCPs.

There are 7 watersheds that are rated as a Class 2 watershed that are on the cusp of transitioning to a Class 1 watershed. Implementation of the PBR project should not move these watersheds down to a Class 1 watershed because this project does not have a watershed improvement projects that could change the score and the changes in the forest would not be enough to change the score because of their low ranking.

Five watersheds have a score of 2.2 that have proposed treatments within the PBR project. Only Victoria Creek-Rapid Creek watershed, 101201100201, has a score of 2.2 and an impaired reach of Victoria Creek (SDDENR, 2010). Both action alternatives propose approximately 6,140 acres, or 20% of the watershed, that could be treated; if all identified stands were thinned (Table 3-3). Neither alternative should change the watershed condition class rating because of the small amount of the watershed that could be potentially be treated and the low percentage that forest cover and fire regime account to the rating of watershed condition class.

Ten out of the 14 watersheds that are both Class 2 with an impaired waterbody, proposes less than 20% of the watershed that could be treated if all identified stands were thinned (Table 3-3). Due to the small amount of the watershed that is proposed for treatment, under Alternative B and C, there should be no change of watershed class from the implementation of either alternative. The reason is because of the small level of changes in forest health, forest cover, and fire regime/wildfire to adjust the actually rating of the watershed. Four watersheds have more than 20% of the watershed that could be treated under both action alternatives (Table 3-3). Again, by following the design criteria, FPS&Gs, and WCPs there should not be a change in the watershed condition class to move these watersheds to a Class 3 watershed.

Table 3-3 Watersheds with an Impaired Stream or Lake

Watershed	Impaired stream or lake[1]	Watershed Condition Class	Alternative B (acres)	Alternative C (acres)
Ruby Ck- French Ck 101201090601	French Creek	Class 2 Score= 1.8	518 (2%)	518 (2%)
Grizzly Bear Ck-Battle Ck 101201090801	Battle Creek Grizzly Bear Creek Horsetheif Lake	Class 2 Score=2.0	3,641 (14%)	3,641 (14%)
Deadman Gulch-Battle Creek 101201090803	Battle Creek	Class 1 Score=1.5	2,695 (9%)	2,695 (9%)
Headwaters Spring Creek 101201090901	Spring Creek (above Sheridan Lake)	Class 2 Score=2.0	21 (<1%)	21 (<1%)
Newton Fork – Spring Creek 101201090903	Spring Creek (above Sheridan Lake)	Class 2 Score=2.0	2,190 (9%)	2,190 (9%)
Sheridan Lake-Spring Creek 101201090904	Spring Creek Sheridan Lake	Class 2 Score= 2.1	1,384 (6%)	1,384 (6%)
Johnson Gulch-Spring Creek 101201090905	Spring Creek (below Sheridan Lake)	Class 2 Score=2.0	4 (<1%)	4 (<1%)
North Fork Rapid Creek 101201100101	North Fork Rapid Creek	Class 2 Score=2.0	6 (<1%)	6 (<1%)
Deerfield Lake-	Deerfield Lake	Class 2	645 (8%)	645 (8%)

Watershed	Impaired stream or lake[1]	Watershed Condition Class	Alternative B (acres)	Alternative C (acres)
Castle Creek 101201100106		Score=2.1		
Victoria Creek-Rapid Creek 101201100201	Victoria Creek	Class 2 Score=2.2	6,140 (20%)	6,140 (20%)
Town of Roubaix-Elk Crk 101201110601	Elk Creek	Class 2 Score=2.0	6,040 (24%)	6,040 (24%)
Little Elk Creek- Elk Creek 101201110602	Elk Creek	Class 2 Score=1.9	2,239 (9%)	2,239 (9%)
Upper Whitewood Creek 101202020207	West Strawberry Creek Whitewood Creek[2]	Class 2 Score=1.8	4,489 (10%)	4,489 (10%)
Park Creek 101202020701	Bear Butte Creek Strawberry Creek	Class 2 Score=1.9	8,924 (44%)	8,924 (44%)
Middle Spearfish Creek 101202030302	Iron Creek Lake	Class 2 Score=2.1	4,723 (15%)	7,732 (24%)

[1]Impaired streams are listed in more detail in The 2010 South Dakota Integrated Report for Surface Water Quality Assessment (SDDENR 2010).
[2]The impaired reach of Whitewood Creek is not on NFS lands.

Under Alternatives B and C there is a potential for road conversion. Additionally Alternative C, there is potential for new temporary roads or system roads. All new system roads to be built or converted would be a Level 1 road (or closed after use for timber activities). These roads would not change the open road density and therefore; no change to roads and trails indicator for watershed condition class.

Alternatives B and C - Cumulative Effects

Implementation of the two action alternatives should not change the Watershed Condition Class for the 95 assessed watersheds within the project area. Past projects area already assessed within the existing Watershed Condition Class score as one of the 12 indicators (USDA Forest Service, 2011k). Current and foreseeable projects on NFS lands would not change the Watershed Condition Class. Only, if there is a project that was on both NFS and non-NFS lands would a Watershed Condition Class rating change. However; there are no areas where this is planned out in detail.

Seven watersheds are analyzed in more detail for the cumulative effects for water quality: Upper Cold Brook, Upper Beaver Creek, Silver Creek-Rapid Creek, South Fork Castle Creek, Park Creek, Boulder Creek, and Little Spearfish Creek (Table 3-4). Out of the seven watersheds, Boulder Creek watershed is the watershed that has the most potential to change its class rating (Table 3-4). Currently, Boulder Creek watershed is ranked as 1.7 and only needs to decrease one-tenth to become a Class 1 watershed. Again, when accessing watershed condition class past projects were considered. Implementation of either Alternative B or C should not cause the Boulder Creek watershed change its watershed condition class in conjunction with future and foreseeable projects.

Table 3-4 Watersheds and Associated Watershed Condition Class

Watershed	Watershed Condition Class	Alternative B (acres)	Alternative C (acres)
Upper Cold Brook, 101201090101	Class 1, Score=1.5	8,385 (31%)	8,385 (31%)
Upper Beaver Creek, 101201090201	Class 2, Score= 1.8	11,420 (50%)	11,420 (50%)
Silver Creek-Rapid Creek, 1012011000103	Class 2, Score=2.0	9,960 (45%)	9,960 (45%)
South Fork Castle Creek, 1012011000105	Class 2, Score= 2.0	9,561 (36%)	9,561 (36%)
Park Creek, 101202020701	Class 2, Score=1.9	8,924 (44%)	8,924 (44%)
Boulder Creek, 1010202020702	Class 2, Score=1.7	9,576 (34%)	9,576 (34%)
Little Spearfish Creek, 101202030303	Class 2, Score= 1.9	5,199 (28%)	5,245 (29%)

No changes to watershed condition class and impaired streams or lakes are expected to these watersheds when considering the proposed actions in Alternatives B and C and any foreseeable projects. This is due to the adherence to the FPS&Gs and WCPs in upcoming Forest Service projects. Therefore; no cumulative effects would be expected under either action alternative.

Water Quality: Sediment

"Sediment deposits in stream beds results in a shift toward burrowing invertebrate taxa that are unavailable as prey (Suttle et al. 2004). Increased sedimentation alters the suitability of fish spawning and rearing reproduction. Implementation of these alternatives can be broken into timber activities and roads.

The focus of the sediment assessment assumes the full implementation of appropriate best management practices (BMPs) and/or Watershed Conservation Practices (WCPs) to result in the no additional sedimentation or to limit sediment yields of the harvesting activities occurring within the project area. Increases in sediment yield themselves do not constitute an adverse impact. However; when they adversely impact the beneficial uses of a stream they would be considered a violation of the Forest Plan. Currently, there are no listed streams on the Forest that are listed due to sediment by the states of South Dakota or Wyoming (SDDENR, 2010 and WYDEQ, 2010).

The land next to streams is referred to as the Watershed Influence Zone (WIZ) or a streamside management zone (SMZ). These terms are used interchangeably often. The Watershed Conservation Practices Handbook (FSH 2509.25, USDA Forest Service, 2006d) defines the WIZ as 100 feet minimum from each bank of perennial and intermittent streams, lakes, and wetlands. South Dakota Best Management Practices (BMPs) defines streamside management zones (SMZs) as a strip of at least 50 feet wide on each side of the stream (SD State University et al, 2003). Wyoming Forestry Best Management Practices defines SMZs as a strip at least 50 feet wide on each side of a stream, lake or other body of water, measured from the ordinary highwater mark, and extending beyond the high water mark to include wetlands and areas that provide additional protection in zones with steep slopes or erosive soils (p.12, WYDEQ, 2006). The width of the WIZ for the Pine Beetle Response project (PBR) is to follow the WCPH definition of 100 feet on either side of the stream or 200 feet total width.

Areas designated as no tracked or wheeled equipment zones would be 50 feet from the top of the stream bank. Some harvest activities could occur within the WIZ. Mainly this will be from line pulling or directional felling of trees. Activities that could occur within the WIZs are limited timber harvest activities (commercial and products other than logs [POL]), non-commercial thinning activities (ex. cut and chunk) and cut-equipment pile-burn. Skid trails would be no closer than 50 feet from intermittent and perennial streams, springs, and wetlands. Temporary roads could cross streams; however the goal is keep temporary roads outside of the WIZ if possible.

Some proposed non-commercial activities are not of concern relating to sediment. Non-commercial vegetative treatment activities for PBR include cut and chunk, chipping, and cut-hand pile-burn. Non-commercial activities could occur over all proposed treatment areas in both action alternatives. There is a higher likelihood that the non-commercial activities would occur on slopes greater than 40% than commercial activities. Non-commercial activities generally are done with limited or no mechanized equipment and results in no or minimal ground disturbance.

Timber management was not considered as a major source of sediment into streams especially as compared to roads (USDA Forest Service, 1996c), especially with the implementation of SMZ buffers. EPA (2005) shows the effectiveness of a SMZ buffer for reducing sediment input to streams from timber harvesting. Libohova (2004) found that thinning treatments in ponderosa pine generated minimal to no sediment yield.

Roads are considered the primary contributors of sediments to streams in managed watersheds (USDA Forest Service, 1996c and EPA, 2005). Roads can also impact the ecological integrity of a watershed in many ways. Roads built on soils with higher erosion potential and with an improperly planned road drainage network can impair the water quality in nearby streams (USDA Forest Service, 1996c and 2006d). Under-sized culverts or bridges can wash out, contributing to erosion and sedimentation to levels that can be detrimental to other aquatic resources (USDA Forest Service, 1996c).

Roads continually used will continue to produce sediment, especially when use is allowed during wet weather (USDA Forest Service 1996c, p.III-88) or if roads are not maintained and able to degrade (EPA, 2005). Sedimentation from roads usually comes from large storm events during or just after road construction (EPA, 2005). If WCPs are followed with regularly scheduled maintenance then these sediment pulses should the minimized. Outsloping roads will also reduce the amount of sediment that could potentially reach the stream (EPA, 2005). Road construction is a major source of sediment that reaches streams (EPA, 2005). It is estimated that one-third to one-half of road erosion occurs during the first year after construction, dropping quickly to near background levels within 2 to 3 years if continued use is not allowed (EPA 1976, in USDA Forest Service 1996c, page III-88). Again, there are no listed streams within the Black Hills National Forest due to sediment (SDDENR, 2010 and WYDEQ, 2010).

Alternative A - Direct/Indirect Effects

The No Action Alternative would have no new activities associated within the project area although existing approved projects are expected to be completed. Sediment delivered to the streams will remain at current levels and would not increase as the result of this alternative.

Alternative A would not improve any of the culverts where there are direct sediment source into streams from past Forest improvements. Roads would continue to be a sediment source to streams at any of the existing CDAs within the project area. Sedimentation levels within streams would either stay at current levels or increase with the selection of Alternative A.

Alternative A has a higher fire and fuel hazard rating (Pechota, 2012). If a wildfire were to occur, sediment will be delivered to the streams. Large amounts of sediment will occur the first year after the fire and will decrease over the next three to five (3-5) years as the vegetation and ground cover recovers. This was observed on the Jasper Fire area (Keyser et al, 2006). At first, there would be a large flush of sediment moving downstream. The large flush of sediment would come from hillsides and roads. Sediment and ash would be deposited along floodplains and within streams. This could cause streams to change the majority size class of stream bed sediments. Usually, there is a layer of fine-sized sediment (2 mm or less) is deposited along point bars. If there is a large flow event post-fire, mid- channel bars could develop or streambank erosion could occur. Sediment would choke the system for about three years and then start tapering off depending upon the precipitation events.

Alternative A would have no direct effects to water quality due to sediment because there are no activities occurring with the proposed treatment areas. The potential indirect effect would be if a wildfire occurs, as discussed above.

Alternative A- Cumulative Effects

Sediment is naturally occurring in the environment. The stream systems have adapted and function at different levels and ranges. The introduction of sediment from human associated activity, if excessive, can impact water quality.

Past and current activities have contributed sediment to the streams. Past activities include mining, homesteading, wildfires, and road building. Private lands continue to be developed at varying rates across the Forest. Current grazing activities would continue under existing allotment management plans, with activities including maintenance of water developments, cattle guards, and fences. Harvest and post-harvest activities would continue on active sales and recently closed sales. Timber harvest can add sediment if equipment crosses streams to get to units or if skidding occurs along or across streams. Mining can contribute point-source impacts adding sediment at specific locations. Mining areas are generally historic sites and any new mining activities would have BMPs implemented to minimize or eliminate sediment added to streams. Usually the road related activities are a major contributor. Any existing CDAs within the Forest are likely to continue contributing sediment to streams.

Cumulative impacts from sediment produced by the effects of high intensity wildfires would be expected if a large, intense wildfire burned in the project area. Alternative A has a higher percentage of lands that are at very high and high fire risk as compared to the three action alternatives. Impacts from sediment could occur if a large wildfire were to occur.

No new activities would commence under Alternative A and no direct effects. There is potential for cumulative effects from the indirect effects due to fire; as described above.

Alternative B - Direct/Indirect Effects
Alternative B considers treatment over 242,000 acres of land with a variety of methods across the Forest. There are 131 miles of ephemeral streams within the proposed treatment areas that could be good sediment carriers during times of flow. Also, there are 410 miles of perennial and intermittent streams that cross the proposed treatment areas. Commercial vegetative treatments propose to mechanically treat only 20% of the total acres or up to 48,400 acres under Alternative B.

Over the entire project area, 10,887 acres are located in the WIZ (Table 3-5). Harvest methods would be dependent on the terrain and include ground based and cable logging systems. Commercial and POL timber harvest would be utilized to modify stand structure and reduce stand density. With implementation of the FPS&G, which include WCPs and BMPs, the potential to generate sediment from commercial treatments is low for this alternative.

Table 3-5 Acres of Treatment within WIZ

Activity	Alternative A	Alternative B	Alternative C
Total commercial, POL, cut-equipment pile-burn activities	0 acres	10,887 acres	11,390 acres
Potentially treated	0 acres	2,177 acres[1]	5,695 acres[2]

[1]Alternative B proposes to only treat 20% of the entire project area (242,000 acres) with commercial or POL activities.
[2]Alternative C proposes to treat 50% of the entire project area (248,000 acres) with commercial or POL activities.

Commercial and POL timber harvest proposes to treat up to 2,177 acres within the WIZ under Alternative B (Table 3-5). Commercial, POL, and cut-equipment pile-burn activities will be limited within the WIZs. Limited mechanical entries would reduce the potential for sediment to reach streams. Activities that would occur within the WIZ are limited commercial and POL timber activities, and limited cut-equipment pile-burn. Minimal sediment may be generated from the commercial activities, but by implementing the FPS&G, which include WCPs and BMPs, very little to no sediment would be generated.

The non-commercial non-removal activities could occur within the entire WIZ buffer. These activities include: cut and chunk, cut and chip, and cut-hand pile-burn. These activities could be within the 100-ft WIZ. With the full implementation of the FPS&G, which include the WCPs and BMPs, the amount of sediment from harvest, post-harvest (KV), and non-commercial non-removal activities would not be expected to result in a significant impact on water quality. Timber activities would have little to no effect.

Under both the action alternatives, temporary roads, road construction, reconstruction, and pre-use maintenance could cross soil map units that may present a potentially severe erosion hazard associated with on-road/on-trail activities. According to the Engineering Design Guidelines, various measures can be used to protect highly erodible soils or road surface material, (Taglioli, 2012). These practices and following the WCPs and BMPs would generally be expected to keep erosion on new and reconstructed roads to a minimum in the PBR project area. These measures, along with implementation of the maximum cross-drain spacing outlined in the Forestry Best Management Practices for South Dakota (SD State University et al, 2003) or the Wyoming Forestry BMPs (WYDEQ, 2006) and shown in Tables 1 and 2 above in the Design Criteria section, would be expected to further reduce concentration of surface runoff on highly erodible soils, thereby limiting erosion at those sites. Sediment entering the stream would be localized at the areas of construction and reconstruction activities. There would be a sediment pulse during

the time of action, however; it would reduce under time and distance away from the site of road work. If the road construction activities occur in Wyoming, they would comply with the Wyoming Water Quality rules about turbidity (USDA Forest Service, 2012b).

Maintenance and temporary use of roads within the WIZ and at stream crossings have the potential to increase sediment because the road surface is disturbed during operations and material on the road can be easily mobilized during precipitation events. With activities at stream crossings and roads in the WIZ there would be some sediment produced. With the implementation of the FPS&Gs, which include WCPs and BMPs, the amount of sediment from roads would be localized, in quantities that should not affect water quality.

Alternative B proposes only reconstruction, relocation, and pre-use maintenance activities would occur. Approximately 5% of the existing routes (15 miles) on the ground could be converted into Level 1 FS system roads. There should be no new construction of system and temporary roads under Alternative B (see Chapter 2) and no new road-stream crossing of intermittent or perennial streams. These activities would be expected to contribute to varying degrees to erosion of the road itself and to a limited extent potential of erosion of soils located near the road. Roads can generate sediment and impact water quality due to sediment would be localized with this alternative would be a slight increase over Alternative A and there would be a direct effect from roads.

There would be a slight increase in potential for sedimentation from Alternative B in the short term (<5 years) due to activities related to roads usually at existing stream crossings. In the long term (>5 years) sediment potential would be reduced by the action alternative as compared to existing conditions because of the repair or fixing of some of the CDAs during road improvement activities. Implementation of Alternative B should not impair streams within the PBR proposed treatment area. Therefore; streams should continue to meet their beneficial and designated uses as determined by the states of SD and WY.

Alternative B - Cumulative Effects

There would be cumulative effects on water quality due to sediment from Alternative B because there are direct and indirect effects. Implementation of Alternative B would not be during one year, but over five to seven years across the entire Forest. This allows the potential cumulative effect to be minimal due to the space and time extent of Alternative B because the effects would be localized and not affect the entire watershed. Therefore; beneficial and designated uses of streams, as determined by the states of SD and WY should not be affected by the sediment to affect water quality.

Alternative C - Direct/Indirect Effects

Alternative C considers treatment over 248,000 acres of land with a variety of methods across the Forest. There are 131 miles of ephemeral streams within the proposed treatment areas that could be good sediment carriers during times of flow. Also, there are 430 miles of perennial and intermittent streams that cross the proposed treatment areas. Commercial vegetative treatments propose to mechanically treat only 50% of the total acres or up to 124,000 acres under Alternative C.

Over the entire proposed treatment areas of Alternative C, 11,390 acres are located in the WIZ (Table 3-5). Harvest methods would be dependent on the terrain and include ground based and cable logging systems. Commercial and POL timber harvest would be utilized to modify stand

structure and reduce stand density. Commercial and POL timber harvest proposes to treat up to 5,695 acres within the WIZ under Alternative C (Table 3-5). With implementation of the FPS&G, which include WCPs and BMPs, the potential to generate sediment from commercial treatments would be low for this alternative and effects would be similar to what is described under Alternative B. Effects from noncommercial activities would also be similar as described under Alternative B.

Alternative C proposes new system and temporary road construction. Up to 250 miles of new road construction and temporary roads would provide access to the harvest activities. There is an estimated 34 new road-stream (intermittent and perennial) crossings (Averaging one crossing for every three watersheds). Additionally, 15% of the existing routes (46 miles) could be converted into system roads. In addition the road reconstruction, relocation, and pre-use maintenance along existing routes, road activities would be expected to contribute to erosion of the road itself and to soils located near the road. With this amount of new road; it is likely of a new system or temporary road construction within a WIZ. Project design criteria and consultation with the hydrologist would help protect these localized areas where a road crosses a stream.

As described above, under Alternative B, erosion would be limited to roads. However; due to the amount of roads to be built, Alternative C would have a higher sediment load entering streams from roads than in Alternative B. Road design would continue to follow Engineering Design Plans (Taglioli, 2012), BMPs, and WCPs to reduce sediment entering in the stream. By following the FPS&Gs, that include the WCPs, and design criteria, sediment entering into streams should be constrained during the times of road construction at stream crossings. There is a higher likelihood of sediment reaching streams under Alternative C as compared to Alternative B. However; the extent of the sediment reaching streams would be low and at localized areas. Overall; water quality would be expected to be at current levels. Therefore; there are no expected changes that could cause streams to no longer meet their beneficial or designated uses as defined by SD and WY.

Alternative C - Cumulative Effects
Cumulative effects would be similar, but greater under Alternative C than under Alternative B. This is due to the potential of 250 miles of system or temporary road building and 34 road-stream crossings. Implementation of Alternative C would not be during one year, but over five to seven years across the entire Forest. This allows the potential cumulative effect to be minimal due to the space and time extent of Alternative C because the effects would be localized and not affect the entire watershed. There would not be road-stream crossings in every watershed. With the estimated 34 road-stream crossings across the forest, on average, only one in three watersheds will have a road-stream crossing.

Water Quality: - Chemical
"Water purity can be degraded by placing concentrated pollutant sources near water bodies, applying harmful chemicals in or near water bodies, or intercepting hazardous rock strata by roads. Degrading water purity can impair or destroy use of the water by aquatic biota and humans," (USDA Forest Service, 1996c).

Alternative A - Direct/Indirect Effects
Alternative A does not propose any new activities. There should not be any direct or indirect effects foreseeable that would affect water quality from the use of chemicals and/or pathogens from this project.

Alternative A - Cumulative Effects
Alternative A has no cumulative effects related to water quality because there are no direct and indirect effects.

Alternatives B and C - Direct/Indirect Effects
Both Alternatives B and C include activities that require the use of chemicals or pathogens. This includes insecticide spraying in campgrounds, administrative sites, and legacy trees. Also, the spraying of noxious weeds following ground disturbance (from both timber and road activities) would occur under both alternatives. None of these activities should involve the distribution of concentrated pollutant sources near water bodies or applying harmful chemicals near water bodies due to following application instructions, State BMPs, WCPH, and National Pollution Discharge Elimination System (under the Clean Water Act).

Application of pesticides for weed spraying post –harvest will follow the guidance in the WCPH Management Measure 17 for application within WIZs (USDA Forest Service, 2006b) and the National Pollution Discharge Elimination System (NPDES) guidance, so there should not be any degradation to water quality from weed spraying.

Alternatives B and C include activities that require the use of chemicals, pathogens, or pesticides. As discussed earlier, all use of these hazardous substances would be compliant to NPDES, Forest Plan Standards, WCPs, and BMPS. Following these guidelines there would be a reduced risk to water quality from the use of these hazardous substances. The risk would be greater under Alternative C than under Alternative B because there are more lands to be treated under Alternative C than in Alternative B. The risk for impairing water quality from chemicals and pathogens is the greatest under Alternative C and the least under Alternative A.

Alternatives B and C - Cumulative Effects
Existing timber harvest activities, weed spraying, road dust reduction, highway snow removal, and grazing practices would continue on the Forest. These activities combined with proposed activities within Alternatives B and C should not cause water quality to decrease within streams from proposed use of chemicals and pathogens as long as NPDES guidance, the WCPs, and State BMPs are followed.

Water Quality: Stream Temperature
"Summer water temperature is increased, and winter water temperature is decreased, by removing shade..." (USDA Forest Service, 1996c).

There are 14 watersheds that have streams or lakes that have impaired water bodies due to temperature according to SDENR (2010, Table 3-6). There are no waterbodies listed for temperature in the state of WY (WYDEQ, 2010).

Table 3-6 Temperature Impaired Watersheds and WIZ Proposed Treatment Areas

Watershed	Temperature Impaired stream or lake[1]	Total WIZ Acres	Alternative B (max WIZ acres, % of WIZ) (WIZ PTA acres, % of WIZ)[3]	Alternative C (max WIZ acres, % of WIZ) (WIZ PTA acres, % of WIZ)[4]
Ruby Ck- French Ck 101201090601	French Creek	1,797	18 (1%) 4 (<1%)	18 (1%) 9 (1%)
Grizzly Bear Ck- Battle Ck	Battle Creek	1,798	148 (8%)	148 (8%)

Watershed	Temperature Impaired stream or lake[1]	Total WIZ Acres	Alternative B (max WIZ acres, % of WIZ) (WIZ PTA acres, % of WIZ)[3]	Alternative C (max WIZ acres, % of WIZ) (WIZ PTA acres, % of WIZ)[4]
101201090801	Grizzly Bear Ck Horsethief Lake		30 (2%)	74 (4%)
Deadman Gulch- Battle Ck 101201090803	Battle Creek	1,075	74 (7%) 15 (1%)	74 (7%) 37 (3%)
Headwaters Spring Creek 101201090901	Spring Ck (above Sheridan Lake)	1,347	0 (0%) 0 (0%)	0 (0%) 0 (0%)
Newton Fork – Spring Creek 101201090903	Spring Ck (above Sheridan Lake)	1,457	20 (1%) 4 (<1%)	20 (1%) 10 (1%)
Sheridan Lake- Spring Creek 101201090904	Spring Creek Sheridan Lake	2,212	1 (<1%) 0 (0%)	1 (<1%) 0 (0%)
Johnson Gulch-Spring Creek 101201090905	Spring Ck (below Sheridan Lake)	1,214	0 (0%) 0 (0%)	0 (0%) 0 (0%)
North Fork Rapid Creek 101201100101	North Fork Rapid Creek	1,785	0 (0%) 0 (0%)	0 (0%) 0 (0%)
Deerfield Lake-Castle Ck 101201100106	Deerfield Lake	774	2 (<1%) 0 (0%)	2 (<1%) 1 (<1%)
Victoria Creek-Rapid Crk 101201100201	Victoria Creek	1,809	75 (4%) 15 (1%)	75 (4%) 38 (2%)
Town of Roubaix-Elk Ck 101201110601	Elk Creek	1,896	400 (21%) 80 (4%)	400 (21%) 200(11%)
Little Elk Ck- Elk Ck 101201110602	Elk Creek	1,555	243 (16%) 49 (3%)	243 (16%) 122 (8%)
Park Creek 101202020701	Bear Butte Creek	1,667	814 (49%) 163 (10%)	814 (49%) 407 (24%)
Middle Spearfish Creek 101202030302	Iron Creek Lake	2,338	190 (8%) 38 (2%)	518 (22%) 259 (11%)

[1]Temperature impaired streams are listed in more detail in The 2010 South Dakota Integrated Report for Surface Water Quality Assessment (SDDENR 2010).
[2]There are no temperature impaired streams in the Black Hills National Forest in Wyoming.
[3]This show the 20% that could potentially be treated by commercial harvest. All acres within the WIZ could be treated with non-commercial activities.
[4]This shows the 50% that could be potentially treated by commercial harvest. All acres within the WIZ could be treated with non-commercial activities.

Direct and Indirect Effects Common to All Alternatives

There would be an effect on stream temperature from MPB, fire loss, or timber harvest because they would remove trees. There would be less of an effect on temperature along streams within meadows. These areas usually have less ponderosa pine trees and if there are trees, they are riparian shrubs or spruce. However; usually these streams are dominated sedges and rushes for stream shading. Areas where the loss of ponderosa pine trees would affect shade are within streams that are in narrow and steep valleys and travel through rugged terrain. Here, the riparian corridor is extremely narrow, usually to the floodplain and ponderosa pine trees are the major source for stream shading. Stream temperature would be expected to increase in these sections from the loss of the ponderosa pine. However; these riparian areas also include riparian shrubs and spruce trees where the soil moisture is higher; that could be unaffected by the MPB and fire.

These areas would continue to provide shade to streams. Therefore; effects to stream temperature would be localized to the stream reaches where stream shading is primarily from ponderosa pine.

Alternative A - Direct/Indirect Effects
There would be no direct effects from this alternative because there would not be any new activities occurring across the National Forest and the watersheds to reduce shade. There would be no direct effects on any of the impaired waterbodies.

With the loss of trees in the watershed due to either MPB or fire, there could an indirect effect. With the loss of biomass, there would be lower interception and evapotranspiration rates. More water would be available for groundwater recharge and streamflow; resulting in increased streamflows. More water in the streams could mean more stable water temperatures.

Alternative A - Cumulative Effects
Cumulative effects to water temperature could occur from the potential indirect effects mentioned above. Neither positive nor negative cumulative effects on stream temperature are expected. This is because streams would stay at or around current and potential conditions as described under Alternative A.

The 14 waterbodies listed as impaired for temperature (SDDENR, 2010) would continue to be impaired and would not benefit from the potential indirect effects, as described above. Hence, there are no expected cumulative effects to occur on these 14 impaired waterbodies (SDDENR, 2010) from the implementation of Alternative A.

Alternative B - Direct/Indirect Effects
There is potential for direct effects to water temperature from this alternative by removing shade in the WIZ from timber activities. Of the 14 temperature impaired watersheds, 10 would have no or minimal direct effects because less than five percent of WIZ acreage (75 acres) would have a proposed treatment (commercial or noncommercial, Table 3-6). The other four temperature impaired watersheds have PTA in the WIZ ranging from 100 acres to 400 acres (Table 3-6). Treatments within these watersheds could cause an increase of stream temperature with the loss of stream shading provided by ponderosa pines. However; in reaches where spruce and riparian shrubs are the dominant shade source, stream temperature should not be affected. Therefore; stream temperature should vary only along the stream reaches with ponderosa pines within and nearby its riparian corridor.

Direct effects under Alternative B would be similar as indirect effects under Alternative A for stream temperature from timber activities. Treatments in the WIZ would remove bug trees and thin trees and leave some trees. These remaining trees would continue to shade streams but with a lower density and more solar radiation could reach stream; thereby potentially increasing stream temperature. There areas would only occur on short stream reaches and not continuous along the stream channel. Therefore; the increase of stream temperature would be localized in these areas of reduced tree density. These effects would be similar to what is discussed under Alternative A, but to a lesser degree.

The effects of the loss of biomass through the thinning of trees in conjunction with the loss from MPB would be similar as described under Alternative A with the potential of more water in streams. Again, more water would be available for groundwater recharge and streamflow; resulting in increased streamflows. More water in the streams could mean more stable water temperatures.

Alternative B does not propose any new road (system or temporary) construction. Therefore; there would not be any new road-stream crossings constructed that could disrupt streamside vegetation. The effects of roads would be similar to Alternative A because only existing crossings would be used and there should already be a loss of streamside vegetation providing shade. The effects from the loss of streamside vegetation are also discussed more specifically in the Riparian Areas section, below.

Alternative B - Cumulative Effects
Cumulative effects to water temperature can occur from the potential direct and indirect effects mentioned above. The streams and lakes listed as impaired (SDDENR, 2010) would continue to be impaired and would not benefit from the potential direct effects. Cumulative effects under Alternative B would be similar as what is described under Alternative A.

Alternative C - Direct/Indirect Effects
Direct effects to stream temperature would be similar to what is described under Alternative B. The treatments in the watersheds with impaired waterbodies (SDDENR, 2010, Table 3-6) would continue to have increased stream temperature from the removal of shade trees from timber activities (commercial, POL, and noncommercial).

The effects of the loss of biomass through the thinning of trees in conjunction with the loss from MPB would be similar as described under Alternative A with the potential of more water in streams. Again, more water would be available for groundwater recharge and streamflow; resulting in increased streamflows. More water in the streams could mean more stable water temperatures.

However; Alternative C has the potential for the greatest short-term increase of stream temperature in localized areas because there are more lands within the WIZ that could be thinned. Again; the effects of losing stream shading with the loss of ponderosa pine trees would dissipate over time as there is regeneration providing shade. These effects would be localized and would not affect the watershed as a whole.

Under Alternative C, there is a potential for new road (system or temporary) construction that could cross a perennial or intermittent stream. It is estimated that there would be 34 new road-stream crossings. Roads can affect stream temperature at newly constructed road crossings at localized sites by removing streamside vegetation. At the locations of new road-stream crossings; there could be a permanent loss of stream shading by riparian vegetation. Over time, some riparian vegetation could be established at the temporary road-stream crossings, but the timeframe could be very long (years). This is because of the soil compaction that occurs within a temporary road; it could take extra time for re-establishment of riparian shrubs. The effect of roads on stream temperature would be localized to the areas where there is a new road-stream

crossing and immediately downstream until where the riparian vegetation is established. Because Alternative C proposes new roads; Alternative C could have a greater effect on stream temperature at new road-stream crossings as compared to either Alternatives A or B.

Alternative C - Cumulative Effects
Cumulative effects to water temperature can occur from the potential direct and indirect effects mentioned above. The streams and lakes listed as impaired (SDDENR, 2010) would continue to be impaired and would not benefit from the potential direct effects.

Cumulative effects would be similar as described under Alternative A because there still is a loss of stream shading from the loss of trees under all alternatives.

Alternative C differs from the other alternatives due to road building. As a result, there is a potential for negative cumulative effects at localized areas at the locations of potential road-stream crossings from either a temporary or system road. These cumulative effects would be just downstream of the crossing and would not affect the watershed as a whole. With an estimated 34 road-stream crossings, only one in three watersheds across the forest would be affected.

Flow Regimes
"Flow regimes can be altered by major changes in cover type or ground cover, dense road networks, or water projects. Water temperature and chemistry, sediment transport, aquatic habitats, and aquatic life cycles can be degraded," (USDA Forest Service, 1996c).

Flow regimes are discussed in detail in the Forest Plan (USDA Forest Service, 1996). In general, flow regimes in the watersheds of the Black Hills are constantly changing and are never stagnant. Flow regimes are dependent upon precipitation and vegetation within a watershed. Precipitation is the main factor in flow regimes, the more precipitation that occurs, and the more water that is yielded from a watershed. Vegetation is the other factor. Water that is used by the vegetation would not be yielded from the watershed. The more vegetation, the less water yield that would be delivered from the watershed and watersheds with less vegetation would yield more water (USDA Forest Service, 1996c). The density of the vegetation in the Black Hills has generally been increasing over the decades with the onset of fire suppression in the Black Hills. The effects of fire suppression can reduce water yield slowly over time with the increase of vegetation across the watersheds.

Roads in the Black Hills have a minimal effect on flow regime because of the semi-arid precipitation climate regime of the Black Hills. There is not enough precipitation for the roads to have much of an affect. There are a few water projects in the Northern Hills related to Homestake that have affected the flow regimes on a few streams. East Spearfish Creek, Elk Creek, Tillson Creek, and Spearfish Creek have flows diverted from the stream while Whitewood Creek gain flows. Also dams (Deerfield, Pactola and Sheridan) on streams affect the flow regimes downstream of the structures. There is no water projects proposed with this project.

Alternative A - Direct/Indirect Effects
There would be no direct effects to flow regimes from this alternative because there would not be any new activities (timber harvest or roads) occurring across the watersheds and National Forest

as a result of this alternative. Indirect effects on flow regime (increase) can come from pine tree mortality from the Pine beetle by reducing the vegetation. This will be offset over time with growth of new trees. However the indirect changes to flow regimes would be minor because no major changes in cover type or ground cover is expected over large portions of the watersheds. If wildfire were to occur there could be an indirect effect on flow regime by yielding more water from the area that was burned.

Alternative A - Cumulative Effects
Cumulative effects from this alternative will occur from indirect effects since there are no direct effects. These effects (pine tree mortality from Pine beetle or wildfire) would be added to the ongoing activities such as the eight present/foreseeable projects that would likely be implemented over time. Most effects are minor while effects from wildfire could be major depending on the size of the area burned.

Alternatives B and C - Direct/Indirect Effects
Minor direct effects to flow regimes (increase) may occur with implementation of either action alternative removing vegetation (timber harvest) from the watersheds. The effect would be minor because major changes within the watersheds would not occur. Reviewing the 112 watersheds across the Forest, 26 watersheds have no proposed treatments, 53 watersheds would have less than 10% of the area treated and 33 watersheds have greater than 10% of the area treated. This is assuming an even distribution of treatments across the Forest during implementation. Upper Beaver Creek watershed, 101201090201, has the most potential treatment. It could have up to 25% of the watershed affected with commercial harvest activities, under Alternative C. This amount of treatment would not cause a major change to the cover type or ground cover within the watershed so there would only be a minor direct effect to flow regime (increase).

New roads that cross streams (estimated 34 for Alternative C) have the potential to have a minor direct effect on flow regimes (increase). It is expected to be minor because the roads when constructed will be disconnected from the stream as much as possible, thereby limiting the amount of water being delivered unfiltered to the stream.

Indirect effects with these alternatives would be the same as described under Alternative A.

Alternatives B and C - Cumulative Effects
Subtle changes to the flow regimes would occur with either action alternative creating a cumulative impact. However, changes to the flow regime would not be detectable if a gaging station was available and measuring stream flow and are expected to be minor because there would be no major changes to cover type and ground cover.

Riparian Areas, Wetlands and Springs
"Riparian ecosystems provide shade, bank stability, fish cover, and woody debris to aquatic ecosystems. (USDA Forest Service, 1996c). "Wetlands control runoff and water quality, recharges ground water, and provides special habitats. Actions that may alter their ground cover, soil structure, water budgets, drainage patterns, and long-term plant composition can impair these values," (USDA Forest Service, 1996c). Springs are managed as a subset of

wetlands (USDA Forest Service 2010c). Management activities within the riparian area and wetlands can damage the vegetation and reduce the riparian areas.

Alternative A - Direct/Indirect Effects

There would be no direct effects to riparian areas, wetlands and springs from this alternative because there would not be any new activities occurring as a result of this alternative.

If the pine beetle infestation kills pine tree within the riparian areas; there could be a positive indirect benefit. This would increase the sunlight to the riparian areas that are currently being shaded out by pine trees. Therefore; there is a potential for more riparian shrubs to be established due to the loss of pine trees.

If there were a wildfire to occur; effects to the riparian areas, wetlands, and springs would be similar to existing conditions. This is due to the fact; that there areas are normally wetter than the surrounding areas and hillsides. It would be expected to lose some of the riparian shrubs; however riparian grasses (rushes and sedges) should re-establish quickly.

Alternative A - Cumulative Effects

There are no cumulative effects to riparian areas, wetlands, and springs from Alternative A because there are no direct effects.

Indirect effects can have a positive a cumulative effect by increasing riparian vegetation.

Alternatives B and C - Direct/Indirect Effects

Implementation of these alternatives can be broken into timber harvest and roads.

Timber harvest should have no direct or indirect effects on riparian areas, wetlands and springs with the implementation of the design criteria, as described above. The design criteria would assure no impacts to riparian areas, wetlands and springs from timber harvest because equipment and disturbed areas will be kept at a distance.

Roads would have no direct or indirect effects on wetlands and springs with the implementation of the design criteria, as listed above under the wetlands header. These more specific design criteria are established for wetlands to maintain compliance with Executive Order 11990 (EPA, 2012c) and the Clean Water Act, Sections 401 and 404 (EPA, 2012a). The design criteria would assure no impacts to wetlands and springs from roads because roads would be kept at a distance.

Roads (temporary or system) can have a direct effect on riparian areas when they cross intermittent and perennial streams. The design criteria would minimize the impacts to riparian areas from roads, but there would be some direct impacts to the riparian area. At the crossing, roads cannot avoid the riparian area; therefore a direct impact. For system roads the impact would be permanent. For a temporary road, the riparian vegetation should reestablish once the road is removed. However; it could take decades to recover from the disturbance.

There is a difference between Alternative B and C. Generally Alternative C would have more potential to impact the riparian area because there could be up to 250 miles of road construction

with this alternative and an estimated 34 new road-stream crossings. Where new roads cross riparian areas, there would be an adverse impact.

Alternatives B and C - Cumulative Effects
There are no cumulative effects to wetlands and springs from timber harvest and roads.

There are no expected cumulative effects to riparian areas from timber harvest because there are no direct or indirect effects. There are cumulative effects to the riparian ecosystem. This will add to the impacts that has already occurred (roads, private land development, grazing) in the watersheds. Cumulative impacts to the riparian ecosystem would be adverse, but localized at the road crossings. With the estimated 34 road-stream crossings, only one in three watersheds across the forest would be affected.

Floodplains
Floodplains are important to stream systems as a way for high-water flows to escape the stream channel (USDA Forest Service 1996c). They allow water to spread out during floods and store water temporarily and when flows subside slowly release the stored water. Floodplains are protected by E.O. 11988 (EPA, 2012b) to reduce short and long term impacts to floodplains from modifications.

Alternative A - Direct/Indirect Effects
Alternative A would have no new proposed activities. Roads that are currently affecting floodplains (encroaching or filling) will continue to do so. It is expected that floodplains would stay generally at existing conditions. Trees that are killed by the Pine beetle and fall in the floodplain would not affect the floodplain because water would still be able to spread out during a flood and would not be inhibited by the downed trees.

This alternative would not have any direct or indirect effects on floodplains because there are no new activities.

Alternative A -Cumulative Effects
There are no cumulative effects to floodplains from Alternative A because there are no direct or indirect effects. The ability of streams to access their floodplains would not change.

Alternatives B -Direct/Indirect Effects
No direct or indirect effects are expected from timber activities (commercial and noncommercial) on floodplains, because there are no expected physical changes to floodplains.

Some roads currently located in floodplains would be maintained or reconstructed. This would generally improve the condition of floodplains in the project area by improve road- stream crossings. Improvement to road-stream crossings that are currently a CDA or are fish impassible could also improve the access of the stream to the floodplains during high flow.

By following the WCPs, BMPs, design criteria and State laws, impacts to floodplains would be minimal to none.

Alternative B -Cumulative Effects
There will be continued road and trail construction that is proposed from other Forests projects and on private lands that could affect floodplains. These activities combined with the road activities proposed in Alternative B would have a minor long-term cumulative effect on floodplains within watersheds where road are being built.

Alternatives C -Direct/Indirect Effects
No direct or indirect effects are expected from timber activities (commercial and noncommercial) on floodplains, because there are no expected physical changes to floodplains.

Some roads currently located in floodplains would be maintained or reconstructed. This would generally improve the condition of floodplains in the project area by improve road- stream crossings. Improvement to road-stream crossings that are currently a CDA or are fish impassible could also improve the access of the stream to the floodplains during high flow.

Alternative C could have an estimated 34 road-stream crossings from either new system roads or temporary roads. It is not known how many new crossings could cross mapped 100-year floodplains during implementation. All new road-stream crossings would be installed to sustain bankfull dimensions and be consistent with the WCPs and BMPs. Protecting floodplains would be achieved by implementing the following the stated design criteria.

There is a difference between Alternative B and C. Generally Alternative C would have more potential to impact the floodplain because there could be up to 250 miles of road construction with this alternative and 34 new road-stream crossing. Where new roads cross floodplains, there would be an adverse impact. By following the WCPs, BMPs, design criteria and State laws, impacts to floodplains would be localized at the site of the road-stream crossing.

Alternative C -Cumulative Effects
There will be continued road and trail construction that is proposed from other Forests projects and on private lands that could affect floodplains. These activities combined with the road activities proposed in Alternative C would have a long-term cumulative effect on floodplains within watersheds where road are being built. With the estimated 34 road-crossings, only one in three watersheds across the forest would be affected.

Cumulative Effects on Target Watersheds

Overall there were six watersheds that proposed activities under the PBR Project greater than 30% of the watershed. These watersheds are: Upper Cold Brook Creek, Upper Beaver, Silver Creek-Rapid Creek, South Fork Castle Creek, Park Creek, and Boulder Creek. One watershed, Little Spearfish Creek, has proposed activities under PBR that was greater than 25%.

Cumulative watershed effects were analyzed on these seven watersheds with greater than 25% proposed treatment areas under Alternatives B and C. These watersheds have the greatest potential for cumulative effects because there is more land proposed for treatment and road building. There could still be a cumulative effect on watersheds below 25%; however the risk is lower than the watersheds over 25%. Therefore; the focus of the cumulative watershed effects analysis will be on watersheds with greater than 25% PTAs.

Because no direct or indirect effects are expected on watersheds with less than 10% proposed treatment areas; no cumulative effects are expected within these watersheds. Again, the reasoning is due to the minimal amount of lands that are proposed for disturbance within these watersheds.

Upper Cold Brook Watershed

Table 3-7 Upper Cold Brook Watershed Cumulative Effects Summary

Pine Beetle Response Effects Summary, HUC 101201090101				
Upper Cold Brook HUC 12 – 27,320 acres				
Past Actions				
Timber Harvest				
Time Period	Acres Of Commercial Activities			% Of Watersheds
2002-2006	113			<1%
2007-2011	2,764			10%
Fire				
Year	Fire		Acres	% Of Watershed
1966	Ventling Draw		173	1%
1991	Shirttail		468	2%
Past, Present and Future Actions				
Grazing – Federal				
Allotment	Allotment Acres	Acres of Allotment within Watershed	Percent of Allotment within Watershed	% Of Watershed
Community	4,712	4,712	100%	
Park	3,088	194	6%	
Pleasant Valley	24,802	7,376	30%	
Rifle Pit	5,757	923	16%	
South Custer	13,495	3,307	25%	
Total		16,512		60%
Ownership				
Status	Acres			% Of Watershed
Private Land	11,099			41%
Roads and Trails				
	Miles	Acres		% Of Watershed
Public Roads	29	70		
Open Forest Roads	70	171		
Closed Forest Roads	8	20		
Nonsystem Roads	8	20		
Total	50	120		1%
Proposed Action				
	Activity		Acres or Number	% Of Watershed
Alternative B				
	Commercial Harvest		1,677	6%
Alternative C				
	Commercial Harvest		4,193	15%
	New Roads, 4.1 miles		10	<1%
	Road-stream Crossing		1	
Full treatment				
	Commercial Harvest		8,386	30%
Foreseeable Actions				
None				0%

Past sales harvested in the last 10 years include; Bluebird, Echo Valley, Fossil, Henderson, Hopkins, Lime Kiln, Painter, Pleasant and Sydney POL.

Full treatment means that all of the high-risk stands proposed under Alternatives B or C would be treated through commercial harvest instead of the a mix of commercial and non-commercial activities. Up to 30% of the watershed has proposed activities under either Alternative B or C. The proposed activities are commercial and non-commercial vegetation management. Most of the timber activities would not have cumulative effects because there are no direct effects.

Use of roads related to timber harvest would have cumulative impacts to water quality due to sediment; especially under Alternative C where there is the potential for new road construction near streams. With the installation of one new culvert and other road reconstruction activities would introduce sediment into streams even with the use of WCPs and BMPs. However; with the implementation of WCPs and BMPs there should not be enough sediment to cause a long-term cumulative effect. This is due to the fact that the sediment pulse should be in short duration during the time of construction or reconstruction activities.

Upper Beaver Creek Watershed

Table 3-8 Upper Beaver Creek Watershed Cumulative Effects Summary

Pine Beetle Response Effects Summary, HUC 101201090201				
Upper Beaver Creek HUC 12 – 22,753 acres				
Past Actions				
Timber Harvest				
Time Period	Acres Of Commercial Activities			% Of Watersheds
2002-2006	688			3%
2007-2011	3,200			14%
Fire				
Year	Fire	Acres		% Of Watershed
1990	Cicero Peak	1,148		5%
Past, Present and Future Actions				
Grazing – Federal				
Allotment	Allotment Acres	Acres of Allotment within Watershed	Percent of Allotment within Watershed	% Of Watershed
Cicero	25,787	10,231	40%	
Rifle Pit	5,757	848	15%	
South Custer	13,495	5,659	42%	
Total		16,738		74%
Ownership				
Status	Acres			% Of Watershed
Private Land	6,170			27%
Roads and Trails				
	Miles	Acres		% Of Watershed
Public Roads	42	102		
Private Roads	1	3		
Open Forest Roads	50	122		
Closed Forest Roads	12	30		
Nonsystem Roads	32	78		
Total	138	336		1%

Pine Beetle Response Effects Summary, HUC 101201090201			
Upper Beaver Creek HUC 12 – 22,753 acres			
Proposed Action			
	Activity	Acres or Number	% Of Watershed
Alternative B			
	Commercial Harvest	2,284	10%
Alternative C			
	Commercial Harvest	5,710	25%
	New Roads, 8.5 miles	11	<1%
	Road-stream Crossing	1	
Full treatment			
	Commercial Harvest	11,420	50%
Foreseeable Actions			
None			0%

Past sales harvested in the last 10 years include; Bluebird, Echo POL, Echo Valley, Fossil, Garsong, Noah Settlement, Painter, Silverstar, Sydney POL and Virginia Settlement TS.

The Upper Beaver Creek watershed has the most potential for a cumulative watershed effect from the Pine Beetle Response project. This is because it has the most area proposed to be treated; up to 50% of the watershed under either Alternative B or C. Because there are more lands potentially up for treatment, there is a potential for a fair amount of new road construction. The proposed activities are commercial and non-commercial vegetation management. Most of the timber activities would not have cumulative effects because there are no direct effects.

Use of roads related to timber harvest would have cumulative impacts to water quality due to sediment. Especially under Alternative C where there is the potential for new road construction near streams. With the installation of one new culvert and other road reconstruction activities would introduce sediment into streams even with the use of WCPs and BMPs. However; with the implementation of WCPs and BMPs there should not be enough sediment to cause a long-term cumulative effect. This is due to the fact that the sediment pulse should be in short duration during the time of construction or reconstruction activities.

Silver Creek – Rapid Creek Watershed

Table 3-9 Silver Creek-Rapid Creek Watershed Cumulative Effects Summary

Pine Beetle Response Effects Summary, HUC 101201100103				
Silver Creek – Rapid Creek HUC 12 – 22,289 acres				
Past Actions				
Timber Harvest				
Time Period	Acres Of Commercial Activities			% Of Watersheds
2002-2006	1,964			9%
2007-2011	2,565			12%
Fire				
Year	Fire	Acres		% Of Watershed
1931	Rochford	78		<1%
1934	Bloody Gulch	514		2%
Past, Present and Future Actions				
Grazing – Federal				
Allotment	Allotment Acres	Acres of Allotment within	Percent of Allotment within Watershed	% Of Watershed

Pine Beetle Response Effects Summary, HUC 101201100103				
Silver Creek – Rapid Creek HUC 12 – 22,289 acres				
		Watershed		
East Rapid	18,590	13,338	72%	
Reynolds Prairie	29,971	2,300	8%	
Wolff	17,051	4,831	28%	
Total		20,469		92%
Ownership				
Status	Acres			% Of Watershed
Private Land	1,626			7%
Roads and Trails				
	Miles	Acres		% Of Watershed
Public Roads	20	48		
Private Roads	<1	1		
Open Forest Roads	58	140		
Closed Forest Roads	40	96		
Nonsystem Roads	26	62		
Total	143	346		2%
Proposed Action				
	Activity		Acres or Number	% Of Watershed
Alternative B				
	Commercial Harvest		1,992	9%
Alternative C				
	Commercial Harvest		4,980	22%
	New Roads, 8.4 miles		21	<1%
	Road-stream Crossing		0	
Full treatment				
	Commercial Harvest		9,960	45%
Foreseeable Actions				
Pactola	Commercial Harvest		1,957	9%
Sota Trails connection	ATV trails		3	<1%

Past sales harvested in the last 10 years include; Ant, BHEC 2010, Felis, Greenant, Hanna, Hop Creek, Honker POL, Lost Park, Mercedes, Merry-Go-Round, Minnesota Box, Minnex, Ring Around, Rochford, Sapa Bugs, Squid and Tissue Stewardship POL. There is approximately about 100 acres under active mining claims within this watershed that occur near streams. Sediment could enter streams from mining operations. The pulse of sediment should be short-term and should not contribute to long-term sedimentation to the streams.

Up to 45% of the watershed has proposed activities. The proposed activities are commercial and non-commercial vegetation management. Most of the timber activities would not have cumulative effects because there are no direct effects.

Use of roads related to timber harvest would have cumulative impacts to water quality due to sediment. Especially under Alternative C where there is the potential for new road construction near streams. Road reconstruction activities would introduce sediment into streams even with the use of WCPs and BMPs. However; with the implementation of WCPs and BMPs there should not be enough sediment to cause a long-term cumulative effect. This is due to the fact that the sediment pulse should be in short duration during the time of construction or reconstruction activities.

South Fork Castle Creek Watershed

Table 3-10 South Fork Castle Creek Watershed Cumulative Effects Summary

Pine Beetle Response Effects Summary, HUC 101201100105				
South Fork Castle Creek HUC 12 – 26,749 acres				
Past Actions				
Timber Harvest				
Time Period	Acres Of Commercial Activities			% Of Watersheds
2002-2006	889			3%
2007-2011	8,480			32%
Fire				
Year	Fire	Acres		% Of Watershed
2000	Jasper	66		<1%
Past, Present and Future Actions				
Grazing – Federal				
Allotment	Allotment Acres	Acres of Allotment within Watershed	Percent of Allotment within Watershed	% Of Watershed
Crows Nest Upper Beaver	40,384	5,796	14%	
Deerfield	7,557	5,593	74%	
Ditch Creek	15,773	9,438	60%	
Gillette Prairie	4,024	225	6%	
Murphy	6,137	524	9%	
Sixmile	4,396	4,140	94%	
Total		25,716		96%
Ownership				
Status	Acres			% Of Watershed
Private Land	1,526			6%
Roads and Trails				
	Miles	Acres		% Of Watershed
Open Forest Roads	58	139		
Closed Forest Roads	65	159		
Nonsystem Roads	19	47		
Total	142	345		1%
Proposed Action				
	Activity		Acres or Number	% Of Watershed
Alternative B				
	Commercial Harvest		1,912	7%
Alternative C				
	Commercial Harvest		4,780	18%
	New Roads, 4.8 miles		12	<1%
	Road-stream Crossing		3	
Full treatment				
	Commercial Harvest		9,560	36%
Foreseeable Actions				
None				0%

Past sales harvested in the last 10 years include; Annebelle, Baseline Bugs, Coulsen, Coulsen Bugs, Crooked Uncle, Duck, Hat, Hughes, Mystic 07, Nichols, Odakota, Pole Creek, South Dee, South Fork and Thumb.

Up to 36% of the watershed has proposed activities under either Alternative B or C. The proposed activities are commercial and non-commercial vegetation management. Most of the timber activities will not have cumulative effects because there are no direct effects.

Use of roads related to timber harvest would have cumulative impacts to water quality due to sediment. Especially under Alternative C where there is the potential for new road construction near streams. With the installation of three new culverts and other road reconstruction activities would introduce sediment into streams even with the use of WCPs and BMPs. However; with the implementation of WCPs and BMPs there should not be enough sediment to cause a long-term cumulative effect. This is due to the fact that the sediment pulse should be in short duration during the time of construction or reconstruction activities.

Park Creek Watershed

Table 3-11 Park Creek Watershed Cumulative Effects Summary

Pine Beetle Response Effects Summary, HUC 101202020701				
Upper Cold Brook HUC 12 – 20,453 acres				
Past Actions				
Timber Harvest				
Time Period	Acres Of Commercial Activities			% Of Watersheds
2002-2006	1,472			7%
2007-2011	1,670			8%
Fire				
Year	Fire	Acres		% Of Watershed
1931	Lost Gulch	40		<1%
2002	Grizzly Gulch	1,852		9%
205	Camp Five	242		1%
Past, Present and Future Actions				
Grazing – Federal				
Allotment	Allotment Acres	Acres of Allotment within Watershed	Percent of Allotment within Watershed	% Of Watershed
Bear Butte	18,616	8,009	43%	
Upper Elk Creek	8,813	2,864	32%	
Total		10,873		53%
Ownership				
Status	Acres			% Of Watershed
Private Land	6,090			30%
Roads and Trails				
	Miles	Acres		% Of Watershed
Public Roads	19	45		
Private Roads	5	12		
Open Forest Roads	50	122		
Closed Forest Roads	21	51		
Nonsystem Roads	40	97		
Total	135	327		2%
Proposed Action				
	Activity		Acres or Number	% Of Watershed
Alternative B				
	Commercial Harvest		1,785	9%
Alternative C				

Pine Beetle Response Effects Summary, HUC 101202020701			
Upper Cold Brook HUC 12 – 20,453 acres			
	Commercial Harvest	4,462	22%
	New Roads, 5.3 miles	13	<1%
	Road-stream Crossing	0	
Full treatment			
	Commercial Harvest	8,924	44%
Foreseeable Actions			
None			0%

Past sales harvested in the last 10 years include; Boomer, Corral, Dano, Deadman, Elk Creek, Kirk, Legacy Mig, Lost, Meadow, Mineral, Redhill and Vanocker.

Up to 44% of the watershed has proposed activities under either Alternative B or C. The proposed activities are commercial and non-commercial vegetation management. Most of the timber activities would not have cumulative effects because there are no direct effects.

Use of roads related to timber harvest would have cumulative impacts to water quality due to sediment. Especially under Alternative C where there is the potential for new road construction near streams. Road reconstruction activities would introduce sediment into streams even with the use of WCPs and BMPs. However with the implementation of WCPs and BMPs there should not be enough sediment to cause a long-term cumulative effect. This is due to the fact that the sediment pulse should be in short duration during the time of construction or reconstruction activities.

Boulder Creek Watershed

Table 3-12 Boulder Creek Watershed Cumulative Effects Summary

Pine Beetle Response Effects Summary, HUC 101202020702				
Boulder Creek HUC 12 – 26,702 acres				
Past Actions				
Timber Harvest				
Time Period	Acres Of Commercial Activities			% Of Watersheds
2002-2006	0			0%
2007-2011	2,178			8%
Fire				
Year	Fire	Acres		% Of Watershed
1931	Lost Gulch	362		1%
1959	Deadwood	382		1%
2002	Grizzly Gulch	4,676		18%
2005	Camp Five	533		2%
Past, Present and Future Actions				
Grazing – Federal				
Allotment	Allotment Acres	Acres of Allotment within Watershed	Percent of Allotment within Watershed	% Of Watershed
Bear Butte	18,616	2,135	11%	
Crook Mountain	5,109	1,317	26%	
Total		3,452		13%
Ownership				
Status	Acres			% Of Watershed

Pine Beetle Response Effects Summary, HUC 101202020702				
Boulder Creek HUC 12 – 26,702 acres				
Private Land	15,036			56%
Roads and Trails				
	Miles	Acres		% Of Watershed
Public Roads	34	83		
Private Roads	4	10		
Open Forest Roads	16	40		
Closed Forest Roads	24	58		
Nonsystem Roads	18	45		
Total	97	235		1%
Proposed Action				
	Activity		Acres or Number	% Of Watershed
Alternative B				
	Commercial Harvest		1,815	7%
Alternative C				
	Commercial Harvest		4,538	17%
	New Roads, 10.9 miles		27	<1%
	Road-stream Crossing		1	
Full treatment				
	Commercial Harvest		9,076	34%
Foreseeable Actions				
None				0%

Past sales harvested in the last 10 years include; Alkali, Boomer, Boulder, Deadman, Elkbugs, Kirk, Mackey, Radio, Redhill, Sturgis Quarter Mile and 139 FB. There are two active mining claims along streams within this watershed for a total of 85 acres. When mining activities are being conducted; there is some sediment entering streams.

Up to 34% of the watershed has proposed activities under either Alternative B or C. The proposed activities are commercial and non-commercial vegetation management. Most of the timber activities would not have cumulative effects because there are no direct effects.

Use of roads related to timber harvest would have cumulative impacts to water quality due to sediment. Especially under Alternative C where there is the potential for new road construction near streams. With the installation of one new culvert and other road reconstruction activities would introduce sediment into streams even with the use of WCPs and BMPs. However; with the implementation of WCPs and BMPs there should not be enough sediment to cause a long-term cumulative effect. This is due to the fact that the sediment pulse should be in short duration during the time of construction or reconstruction activities.

Little Spearfish Creek Watershed

Table 3-13 Little Spearfish Creek Watershed Cumulative Effects Summary

Pine Beetle Response Effects Summary, HUC 101202030303			
Little Spearfish Creek HUC 12 – 18,288 acres			
Past Actions			
Timber Harvest			
Time Period	Acres Of Commercial Activities		% Of Watersheds
2002-2006	3,984		22%
2007-2011	2,221		12%

Fire				
Year	Fire		Acres	% Of Watershed
None	None		0	0%
Past, Present and Future Actions				
Grazing – Federal				
Allotment	Allotment Acres	Acres of Allotment within Watershed	Percent of Allotment within Watershed	% Of Watershed
Little Spearfish	9,181	6,668	73%	
Pettigrew	7,504	2,339	31%	
Plateau	16,494	4,303	26%	
Stearns Park	10,878	4,604	42%	
Total		17,914		98%
Ownership				
Status	Acres			% Of Watershed
Private Land	579			3%
Roads and Trails				
	Miles	Acres		% Of Watershed
Public Roads	1	3		
Open Forest Roads	56	135		
Closed Forest Roads	22	54		
Nonsystem Roads	21	51		
Total	100	243		1%
Proposed Action				
	Activity		Acres or Number	% Of Watershed
Alternative B				
	Commercial Harvest		1,040	6%
Alternative C				
	Commercial Harvest		2,623	14%
	New Roads, 4.1 miles		10	<1%
	Road-stream Crossing		0	
Full treatment				
	Commercial Harvest		5,246	29%
Foreseeable Actions				
Geranium Rx	Prescribe Fire		2,752	15%
Limestone Rx	Prescribe Fire		1,208	7%

Past sales harvested in the last 10 years include; Beartown, Breakneck, Central, Geranium, Hellox, Hellsgate, Obrian, Pit, Plateau, Purgatory, Raddick, Riffle, Riffle Pit, Rimrock and West Rim.

Up to 29% of the watershed has proposed activities under Alternative C. The proposed activities are commercial and non-commercial vegetation management. Most of the timber activities would not have cumulative effects because there are no direct effects.

Use of roads related to timber harvest would have a cumulative impact to water quality due to sediment. Especially under Alternative C where there is the potential for new road construction near streams. Road reconstruction activities would introduce sediment into streams even with the use of WCPs and BMPs. However; with the implementation of WCPs and BMPs there should not be enough sediment to cause a long-term cumulative effect. This is due to the fact that the sediment pulse should be in short duration during the time of construction or reconstruction activities.

SOILS

Introduction
This section discusses the components of the Black Hills National Forest soil resources that could be affected by the proposed activities. They are soil productivity, soil erosion and mass failure. Effects to the watershed resource as a whole are discussed in the hydrology section.

Soil Productivity
Soil productivity is the ability of the soil to supply the water and nutrients needed to sustain plant growth. Variables that influence soil productivity include physical soil characteristics, organic matter and soil biological activity.

Physical Soil Characteristics
Physical soil characteristics include soil depth, pore space and bulk density. Changes in these occur when ground-based equipment make repeated passes over the soil. These activities compress or compact soils and, if soils are wet enough, can result in rutting and puddling of the soil resource. Clay and loam soils generally compact more than sandy soils (USDA Forest Service 2006c). These changes to the physical soil characteristics reduce the pore space volume and water holding capacity. These physical changes reduce infiltration rates, slow soil drainage, impede root growth and reduce plant-available water and nutrients. Physical soil disturbances also decrease gas exchange, affecting both plants and soil biota.

Organic Matter
Organic matter in its various forms contributes to soil productivity. Humus is decomposed organic matter. Duff and litter are partially decomposed leaves, needles and twigs on the surface of soils. Large woody debris consists of woody stems greater than three inches in diameter. Decomposed large woody debris can supply moisture to plants after the soils dry. Organic matter provides nutrients and can retain moisture for soil organisms and plants.

Soil Biological Activity
Soil organisms, including fungi and bacteria, are required by and drive the nutrient cycling process by decomposing organic matter components and releasing the nutrients for use by plants. Soil organisms depend on organic matter for the nutrients they need to carry out their life processes. Decomposed large woody debris provides important habitat for the survival of mycorrhizae fungi. These fungi form a symbiotic relationship with tree roots, increasing water and nutrient uptake by the trees and the fungi.

Soil Erosion
Soil erosion is the movement of soil particles by water, wind or ice. In forested sites on steep slopes, water is the generally the most common driver of erosion. Generally, depending on a variety of site characteristics, potential for the greatest erosion is on steeper slopes (above 30%) and potential decreases as the slope decreases. Erosion is generally infrequent on undisturbed forest soils for two primary reasons: (1) organic matter is generally at levels that provides a protective layer on the soil surface that limits the impact of raindrops and allows water to infiltrate; and (2) the surface soil below the organic layer is by nature generally porous, allowing water to infiltrate into and through the soil profile.

Soil erosion can occur when the surface soil is compacted or when the loose surface soil and its protective layer of organic material are changed or removed, such as by disturbances associated with management activities. Compaction, rutting and puddling can affect infiltration to the point that there can be a reduction in the movement of water into the soil and water can be channeled and concentrated. As a result, water runoff (overland surface flow) is increased and carries soil particles with it. Natural disturbance occurrences such as fire result in the removal of organic matter layers from the soil surface. When surface organic matter is removed, soil pores can become plugged by material (particles) impacted from precipitation events (raindrops) resulting in overland surface flow and increased rates of soil erosion.

Mass Failure

Mass failures (also known as mass movement, soil slippage or landslides) can be triggered by natural or man-made disturbances. Mass failures can be triggered from changed conditions resulting from sequences of natural events, such as wildfire followed by high intensity precipitation events. Some areas on the Forest have characteristics that contribute to a greater potential for instability and are considered to have a greater likelihood or susceptibility to mass failures based on those characteristics which can include soil or bedrock features.

Management activities can contribute to changing soil moisture conditions such as contributing to saturated conditions in localized areas. Activities can create conditions that result in channeling water and concentrating it onto a limited area on hill slopes, for example, below a road culvert or a rutted skid trail. Mass failures triggered by human causes are classified as detrimental soil disturbance. These disturbances result in significant long-term changes in soil productivity that last centuries. Only mass failure information as it relates to potential effects to soil productivity is discussed in this section.

Information Sources

Forest Service Manual (FSM) Section 2550 (USDA Forest Service 2010a) and the USDA Forest Service Region 2 Watershed Conservation Handbook (WCPH) (USDA Forest Service 2006d) reference scientific literature and based on science identify direction to be implemented during project activities on Forest Service administered land for maintaining or improving soil productivity. The FSM and WCPH, along with the revised Forest Plan as amended (2005, the 1996 EIS to the 1997 Forest Plan Revision, the Phase II Amendment EIS (2005g), Forest monitoring reports and direction and information contained within the R2 WCPH identify design criteria and document effectiveness to reduce anticipated detrimental soil disturbances associated with activities that may occur on potential treatment areas within the Mountain Pine Beetle Response Project on the Black Hills National Forest (BKF). Numerous bulk density samples have been collected on the Black Hills National Forest in various areas that have been managed for timber production (cutting units). Forest monitoring reports since 1998, with the most recent BKF Plan monitoring report being issued in 2010 (USDA Forest Service 2010b) have provided information regarding effects based on past activities. Since the activities proposed as part of this project can generally be expected to create varying levels of site and soil disturbances similar to activities that have occurred previously on the Forest and project activities are to implement Forest Plan standards and guidelines, cumulative effects are generally expected to be within those that were described in the FEIS for the Phase II Amendment to the Forest Plan (USDA Forest Service 2005g).

Analysis Area Description
The analysis area forms the boundary for the direct, indirect and the cumulative effects soils analysis. It consists of the specific potential treatment areas (see Appendix D - Maps) and potential activities that would occur for the MPBR Project. This analysis area was selected because that is where the effects of implementing the proposed activities would occur. The specific effects on soils are localized in association with those areas that would receive treatments, the construction and rehabilitation of temporary roads that may be created to access the treatment areas, the construction and maintenance of new permanent roads, and where landings would be created. Effects generally would not extend beyond the proposed specific localized activity unit (i.e. cutting unit) for treatment (USDA Forest Service 2010e, 2006) or along the routes created to access the treatment unit. For the temporal range of effects please refer to "Duration of Effects" in the discussion that follows.

Affected Environment
This project is different from other recent Forest projects in that it is generally considered to be an anticipatory, flexible EIS process (USDA Forest Service 2012e) project to address continued expansion of mountain pine beetles and mortality issues associated with mountain pine beetle activity. While there is general soil information available for soils within the project area of potential treatment areas and potential road creation areas, this project specifies that it relies on required expedited resource reviews, site investigations and route reviews prior to project implementation activities and that site specific locational design criteria would be identified at that time and implemented during activities. This would occur after a Decision for the project has been issued.

The MPBRP potential treatment areas and potential access routes are located throughout various portions of the Black Hills Ecoregion and located on various soils. Soils of the Black Hills National Forest (the analysis area) have generally been mapped and described at an Order 3 (USDA Forest Service 1991), which is the level of data generally mapped for various Forest uses, such as range planning (Additional information on soil survey can be accessed at http://soils.usda.gov/technical/manual). Background soil resource information for the Forest is available in the Final Environmental Impact Statement for the Revised Land and Resource Management Plan for the Forest (USDA Forest Service 1996b), and in the Final Environmental Impact Statement for the Phase II Amendment to the 1997 Revised Land and Resource Management Plan for the Black Forest (USDA Forest Service 2005g). Information on various specific components for Forest soil map unit resources have been and are periodically updated (such as through the 2007 update to the Lawrence County Soil Survey) by the Natural Resources Conservation Service (NRCS) and have become available to the public through a NRCS website located at http://soils.usda.gov/. Hard copy issues of Black Hills county soil surveys have become out-of-date and generally should not be used; therefore they were not referenced for this project analysis.

Potential treatment units identified in the proposed action are located within two Major Land Resource Areas (MLRA) of the Black Hills Ecoregion: MLRA 61 – Black Hills Footslopes and the majority of the treatment areas located in MLRA 62 – Black Hills (MLRA information can be accessed at http://www.cei.psu.edu/mlra/). The majority of the potential treatment areas are located in MLRA 62. NRCS recently (2011) released an updated electronic soil map for the Black Hills Ecoregion Major Land Resource Area 62 (MLRA) that includes updates to many map unit symbols, to soil series included within various map units and updates to various soil descriptions

and interpretations. Black Hills soil resource information is publicly available for MLRA 61 and 62 and can be accessed through various web information sites, such as Soil Data Mart, Soil Data Viewer, MLRA Explorer, Web Soil Survey and other links that are available at http://soils.usda.gov/. Any of that soil information that is posted to NRCS soil web links can be updated at any time as new information is gained about specific soils. Soil map units associated with the MPBRP action alternatives were identified through the use of Geographic Information System (GIS) capabilities. Based on that process soil map units are currently listed in this report for the action alternatives (Alternatives B and C) potential treatment areas.

A map unit delineated polygon on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Based on this variability, areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas (such as rock outcrops) for which it is named and some minor components that belong to taxonomic class other than those of the major soils (Soil Survey Staff 2012).

Soil survey map unit symbols for units included in the new MLRA 62 soil survey legend begin with the letter Q (example: Q0828C). Soil survey map unit symbols in MLRA 61 vary by soil survey area (county) and do not currently begin with a Q (examples of map unit symbols in MLRA 61: BvD, RoF, 157).While the majority of the action alternative potential treatment areas are located in MLRA 62, general information for both of the MLRAs is provided.

MLRA 61 – Black Hills Footslopes: The general geology of MLRA 61 is an area consists of marine sediments older than the Cretaceous Pierre Shale on the high plains surrounding this area. The older rocks were brought closer to the surface during the uplift that formed the Black Hills. The Lower Cretaceous Fall River and Lakota (Inyan Kara Group) sandstones occur on the outside boundary of the area and are referred to as the Dakota Hogback. Permian limestone and shale of the Minnekahta limestone form the inside boundary and occur in the mountains of the Black Hills (MLRA 62). The Triassic red beds of the Spearfish shale form a low valley, the "red valley," surrounding the Black Hills between the two ridges formed by the Inyan Kara and Minnekahta Formations. The red beds have gypsum and anhydrous layers. Ground-water seepage can dissolve these layers, creating sinkholes on the surface.

MLRA 62 – Black Hills: The core of the Black Hills is a mass of granite with steeply dipping metamorphic rocks, primarily slate and schist, directly surrounding it. A plateau of Mississippian limestone surrounds the igneous and metamorphic rock core. This Pahasapa (Madison) limestone is broken around the outer edges of the uplifted area. The Permian Minnekahta limestone forms the outermost boundary of the area. Many other tilted sandstone, shale, and limestone units are exposed like a bathtub ring inside the steeply dipping Pahasapa limestone. These older units are also exposed on the valley walls along the major drainages that cut through the rock layers.

Potential Treatment Areas by Soil Map Unit Located in Each County

Potential treatment areas are located within each county that the Forest is located within. Lawrence County is the only county with total potential treatment area variances between the action alternatives.

There is a lengthy list of soil survey map units included in the potential treatment area for each project action alternative. Due to the length, that list is not included here but is included in the project record.

Environmental Consequences

Introduction

The analysis of effects for soils assumes that design criteria outlined in Appendix B would be implemented during project activities and site reviews prior to implementation would occur. This analysis discusses the expected disturbance resulting from the implementation of the action alternatives and describes potential risks of effects to the soil resource associated with various disturbances. Various similar harvest systems and design criteria have been implemented during past Forest projects and monitored for effectiveness. Soil monitoring has been included in Forest monitoring reports. The most recent Forest Plan monitoring report was issued in 2010 (USDA Forest Service 2010b).

Cumulative effects for soil resources have generally been discussed in terms of the treatment activity areas. The Forest Service Manual (USDA Forest Service 2010f) defines an activity area as a land area affected by a management activity to which soil quality standards are applied. An example of an activity area is a harvest unit. Per manual direction, soil quality standards do not apply outside of an activity area. Effects to the watershed resource as a whole are discussed in the Hydrology section.

The FSM defines soil quality guidelines in terms of detrimental soil disturbance which includes: compaction, rutting, displacement, severely-burned soil, surface erosion and soil mass movement (mass failures). It is important to consider and understand that not all site or soil disturbances are detrimental disturbance. For example, compaction of soil resources can occur, however soil bulk density increases associated with disturbances can occur to various levels which may not be at levels considered to be detrimental.

Assumptions used discussing potential disturbance associated with various activities and used in this analysis:

- That mountain pine beetle activity and associated ponderosa pine beetle mortality would continue to occur at similar levels as in recent previous years.
- That based on a time period of five to seven years for project activities to be implemented following a decision, there is potential that some level of the potential treatment acres will have mountain pine beetle mortality and no ground disturbance activity would occur at those locations.
- The Forest Plan will be followed.
- Forest Service Manual 2500 – Watershed and Air Management, Chapter 2550 – Soil Management and Watershed Conservation Practices (FSH2509.25) will be followed.
- Recent (2008f) WO Forest Service direction (FSM 2800) for geologic hazard expands beyond the soil guideline (FP Standard 1108 developed for the 1997 Plan) will be followed.
- Design criteria identified to be in compliance with Forest Plan direction would be implemented and adequate funding would be provided for effective implementation; timely assessment or monitoring of soil resource components and conditions would occur.
- The implementation of the wildlife standard for retaining large woody debris (Standard 2308a) is expected to attain the Forest Plan Objective (212) of 5 to 10 tons per acre of large

woody debris (greater than 3-inches in diameter) retained within activity areas to provide organic matter reservoirs for nutrient cycling.

- If review of monitoring design criteria implementation indicated issues during implementation, that implementation or design criteria would be altered or adapted to address issues. If a soil issue was identified after implementation that actions would be identified and funding would be available to implement any needed rehabilitation.
- The areas with the greatest likelihood of experiencing the greatest amount of mechanized ground based harvest and cable timber harvest would be within 4B and 4C structural stage stands.
- Harvest of timber through the use of helicopter or cable methods only remove boles and would retain well distributed slash on site of removal.
- In general, the treatment activities of cut and chunk, cut and chip, cut-hand pile-burn, insecticide spray, helicopter timber harvest, would generally result in low or limited amounts of disturbance to the soil resource. If cable harvest is able to suspend boles, little ground disturbance would be expected on the slopes and slash would generally be expected to be retained on site. Associated ground disturbance would be with road development for harvest equipment and landings to load trucks. In general, the most disturbance and greatest potential for site disturbance to occur to that defined as a detrimental level would be associated with the following activities: Cut-Equipment Pile-Burn, Ground Based Timber Harvest (and associated landings), and construction of roads.
- Based on recent observations of MPB infested areas that have been treated or areas with extensive MPB mortality, potential treatment area post treatment basal areas are expected to be similar to that experienced during seed-tree harvest.

Direct and Indirect Effects of Alternative A – No Action

Alternative A provides a baseline to evaluate the effects of the action alternatives. The effects on soils are discussed as changes over time on soil productivity, soil erosion and mass failures.

Soil Productivity

Alternative A would not result in short-term effects on the soil resource over and above the existing condition. No additional road building, timber harvest, or non-commercial thinning or other activities described for the potential treatment areas would disrupt natural soil processes.

Physical Soil Characteristics

Alternative A would not result in soil compaction, rutting, puddling or soil displacement. In areas where past timber management may have resulted in compacted soil conditions, soil productivity would generally be expected to slowly improve as plant roots, soil organisms and freeze-thaw events loosen the soil.

Organic Matter

With implementation of Alternative A, standing dead trees would eventually fall over and contribute coarse woody debris. Needles and branches would remain on the site and fall to the ground. Soil organisms would decompose organic materials thus adding humus to the soil. Over time, nutrients associated with this material would become available for plant growth. As the ponderosa pine tree canopies close in and shade the soil surface, soil organisms activity generally slows in association with cooler temperatures and decomposition rates would generally reduce to levels that allow organic matter and nutrients to accumulate on the soil surface. This process

would continue until another major disturbance, such as fire or a windstorm, opens the tree canopy allowing sites to have increased temperatures and contribute to increase downed wood recycling processes again.

Soil Organisms
Microorganism populations would fluctuate with the changes in the microclimate and the organic matter on the soil surface. These changes would be in response to the changing vegetation as a result of natural events such as fire, wind throw of trees and other sources of natural vegetation mortality.

Soil Erosion
Alternative A would generally be expected to result in the continuance of any current soil erosion to decrease as vegetation returns to soil surfaces capable of supporting vegetation that currently lack plant cover. Any wildfires that may occur would generally be expected to result in a short-term localized (within the burned boundaries) increase in soil erosion (based on recent Burned Area Emergency Response assessment observations this generally occurs within the first year or two following the fire during favorable years and then generally recovers within three to five years areas have generally revegetated to the extent that erosion has returned to general background levels). Soil erosion rates would fluctuate with natural changes in vegetation cover.

Mass Failures
Alternative A would not change the natural site instability characteristics or the risk of mass failures within the project area. Various natural events (fire, precipitation) would still be expected to occur under this alternative and if they would occur at areas with instability characteristics, it is expected that localized mass failure could be triggered and continue to occur under this alternative. Mass failures would not be related to this project.

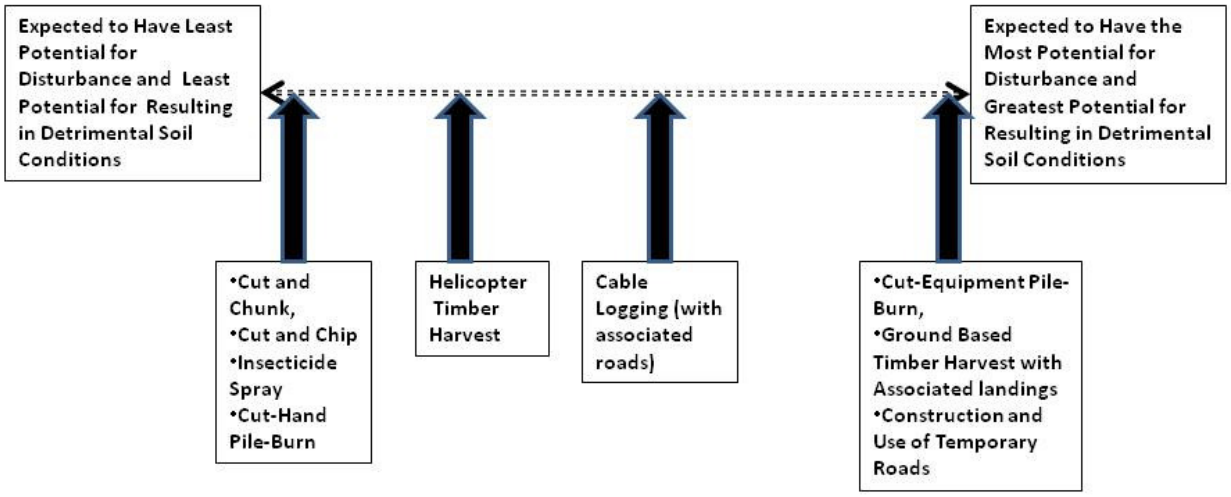
Direct and Indirect Effects of Action Alternatives – Alternatives B and C

Soil Productivity
The following paragraphs are based on the Forest intent to maintain soil productivity while addressing the purpose and need of the project. The project includes alternative design, treatment methods and design criteria that are expected to result in less disturbance to various soil resources with potential greater risks of productivity loss such as through operating during dry or frozen conditions, limiting the extent of temporary roads, skid trails and landings and rehabilitating those features so that detrimental soil conditions occupy less than 15 percent of each activity area.

While not on a true scale, Figure 3-1 provides a general comparison of Mountain Pine Beetle Response Project potential activities and expected potential ground disturbance based on past activity field observations on the Black Hills National Forest. These observations are consistent with what has been documented in a recent publication by the USFS Rocky Mountain Research Station for the USFS Northern Region (Reeves et al. 2011). In that publication, it was stated that there was a significant difference in an areal extent of detrimental soil disturbance following timber harvest operations among ground based, skyline (cable logging) and helicopter systems; among harvest seasons; and among National Forests. The frequency of detrimental soil

disturbance harvest operations in the Northern Region followed the general trend of ground-based>skyline (cable)>helicopter. Further information in that document, similar to what the Black Hills has documented with sampling bulk densities (USDA Forest Service 2010f), documented that winter ground-based harvest resulted in a significantly lower areal extent of DSD than summer ground-based harvest. On the Black Hills, the DSD extent (of soil bulk density increases) on sites sampled was also very low to not even detectable when sites were harvested during dry soil moisture conditions in the summer (USDA Forest Service 2010f). The visual feature provides a quick general overview of which activity would also likely have the greatest potential for detrimental soil disturbance. In association with that, the activities with the greatest potential for detrimental soil disturbance also would be expected to have the most design criteria implemented during implementation.

Figure 3-1 Comparison of Potential Activities and Potential Ground Disturbance on Soils



Physical Soil Characteristics

There are soils within the potential treatment areas with greater potential to be compacted (increase in soil bulk density) to detrimental levels if activities occur when soils are wet. The following soil survey map units (listed by soil survey map unit symbols) in each of the counties have a least one of the dominant map unit components with a severe hazard rating for compaction.

Lawrence County: Q0100C, Q0102E, Q0104G, Q0106E, Q0108E, Q0108G, Q0114D, Q0114E, Q0206B, Q0209D, Q0216B, Q0217C, Q0225D, Q0226E, Q0227E, Q0239D, Q0400B, Q0401B, Q0403B, Q0407C, Q0409E, Q0411C, Q0413C, Q0415D, Q0416C, Q0418E, Q0420G, Q0501B, Q0502C, Q0506D, Q0508C, Q0509C, Q0510E, Q0512C, Q0514C, Q0518B, Q0518C, Q0520C, Q0538A, Q0540C, Q0540F, Q0552D, Q0568B, Q0568E, Q0570F, Q0572D, Q0584E, Q0584F, Q0586E, Q0901B, Q0928C

Custer County: BrB, GrD, GrF, PgC, Q0304D, Q0310D, Q0312E, Q0315E, Q0322D, Q0413C, Q0415D, Q0416C, Q0418E, Q0420G, Q0422C, Q0502C, Q0514C, Q0520C, Q0552D, Q0584E, Q0587E, Q0608B, Q0609C, Q0620C, Q0675E, Q0676E, Q0680D, RpC, RrE

Pennington County: Q0200C, Q0206B,Q 0209D, Q0211E, Q0216B, Q0226E, Q0239D, Q0307B, Q0310D, Q0312E, Q0315E, Q0322D, Q0400B, Q0401B, Q0405D, Q0408E, Q0409E, Q0411C, Q0413C, Q0415D, Q0416C, Q0418E, Q0420G, Q0422C, Q0501B, Q0502C, Q0512C, Q0514C, Q0520C, Q0552D, Q0576C, Q0584E, Q0584F, Q0586E, Q0587E, Q0608B, Q0609C, Q0611C, Q0619C, Q0620C, Q0632E, Q0675E, Q0676E

Meade County: Q0106E, Q0108E, Q0108G, Q0114D, Q0501B, Q0502C, Q0506D, Q0509C, Q0510E, Q0514C, Q0518B, Q0518C, Q0520C, Q0535C, Q0553E, Q0568B, Q0568E, Q0570F, Q0572D, Q0584E, Q0584F, Q0586E, Q0611C,Q0675E, Q0676E, Q0901B
Crook County: 125, 13, 156, 157, 164, 166, 170, 172, 179, 187, 198, 37, 38, 66, 67, 86, 93, 95, 96, 98, Q0100C, Q0102E, Q0106E, Q0114D, Q0114F, Q0400B, Q0407C, Q0408E, Q0409E, Q0411C, Q0411E, Q0418E, Q0509C, Q0510E, Q0512C, Q0512E, Q0516C, Q0518B, Q0518C, Q0519B, Q0540C, Q0540F, Q0556C, Q0556F, Q0584E, Q0584F, Q0801B, Q0803E, Q0808A, Q0811C, Q0815C, Q0815E, Q0817A, Q0826C, Q0826F, Q0827C, Q0827E, Q0828C, Q0828F, Q0834B, Q0834C, Q0836B, Q0838C, Q0840C, Q0841B, Q0842C, Q0848B, Q0852C, Q0852E, Q0854B, Q0854C, Q0854E, Q0922C
Weston County: 15, 56, 57, 84, Q0400B, Q0401B, Q0405D, Q0408E, Q0409E, Q0411C, Q0416C, Q0418E, Q0420G, Q0512C, Q0512E, Q0584E, Q0584F, Q0586E
Fall River: BoB, BpB, BvD, CnD, MmE, MpE, NoB, NoC, Q0608B, Q0620C, Q0640B, Q0657D, ReD, RgF, TaC, TgC

Ground-Based Harvest: Ground-based harvesting would generally result in localized direct and indirect effects on soil physical characteristics within the boundaries of proposed activity areas. Ground based systems would generally occur across the landscape on slopes generally less than 40 percent slopes. The likelihood for the most potential detrimental effects, including that of compaction, would be concentrated on skid trails and temporary roads and landings within or associated with timber units that are treated. Minimizing the area occupied by landings or to reuse landings, skid trails or unauthorized roads are included in the project design criteria (Appendix B) to reduce potential extent of detrimental effects. Design criteria includes operating on dry or frozen conditions to prevent bulk density increases to a detrimental level on soils with characteristics that level may be more likely to occur (refer to the list of those units above). Dry conditions are generally when soils are at moisture levels lower than what is at a field capacity level, below what is known as the plastic limit (USDA Forest Service 2006). Rutting and puddling are most often associated with mechanical logging on soils that are wet, or above the plastic limit (generally when soil can be rolled into 3 millimeter threads without breaking or crumbling). By operating during low soil moisture conditions, there is the potential to limit the amount of detrimental soil disturbance on skid trails.

Operating on slash is generally effective for buffering the effect of equipment operation on mineral soil. Thus if systems are used that significant slash is maintained on the skid trails, detrimental effects could be limited.

Design criteria include rehabilitation implementation of the landings and skid trails. If in some cases where there would be opportunities to utilize designated Forest transportation system roads for helicopter log landing sites, then it is generally expected that there would be little to no effect on adjacent soil resource productivity.

Cable Timber Harvest: This type of harvest operation on any of the potential treatment areas (generally on areas over 40% slope areas) would generally be expected to result in direct and indirect effects on soil physical characteristics within the localized areas that the method would be used. In the past on the Black Hills, it has been observed that areas of compaction associated with cable systems have generally been to be less than effects to soils associated with ground-

based operations, and very localized. As stated earlier, this is generally consistent with what has been recently documented by the USFS Rocky Mountain Research Station in the Northern Region Forests (Reeves et al. 2011).

Design criteria include rehabilitation implementation of the landings. If in some cases where there would be opportunities to utilize designated Forest transportation system roads for helicopter log landing sites, then it is generally expected that there would be little to no effect on adjacent soil resource productivity.

Helicopter Timber Harvest: Helicopter yarding, to generally be used on slopes greater than 40% (USDA Forest Service 2012e) is generally expected to avoid impacts associated with ground-based equipment, including that of compaction, within a cutting unit. General observations of limited disturbances associated with recent (within the last two years) winter helicopter logging activities on the Black Hills (on Forest and State Park administered lands) indicate there is limited likelihood that impacts within the tree removal areas are detrimental. Helicopter logging is generally expected to use full suspension and slash (limbs, branches and cull material) is retained where the trees were dropped on hill slopes. Most impacts associated with helicopter logging were observed to be associated with the log landings and any temporary roads to access the landings.

Design criteria include rehabilitation implementation of the landings. If in some cases where there would be opportunities to utilize designated Forest transportation system roads for helicopter log landing sites, then it is generally expected that there would be little to no effect on adjacent soil resource productivity.

Cut and Chunk, Cut and Chip, Insecticide Spray, Cut-Handpile-Burn: These types of treatments result in little to no ground disturbance and organic matter is left distributed throughout the area. Very little to light ground based equipment are used with these activities therefore compaction is generally not expected.

Summary: Generally, protection of the soil resource would be expected through the site specific or localized identified design criteria (Appendix B, MPBRP DEIS) to be selected prior to implementation (USDA Forest Service 2012e) and increases in bulk density would be expected to remain within the limits specified. Cable logging and helicopter logging would generally be expected to result in fewer localized impacts to soil resources than ground-based equipment when used on the appropriate slopes. Temporary roads, skid trails and landings associated with any of the commercial timber removal activities are to be rehabilitated (Appendix B, MPBRP DEIS). Very limited to no increases in soil bulk density is expected within the areas that have the activities of Cut and Chunk, Cut and Chip, Insecticide Spray, Cut-Handpile-Burn.

Organic Matter

As identified in Chapter 2 of the DEIS, there are several different potential project treatments and activities. These treatments would leave varying localized amounts of organic matter on the site. Reduced organic matter can be associated with potential for reduced soil nutrient levels.

The total amount of nutrients on a site would likely be reduced where soil organic matter would be removed or displaced. If a non-commercial vegetation management treatment, such as dead fall treatments of cut and chunk would be used, then soil productivity issues with nutrient removal would generally not be expected since organic material is not physically removed from the site. Commercial vegetation management with ground based equipment often removes whole trees (including limbs and branches) from sites in order to also target the reduction of fuels in the stand in order to aid in fire suppression should a fire occur. Commercial harvest activities that utilizes helicopter logging or cable logging systems generally removes the larger bole stem of the tree and retains non-commercial bole material and other tree components (branches and limbs) on site. In fuel break areas, this material may be hand-piled and burned (refer to Fire and Fuels section).

There are some soil resources with limited natural nutrient holding capacity capabilities and have a limited ability to naturally buffer potential productivity losses associated with nutrient cycling. These are generally soils with naturally limited organic matter levels in the soil profile, have little to no topsoil or are restricted in depth (shallow soil layers above bedrock). Not all soils have been sampled for lab characterization and the NRCS has extrapolated lab results information to similar soils within the MLRAs. Generally, some areas where soils with the features identified above are located are along rocky ridge tops or in the central crystalline core area. These soils may occur as inclusions or minor components (approximately 10% or less of the map unit) within a number of soil survey map units within the project area, but are dominant soil survey map unit components in a number map units. Forest Plan Standard 1102 (Guideline a.) and WCPH Management Measure 14 (14.2 Design Criteria a.) specify amounts of organic material to be left during timber production treatment activities on those managed as suitable timber lands. Both directional documents recognize that when there are fuels loading concerns that the amount of slash to be retained for suitable timber land long term productivity may be adjusted (refer to the Fire and Fuels section for slash retention on those lands where there are fuel concerns and DEIS maps identifying areas of the project with fuel loading concerns). Soils identified per Forest service direction for slash retention on those lands suitable to be managed for timber production: Limited organic matter levels (less than 2% organic material in the topsoil), topsoil layer less than 1 inch in depth, or effective rooting depth (total soil depth) of less than 15".

Soil Survey Map Units with at least one of the dominant components that has soils with topsoil thinner than one inch, topsoil (A horizon) organic matter less than two percent or an effective rooting depth less than 15 inches (Forest Plan Standard 1102; WCPH Management Measure 14)

Lawrence County: Q0106E, Q0108E, Q0108G, Q0110E, Q0110G, Q0112G, Q0114D, Q0114E, Q0202E, Q0203D, Q0221F, Q0231G, Q0407C, Q0409E, Q0411C, Q0416C, Q0418E, Q0420G, Q0551C, Q0552D, Q0553E, Q0554F, Q0571E, Q0588D, Q0906D, Q0918C
Custer County: Q0001E, Q0003C, Q0004E, Q0005G, Q0302E, Q0304D, Q0317G, Q0319G, Q0414E, Q0416C, Q0418E, Q0420G, Q0552D, Q0571E, Q0588D, Q0590E, Q0622F, Q0653D, Q0658D, Q0659E, Q0664E, Q0665E, Q0672C, Q0677D, RfE, RhD
Pennington County: Q0001E, Q0003C, Q0005G, Q0202E, Q0203D, Q0231G, Q0302E, Q0304D, Q0317G, Q0408E, Q0409E, Q0411C, Q0416C, Q0418E, Q0420G
Meade County: NaD, Q0106E, Q0108E, Q0108G, Q0110E, Q0110G, Q0112G, Q0114D, Q0514C, Q0551C, Q0552D, Q0553E, Q0554F, Q0571E, Q0588D, Q0658D, Q0659E, Q0664E, Q0665E

Crook County: 156, 157, 164, 166, 170, Q0106E, Q0108E, Q0114D, Q0114F, Q0202E, Q0407C, Q0408E, Q0409E, Q0411C, Q0411E, Q0412D, Q0418E, Q0516C, Q0556C, Q0556F, Q0852C, Q0852E, Q0918C
Weston County: 57, Q0412D, Q0521E, Q0621E, Q0664E
Fall River County: Q0657D, Q0659E, Q0660F, Q0665E, Q0668F, SpF

Ground-Based, Cable and Helicopter Timber Harvest, Cut and Chunk, Cut and Chip, Insecticide Spray, Cut-Handpile-Burn: Design criteria is identified for post treatment slash retention on potential treatment areas with soils with specific characteristics (limited organic matter, limited topsoil, and/or limited depth) to address Forest Standard 1102 (Guideline a.) and WCPH Management Measure (14) (USDA Forest Service 2006d) during clearcut and seed tree harvest. Leaving dead trees, implementing the design criteria or implementing the activities that leave the organic material on site (cut and chunk, lop and scatter, etc.) would generally be expected to maintain nutrient cycling capabilities of those localized areas that are classified as suitable timber lands and to be managed to continue to produce a sustained productivity of timber into the future. Several of the potential treatment units included within this project are located within soil survey map units on soils that formed under grassland vegetation. It is expected that pine has encroached into those grassland areas and removal of the trees in those areas would be in areas that are have not been classified as suitable for timber production management or to be managed for timber production. Therefore, Forest Standard 1102 and WCPH Management Measure 14 for the retention of material to aid with site regeneration and seedling establishment would not apply from the standpoint of maintaining nutrient cycling for a sustained level of long term timber production. Therefore, those soil survey map units were not included in the list above. Direction in the Forest Plan recognized the need to remove material along roads and trails that serve as fuel breaks and provided for that need in the second portion of Forest Standard 1102 (Guideline b). In areas with fuel loading concerns result in a selection to implement Guideline b. (FP Standard 1102) over Guideline a. coincide with map units listed above, there may be some long term effects to nutrient cycling in the localized areas where those actions occur.

The ground based harvest has the most potential for removing material from the site. A whole tree harvest system, removing the tree bole as well as the tree canopy (tops, branches, needles) generally removes all of that material from the site and is often used when there is a fuel loading concern. Some stumps and the below ground roots would still be on site and provide some material for nutrient cycling in those areas. Cable and helicopter harvest generally retain slash on site and the material would provide for nutrient cycling and would meet Forest Plan and WCPH direction for slash retention.

The activities of Cut and Chunk, Cut and Chip and Insecticide Spray would generally not be expected to remove much if any woody material from any site where they are used. Implementation of Cut-Handpile-Burn would alter distribution of some woody material into piles and some would be burned, however, burning releases some of the nutrients back into the soil where the piles are located. This type of activity usually occurs within the areas identified as fuel breaks or around high value/high risk areas where fuel reduction has been determined to be needed to address safety.

Summary: Generally, while effects are expected to occur, protection of the soil resource would be expected through the site specific or localized identified design criteria (Appendix B, MPBRP

DEIS) to be selected prior to implementation (USDA Forest Service 2012e) and nutrient cycling material on sites to be managed as suitable timber land to provide a sustained yield of timber volume through time would be expected to remain within the limits specified. Cable logging and helicopter logging would generally be expected to result in fewer potential localized impacts to retention of woody material on the soil survey map units specified than ground-based equipment. Very limited removal of woody material is expected within the areas that have the activities of Cut and Chunk, Cut and Chip, Insecticide Spray, Cut-Handpile-Burn.

Soil Microorganisms

A variety of organic matter left on the potential treatment areas would generally be expected to benefit soil microorganisms by providing substrate and habitat. While uncertain, an assumption is that during the implementation of activities and design criteria there would generally be some component of both dead and live trees that are distributed across the landscape. In addition, the potential treatments would be implemented so that less than 15 percent of the area would be detrimentally disturbed. There are areas that would generally be expected to be undisturbed by equipment. Cut and chunk, cut and chip and cut-handpile- burn would generally be expected to have the least surface disturbance. While a treatment is to cut-handpile-burn, there are design criteria in Appendix B applicable to all areas to be treated and include coarse woody debris retention, snag retention and retention of a specific number of small unburned handpiles to support prey. Implementation of those design criteria as well as stumps left at the surface and roots from trees that were removed would continue to provide material for micro-organisms.

Soil compaction, puddling, rutting and displacement reduce the ability of soils to exchange oxygen and carbon dioxide thus affecting soil microorganism survival. Favorable habitat for soil organisms would generally be maintained because the potential treatment areas would be designed to reduce soil disturbance to meet Regional and Forest direction.

Summary: Because the amount of detrimental physical soil changes are to be minimized through implementation design criteria and because organic matter in various forms are to remain on the potential treatment units, the effects to soil microorganisms would generally be expected to be limited. Implementation would retain a variety of organic matter components to remain on sites, including living trees and other forest vegetation. In addition, activities would implement actions so that the organic layer on the soil surface would be retained on the majority of the area, providing habitat and nutrients for soil microorganisms.

Soil Erosion

Where there is greater than a low risk of soil erosion there are design criteria specified for project implementation. Project required review of site conditions prior to treatment is to result in identification of design applicable to the specific sites. Effective implementation of those design criteria is generally expected to limit erosion to acceptable limits. See the project design criteria and monitoring to determine effectiveness identified in Appendix B.

Sediment from the designated permanent transportation system (with associated cut and fill and adjacent parking or pull out features, etc.) can have direct and indirect effects on water quality through sedimentation, but is not a component of the soil quality assessment process. These effects are identified in the Hydrology section.

As can be expected, the erosion hazard rating for soils is strongly influenced by slope steepness. The erosion hazard ratings for soils within potential treatment areas were obtained by accessing the NRCS Soil Data Mart site and selecting FOR – Potential Erosion Hazard (OFF-Road/Off Trail) accessed at http://soildatamart.nrcs.usda.gov/. The ratings in this interpretation indicate the hazard of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface. The ratings are based on slope and soil erosion factor K. The soil loss is caused by sheet or rill erosion in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by logging, grazing, mining, or other kinds of disturbance. The hazard is described as "slight," "moderate," "severe," or "very severe." A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions; "moderate" indicates that some erosion is likely and that erosion-control measures may be needed; "severe" indicates that erosion is very likely and that erosion-control measures, including revegetation of bare areas, are advised; and "very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical (Soil Survey Staff 2012a, 2012b). There are potential treatment units located in areas with severe and very severe hazard rating for soils. The following soil survey map units in each of the various county potential treatment areas were identified to have a least one of the dominant map unit components with a severe or very severe hazard rating for erosion:

Lawrence County: Q0104G, Q0108G, Q0110E, Q0110G, Q0231G, Q0232G, Q0420G, Q0530G, Q0554F, Q0566F, Q0570F, Q0584F, Q0585G, Q0589G
Custer County: BwE, CdF, GrF, HtG, NcE, NfE, Q0005G, Q0317G, Q0319G, Q0420G, Q0530G, Q0589G,Q0591G, Q0613F, Q0634G, Q0655G, Q0678G, RsF
Pennington County: Q0005G, Q0231G, Q0232G, Q0317G, Q0319G, Q0420G, Q0584F, Q0585G, Q0589G, Q0591G, Q0634G, Q0655G, Q0678G
Meade County: Q0110E, Q0110G, Q0112G, Q0530G, Q0554F, Q0566F, Q0570F, Q0584F, Q0585G, Q0589G, Q0591G, Q0678G
Crook County: 155, Q0114F, Q0556F, Q0563G, Q0584F, Q0585G, Q0826F, Q0926G
Weston County: 92, Q0420G, Q0584F, Q0585G, Q0589G
Fall River County: MnF, Q0660F, Q0668F, Q0678G, RoF, RrF, SpF

Most of those map units identified with a severe erosion hazard rating are located on slopes over 40% and the alternatives have already been designed to avoid or limit activities that are to occur on those slopes. Alternative design includes that generally no ground based mechanized harvest equipment would occur on areas over 40% (see Chapter 2). Cable and helicopter harvest, as well as the other activities with relatively low potential for disturbance (such as cut and chunk) may occur on slopes over 40%.

Rather than include a list of all of the soil map units with a dominant map unit component with a moderate erosion hazard as compared to those with slight hazards for erosion, a generalization is provided here. In general, dominant soil survey map unit components on slopes of 15 to 40% are identified as having a moderate hazard rating for potential erosion. Soils on slopes below 15% are generally identified to have a slight hazard for potential erosion. Examples of site characteristics that can influence those slope percentage breaks can include the amount of surface rock a site has or if there may be a significant amount of mica in the soil.

Ground-Based Harvest: Ground-based harvesting would generally result in localized direct and indirect of soil erosion effects within the boundaries of potential treatment activity areas. Ground based systems would generally occur across the landscape on slopes generally less than 40 percent slopes as part of the design of the alternatives referred to earlier. Soils on slopes over between 15% and 40% have greater potential for erosion (moderate erosion hazard) to occur to a level that could be detrimental than soils on slopes below 15% (generally an erosion hazard of slight). The likelihood for the most potential detrimental effects would be concentrated on skid trails and temporary roads associated with timber units where trees are removed. Minimizing the area occupied by skid trails or to use unauthorized roads are included in the project design criteria (Appendix B) to reduce potential extent of detrimental effects, including creating conditions that can contribute to increased erosion potential. Design criteria includes operating on dry or frozen conditions on areas with a greater likelihood for compaction to prevent bulk density increases to a detrimental level on soils with characteristics that level may be more likely to occur (refer to the list of those units above). This design criteria is also beneficial from the standpoint of soil erosion. Operating the winter when the ground is frozen or there is snow pack limits ground disturbance potential.

Operating on slash is generally effective for buffering the effect of equipment operation on mineral soil. Thus if systems are used that significant slash is maintained on the skid trails, detrimental effects could be limited.

Management activities that implement project design criteria for retention or placement of organic matter on the soil surface would be expected to keep soil erosion to levels not considered to be detrimental.

Cable and Helicopter Timber Harvest: Cable and helicopter harvest generally results in limited potential for erosion. Ground disturbance, except at landings and roads, generally does not occur with this type of harvest. Potential areas of erosion associated with this type of harvest is generally expected to be very limited and expected to be localized in association with temporary roads and landings.

Cut and Chunk, Cut and Chip, Cut-Hand Pile-Burn, Spray: Soil erosion would generally be expected to be limited if any as a result of these types of treatments since there is very limited ground disturbance expected. Thinned or chunked woody material would generally add cover to the soil surface, reducing the potential risk of erosion. Insecticidal spray operations would generally not be expected to remove ground cover material. Hand piling activities would generally not be expected to increase risk of soil erosion. Handpiles for burning are generally small (generally less than 20 feet in diameter) and scattered across units with expanses of vegetated areas in between. Because of their size, small piles generally have limited to no issues with soil heating and have been observed to generally revegetate within two years of when they were burned.

Summary: Generally, protection of the soil resource would be expected through the site specific or localized identified design criteria (Appendix B, MPBRP DEIS) to be selected prior to implementation (USDA Forest Service 2012a) and increases in erosion to levels defined as detrimental would be expected to remain within the limits specified in the WCPH. Cable logging and helicopter logging would be expected to result in fewer localized impacts to soil resources as

compared to the use of ground-based equipment when used on the appropriate slopes. Temporary roads, skid trails and landings associated with any of the commercial timber removal activities are to be rehabilitated and monitored (Appendix B, MPBRP DEIS), including providing proper drainage to limit potential for erosion. Very limited to no increases in erosion to a level considered to be detrimental is expected within the areas that have the generally low ground disturbance activities of Cut and Chunk, Cut and Chip, Insecticide Spray, Cut-Handpile-Burn.

Mass Failures

Mass failures are generally located in areas with slope stability concerns. As identified earlier, there are slope instability areas in the Black Hills. Proposed project ground-based mechanized treatments are planned for areas with slopes that are generally less than 40 percent. Operating on slopes less than 40% is a project design to limit the likelihood for the risk of mass failures. Other project design (design criteria in Appendix B) includes avoiding the use ground based equipment for timber removal or the creation of roads on slopes above 30% on specific soil survey map units (identified below) unless potential treatment sites or access routes (temporary roads, permanent roads) proposed to be located on slopes over 30% are reviewed for stability. Design criteria also specifies that on sites that are reviewed over 30% on those specific soil survey map units, and on any other potential treatment sites or proposed access routes on slopes greater than 55%, that have visual characteristics of instability, cable logging or helicopter logging is also to be avoided. Implementation of the site reviews and route reviews prior to potential treatment activity or access route creation along with implementation of design criteria (Appendix B) for proposed activities on slopes over 30%, would generally expected to limit the extent of potential detrimental soil disturbance associated with mass failures.

Recent (2011) published soil survey and soil information updates have taken place for MLRA 62 – Black Hills by the Natural Resources Conservation Service (NRCS). Personal communication has occurred with Natural Resource Conservation Service Soil Scientists who were primary investigators for mapping and gathering data for soils within MLRA 62. Various sites were observed to have mass failures or slides or characteristics that indicate a greater likelihood for instability issues. Electronic communication has also occured regarding soils with potential stability issues (Westerman pers. comm. 2012; Brady pers. comm. 2011). Forest Plan Guideline 1108(a) addresses stability as related to soil productivity. Updated NRCS soil information and revised soil series were used to develop a list of soil survey map units applicable to the guideline (guideline was developed for the 1997 Revised Forest Plan; not changed for the Phase II Amendment 2006g). Design criteria to address slope stability investigations and potential activity avoidance on uninvestigated sites or unstable features applies for the following soil survey map units (by map unit symbol) included in MPBRP potential treatment areas and along any routes (temporary roads and permanent roads) to be created to access potential treatment areas:

MLRA 62 Soil Survey Map Units - Q0001E, Q0006E, Q104G, Q0106E, Q0108E, Q0108G, Q0110E, Q0110G, Q0112G, Q0114E, Q0114F, Q0202E, Q0211E, Q0213G, Q0214E, Q0221F, Q0226E, Q0227E, Q0231G, Q0232G, Q0239D,Q0302E, Q0315E, Q0317G, Q0319G, Q0408E, Q0409E, Q0510E, Q0512E, Q0530G, Q0536F, Q0540F, Q553E, Q0565E, Q0566F, Q0568E, Q0570F, Q0571E, Q0572D, Q0584E, Q0584F, Q0585G, Q0586E, Q0587E, Q0589G, Q0590E, Q0634G, Q0655G, Q0659E, Q0664E, Q0665E, Q0675E, Q0676E, Q0678G, Q0826F, Q0827E, Q0828F, Q0910E, Q0926G.

MLRA 61 Soil Survey Map Units – 57, 93, 96 and 98.

Temporary Road Construction: Temporary roads constructed for this project that utilize existing road templates would be rehabilitated by any site-appropriate combination of the design criteria in Appendix B. These would include such actions as removing any installed culverts or temporary bridges, installing erosion control features, placing large woody material on the template and/or seeding or planting with the native plants as specified by the assigned project implementation botanist.

In addition, the project specifies that newly constructed temporary roads would be rehabilitated after use. Rehabilitation of new temporary roads would be done utilizing the design criteria identified in Appendix B and based on site review of individual site conditions. Appendix B also specifies that implementation and effectiveness monitoring. If monitoring indicated that design are not accomplishing resource objectives that additional design activities would be identified for implementation. Implemented restoration activities would not ameliorate the detrimental soil impacts immediately, but they would generally be expected to improve soil conditions compared to no actions to rehabilitate temporary road conditions. The establishment of vegetation and associated additions of organic matter would contribute to the recovery of production of the features. Any actions taken to recontour the temporary road features would generally be expected to be to the level to provide a suitable seed bed for native forest vegetation. These conditions would generally be expected to accelerate the recovery of the soil effects related to temporary roads as discussed in the first part of this document.

As identified in the earlier section on erosion, some level of erosion is expected from temporary road construction and re-construction where native surfaces are exposed to rainfall impact and overland flow. These areas are expected to have short-term increases of soil erosion (above two to five tons per acre). As has been observed elsewhere, effects would be expected to decrease as roads are obliterated immediately following use.

Cumulative Effects

Comparison of Action Alternatives – Alternatives B and C

The Mountain Pine Beetle Response Project Activity Table in Chapter 2 displays the total acres of potential treatments and the types of activities by alternative. Anticipated miles of various types of access route construction and reconstruction are also displayed. At this point, while it is unknown or cannot be predicted where and how intensive activities may be because it is unknown what activity tool would be used in anticipation of potential treatment sites, Chapters 1 and 2 documents that Alternative C has far more extensive levels and acres of treatment activities, both harvest and access route creation, as compared to Alternative B. It is stated that project implementation of activities would have pre-site reviews and implementations of activities are to be in compliance with Forest Plan standards and guidelines, WCPH direction and project design criteria. In addition, it is stated in Appendix B in the monitoring section, that monitoring is to occur for implementation and effectiveness. And that if design that was implemented did not achieve resource objectives that design would be adjusted. It is expected that a far greater extent of areas could have site disturbance under Alternative C, and likely more areas of soil disturbance achieving the level of detrimental soil disturbance as compared to Alternative B. Alternative B has 6,000 less acres available for treatment

(does not include Spearfish Canyon treatment areas that are included in Alternative C) and has significantly less commercial harvest (Alt. B - 48,000 acres vs. Alt. C -124,000 acres). Cable harvest in Alternative B is to only utilize existing roads/routes and has far less pending roads. There is an estimated 304 miles in Alternative B of conversion and temporary roads versus an estimated 857 miles of new, converted and temporary roads in Alternative C. In estimating where roads might potentially be created to access some of the larger groupings of potential treatment areas (watersheds generally having greater than 10% of their area with potential treatment areas) and then comparing to soil map units with at least one of the dominant soils having a road suitability limiting feature value of greater than 0.1 for landslides, it is estimated that Alternative C could have approximately 95 miles of various types of new roads within soil map units with slope stability concerns. In addition, Alternative C removes well over double the volume of commercial sawtimber therefore it is expected that there would be well over double the amount of general disturbance effects expected to surface site components (including soils) in Alternative C. The assumption, not knowing where a potential treatment is to be used, the precipitation patterns and soil moisture conditions present at the time, etc. is that the level of soil disturbance impacts are attributable to the implementation of project designs, amount of temporary road construction, how designated helicopter landing sites are created and how well and successfully effective the rehabilitation of those project activity features occur. Simply based on potential, Alternative B would be the action alternative with far fewer effects to soils to a detrimental level associated with project activities as compared to Alternative C (greater acres of disturbance in general and greater number of acres on steep slopes with more potential for erosion and instability concerns; access route creation). Since actions are similar to those described in the FEIS documents, effects to soils would be similar to those described in the FEIS as identified for the 1997 Forest Plan EIS (1996) and Phase II Amendment EIS (2005). Acknowledging that there is far greater potential for effects to the soil resources and to a detrimental level in Alternative C, design criteria to be implemented were included in Appendix B to protect the soil resource. Implementing the alternatives as designed as described in Chapter 2, utilizing the design criteria listed in Appendix B (including avoidance of sites with stability concerns and road route reviews), monitoring and taking action to immediately adjust design criteria to achieve resource protection objectives as specified in Appendix B would generally be expected to comply with soil direction in the R2 WCPH and the Black Hills NF Forest Plan through implementation of either action alternative.

Contrasting Effects of Proposed Action with Past Actions

Generally, the estimated level of detrimental disturbance from this proposed project is expected to be similar to past Forest activities since there are similar implementation activities and similar design criteria to be implemented during project activities to protect soil resources. While the purpose and need for this project is for addressing pine beetle mortality and expansion, the direction for maintaining or improving soil productivity continues to be National, Region 2 and Forest direction. Project differences to similar recent past projects:

Site reviews for treatment and to specify design criteria is to occur following the decision.

- Potential for greater levels of helicopter and cable logging.
- Potential for greater levels of cut and chunk activities.
- Focus of the treatment is only four ponderosa pine structural stages (3B, 3C, 4B, 4C).
- No hardwood, spruce or pine encroachment treatments.
- No broadcast prescribed burning.
- Use of insecticides and semiochemical spray.

- No regeneration harvests.
- No site preparation activities.
- All project activities to be completed within 5-7 years as compared to approximately 10 years.

In addition, timber sale units and roads in both Wyoming and South Dakota have been audited for compliance with BMPs. Project activities and timber harvest units have been monitored per project NEPA decisions. Some activities have the potential to contribute to making the end result better than some had been in the past such as eliminating unauthorized routes that may currently be contributing to erosion issues (see the MPBRP Engineering Section).

Duration of Effects

Displacement and erosion, the loss of topsoil, is a long-term effect and can be a permanent loss of soil productivity. However, alternative design, such as restricting various activities on slopes greater than 40%, avoiding road construction or treatments on slopes with stability issues, etc. and design criteria implementation specific to reduce the occurrence erosion and rehabilitation of roads would be expected to areas against topsoil losses. Revegetation of sites following harvest activities in the Black Hills have generally been observed or documented to occur within two to three years. Timber activity sites or post sale activity sites that have not generally revegetated in that time frame have generally had some other disturbance (such as OHV activity). The recent Forest Travel Management Decision has not authorized that use on areas other than designated routes. Therefore, it is generally expected that disturbed sites with this project would generally revegetate within the two to three year timeframe that has been observed and documented during site reviews, BMP monitoring and BMP Audit reviews. Temporary roads and landings take longer to revegetate in association with increases in bulk densities and greater amounts and multiple disturbances. Design criteria are included placement of drainage features, slash placement and rehabilitation to limit erosion. Revegetation can occur as early as the two to three year time frame as for other disturbance areas, but may take up to five years on sites with less potential. Rehabilitation and timeframes are within those identified national and regional direction.

Uncertainties exist as to how long compaction may last in the Black Hills. As has been documented in several Forest monitoring reports since 1998, soil bulk density sampling has occurred on areas of various levels of harvest activities at various locations within the Black Hills area. Although a limited number of sites are available to base conclusions on, there is evidence to support (USDA Forest Service 2010b):

That sampling results are generally consistent with statements made in the Watershed Conservation Practices Handbook, Chapter 10 – Management Measures and Design Criteria, Amendment 2509.25-2600-2 (effective 4/20/2006) regarding soil compaction. The handbook describes that soil compaction is caused by the weight of vehicles and animals on the ground and soils compact when soil moisture exceeds the plastic limit. Consistent with the Handbook, there is evidence that soils in the Black Hills can compact when some level of timber harvest (or post sale activity) equipment activity occurs when some degree of moist to wet soil conditions exist.

Also consistent with the same Forest Service Handbook, the data generally collected for sites that were harvested during the below average precipitation years (2000 through 2008) provided evidence that operating timber harvest equipment (not specific to various volumes removed or

silviculture prescription applied) during dry soil moisture conditions can be expected to prevent or limit increases in soil bulk densities, or limit the likelihood for increases in soil bulk density effects.

While uncertain that soil bulk density levels would decrease or decrease as fast on every soil within the Black Hills, there is evidence that conditions were such that within one geographic area, on one type of soil, and to the depth sampled, that the mean soil bulk density decreased from levels above the threshold classified as "detrimental compaction" to levels below the threshold within the time period of one year. It is unknown what factors may have contributed to this level of decrease, but potentially the decrease may have been associated with soil moisture and temperature conditions that favored active freezing and thawing conditions at the site during that specific year, that the flush of herbaceous growth (and the associated increased root activity) that was observed on site may have contributed to the decline in soil bulk density levels, that water movement on the cutting unit slope may have influenced site conditions within the upper 10 cm (approx. upper 7 inches) of the soil profile, or some other unknown site characteristics. Sites that experience reductions in organic matter content are generally expected to reverse as vegetation establishes and growth occurs. Organic debris accumulates on the soil surface and plant roots establish and are decomposed in the soil. These organic materials break down and release nutrients and improve the quality of the soil by improving soil structure and contribute to reducing compacted conditions and other detrimental soil disturbances. Organic matter accumulation is often associated with the revegetation timelines. General disturbance of wood removal sites would be expected to accumulate organic debris within the two to three year timeframe. Some of those sites would have beetle killed trees that would not be removed and would accumulate material immediately as needles and branches drop, and eventually larger material accumulate as the trees drop over time. Temporary roads and landings will take longer and unless slash is placed on those sites it is expected that it could take up to five years to develop organic debris to levels to contribute to reducing to improved soil structure.
Changes in soil microorganisms are generally not expected to be permanent. Stumps and below ground roots would remain in all activity areas. Slash or chunked material would remain at other locations. Landings and temporary roads are to be rehabilitated and recovery would generally be expected to begin as soon as various organic matter components begin increasing again in the soil, which are expected to begin soon (within 2-5 years) after site activities have occurred.

Effects of Ongoing and Reasonably Foreseeable Activities
Most ongoing and foreseeable activities would not overlap with either action alternative in both time and space. Specifically, their effects do not overlap in space as they occur outside of the potential treatment areas.

Combined Effects from Past, Proposed, Ongoing and Foreseeable Activities
Several potential treatment areas in the action alternatives would have localized cumulative effects from the combination of past and proposed activities. Some would have very few cumulative effects because some MPBRP potential treatment areas have not had, or had limited similar activities in the past. Examples of these types of areas are locations with slopes over 40% such as those in the very southern Black Hills, or areas within Spearfish Canyon Scenic Byway Management Area. Appendix B identifies that post-implementation monitoring would be performed to identify implementation effectiveness and if adjustment to design criteria to occur as treatment activities continue to meet resource protection objectives. This monitoring would

also demonstrate compliance with Forest Plan and Regional direction. For the commercial activities, the Sale Administrator would monitor all units during management activities to assure that harvest activities would occur during operating conditions specified in the design criteria and are adequate to minimize effects to the soil resource.

If monitoring results document an area where detrimental soil disturbance may be in excess of 15 percent within an activity area, design is to be adjusted and rehabilitation and restoration activities would be identified and would occur to move the activity units back towards improved soil conditions. Additional units that were treated in a similar fashion would be expected to be reviewed at this time as well.

The Project design criteria, restoration activities to improve soil conditions would also include scarification or ripping of temporary roads, some of the more intensively used skid trails and landing areas with the intent to reduce soil compaction. A basic intent is to improve the potential for tree seedling establishment, survival and growth through restoring site conditions that support biological processes, improved root penetration and soil drainage. Soil restoration at these sites is not the immediate result of ripping, planting or any other activity. The goal of soil restoration activities is to create favorable conditions for impaired soils to begin the recovery process.

TRANSPORTATION

Existing Transportation System

For the purposes of this EIS, the term "Existing Transportation System" is comprised of (1) the full implementation of the Travel Management ROD, (2) National Forest System Roads (Maintenance Level (ML) 1 through 5 roads) that are currently on the ground, and (3) unauthorized routes that are also currently on the ground. An unauthorized route is a road or trail that exists on the ground but is not a forest road or trail or a temporary road or trail and it is not a National Forest System Road.

The transportation system that is intended for public travel was established by the Travel Management Plan Record of Decision (ROD) signed on May 7, 2010. Implementation began with publication of the Motorized Vehicle Use Map (MVUM) effective December 1, 2010. The ROD designates certain roads and trails as open to motorized vehicle traffic on lands administered by the Forest and also assigns a class of vehicle and season of use to these designated roads or trails. Trail designations in the ROD were the result of either changing an existing National Forest System Road (NFSR) to a Forest System Trail, or converting an unauthorized route to a system trail. Some NFSR's were also changed from the status of "highway legal only" to "mixed use" (also referred to as roads open to all motorized uses).

Most, but not all of, the designated roads and trails included in the Travel Management ROD have been implemented on the ground. Implementation of the full Travel Management ROD is ongoing and expected to be completed in the near future.

The Travel Management Plan ROD designated approximately 3,864 miles of open roads and trails within the Forest boundary. The Travel Management Plan Final Environmental Impact Statement indicated that there are approximately 1,316 miles of ML 1 roads and approximately 4,109 miles of unauthorized routes. As a comparison, there are approximately 605 miles of designated open roads

and trails, 236 miles of ML 1 roads, and 301 miles of unauthorized routes within the MPBR PTAs. Table 3-14 illustrates miles of routes within the MPBR Project Area.

Table 3-14 Miles of Roads/Routes

Designation	ALTERNATIVE A - Length in Miles		
	Open Yearlong	Seasonal	Total
Highway Legal Only	1,836	773	**2,609**
Roads Open to All	328	220	**548**
Trails Open to All	81	67	**148**
Trails Open to Vehicles <50" (Wyoming)	0	72	**72**
Trails Open to Vehicles <62" (South Dakota)	245	152	**397**
Trails Open to Motorcycles	52	38	**90**
Totals	**2,542**	**1,322**	**3,864**
ML 1 NFSRs are approximately 1,316 miles and unauthorized routes are approximately 4,109 miles.			
Designation	**ALTERNATIVE B - Length in Miles**		
	Open Yearlong	**Seasonal**	**Total**
Highway Legal Only	255	118	**373**
Roads Open to All	51	41	**92**
Trails Open to All	21	17	**38**
Trails Open to Vehicles <50" (Wyoming)	0	8	**8**
Trails Open to Vehicles <62" (South Dakota)	54	17	**71**
Trails Open to Motorcycles	12	11	**23**
Totals	**393**	**212**	**605**
ML 1 NFSRs are approximately 236 miles and unauthorized routes are approximately 301 miles.			
Designation	**ALTERNATIVE C - Length in Miles**		
	Open Yearlong	**Seasonal**	**Total**
Highway Legal Only	255	119	**374**
Roads Open to All	51	41	**92**
Trails Open to All	21	17	**38**
Trails Open to Vehicles <50" (Wyoming)	0	8	**8**
Trails Open to Vehicles <62" (South Dakota)	54	17	**71**
Trails Open to Motorcycles	12	11	**23**
Totals	**393**	**213**	**606**
ML 1 NFSRs are approximately 240 miles and unauthorized routes are approximately 305 miles.			

Table 3-15 displays road and trail densities within the MPBR PTAs. Alternative B encompasses 242,000 acres and Alternative C encompasses 248,000 acres. This does not include State, County, Private or unauthorized routes; nor does it include Private land.

Table 3-15 Open Road/Trail Density in the MPBR PTAs for Alternatives B and C.

ALTERNATIVE B (242,000 acres or 378 square miles)		
Road/Trail Density	**Length (Miles)**	**Miles/Square Mile**
Seasonally Open (May 15 to Dec 15)	212	0.6
Open Yearlong	393	1.0
ALTERNATIVE C (248,000 acres or 388 square miles)		
Road/Trail Density	**Length (Miles)**	**Miles/Square Mile**
Seasonally Open (May 15 to Dec 15)	213	0.5
Open Yearlong	393	1.0

Road (excluding unauthorized routes) and trail mileages within the MPBR PTAs total approximately 919 miles for Alternative B and 938 miles for Alternative C. These miles are a combination of state, county, and forest system roads. State and county roads provide access to and through the area. Roads within the MPBR PTAs provide access to a variety of resources. In Alternative B, 78 miles of road are maintained by other public entities such as Counties and the Department of Transportation. Alternative C contains 92 miles of roads maintained by other public entities. The Forest Service typically maintains ML 3, 4 and 5 roads annually. The remaining system roads (ML 1 and 2) are reviewed for maintenance needs every five years or sooner if identified for other management needs or if they are causing resource damage.

As with any planning area, road conditions vary throughout the area. In areas of active and recent timber sales, the roads meet maintenance standards due to the ongoing or recent maintenance activities by the timber purchaser. Other maintenance level 1 and 2 roads, which may have not had grid maintenance recently, may not meet maintenance standards. Segments of roads may be located in or cross drainage bottoms, meadows or other wet areas. These road segments may not drain properly and may be contributing to sediment movement. Some road sections that cross drainages may not have a hardened surface or a proper design through the crossing and portions may have steep grades, which will show evidence of road rutting and surface material loss. Numerous roads may have small diameter trees growing within the roadway limits, restricting sight distance and road width.

Unauthorized routes are present throughout the project area. These unauthorized or "user defined" routes may have been created by repeated use or with previous management activities. Additionally, these roads may or may not have been designed to prevent sediment movement and provide adequate flow capacity at stream crossings.

The following issues and concerns are common throughout the Black Hills National Forest:

- Although much of the Black Hills has had treatment in the past, the road system may not be adequate to provide access to all areas.
- Steep terrain and private property may block access and make it difficult for resource management.
- Portions of roads may be located in or near drainage bottoms, creating drainage problems, soil erosion, soil movement and sediment deposits.
- Roads that cross streams and drainage bottoms may be contributing sediment because they may not have a hardened surface or proper design through the crossing.
- Existing roads that may not have adequate drainage may be causing rutting, water ponding, washouts, and aggregate and native surface material loss.
- Unauthorized routes are located throughout the MPBR PTAs. Roads may not have drainage structures or road templates and may be located in wet areas, meadows, and drainage bottoms.
- Fire suppression activities may be obstructed or slowed by poor or no road access to areas.
- Temporary bridges or other designed crossing may be needed to cross drainages.
- Some existing road closures may be ineffective.
- As tree mortality increases and they fall across roads, there is an increased likelihood roads would be inaccessible for periods of time.

Proposed Transportation System
The proposed transportation system would meet existing and anticipated future transportation needs. It would address the existing resource concerns. Access for resource management must take into consideration soil and water resources, public safety, economics, wildlife, visual aesthetics and other resource needs.

The proposed transportation system would be accomplished by utilizing existing NFSRs, reconstructing existing NFSRs, reclassifying unauthorized routes to NFSRs (herein called convert or conversion), utilizing/reconstructing trails, and constructing additional system roads. It should be noted that NFSRs, State, County and unauthorized routes would be utilized to access the PTAs. The proposed road activities discussed in each alternative would include routes in the PTAs and routes outside of the PTA. Road reconstruction would include betterments, restoration or realignment. Some existing unauthorized routes would be reclassified to system roads and reconstructed if they are converted to NFSRs. Some trails would be temporarily changed to roads and then returned to trails after management activities are completed. Some existing unauthorized routes would be used as temporary roads and then reclaimed and closed when management activities are completed. Remaining unauthorized routes not used for the proposed activities and not identified as a route in the travel management plan would be addressed in future decisions or decommissioned in the future when funds become available. Construction of new roads would provide access to areas not previously accessed due to private land ownership patterns and/or steep terrain.
NFSRs, State, County and unauthorized routes would be utilized to connect with routes within the PTAs. NFSRs, State, County and unauthorized routes may be used to access proposed transportation system would vary somewhat between the action alternatives. Reconstruction activity would bring road standards up to the minimum necessary to accommodate commercial timber haul while protecting soil and water resources. New NFSR construction would be classified as ML 1 road construction, and therefore closed and put into storage for future use. Temporary roads utilize existing unauthorized routes or are constructed in locations approved by the Forest Service. Table 3-16 summarizes estimated mileages and estimated costs for the Alternatives.

Table 3-16 Activity in Miles and Estimated Cost for Alternatives B and C

Activity	Alternative A	Alternative B	Alternative C
Maintenance	0	666	1,707
Reconstruct (including Convert Unauthorized Route to NFSR, 15 miles-Alt B, 46 miles-Alt C)	0	102	269
New Construction	0	0	70
Existing Temporary	0	202	338
New Temporary	0	0	180
Estimated Cost*	**$0**	**$2,046,000**	**$6,355,000**

*For the estimate above, the following average cost per mile was used: Maintenance $300/mi, Reconstruct/Convert = $8,000/mi, New Construction = $15,000/mi, and Temporary = $5,100/mi

Miles of road work in Table 3-16 are approximate lengths. A significant storm event or the extent of time between project planning and project implementation may trigger changes in road conditions. If road conditions worsen before project implementation, additional reconstruction may be necessary.

The average road density for the Black Hills National Forest, including system and unauthorized road miles, is 4.4 miles per square mile as shown in the Forest Plan (Phase II Amendment). Total road densities (open and closed road densities) would remain the same from those shown in Table 2 under Alternative B. The total road density would increase from those shown in Table 2 under Alternative C because of new NFSR and temporary road construction. All new roads constructed as a result of the MPBR project would be closed after harvest operations; therefore, the open road densities would not change.

Closed system roads would include strategies such as Prohibit, Eliminate and Decommission. Definitions for these management strategies are listed in Chapter 5, Glossary. Unauthorized routes are considered closed under the travel management plan.

Maintenance on system roads used for timber harvest is the responsibility of the Purchaser/Contractor for the life of the Timber Sale Contract. Maintenance includes cleaning out silt from sediment collecting ponds and depositing it in upland locations, keeping erosion control measures functioning by cleaning out any sediment collected in the structure and depositing it in upland locations, keeping all drainage structures and ditches clear and functional, eliminating erosion of cut and fill slope and roadway soils, removing roadway vegetation and blading road surfaces.

Maintenance of the roads after the proposed activity would be the responsibility of the Forest Service and would be performed when needed or with grid maintenance every five years, whichever comes first.

Opportunities:
There may be opportunities to improve the transportation system within the MPBR PTAs and to obtain the minimum road system needed for response to the Pine Beetle Epidemic. These opportunities are:

- Relocate roads sufficiently far from streams or wetlands to minimize sediment discharge and use vegetative buffer strips or barriers to reduce sediment.
- Locate and design crossings to prevent restriction of expected flood flows and minimize sediment movement.
- Reconstruct/realign existing roads to add and improve drainage structures, improve alignment and stabilize the roadbed.
- Secure closures to protect the resource.
- Construct roads or obtain Rights of Way to access areas restricted by steep terrain or private property.
- Use of unauthorized routes for temporary access would allow access to remote sites. When access is no longer needed these temporary roads would be closed and the roadbed would be stabilized.

Environmental Consequences

Alternative A – No Action

Direct and Indirect Effects
Under Alternative A there would be no direct effects to the existing transportation system from the Mountain Pine Beetle Response Project. There would be no change in the transportation

system, the travel management, or the road densities due to this Alternative. Scheduled annual and grid maintenance would continue as it has in the past.

The beneficial effects of taking no action are that there would be no additional ground disturbing activities, no increased dust and noise, no tree removal, etc. as would occur with Alternatives B and C (see direct effects under Alternative B and C).

The adverse indirect effects of taking no action are that we would forego the opportunity to provide additional maintenance, reconstruction, reclassification of unauthorized routes, and road closings associated with and funded by timber harvesting. With budgets continuing to decline, fewer miles of roads within the area may be maintained to the current standard in the future. Since the system roads within the MPBR PTAs are on different grid maintenance schedules, some of the roads would not receive grid maintenance for up to five years.

Roads located through meadows and in flatter terrains may create undesirable changes to the topography. These roads are difficult to maintain. The location of these roads does not provide for surface water relief or drainage structure effectiveness. Continued use, especially during wet periods, result in the roadbed being lower than the surrounding ground elevation. This would increase maintenance costs and ineffectiveness.

Roads located on steeper grades and roads without an adequate number of drainage structures would continue to lose roadbed surface material. Ruts would deepen as material washes off the road. More substantial maintenance would be required as road conditions deteriorate. Positive driving experiences for some users would be affected as these roads become more difficult to navigate.

Unauthorized routes would remain on the landscape until future projects and funding is secured. Unauthorized routes, in many cases, have no drainage structures, have poor alignment and are located in drainage bottoms, on steep slopes and in meadows, resulting in vegetation compaction and loss.

Current road closures in the project area range from effective to ineffective. The ineffective closures would not be secured to prevent motor vehicle travel. Additional funding would be needed to reinforce these existing closures. This would have the effect of continued use in areas that are meant to be closed to motorized travel to protect the roads and other resources.

Although Alternative A proposes no action, there are effects in the area that would result from ongoing and future activities which include:

- Private road easement requests and construction of these roads.
- Subdivision development access needs.
- Roads needed for transmission line construction.
- The ongoing Black Hills National Forest Travel Management implementation.
- Recreational traffic to and from campgrounds, day use areas and off-road trails.
- Unchecked mountain pine beetle infestation and wildfire could cause the death of trees which would increase water runoff onto the roads and cause surface erosion.
- On-going land resource management activities.

Cumulative Effects

There are eight District Landscape projects that have been proposed or approved. The following is a narrative describing the transportation components that would take place in each project. A

summary of the road miles discussed in each of the narratives is shown in Table 3-17. Transportation data for the Buttes and Calumet projects was not available at the time of analysis. Implementation of these two projects may increase the numbers shown in Table 3-17.

Table 3-17 Summary of proposed transportation miles for the existing District Landscape projects.

Project Area	Maintenance	Reconstruction	Conversion	New Construction	Temporary
Briggs Spring	77.3	35.3	0.8	0	unknown
Vestal	91	34	0.6	0	unknown
Cold Springs	48 reconstruction/ maintenance		2.0	4	8
Pactola	72	29	1.5	17	12
Steamboat	75 reconstruction/ maintenance		5	20	unknown
Herman	21.5	39.4	4.5	1.7	9.1
Buttes	No information available at this time.				
Calumet	No information available at this time.				
TOTAL*	354	169	14	43	29

* Totals were rounded to the nearest whole number

The above mentioned activities have the potential for the following cumulative effects on the transportation system:

1. Increased mixed traffic from: log haul, communities and subdivisions, implementation of the BHNF Travel Management Plan, recreational activities, mining activities, private landowner treatment of MPB, firewood and Christmas tree cutting, livestock grazing, road/utility right-of-way clearing, and treatments of noxious weeds and invasive species.
2. Additional roads may be expected due to private easement requests, subdivision access needs and transmission line construction.
3. Roads may require more frequently placed drainage structures, longer culverts, surface material replacement and more frequent maintenance as a result of increased mixed traffic.
4. Tree mortality due to mountain pine beetles and the consequential increase in wildfire hazard may result in increased water runoff onto the roads and increased erosion, loss of surface material and culvert and drainage failures.
5. All of the above would increase the cost of road repair and maintenance needs in the future.
6. Log hauling with timber sales combined with the associated road reconstruction/construction activities would increase dust, noise, and loss of fines on surfaced roads during project implementation. The normal operating season for road work is from June 1 through November 1, which is extended if weather and ground conditions are favorable. Road maintenance activities would continue for the duration of any timber harvest activities. Shared maintenance responsibilities would have to be coordinated.
7. Road maintenance, reconstruction, and new construction with the District Landscape projects combined with subdivision access private road easements and transmission line construction would have cumulative effects on ground disturbance, vegetation loss, dust/noise increases and sediment movement.
8. There would be a change in the travel management of roads over the next few years as the Forest implements the Travel Management Plan for the Black Hills. The change has the potential to affect travel patterns and may increase mixed traffic on the Forest System roads and trails.

9. System roads would be maintained, thereby reducing the future programmatic maintenance costs and providing an overall a more efficient transportation system.
10. As tree mortality increases and they fall across roads, there is an increased likelihood roads would be inaccessible for periods of time.

EFFECTS COMMON TO ALL ACTION ALTERNATIVES

Direct and Indirect Effects

The action alternatives propose additional maintenance, reconstruction, new construction and road closure activities. Direct adverse effects from these proposed activities are short term vegetation loss, vegetation removal, soil disturbance and compaction, an increase of mixed traffic and traffic delays during project implementation. Short term increases of noise and dust would occur.

Recreational road and trail use associated with the Travel Management ROD may be temporarily affected by transportation needs associated with timber hauling, equipment access, and harvesting activities. Recreational users might not be able to use some of the roads and trails at times during implementation of either action alternative.

Direct and indirect beneficial effects include improvements to existing roads and trails that would comply with Best Management Practices and road design criteria. Safety issues would be addressed in the road design. Existing roads located in meadows would be relocated and/or armored with aggregate material to prevent road indentation, rutting and sediment movement. Existing roads would be realigned and relocated to reduce grades if needed.

Once road improvements are completed, long term maintenance and deferred maintenance costs would decrease. As vegetation is reestablished, the effects on soil erosion would be reduced. The vegetation would aid in stabilizing the roadway and the cut and fill slopes. Positive driving experiences would improve from proper road design and repair of the travel way. The road use pattern in the area would change as unauthorized route, used as temporary roads, are closed and closure devices are secured.

Roads utilized under the action alternatives would be reconstructed, constructed and maintained in accordance to the Best Management Practices and Engineering Design Guidelines (see Appendix A and B). Existing roads with soil and water problems would be designed using the proposed corrective action. The direct and indirect effects of sediment contribution would diminish as these actions are taken.

EFFECTS UNIQUE TO ACTION ALTERNATIVES

Alternative B

The transportation system under Alternative B proposes to construct *no* new NSFRs and *no* new temporary road construction. It is estimated that 666 miles of roads would be maintained, 102 miles of roads would be reconstructed/converted (87 miles of reconstruction and 15 miles of conversion), 202 miles of temporary roads would be utilized. This alternative would utilize existing on-the-ground NFSRs and unauthorized routes to perform management objectives. The above mentioned road activities would include routes in the PTAs and routes outside of the PTAs.

Reconstruction and maintenance activities would take place as needed on NFSRs. Existing unauthorized routes utilized in this Alternative would be used as temporary roads for management activities and then closed after use; except for approximately 5% of unauthorized routes (15 miles) that would be converted to NFSRs. Unauthorized routes that are converted to NFSRs would be closed and put into storage until future activities require utilization of the road. Additionally, this Alternative proposes to conduct cable logging activities where existing NFSRs and unauthorized routes would support such activities.

Direct and Indirect Effects
The proposed transportation plan for Alternative B would maintain, reconstruct and construct fewer miles than Alternative C. Direct effects of cost and ground disturbance are less under this Alternative when compared to Alternative C. Alternative B would improve and repair fewer miles of road than Alternative C but would still reduce adverse indirect effects, such as soil erosion and sedimentation. Future maintenance cost would likely be reduced.

Cumulative Effects
In addition to the cumulative effects common to all action alternatives, Alternative B would have an increase in traffic as compared to Alternative A, but less than Alternative C.

Alternative C

Although it is preferable to utilize existing on-the-ground NFSRs and unauthorized routes to perform management objectives, new roads may be constructed under this Alternative. The transportation system under Alternative C proposes to construct up to 70 miles of new NFSRs. Seventy miles was determined by calculating an average number of road miles per acre based on 24 recent timber sales. The average miles per acre were multiplied by the number of acres in the PTAs for this Alternative. The result was approximately 35 miles of new NFSRs would be needed to accomplish management activities. A majority of the timber sales used to calculate the average miles per acre did not include cable logging activities. In order to account for additional transportation needs, a conservative factor of two was used to estimate the total number of new NFSR road miles needed.

In addition to the new NFSRs, there may be a need for up to 518 miles of temporary roads to access the PTAs. Of the 518 miles, approximately 180 miles may be new temporary roads. Also, it is estimated that Alternative C would maintain 1,707 miles of road and reconstruct/convert 269 miles of roads (this includes 223 miles of reconstruction and 46 miles of conversion). Reconstruction and maintenance activities would take place as needed on NFSRs. Similar to Alternative B, the above mentioned road activities would include routes in the PTAs and routes outside of the PTAs. Existing unauthorized routes utilized in this Alternative would be used as temporary roads for management activities and then closed after use; except for approximately 15% of the temporary roads (46 miles) that would be converted to NFSRs. Temporary roads that are converted to NFSRs would be closed and put into storage until future activities require utilization of the road. See Table 6 for a summary of the activities described above.

Direct and Indirect Effects
The proposed transportation plan for Alternative C would maintain, reconstruct and construct more miles of road than Alternative B. Direct effects of cost and ground disturbance would be greater under this alternative due to more road construction, more treated acres, and cable

logging units. These newly constructed roads would be closed and seeded once treatment operations have been completed. This Alternative proposes to conduct cable logging activities which would require additional NFSRs when compared to other alternatives. However, miles of new road construction may decrease if helicopter logging is implemented as a tool to treat some of these areas.

More miles of existing roads would be maintained with Alternative C, thus reducing adverse indirect effects, such as soil erosion and sedimentation. Future maintenance cost would likely be reduced.

More miles of unauthorized routes would be used as temporary roads than other alternatives and would increase the potential for closure and decommissioning of these roads with timber operations, thus decreasing future decommissioning costs.

Cumulative Effects
In addition to the cumulative effects common to all action alternatives, Alternative C would have the greatest increase in traffic as compared to Alternative A and B.

Table 3-18 Summary of Road Miles

Activity	Alternative A	Alternative B	Alternative C
Acres		48,400	124,000
Maintenance	0	666	1,707
Reconstruct (including Convert Unauthorized Route to NFSR)	0	102	269
New Construction (NFSR)	0	0	70
Existing Temporary	0	202	338
New Temporary	0	0	180

BIOLOGICAL ENVIRONMENT

This section will describe the affected environment and environmental consequences for each alternative to the Biological Environment (Vegetation, Fire and Fuels, Range, Noxious and Invasive Weeds, Wildlife Habitat, Fisheries, and Botany).

VEGETATION

The overall goal of silviculture is to manage the forest environment to achieve desired management goals and objectives. This involves not only the timber resource but also all of the resources that can be found in a forested ecosystem as well as the needs of the forest users. This input is designed to only address the timber resource however, and does so realizing that all of the resources in the entire forested ecosystem are interrelated and interactive. It is the intent of this input to add only information, issues and concerns with regards to the timber resource using the Black Hills National Forest Land and Resource Management Plan standards, guidelines and Phase II Amendment as a desired future condition. In addition, this report is intended to supplement the analysis in the Black Hills LRMP and Phase II Amendment. This is tiered to the

aforementioned documents and applicable silviculture sections. Treatments would be formulated to address the purpose and need of the Mountain Pine Beetle Response project.

Affected Environment

Mountain Pine Beetle

Mountain pine beetle (Dendroctonus ponderosae) is the number one killer of pines throughout the western United States. The beetle is a native species to the West and attacks most pine species including ponderosa pine in the Black Hills. Mountain pine beetles (MPB) have always been a part of the Black Hills Forest ecosystem, with outbreaks occurring periodically. The largest recorded outbreak occurred from the late 1890's through the early 1900's, and killed an estimated 1.5 billion board feet of timber (USDA, Forest Service. 2010b).

Mountain pine beetles prefer dense stands of mature pine trees greater than seven inches in diameter. Adult flight typically occurs in July and August, with the peak flight around the first week of August. During this flight, adult beetles leave previously infested trees and attack and kill new host trees. The adults attack green trees, chew through the bark and construct galleries along which eggs are laid. Larvae hatch from the eggs and begin feeding on the phloem of the tree in late summer to early fall. Larvae, pupae or callow adults over-winter under the bark of the infested tree.

During the mid-1990s, beetle mortality was light and scattered throughout the Black Hills. In 1997, there was a noticeable increase in mortality detected. The 1999 survey showed another sharp increase from 1998, with much of the heaviest damage concentrated into a few areas. The aerial survey from 1999 detected a total of 25,562 trees killed throughout the Black Hills. This is an increase from the 10,726 trees killed on National Forest System lands in 1998. In 2000, the amount of mortality increased again to 38,262 trees. In all cases, much of the damage was concentrated in groups of 25 trees or more in a few areas. More than 60% of the total tree mortality recorded in the 1999 and 2000 aerial surveys was found in the Beaver Park area. Other areas sustaining concentrated pockets of tree mortality included Bear Mountain, Steamboat Rock and areas west and south of Deerfield Lake. In 2001 there was a tremendous increase in the number of trees killed. From 2002 through 2005 an increase in beetle mortality was beginning to concentrate in the central Hills, with smaller spots elsewhere. From 2006 through 2010 epidemics intensified and continued on about 25,000-40,000 acres per year in the central Hills and intensified with new areas beginning to appear in the northern and southern Hills. In 2011 the acres affected with new attacks was approximately 67,000 acres. Since 1996, approximately 405,000 acres of NFS lands have been affected by MPB. These "Acres affected" do not indicate the intensity or frequency of mortality due to MPB infestation, which can range from one tree per acre to more than 100 trees per acre and which can occur on a specific acre in more than one year.

Stand density is the primary driver of MPB infestation, which is abundant and continuous throughout the potential treatment areas. The overall hazard (risk) of MPB infestation can be considered high in the project area. The rating refers to the potential for losses within a stand if an infestation occurs and not the probability of an infestation. If an infestation occurs within stands with a high risk rating, then one can expect higher overall losses than those stands with lower hazard ratings. The potential treatment areas are rated at high hazard for MPB, with an overall infestation hazard rating of high. The probability - or risk - of infestation is also high due to the ongoing epidemic across the Forest.

The Black Hills forest ecosystem is shaped by infrequent stand-replacing fire and insect outbreaks along with frequent surface fire and is characterized as having a mixed fire regime. Stand-replacing fire has been a major component of the landscape since 2000, burning 14 percent of the Forest. Ecologically this pattern may be consistent with what might be expected from large but infrequent events under the historic disturbance regime. However, stand-replacing fire is generally considered to be socially undesirable from the standpoint of human safety, effects to private and public property, and to the alteration of the flow of goods and services from the Forest. Fire of any type has been suppressed and continues to be suppressed when possible for social reasons, and has contributed to altering the function of the mixed-severity fire ecological system. Current dense conifer forest conditions can be expected to contribute to the likelihood of additional large stand-replacing fires within the Black Hills ecosystem. Also, a variety of factors including that of fire suppression and associated alterations to ecological systems has contributed to changes in the function of or the reduced extent of other Black Hills ecosystem components, including early successional ecological communities, such as grassland and meadow communities, hardwood communities, beaver dominated riparian communities, and areas of relatively open ponderosa pine with generally higher levels of understory diversity.

Past Actions affecting Existing Condition of Silviculture/Timber

Records indicate that harvesting within the National Forest (project area) has occurred as far back as the 1880s. Prior to settlement of the Black Hills traditionally thought of as the 1870s, the forest structure was influenced by American Indian use of fire and natural disturbances such as lightning creating wildfires, windthrow and insects. Settlement of the Black Hills triggered logging to support mining and railroads. The early logging days caused concern for wise use of the lands which precipitated the National Forest Reserve and transition to the National Forest. The mission of the U.S. Forest Service identified today as "caring for the land and serving people".

Silvicultural treatments were designed to address management's purpose for action. Essentially the forest stands were treated to lower the basal area to promote increased growth and vigor and regenerate stands of timber (See Appendix C).

Stand Structure

The potential treatment areas, focusing on high density, high risk stands of pine were selected and stand data information was extracted from the vegetation database on November 3, 2011.

The Forest has identified and labeled timber stands using the variable of "structural stage" as the vegetation database landscape unit of measure to identify, monitor and improve upon through forest management practices. The structural stage attribute is the crosswalk measure from describing the forest structure to addressing habitat requirements for the wide range of wildlife and birds.

Timber sales with NEPA decisions signed which have harvest units completed (logged) were included in the existing forest-wide structural stage numbers. Harvest units completed show the new existing structural stage. Units that have not been logged do not indicate the post-harvest resulting structural stage change. The following is the structural stage characteristics as defined by the Forest Plan.

Structural Stage 1 (Grass/Forb): An early forest successional stage during which grasses and forbs are the dominant vegetation. At the site level, Structural Stage 1 is defined as nonstocked,

with an average maximum density (AMD) less than 10 percent. Small-scale Structural Stage 1 within sites are at least one acre in size, do not meet the seedling stocking criteria, and contain no saplings, poles, or mature trees.

Structural Stage 2 (Shrubs/Seedlings): Developmental stage dominated by tree seedlings (less than one inch dbh) and shrub species.

Structural Stage 3 (Sapling/Pole): Developmental stage dominated by young trees 1 to 7 inches dbh, 10 to 50 feet tall, and usually less than 50 years old. This stage is subdivided into three canopy closure classes: A (less than 40 percent); B (40 to 70 percent); and C (greater than 70 percent).

Structural Stage 4 (Mature): Consists of trees larger and older than structural stage 3. Also classified by the same canopy closure categories as structural stage 3.

Structural Stage 5 (Late Succession): This structural stage is characterized by very large trees (16+ inches DBH) 160 years of age and older. (Mehl 1992).

Table 3-19 displays the distribution of structural stages within each management area across the Black Hills National Forest (USDA Forest Service. 2010b).

Table 3-19 Forest-wide Structural Stages and Management Areas

All Management Areas		
Structural Stage	**Existing Forest**	**Percent**
1	84,359	7.6%
2	37,033	3.3%
3A	56,933	5.1%
3B	76,509	6.9%
3C	41,383	3.7%
4A	301,892	27.2%
4B	346,128	31.2%
4C	159,268	14.4%
5	5,480	0.5%
Total	1,108,985	100.0%

The Black Hills Land and Management Plan Phase II Amendment specifies that certain management areas (MA's) should be managed to provide a distribution of structural stages in a variety of sizes and shapes. It further specifies the structural stage objectives (percentage) for each MA. Within the MPBR Project there are five such MA's: 4.1, Limited Motorized Use and Forest Product Emphasis; MA 5.1, Resource Production Emphasis; MA 5.4, Big Game Winter Range Emphasis; MA 5.43, Big Game and Resource Production; MA 5.6, Forest Products, Recreation Big Game Emphasis.

Table 3-20 Structural Stage Distribution

Management Areas: 4.1, 5.1, 5.4, 5.43, 5.6		
Structural Stage	**Existing MPBR**	**Percent**
1	0	0.0%
2	0	0.0%
3A	0	0.0%
3B	19,172	9.1%

3C	14,731	7.0%
4A	0	0.0%
4B	118,868	56.2%
4C	58,797	27.8%
5	0	0.0%
	211,568	100.0%

The above management areas (Table 3-20) are the Forest's primary treatment areas for forest management and are generally labeled as suitable timberlands. The other MA's (MA 3.31, Backcountry Motorized MA 3.32, Backcountry Non-Motorized; MA 4.2A, Spearfish Canyon (Alternative C only); MA 5.1A, Southern Hills; MA 5.2A, Fort Meade VA Hospital Watershed; and MA 8.2, Developed Recreation Complexes are classified as non-suitable timberlands where integrated forest pest management activities would occur to reduce MPB risk and fuel hazard.

Desired Future Conditions (DFC)

Insect and Disease: The Forest Plan direction is to "consider preventive vegetation management practices, including silvicultural treatments, to protect forest stands from insect and disease epidemics" (Phase II Amendment, Page II-47). Also, Phase II Goal 10, Objective 10-07 states "Where outbreaks of mountain pine beetle could present risks to management objectives for ponderosa pine, reduce acreage of ponderosa pine stands that are in medium or high risk for infestation" (Phase II, I-36). Goal 11, "Enhance or maintain the natural rate of recovery after significant fire and other natural events while maintaining a mosaic of fuel-loading conditions to facilitate future fire suppression activities" (Phase II, I-38).

Silvicultural Prescriptions: Silvicultural systems used would be dependent on the structure desired to meet the purpose and need of this project. Guidelines for commercial and non-commercial thinning would be followed as specified in Chapter II of the Phase II Amendment to the Forest Plan and stocking charts in Appendix H of the Forest Plan. Generally, stands would be treated to achieve lower stocking levels for a reduction of crown fire hazard and mountain pine beetle hazard. For further detailed discussion of these methods refer to Chapter II-24 of the Phase II Amendment and Appendix H of the Forest Plan.

Very Large Tree Size: Objectives 4.1-203, 5.1-204, 5.4-206, 5.43-204 and 5.6-204 in the Phase II Amendment call for 10% of the 4 ponderosa pine structural stage (sawtimber nine inches and larger) have an average tree size of "very large," where the average size pine is greater than 16 inches diameter breast height (dbh).

Wildfire: Goal 10: Establish and maintain a mosaic of vegetation conditions to reduce occurrences of high intensity fire, insect, and disease events, and facilitate insect and disease management and firefighting capability. Objective 10-01 states that stands will be managed for 50% to 75% moderate-to-low fire hazard in the wildland-urban interface and reduce fire hazard within proximity of structures to current NFPA standards. Additional guidance has also been provided from the Healthy Forest Restoration Act of 2003 and other National level policy and directives.

Alternative A – No Action

The No Action Alternative assumes that no implementation of any elements of the proposed action or other action alternative would take place within the MPBR Project Area. This

alternative represents no attempt to actively respond to the purpose and need for action, the issues, or concerns identified during scoping for this project. There would be no effort to modify existing vegetation and related fuels conditions in the project area. Vegetation structure would change over time through natural growth and mortality and events such as wildfires, storms, and insect and disease outbreaks. None of the actions associated with this EIS would occur.

Actions such as ongoing Forest protection efforts, fire suppression, noxious weed treatment, and recurring road maintenance on system roads would continue as directed by the Forest Plan. Vegetative management would not take place unless authorized by other decisions.

Direct and Indirect Effects

Mountain Pine Beetle Based on current stand conditions, research and field observations, the overstocked stands of pine pose a high hazard for mountain pine beetle infestation. This hazard would likely increase over time as stands grow and stocking levels increase. The potential treatment areas have a high risk rating. Coupling with the high beetle populations in the area, the likelihood of a continuous, widespread, epidemic-level infestation of mountain pine beetle is high. If no action is taken, many currently forested areas could lose most or all of their mature pine overstory. This loss of mature pine trees would add greatly to fuel loads and wildfire hazard on a long-term basis (see Fire and Fuels Report), and cause substantial changes to wildlife habitat (see Wildlife Report).

If pine stands are left untreated, the mountain pine beetle hazard would remain high in the majority of the project area until stocking levels decrease due to mortality from insect activity or wildfire. It is not possible to determine when stands would become infested and the precise level of beetle-caused mortality, but reasonable estimates can be made based on the current extent of the epidemic, the expanding pine beetle brood populations available to infest new trees, and the large volume and wide distribution of high hazard stands in the project area. What is apparent is that there would be considerable changes in the landscape in the Project Area (USDA Forest Service. 2012a).

At this time, beetle activity and mortality is generally still heaviest in the central Hills. However, the northern and southern Hills are the areas experiencing the largest growth and expansion of beetle mortality over the past 2-3 years. Beetle activity has been relatively light in the Bearlodge Mountains and in the far southern Hills (generally south and west of Jewel Cave), both of which have portions of MPBR Project.

In the hardest hit areas, near complete mortality of the larger trees could occur on up to 50 percent of structural stage 4C. This mortality of 4C would result in a mix of structural stage 2 and 3A due to the prolific pine regeneration' that occurs naturally in the Black Hills, thus avoiding the non-stocked structural stage 1. Structural stage 3A stands would result from the advance regeneration presently occurring within the stands. The other 50% of the 4C the mountain pine beetle attack area size could result in a variation of overstory stand densities resulting in mostly a 4A structure with some 4B. As the mountain pine beetle moves across the landscape there is the probability of complete landscapes being killed over time as evident of the sequential aerial detection survey maps specific to the present mountain pine beetle cycle.

In structural stage 4B, which is a slightly more open tree canopy than 4C but still classified as

high risk, the mortality of larger trees is similar to structural stage 4C resulting in mostly 4A, some would remain as 4B and a mix of 2 and 3A. Like 4C, there is the probability of complete landscapes being killed overtime if untreated.

In structural stage 3C, the pine overstory generally ranges between 5-9 inch DBH. Overstory mortality of 90% would leave remnants in the 3B and 3C stand densities of varying patch sizes. This mortality results in mostly structural stage 2 and 3A depending on advanced regeneration similar to the changes in 4B and 4C.

In structural stage 3B which is similar to 3C, but a slightly more open tree canopy, mortality of 90% would leave smaller remnants in 3B of varying patch sizes. This mortality results in mostly structural stage 2 and 3A depending on advanced regeneration similar to the changes in 4B and 4C. In other structural stages, such as structural stages 3A and 4A that have a lower probability of mountain pine infestation, individual trees or small groups of trees, may become infested due to the on-going epidemic.

There is a probability of mountain pine beetle infestation in structural stage 5 that are denser in structure. Likewise, there is probability of some 3B or 3C or 4B or 4C stands would transition into structural stage 5.

Stands in high mortality areas would revert to younger age structural stages. Adding younger structural stage stands would increase vegetation diversity in the area, which is dominated by mature pines. However, the large volume of dead and down trees would significantly increase fuel loads and wildfire hazard in the wild-land urban interface areas. This increases the probability for large, intense wildfires resistant to control that threaten natural resources, private property, and human life.

The areas of lower infestation levels would also have lower overall mortality rates. This may not be the actual case, as the current epidemic could easily overwhelm forested landscapes. In these areas, structural stage 4B, 4C and 5 stands are expected to have substantial beetle-caused mortality, with a high percentage being changed to structural stage 4A, and lesser amounts to younger structural stages 2 and 3 as in the higher infestation level areas.

The large tree mortality across the project area would greatly increase the amount of large-diameter snags within MPBR project area. These new snags would be well distributed across the project area. However, snags created by mountain pine beetle are not expected to remain at high levels for longer than five years following death (Schmid et. al., 2009).

Alternative A (No Action) should result in the most large trees per acre due to the thinning treatment of alternatives B and C (see Figure 3-2). However, if the MPB populations increase substantially, Alternative A could have the lowest amount of stands in the very large tree size class (see Figure 3-3).

Figure 3-2 Alternative A Structural Stages

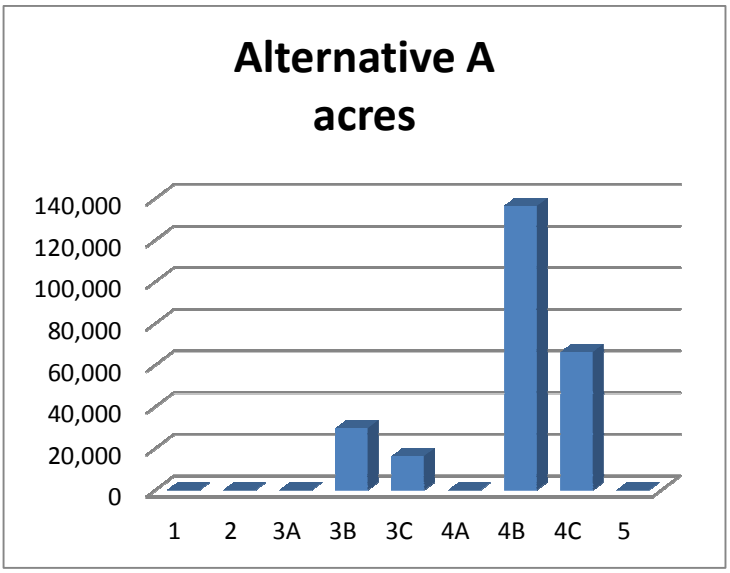
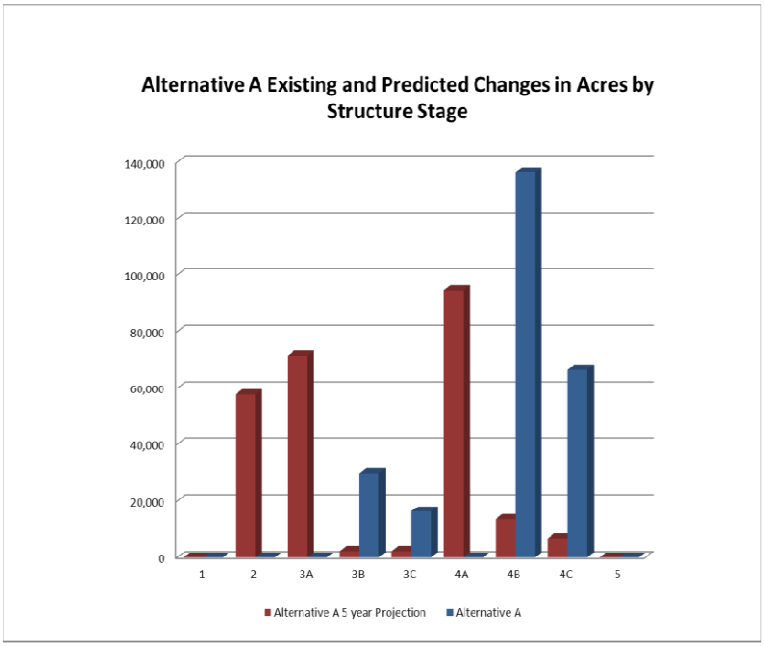


Figure 3-3 Alternative A Structural Stages in Five Years:



Other Effects: The effects of deferring treatment in the project area would be increased mortality and the resulting decrease in growth and yield due to the continuation of the MPB epidemic; reduction of diameter growth due to age and overstocking in stands not impacted by MPB activity; and an increase in the hazard for high intensity wildfire. Age class distribution would dramatically change in those infested areas as the older mature pine is replaced by younger pine due to the unpredictable natural processes such as insect infestations and wildfire. Structural stage imbalances would persist and be exacerbated by the lack of regenerated stands. Long-term effects in stands not heavily impacted by MPB infestation would be an increase in

mortality due to competition between pine and an increase in merchantable defect due to disease. Long-term sustainability of the timber resource would be in jeopardy since much of the mature forest would be killed by the MPB and relatively few acres are currently young and available to grow into the next generation of mature forest.

Some timber harvesting is occurring on private land within the project area, mostly in conjunction with mountain pine beetles, fuels reduction and development. Activities on private land are proportional to the percent of private lands in relation to the National Forest boundary. The amount of timber harvesting during any one decade however has been small and its effects on National Forest timberland should be minimal.

The hazard of a stand replacing wildfire would be higher without treatment. High intensity wildfires, such as Jasper (2000) and Battle Creek fire (2002) would cause many of the stands to be completely killed. The effect of such a high intensity fire to the timber resource would be a loss of timber value, a large reduction of age class distribution, a disruption of an even flow of timber to local mills, an increase in insects, and a disruption of the natural regeneration process. Solarization would reduce the success of both natural and artificial regeneration. Soil sterilization would reduce productivity for many years, as the process of rebuilding soil horizons in this relatively dry climate is slow.

Cumulative Effects

The effect of past treatments has been an increase of merchantable volume growth, increase in the quality of timber and until recently, a minimal amount of insect and disease infestations. The commercial thinning has reduced the stocking levels in overstocked stands. The effect has been an increase in the quality of the timber through the removal of damaged, diseased, and poorly formed trees. There has been increase in individual tree growth by releasing the remaining trees from competition for light, water, and nutrients. Trees have developed larger diameters due to a reduction of competition. A reduction of the MPB hazard to the pine stands due to the reduction of basal area to lower the level of susceptibility to pine beetle attack has also occurred for stands which have recently been treated.

Some timber harvesting is occurring on private land, mostly in conjunction with mountain pine beetles, fuels reduction and development. Since private land comprises approximately 30% of the project area and approximately 25% of that is timberland, the effects of timber harvesting practices could affect the project area. The amount of timber harvesting during any one decade however has been small and its effects on National Forest timberland should be minimal.

Present and foreseeable projects would continue such as:

Briggs	28,916 Acres	Herman	21,572 Acres	Calumet	31,781 Acres
Cold Springs	13,969 Acres	Pactola	26,017 Acres	Vestal	43,516 Acres
Steamboat	24,596 Acres	Buttes	11,441 Acres		

Fire suppression, firewood gathering and Christmas tree cutting by permit would continue to occur within the area. Continuing development of adjacent private land and actions taken on private land to protect property from wildfire and mountain pine beetle would result in additional scattered openings and lower basal areas, but would have no major effect on the forested landscape within the project area.

With an increasing interest from landowners to manage their forested land, protect their property

from fire and mountain pine beetle infestation, and clear land for home sites, an additional 400 acres may be treated within the next decade. Since the amount of silvicultural activities not connected to this analysis would be minimal, the cumulative effects of these activities under any of the alternatives would also be minimal. Treatments on private land for fire hazard reduction or mountain pine beetles would contribute to both a reduction of hazard from high intensity wildfire and mountain pine beetle.

Alternative A, by not taking any action to address the purpose and need outlined for the MPBR Project, would result in significant changes on the landscape and adverse cumulative effects to the timber resource. These effects would include further movement away from Forest Plan goals and objectives for vegetative diversity, wildfire hazard, mountain pine beetle risk, and timber production. Past and present forest improvements would be negatively affected by ongoing pine beetle infestations and could be completely eliminated where wildfires occur.

Alternative B

Alternative B proposes approximately 41,140 acres of commercial and approximately 7,260 acres of non-commercial (POL) thinning over an approximate five to seven year period to remove mountain pine beetle infested trees and associated trees to lower mountain pine beetle risk and wildfire hazard. Commercial treatments would not be authorized in the Non-motorized Backcountry emphasis area (MA 3.32). Commercial and non-commercial thinning would generally occur on slopes less than 40 percent. Cable logging is proposed in areas with existing roads. This focused forest thinning serves to reduce mountain pine beetle habitat and fuel loads.

Alternative B would utilize existing roads and routes. No new roads would be constructed. Reconstruction of existing NFSRs could include improvements, restoration or realignment. Some existing unauthorized routes may be converted to Level 1 System Roads and closed following management activities. Some System Trails may be temporarily changed to roads and then returned to trails after vegetation management activities are completed.

Integrated Pest Management methods and treatment activities in Alternative B would occur over an approximate five to seven year period. Table 3-21 displays potential treatment acres by Management Area for Alternative B.

Table 3-21 Alternative B Management Areas

Management Area	Acres	Percent
3.31	4,411	2%
3.32	3,120	1%
4.1	4,184	2%
5.1	102,562	42%
5.1A	21,360	9%
5.2A	2,604	1%
5.4	91,691	38%
5.43	4,642	2%
5.6	7,085	3%
8.2	339	0%
Total	242,000	100%

Direct and Indirect Effects
Mountain pine beetle in the untreated treatment areas: See Alternative A Direct/Indirect Effects.

Integrated Pest Management Techniques:

Commercial Timber Harvest: Commercial thinning would occur on approximately 48,400 acres of the area. Commercial thinning would generally consist of thinning from below, removing suppressed and intermediate pine from the stand, and the overmature pine when necessary from the overstory, leaving the non-infected mature pine. Generally, basal areas for commercial thinning would be from 40 to 80 BA. In areas where there are ongoing beetle outbreaks, lowering stand densities even further, such as to 40 BA would be advised. Leave trees in commercial harvest units may generally not be uniformly spaced to create a more natural appearing stand. Treatments adjacent to developed private property may serve as fuel breaks and may be treated differently. Whole tree skidding would be the preferred logging method to remove as much slash as possible during harvest activities to reduce fire hazard.

Sanitation harvest to remove mountain pine beetle infested pine trees may be conducted in areas near or adjacent to stands identified for treatment in order to limit the expansion of mountain pine beetle populations. Large trees would generally be retained and removed only where infested with mountain pine beetle or necessary to meet density objectives, other resource needs, and for landings and other clearings to facilitate timber harvesting activities.

Products Other Than Logs (POL) - products such as posts, poles and fiber from trees or parts of trees less than sawlog size is proposed for7,260 acres. Spacing of leave trees may vary from 12 to 24 feet to create a more natural appearing stand. A reduction of MPB hazard would occur due to the reduction of stocking to lower the level of susceptibility to MPB attack. Slash buildup from non-commercial thinning, if not treated properly, could encourage Ips beetle (Ips pini) buildup and mortality in residual stands of pine. Past practices of lopping, scattering, and burning of slash piles within a year of treatment has reduced Ips beetle infestation to less than a few trees per acre. Scattering slash facilitates the rapid drying of fuels, which reduces conditions favorable for Ips beetle buildup. Additional fuel treatments for fire hazard reduction would also reduce the probability of insect infestations. No major adverse effects are anticipated to the timber resource.

Advanced Logging Systems – Helicopter and Skyline: Approximately 32% of the potential treatment areas have slopes greater than 40%. Skyline treatments would generally thin from above, for economic efficiency, would remove the larger overstory trees and leave a more open stand that is less susceptible to MPB infestation. Alternative B would use existing roads/routes for potential skyline units. Helicopter logging would generally include hand fallers cutting green, infested trees, removing the non-merchantable parts of the trees, and then attaching the logs to a cable suspended from a hovering helicopter. The helicopter would then fly the logs to a landing located adjacent to a road. Logs would then be transported via trucks to a mill. Since ground-based equipment would not be used, the impacts to the resources would be less than cable or ground-based logging. All logging slash left at the site would be treated to a maximum of 18 inches in depth.

Cut and chunk, chipping, cut-hand pile-burn, and cut-equipment pile-burn: These activities have been implemented on the Forest in areas to minimize mountain pine beetle spread. These activities involve the cutting down of infested trees and then bucking/chipping the tree bole and

treating the residual slash by lop and scatter chipping, piling and/or burning.

The cut and chunk activity does not result in a 100% mortality of the mountain pine beetle. Entomologists predict around 80% mortality of mountain pine beetles using the cut and chunk method. Cutting and chunking works best at a smaller, local scale, where all of the infested trees can be treated in one year. However, there is a good chance of annually repeating the cut and chunk activity in the same areas because some of the infested trees may be missed or not all of the beetles in the chunks die. The effects of these activities are usually on a small scale that results in no changes to the stand structural stage forest conditions.

Rights-of-Way: There are state and county rights-of -way throughout the planning area. Many of these have both commercial and non-commercial timber in them. Hazard trees and timber within these rights-of-way would be removed to reduce the risk to motorists and "daylight" the roads to reduce icing. Where timber harvest units are adjacent to these areas the rights-of-way would be included in the timber sale. The effects of removing this timber would be minimal to the timber resource. Public safety would be increased by the removal of hazard trees that could fall on the roads. Removing trees in some areas would increase melting of ice and snowpack and speed the drying of roads. Visibility around curves would be improved.

Roadside Treatments: Primary ingress/egress roads associated with the Wildland Urban Interface (WUI) access are addressed in the Fire and Fuels specialist report and in the CWPP for each county within the Black Hills National Forest. Approximately 162 miles of maintenance level 3, 4, and 5 roads could be treated for ingress/egress.

Treatments would include thinning from below to approximately 20 to 40 square feet of basal area to raise crown base height and increase crown separation of the overstory, and thinning the understory and treating the slash to reduce ladder fuels. Leaving small groups of two to three trees and variable spacing may be desirable to create a more diverse appearance to these treatments. Whole tree harvesting would be used in these areas where possible, and all slash would be removed or piled and burned. Also, conifers would be removed from hardwood stands and inclusions along these routes to reduce the fire hazard.

Semiochemicals - are insect-produced compounds that serve as a chemical communication system for the insect. These are also referred as pheromones. These are available to serve as attractants that are used to monitor populations or to cause attacks on trees to which they are attached (baited hereafter); or as anti-aggregation compounds that attempt to prevent attacks on treated trees. Attractant chemical has been used on a very small or experimental scale. Repellant chemical has been used on the Forest in campgrounds and selected trees on a small scale. At this point, the anti-aggregation pheromone has not been shown to be effective in the Black Hills. According to entomology experts the use of pheromones in conjunction with insecticides has not been proven to be operationally feasible against the mountain pine beetle, let alone been implemented on a landscape-level.

Attractant pheromones in 'tree baits' (small packets) attached to the tree bole prior to the summer beetle flight draw the mountain pine beetle into the baited trees to cause an attack. After the beetle flight has subsided then tree harvesting and removal of the green hit trees (tree baited trees plus surrounding green hit trees) is a necessity so as to not further promote landscape tree

mortality from mountain pine beetles. Tree harvesting must be completed prior to the following spring or beginning of the next mountain pine beetle flight. The purpose to implement tree baiting is to concentrate the mountain pine beetle population. Tree baiting would be in cooperation with the State of South Dakota, State of Wyoming, Rocky Mountain Research Station, U.S. Forest Service Forest Health Services, Wyoming county governments, South Dakota county governments and local timber industry. Entomology experts representing cooperating interested parties would participate with the Black Hills National Forest in treatment design and evaluation for a statistically sound scientific process and review. This technique is not considered as a major management tactic that would be used on a landscape scale, more an infrequently used tactic that is available under certain circumstances and conditions.

There are efforts being initiated by Lawrence County cooperating with local timber industry and private land owners west of Lead, South Dakota to place tree baits on about 10 areas which is approximately 276 acres in total. Tree baits would be placed on selected trees. Selected trees would be on an approximate 50 yard grid across the landscape. Trees in between the baited trees would be treated with repellant to discourage beetle attack. Green hit trees are planned to be harvested and removed before the next mountain pine beetle flight.

Insecticide Spraying: Chemical spraying of selected trees would use chemicals appropriate for a forested environment. Strict adherence to the application instructions of the chemical as specified is important to environmental compliance. This activity is usually specific to high visible and/or important areas that are small in scale in relation to landscapes where the logistical and economic feasibility may be restrictive. Tree spraying is estimated as incidental in size compared to the tree cutting treatment acres. There is no structural stage transition for stands based on tree spraying.

Summary of Integrated Pest Management on Structural Stages:
Similar to Alternative A, it is not possible to determine when or the precise level of MPB activity to then be treated, but reasonable estimates can be made based on the current extent of the epidemic, the expanding MPB brood populations available to infest new trees, and the large volume and wide distribution of high hazard stands in the project area (Allen2011).

Structural stage 1 would remain the same throughout the five to seven years of the MPBR project. Even stands experiencing complete overstory tree mortality from mountain pine beetle infestation would likely be converted to structural stage 2 or 3A due to the prolific Ponderosa pine regeneration.

Structural stage 2 increases due to the dense stands that are not treated that is anticipated to result in the dense stands of 3B/3C/4B/4C converting to structural stage 2 on 20-30% of the stands. The treated acres do not predict conversion of 3B/3C/4B/4C to structural stage 2.

Structural stage 3A increases due to thinning treatment acres. However, the unpredictable nature of mountain pine beetle attack on dense stands that are not treated is anticipated to result in the stands of 3B/3C/4B/4C converting to structural stage 3A on 20-60% of the dense stands of MPBR.

Structural stage 3B decreases from existing inventory and for alternative B due to thinning treatment acres on 3B converting to 3A. Also, due to the unpredictable nature of mountain pine beetle attack on dense 3B stands that are not treated the anticipated result is conversion to structural stage 3A on 60% of the stands, converting to structural stage 2 on 30% of the stands

and 10% remaining in 3B.

Structural stage 3C decreases from existing inventory and for alternative B due to thinning treatment acres on 3C converting to 3A. Also, due to the unpredictable nature of mountain pine beetle attack on dense 3C stands that are not treated the anticipated result is conversion to structural stage 3A on 60% of the stands, converting to structural stage 2 on 30% of the stands, converting to structural stage 3B on 5% of the stands and 5% remaining in 3C.

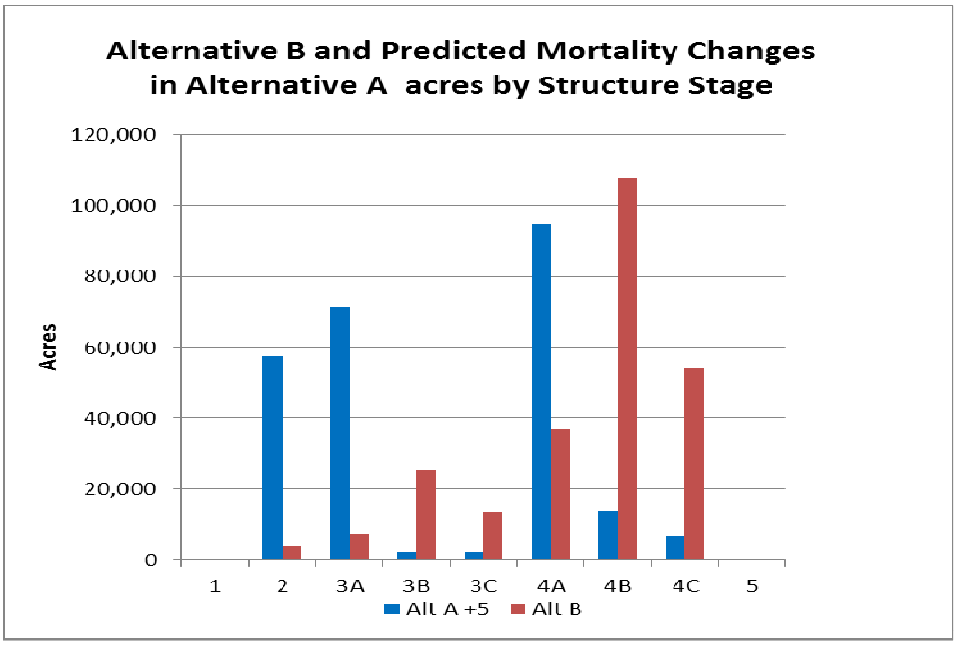
Structural stage 4A increases from treated thinning acres in 4B and 4C stands converting to structural stage 4A. Also, on the untreated stands due to the unpredictable nature of mountain pine beetle attack that half of the 4B and 4C stands convert to structural stage 4A.

Structural stage 4B acres are anticipated to convert to structural stage 3A on 20% of the stands, converting to structural stage 2 on 20% of the stands, converting to 4A on 50% of the stands and 10% remaining in 4B. The treated 4B stands convert to structural stage 4A for 90% of the stands and to structural stage 2 for 10% of the stands where the overstory of stands is removed leaving seedling/saplings.

Structural stage 4C acres are predicted to decrease on the treated stands. On the treated 4B stands convert to structural stage 4A for 90% of the stands and to structural stage 2 for 10% of the stands where the overstory of stands is removed leaving seedling/saplings. It's an opinionated prediction of when the attack comes.

Structural stage 5 has a probability of mountain pine beetle infestation in structural stage 5 stands that are denser. Likewise there is probability of some 3C, 4B or 4C stands transition into structural stage 5 based on professional determination.

Figure 3-4 Alternative A Predicted Changes vs. Alternative B Post Treatment



Very Large Tree Size
Objectives 4.1-203, 5.1-204, 5.4-206, 5.43-204 and 5.6-204 of the Phase II Amendment call for 10% of the 4 ponderosa pine structural stage have an average tree size of "very large," where the average size pine is greater than 16 inches DBH. In areas not treated and heavily infested with MPB, the amount of very large tree size class would go down.

Late Successional Stands
There are currently stands within the project area (Forest) classified as late successional, Structural Stage 5 (SS5). The action alternatives do not propose treating in SS5. Tree mortality from mountain pine beetle may occur in structural stage 5. Small scale occurrence of insects may enhance the characteristics of late successional stands.

Snags
There would be no cutting snags in either action alternative except for safety reasons. The large tree mortality across the project area would greatly increase the amount of large-diameter snags within MPBR project area. These new snags would be well distributed across the project area. However, snags created by mountain pine beetle are not expected to remain at high levels for longer than five years following death (Schmid et. al., 2009).

Alternative C
Alternative C was developed in response to public comments received during the scoping period. The alternative is a more proactive response to the purpose and need for action. Specifically, it responds to concerns about not treating more 'high risk' stands on a landscape basis, treating in advance of MPB, and addresses concerns about safety and access on roadways (ingress/egress).

Alternative C includes all aspects of Alternative B (Proposed Action). Integrated Pest Management techniques would occur on portions of approximately 248,000 acres to reduce the spread of MPB across NFS lands to manage and protect ecosystem components.

Alternative C proposes approximately 105,400 acres of commercial and approximately 18,600 acres of non-commercial (POL) thinning over an approximate five to seven year period to remove MPB infested trees to lower mountain pine beetle risk and wildfire hazard. Alternative C includes three additional elements:

- Landscape level thinning in advance of large beetle infestations to reduce stand densities and the risk of MPB infestation, thereby reducing the wildfire hazard, and creating landscape-scale fuel breaks.
- Treatments in MA 4.2A Spearfish Canyon
- Up to 250 miles of new System (70 miles) and/or temporary (180 miles) road construction

Alternative C would utilize existing roads and construct new System and/or Temporary Roads. Reconstruction of existing NFSRs could include improvements, restoration or realignment. Construction of new temporary roads would not be converted to System Roads. Some existing unauthorized routes (approximately 46 miles) may be converted to Level 1 System Roads and closed following management activities. Some System Trails may be temporarily changed to roads and then returned to trails after vegetation management activities are completed.

Table 3-22 Alternative C Structural Stages Distribution Post Treatment

Management Area	Acres	Percent
3.31	4,411	2%
3.32	3,120	1%
4.1	4,184	2%
4.2A	5,583	2%
5.1	102,979	41%
5.1A	21,360	9%
5.2A	2,604	1%
5.4	91,691	37%
5.43	4,642	2%
5.6	7,085	3%
8.2	339	0%
	248,000	100%

Direct and Indirect Effects

Commercial Timber Harvest: Commercial thinning would occur on approximately 105,400 acres. Effects would be the similar as described under Alternative B. Treating an additional 64,000 acres would reduce the MPB risk and fire hazard compared to Alternative B.

Alternative C proposes to thin areas that are currently at endemic to incipient levels of MPB. According to Schmid et al, 2007, the most important aspect of managing mature ponderosa pine stands in the Black Hills is minimizing MPB-caused mortality. The only effective long-range strategy to minimize MPB-caused mortality is controlling stand conditions through silvicultural means over large landscapes and monitoring for areas of MPB buildup (USDA Forest Service. 2007a.). These are forest management actions that increase tree vigor and reduce stand susceptibility to MPB attack through reducing stocking levels. They are preventive treatments that should be completed prior to stands experiencing beetle outbreaks. Sanitation harvest (removal of infested trees) can also provide protection to surrounding uninfested trees and stands by removing a large source of attacking MPB. Creating diverse stand conditions across the landscape would result in an overall forest that is less susceptible long term to MPB. (Fettig et al, 2007).

Products Other Than Logs (POL) - products such as posts, poles and fiber from trees or parts of trees less than sawlog size is proposed for 18,600 acres. Effects would be the same as described in Alterative B.

Advanced Logging Systems – Helicopter and Skyline: Approximately 33% of the potential treatment areas have slopes greater than 40%. Skyline treatments would generally thin from above, for economic efficiency, removing the larger overstory trees and leaving a more open stand that is less susceptible to MPB infestation. Additional new road construction would be necessary to access the cable units. See the Transportation section for information. Helicopter logging would occur as described under Alternative B.

Cut and chunk, chipping, cut-hand pile-burn, and cut-equipment pile-burn: These activities would occur as described under Alternative B.

Rights-of-Way: There are state and county rights-of -way throughout the planning area. See

Alternative B.

Roadside Treatments: Primary ingress/egress roads associated with the Wildland Urban Interface (WUI) access are addressed in the Fire and Fuels specialist report and in the CWPP for each county within the Black Hills National Forest. With the addition of Spearfish Canyon, additional ingress/egress treatments would occur along 15 miles of ML 3, 4, and 5 roads.

Insecticide Spraying and Semiochemicals - Insecticide spraying and aggregation pheromones for mountain pine beetles would occur as described in Alternative B.

Summary of Integrated Pest Management on Structural Stages
Similar to Alternatives A and B, it is not possible to determine when or and the precise level of MPB to then be treated, but reasonable estimates can be made based on the current extent of the epidemic, the expanding MPB brood populations available to infest new trees, and the large volume and wide distribution of high hazard stands in the project area (Allen, 2011).

Structural stage 1 remains the same within the five to seven year timeframe of the MPBR project. Even stands experiencing complete overstory tree mortality from mountain pine beetle attack would likely be structural stage 2 or 3A due to the prolific ponderosa pine regeneration in the near future or presence of advanced regeneration.

Structural stage 2 increases from existing by 20% due to treating 4B and 4C stands.

Structural stage 3A increases from existing due to thinning treatment acres in 3C.

Structural stage 3B decreases from existing due to thinning treatment acres. Structural stage 3B would convert to 3A.

Structural stage 3C decreases from existing due to thinning treatment acres on 3C would convert to 3A.

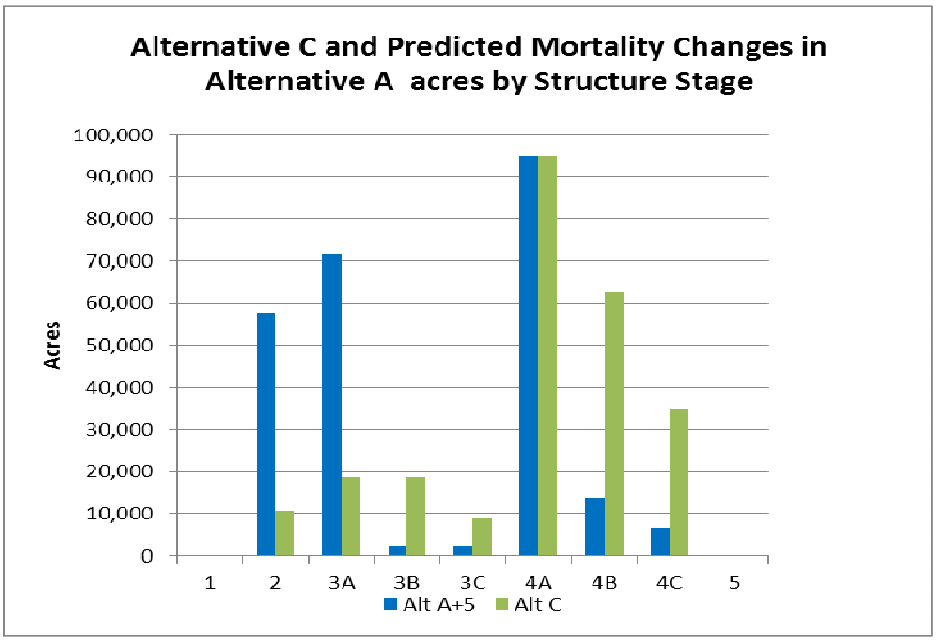
Structural stage 4A increases from treating acres in 4B and 4C stands converting to structural stage 4A. Also, on the untreated stands due to the unpredictable nature of mountain pine beetle attack that half of the 4B and 4C stands convert to structural stage 4A.

Structural stage 4B acres are predicted to decrease on the treated areas. The 4B stands would convert to structural stage 4A for 90% and to structural stage 2 for 10% of the stands where the overstory of stands is removed leaving seedling/saplings.

Structural stage 4C acres are predicted to decrease on the treated areas. The treated 4B stands would convert to structural stage 4A for 90% of the stands and to structural stage 2 for 10% of the stands where the overstory of stands is removed leaving seedling/saplings.

Structural stage 5 - There are no treatments proposed in structural stage 5. There is a probability of mountain pine beetle attack in the structural stage 5 stands that are denser in forest structure. Likewise there is probability of some 3C, 4B or 4C stands transition into structural stage 5.

Figure 3-5 Alternative A Predicted Changes vs. Alternative C Post Treatment



Very Large Tree Size
Objectives 4.1-203, 5.1-204, 5.4-206, 5.43-204 and 5.6-204 of the Phase II Amendment call for 10% of the 4 ponderosa pine structural stage have an average tree size of "very large," where the average size pine is greater than 16 inches DBH. See Alternative B.

Late Successional Stands
There are currently stands within the project area (Forest) classified as late successional, Structural Stage 5 (SS5). Reference structural stage charts above. Tree mortality from mountain pine beetle may occur in structural stage 5. Small scale occurrence of insects may enhance the characteristics of late successional stands.

Snags
There would be no cutting of snags in any action alternative except for safety reasons. For additional information on snags, refer to the Black Hills National Forest Monitoring Report.

Cumulative Effects for both Action Alternatives
Past activities are listed under Alternative A. Cumulative effects of past treatments and treatments proposed in this alternative would generally be positive in view of lower mountain pine beetle risk and fire hazard. Thinning of stands created with harvests would bring those stands into desired condition.

In addition to the present and future activities identified in Alternative A, implementation of the action alternatives would result in a decreased mountain pine beetle risk and reduced risk to high intensity wildfire.

The difference in cumulative effects between the action alternatives is directly related to the quantity and type of treatments. Alternative C would have the highest associated cumulative effect due to

having the highest level of treatment acres. Alternative B would have less impact due to less treatment acres and removing recently infested pine trees. The effects of any of the two action alternatives would generally be positive and move this area toward Forest Plan goals and objectives.

The overstocked stands of pine pose a high hazard to attack by mountain pine beetle. This hazard may increase over time, with growth, due to increasing stocking levels, until natural disturbances act to reduce stand densities. There are 242,000 acres in Alternative B and 248,000 acres in Alternative C of high risk stands. When this fact is added to the fact of high beetle populations in the area, the likelihood of a continuing widespread epidemic-level infestation of mountain pine beetle is high. There are considerable changes in the landscape taking place on the Forest due to mountain pine beetle mortality. On the untreated stands, many currently forested areas would lose some or all of their mature pine overstory. This loss of mature pine trees would add greatly to fuel loads and wildfire hazard (see Fire and Fuels Report), and cause changes to wildlife habitat (see Wildlife Report).

Alternative B and C include integrated pest management activities for treatment on the ground. The sawtimber and products-other-logs treatments transition the existing dense structural stage acres to more open structural stages. Activities such as tree spraying and cut and chunk are predicted to not change the stand structural stages based on the activities' small scale.

The amount of dense forest structure decreases the 3B, 3C, 4B and 4C stands and increases the 2, 3A and 4A stands. The present rate of timber harvest per year, the tree mortality due to mountain pine beetles and wildfires, these activities result in changing the forest structure from the denser stands to a more open stand structure.

After a disturbance event, an ecosystem is capable of restoring itself over time. Management actions can be used to speed this process and reduce the intensity and extent of subsequent events such as a re-burn of fallen dead trees over a large landscape. While some fire or insect-killed areas are an essential habitat component for several species and could be conserved, treatments can be used to break up the continuity of dead trees to provide defensible space so fire crews can slow or stop wildfires. Management actions are used to provide a more even flow of goods and services from the forest. The cost of treatment can be high and the economic value of insect or fire-killed trees is short, often less than a year. Treatment must occur shortly after the disturbance event to recover value.

FIRE and FUELS

Introduction

The project area is largely characterized by closed canopy ponderosa pine (long needle) that is characterized by Habitat Structural Stages 3B, 3C, 4B and 4C. These stands are very conducive to crown fire initiation and spread under the right weather and fuel conditions. Due to the amount of private property, homes, businesses and critical infrastructure major concerns exist with respect to the wildland urban interface (WUI) and at risk communities, specifically relating to public safety. As development of private property increases over time, the potential for WUI issues may increase.

Affected Environment

The present condition of vegetation is characterized by moderately to well stocked stands of ponderosa pine and a general reduction in open grassy meadows, riparian area and hardwood

species. These moderately to well stocked stands of ponderosa pine are highly susceptible to continued Mountain Pine Beetle activity.

Vegetation

When compared to historic conditions, much more of the landscape is now forested and we are losing our open meadows and hardwood stringers which serve as natural fuel breaks. (Phase II Amendment FEIS). As a result of this increased fuel loading, more of the Black Hills is available for, and potentially affected by, large, intense forest fires. The ponderosa pine cover type dominates the landscape and as a result of fire exclusion and past management activities, ponderosa pine has encroached on the non-forested communities, contributing to the reduction in size of the hardwood cover type, creating dense, closed canopy ponderosa pine stands. Surface fuels include duff, small woody debris, dead down logs and long needle litter. Isolated areas of storm damage, and slash from past management activities exist within the project area.

In light of the recent and projected mountain pine beetle activity within and adjacent to the project area, changes in fuel profiles are expected. Mountain pine beetle damage would continue to alter several stand characteristics including canopy fuels, down woody fuels, duff, ladder fuels, herbaceous fuels, and microclimate, in turn altering the fire hazard and potential fire behavior.

Condition Class and Fire Regime

Historically, fires were more frequent and less severe. Fire suppression activities have trended the forest outside historic ranges. Currently, there are three general types of fire regimes in the Black Hills. (USDA Forest Service, 2005a) Fire regimes characterize the role fire plays in an ecosystem. The Condition Class rating can be used to describe the degree of departure from the historic fire regime (Hann et al., 2003). Table 3-23 and 3-24 describes each fire regine followed by a typical stand structure for each Conditions Class.

Table 3-23 Fire Regimes in the Black Hills

	General Characteristics	Major Controlling Variables	Distribution
Frequent, Low-Severity Fire Regimes	Fires recur within any stand at relatively short intervals (10 - 50 years), burning at low severity in the canopy and soil, and variable severity in the understory	***Weather*** (fires occur during dry periods), ***Climate*** (extensive fires tend to occur in dry years that follow 1- 3 wet years), and ***Fuels*** (fuels gradually accumulate during the intervals between successive fires)	Evidence of surface fire in ponderosa pine forests throughout the Black Hills, most frequent at the Prairie-Forest ecotone and less frequent in interior forests at mid to high elevations (Fisher et al. 1987, Brown and Sieg 1996, Brown and Sieg 1999, Brown et al. 2000, Wienk 2001, Brown 2003, Wienk et al. 2004).
Infrequent, High- Severity Fire Regimes	Fires recur within any stand at long intervals (100 – 500+ years), burning at high severity in the canopy and understory, and at variable severity to the soil	***Weather*** and ***Climate*** are the primary controllers (most ignitions extinguish by themselves because of wet conditions; extensive fires occur only in very dry summers; variability in fuels usually has little influence on fire frequency, extent, or severity)	Large areas of even-aged and dense forest and of closed canopy, mature or old-growth forest at the time of settlement are evidence of stand-replacing disturbance (Graves 1899, Shinneman and Baker 1997).
Mixed Severity Fire Regimes	These fire regimes are intermediate between the Frequent, Low- Severity and the Infrequent, High- Severity Fire Regimes. Fires occur at variable intervals (10 - >100 years), and burn at variable severity (patches of high severity intermingled with patches of low or intermediate severity)	***Weather***, ***Climate***, and ***Fuels*** all influence fire frequency, extent, and severity, in complex ways that are not well understood, with enormous variability over time and space	Proposed as the dominant model for fire regimes in ponderosa pine forests of the Black Hills. Under this model, surface fire forms the background process creating forest structure and landscape pattern. However, fires sometimes burn with mixed severity, with both a surface fire and a stand-replacing fire component, and may sometimes create large areas of high severity burns. Forest patches are variable in size and within patch structure (Lentile et al. in press)

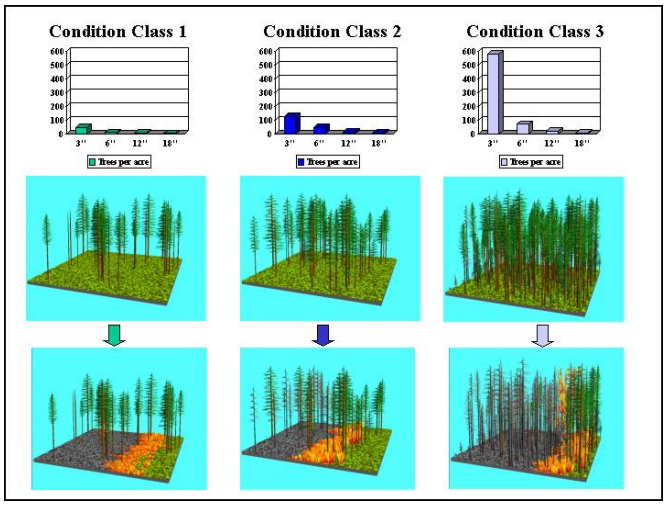
Table 3-24 Fire Regime Condition Class (FRCC)

Fire Regime Condition Class	Description
FRCC1 Low Departure from the central tendency of the historic fire regime.	• Fire regimes are within the historical range. • Risk of losing key ecosystem components is low. • Vegetative attributes are intact and functioning within the historical range.
FRCC2 Moderate Departure from the central tendency of the historic fire regime.	• Fire regimes are moderately altered from their historical range. • Risk of losing key ecosystem components is moderate. • Vegetation attributes have been moderately altered from their historical range. • Fire frequencies have departed from natural frequencies by one or more return intervals, resulting in changes to fire size, intensity, severity, and landscape patterns.
FRCC3 High Departure from the central tendency of the historic fire regime.	• Fire regimes are significantly altered from their historical range. • The risk of losing key ecosystem components is high. • Vegetation attributes have been significantly altered from their historical range. • Fire frequencies have departed from historical frequencies by multiple return intervals, resulting in dramatic changes to fire size, intensity, severity, and landscape patterns.

Central tendency refers to a composite estimate of vegetation characteristics including: species composition, structural stages, stand age, canopy closure, and mosaic pattern; fuel composition; fire frequency, severity, and pattern; and other associated natural disturbances.

The national data characterizes the Black Hills as primarily Condition Class III, high relative risk of significantly altering or losing key components of the ponderosa pine forest system. These conditions significantly increase the probability of a surface fire transitioning to a crown fire with increased burn severity and tree mortality. Evidence of past fires shows the potential for large, high intensity surface fires, and, given the right conditions, stand-replacing fires. Recent examples include the Jasper, Elk Mountain II, Battle Creek, Grizzly Gulch, West Hell Canyon, Rico, Alabaugh, Whoopup, and Coal Canyon Wildland Fires.

Figure 3-6 Typical Stand Structure for each Fire Regime Condition Class



Fire Risk

Risks are defined as those uses or human activities which have the potential to result in a wildfire ignition. Fire history occurrence of both large and point fires were analyzed using the entire 1.2 million acres of the Black Hills since the proposed project area spans such a large area. The fire history data includes fires occurring from 1970 to present. Of the fires identified, 3,781 are known lightning-caused, 161 equipment-caused, 574 campfire-caused, 131 smoking-caused, 147 debris burning-caused, 68 railroad-caused, 133 arson-caused, 83 children-caused and 246 miscellaneous. Both historical fire occurrence data and large fire history (those fires exceeding 100 acres), in and around the project area are depicted. In addition, the percent of the project area impacted by large fire (greater than 100 acres) is displayed. Table 3-25 and Figures 3-7 and 3-8.

Table 3-25 Fire history Occurrence and Size of Fires from 1970 to Present.

Fire Size Class	Fire Size (acres)	Number of Fires
A	0 – ¼	3,292
B	¼ to 9	1,841
C	10-99	133
D	100 – 299	18
E	300-999	14
F	1000-4999	13
G	5000 +	13
U	Unknown	0

Figure 3-7 Point Fire History Within and Adjacent to the Project Area

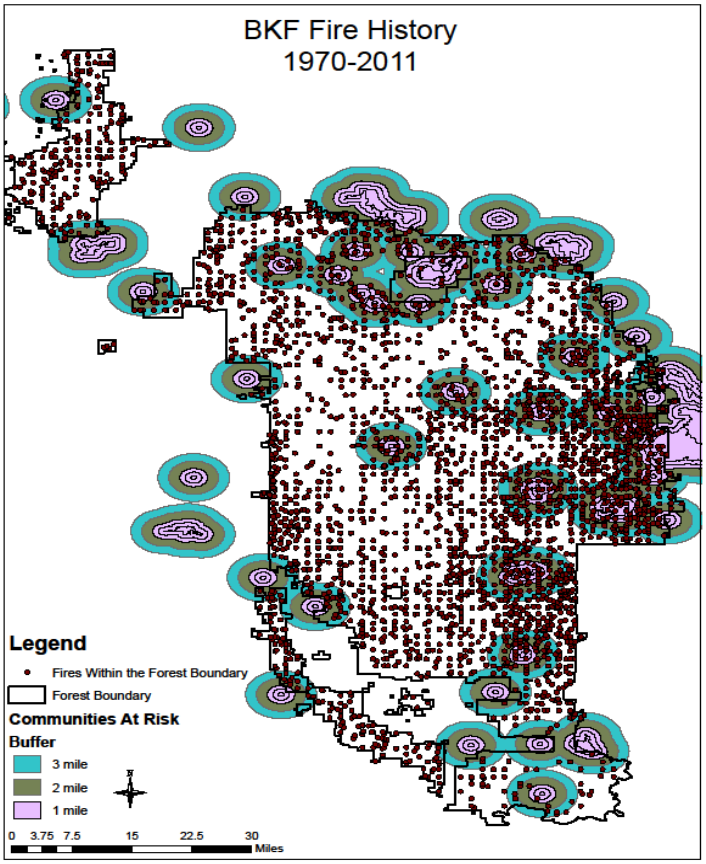


Figure 3-8 Large Fire History (100 Acres or larger) Within and Adjacent to the Project Area.

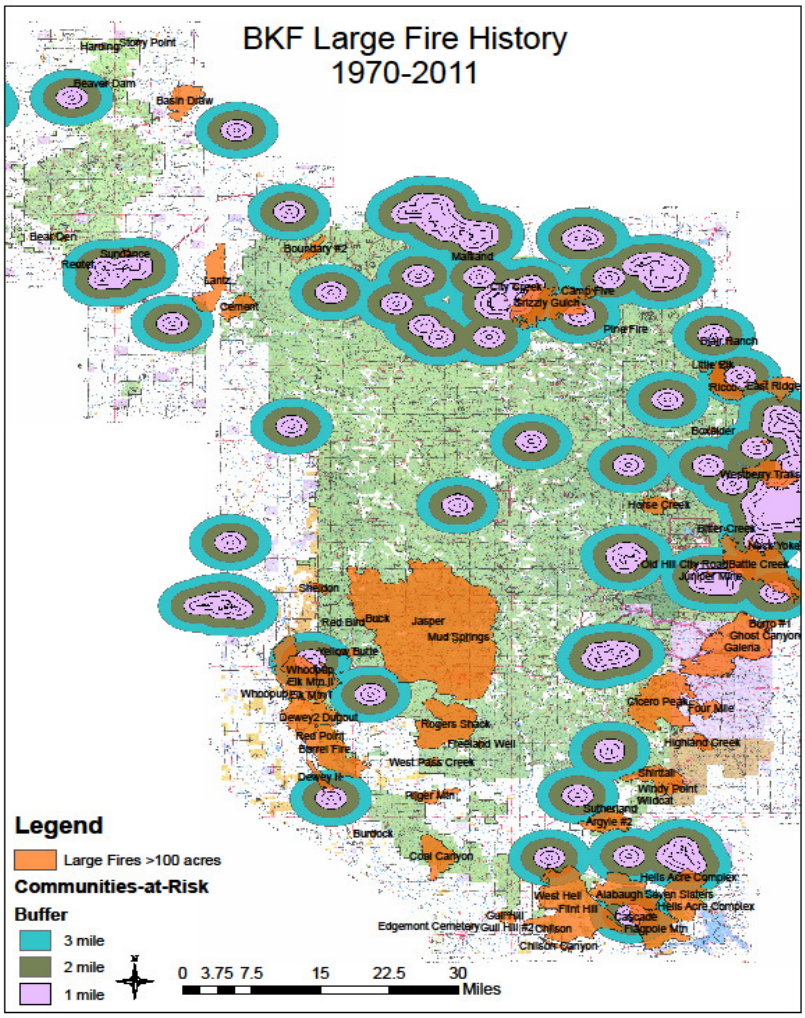


Table 3-26 Area of Large Fire (1970-2011) Within the Project Area (Alternative B)

NUMBER OF LARGE FIRES	LARGE FIRE ACRES	PERCENT OF PROJECT AREA IMPACTED BY PREVIOUS LARGE FIRES	PERCENT OF PROJECT AREA NOT IMPACTED BY PREVIOUS LARGE FIRES
60	311,966	8.6%	91.7%

Table 3-27 Area of Large Fires (1970-2011) Within the Project Area (Alternative C)

NUMBER OF LARGE FIRES	LARGE FIRE ACRES	PERCENT OF PROJECT AREA IMPACTED BY PREVIOUS LARGE FIRES	PERCENT OF PROJECT AREA NOT IMPACTED BY PREVIOUS LARGE FIRES
60	311,966	8.4%	91.6%

The number of fires on the entire Black Hills National Forest system lands has remained fairly constant at 65-130 starts per year. The number of fires that have escaped initial attack has also remained constant. However, these escaped fires have become larger and are more difficult to control with an average large fire size increasing from under 1000 acres per fire in the early 1900's

to over 8000 acres in recent years, having burned approximately 250,000 acres since 1980. This may be due largely, to drought conditions experienced in 2000-2007. Given severe fire weather conditions the average size of fires may be expected to increase due to the increased risk to firefighting personnel and limited tactical options for engaging fires in standing bug killed timber stands as well as for limited tactical options in bug killed stands where standing dead trees have fallen to significantly increase surface fuel loading. This increased surface fuel loading results in increased resistance to control and makes direct attack with handtools extremely slow and difficult.

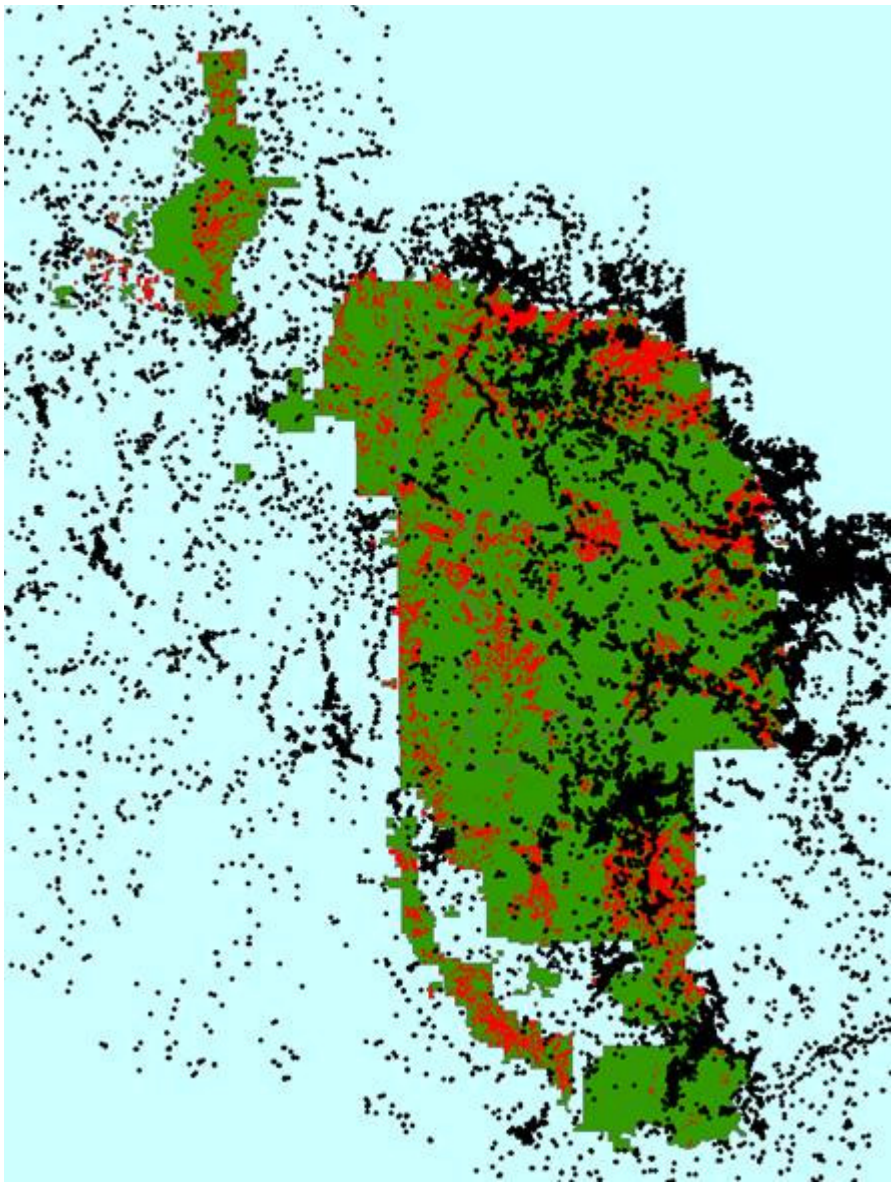
Values at Risk

The Healthy Forests Restoration Act contains two key items relating to community wildfire preparedness. They are the definition of the elements of an *at-risk community* and the establishment of the composition of a community wildfire protection plan. All seven counties that have Black Hills NFS lands within them currently have approved Community Wildfire Protection Plans including: Crook, Weston, Lawrence, Meade, Pennington, Custer and Fall River counties.

1. *At-Risk Community (ARC)* means an area that meets the following conditions:
    - The definition of a wildland urban interface community
    - Includes an environment that is conductive of a large-scale wildland fire
    - Involves a significant threat to human life or property
2. Community Wildfire Protection Plan is a collaborative plan for at-risk communities that:
    - Meets specific standards developed by Wildland Fire Leadership Council and agreed to by applicable federal, state and local government agencies affected by its composition,
    - Identifies and prioritizes areas for hazardous fuel reduction; recommends the types and methods of treatment on Federal and non-Federal land; and includes actions that will protect 1 or more at-risk communities and essential infrastructure, and
    - Includes recommendations to reduce structural ignitability of public and private property throughout the at-risk community.

Values are defined in the forest plan EIS (Appendix E-80) as any or all natural resource improvements, or other values that may be jeopardized if a fire occurs. There are 56 at-risk communities located within the Pine Beetle Response project. To further assess the level of wildfire risk for each community, buffer zones were created at distances of one half, one, two, and three miles around each community and supported through Community Wildfire Protections Plans (Figure 3-9). Based on Mead County Data from 2004 and 2011 data for Crook, Weston, Lawrence, Pennington, Custer and Fall River Counties there are approximately 27,301 structures within 3 miles of the project area under alternative C and 27,267 structures within 3 miles of the project area under alternative B.

Figure 3-9 Structures within 3 Miles of Project Area



Additional values at risk include commercial timber stands, public water supplies, power lines, communication sites (cell towers, radio towers, etc), recreational sites/facilities, range improvements, (fences and spring developments) investments in timber stand improvement and reforestation, wildlife habitat, including snags, forage, riparian areas, security cover, and mid to late seral ponderosa pine stands, sensitive species, as well as water, air and visual quality

Fire Hazard

Fire hazard is defined as a fuel complex that determines the ease of ignition and the resistance to control. Hazard is an expression of what kind of fire may potentially occur and how it affects human values. The fire hazard rating increases as the amount and continuity of surface and canopy fuels increases. As the amount of fuel on a given landscape increases and fuel profiles become more horizontally and vertically continuous, the intensity of a wildfire in that landscape

is expected to increase. Areas with high fire hazard rating have the potential to exhibit more extreme fire behavior with more severe effects than those with a low hazard rating.

A detailed examination of the Hazard rating is best accomplished by reviewing known data regarding the arrangement of the vegetation, or structural stage. The structural stage gives an indication of the current fire hazard and is a stand level rating of crown fire susceptibility. Phase II quantifies fire hazard in relationship to structural stage. Because the proposed treatment areas are in Habitat Structural Stages 3B, 3C, 4B and 4C, the entire projected are has a fire hazard rating of High or Very High based again, on existing structural stages.

Continuous aerial fuels, combined with steep and broken terrain, create the environment for a potentially fast moving stand replacing fire. Direct experience has shown that continuous stands of ponderosa pine can easily support sustained runs of crown fire, either day or night, given the correct weather conditions. High fire severity is a real danger to the existing forest resources but the real danger is to life safety. Rapidly moving fire can easily cut off escape routes for the public and emergency services.

Few studies have been done on MPB, ponderosa pine, tree mortality, and fire. Consequently, we do not have a firm research basis on which to draw conclusions, anecdotal evidence and field experience is currently the best way to draw conclusions. Insect Hazard closely correlates with Fire Hazard Ratings and structural stages previously mentioned. One year post infestation, a ponderosa pine's needles will begin to fade and ultimately turn rust red by season's end, (Hopkins 1905). A fading (dying) or "red top" (dead) ponderosa pine might more easily support the transition from a surface fire to the crowns due to the lack of foliar moisture present within the needles (given the correct weather conditions). The potential for crown fire may increase for this relatively short time while the needles are still attached to the tree. Needles fall from the dead tree in as little as six months or as long as two years depending on weather factors. The fire hazard, as defined by structural stage, would reduce dramatically due to the lack of crowns. With less vegetative cover, sites would become dryer due to increased solar insolation and surface winds. Grasses and forbes would soon begin to be the dominant vegetation. These fine fuels could become the carrier of fire depending on weather conditions, potentially increasing rates of spread. Within five years, 70-95% of the dead trees would fall to the ground (Schmid et al. 2009). The fuel profile has now changed dramatically. The potential for crown fire would disappear in areas severely affected by the MPB. However, fuel continuity would remain albeit different. Surface fuel loadings would go from a typical fuel model 9 (needle cast) at approximately four tons per acre to fuel model 10 (heavy surface fuels) at approximately 15 tons per acre (Anderson 1982) with grasses mixed in. A fire passing through this fuel model would be resistant to control due to higher fireline intensities, flame lengths exceeding four feet (flame lengths greater than four feet require mechanized equipment) and spotting from fire brands. Resulting damage to residual trees, regeneration, and soils would most likely be severe. Direct experience with prescribed fire in fuel model 10 has shown that even under moderate conditions, care must be taken to prevent tree torching (fire transitioning from the surface to the crowns of individual or small groups of trees) and crown scorch (crowns being damaged from convective heat release), both of which can result in mortality of young and mature trees. With increased sunlight and less competition, natural pine regeneration will again to take hold and changing the fuel model once again.

Air Quality

Air quality within the Black Hills National Forest is addressed in the Final Environmental Impact Statement for the 1997 Revised Forest Plan. Overall, air quality within the Black Hills National Forest is very good. Air quality is better than national ambient air quality standards (NAAQS) for all pollutants.

There are two recognized Class 1 airsheds in the Black Hills area, Wind Cave and Badlands National Parks. Wind Cave is located adjacent to the Black Hills National Forest to the southeast, and Badlands is located approximately 75 miles east of the Forest.

A solid working relationship exists between the Black Hills National Forest and the South Dakota Department of Environment and Natural Resources. There have been few if any problems identified and communicated to the Black Hills National Forest regarding negative impacts to air quality relating to prescribed fire activity on the Black Hills National Forest in the last 10 years. The only case of known impacts was a short term event that lasted less than two hours.

The Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS), in compliance with the Clean Air Act. EPA established primary standards to protect public health; and secondary standards to protect public welfare.

EPA established NAAQS primary and secondary standards for six principal pollutants. Of these "criteria" pollutants, one, particulate matter less than 2.5 microns in size ($PM_{2.5}$) is a primary component of smoke emissions from wildland fires including prescribed fires. The primary standard for $PM_{2.5}$ is 15.0 micrograms/cubic meter of air ($\mu g/m^3$). This means that the 3-year average of the weighted annual mean concentration measured at established monitoring stations must not exceed this level. EPA established the secondary standard as equal to the primary standard.

Data from four monitoring stations in the South Dakota portion of the Black Hills are reported for $PM_{2.5}$ on EPA's Airtrends website (http://www.epa.gov/airtrends/). One of these sites meets minimum trends completeness criteria. This site is located in Jackson County, near Badlands National Monument, some 90 miles east of the town of Custer. The other three sites record data but do not meet the minimum trends completeness criteria.

Between 2000 and 2009, monitoring stations in Custer, Jackson and Meade Counties in South Dakota showed $PM_{2.5}$ concentrations at or slightly above 5 $\mu g/m^3$, based on seasonally-weighted annual averages. Measurements in 2001 and 2003 at the Rapid City monitoring station showed levels of about 8 $\mu g/m^3$. No other measurements were recorded for that site, and no measurements after 2009 were recorded for any of the four sites. These measurements are well below the national average for $PM_{2.5}$ concentrations, and are also well below the primary and secondary standards for this criteria pollutant.

Air pollution in the form of PM_{10}, particulate matter smaller than 10 microns diameter, was at one time an issue in the Rapid City area. The 1996 Forest Plan EIS notes that the Rapid City area had been classified as an area not attaining the NAAQS for PM_{10} particulates. In September 2005, the State of South Dakota, Department of Environment and Natural Resources, petitioned the U.S. Environmental Protection Agency (EPA) requesting that the Rapid City area be re-

designated from unclassifiable to attainment status for the PM_{10} standard. EPA published a proposed rule in the Federal Register on December 9, 2005, soliciting public comment on the proposal (70FR73183). On March 6, 2006, the EPA published a final rule approving the request from the State of South Dakota (71FR11162). The approval was based on the State's demonstration that the Rapid City area was in attainment of the PM_{10} national standard, and commitment to continuation of fugitive dust controls. The Rapid City area was officially re-designated from unclassified to attainment status for PM_{10} effective April 5, 2006.

The project area is in the vicinity of two Class 1 airsheds; Badlands National Park and Wind Cave National Park and several communities at risk (Figure 6). The project area is designated as a Class II area allowing higher concentrations of pollutants than the Class I Airsheds. Smoke generated by wildfire is usually greater and cannot be mitigated; however, smoke generated under controlled conditions can be mitigated using the following means:

- Limit treatment area size
- Specify wind directions and speed
- Specify minimum mixing heights
- Stagger ignitions

These design criteria techniques in addition to other control methods for smoke management minimize the impacts of smoke to visibility and human health.

Recommendations for Treatment

The following recommendations are designed to change the fire behavior for wildfire that might occur within the Pine Beetle Response project area. By changing fire behavior we hope to decrease the risk to life, property and natural resources in the At-Risk Communities defined in Phase II and the WUI areas within and adjacent to the project area. These recommendations are designed to reduce fuel loading with treatments including both mechanical methods and prescribed fire treatments that are focused on pile burning that will have a beneficial impact to mitigating fuels loading and subsequent fire behavior providing for increased access and egress issues for the public and emergency responders.

Commercial timber harvest would remove overstory trees to approximately 60 basal area. The cut trees would be whole tree yarded to a landing for limbing, processing and hauling. Limbs and unmerchantable portions of logs should be piled at landings and removed as fuelwood, chipped or burned in place. In areas where commercial thinning is deferred, understory fuels adjacent to private property should be treated by mechanical means.

Prescribed fire applied as a broadcast burn to include areas outside of pile burning was considered but dropped from consideration as a recommended treatment due to the highly fractured nature of stands that make up the project area. The project area stands are based on current structural stages and do not lend themselves to safe and effective prescribed burn unit layout. In many cases, the stand boundaries are mid-slope which presents prescribed fire practitioners with unacceptable risk in both firing and holding operations.

Desired Conditions

The desired condition in the Pine Beetle Response project emphasizes reducing fire hazard by focusing on reducing fuels that could lead to crown fire in stands not yet heavily impacted by mountain pine beetle activity. Crown fire hazard is not separate from fire hazard, but is a key

component of fire hazard, especially in WUI areas. In addition, the correlation between beetle hazard and crown fire hazard in strong, stands that have a high crown fire hazard in most cases also are at high risk from MPB activity. The project design would use a combination of treatments to reduce hazardous fuels thus reducing current fire hazard ratings consistent with Land and Resource Management Report (LRMP) Objective 10-01 (to manage for 50%-75% moderate to low fire hazard within the wildland urban interface. Fuels are to be treated around all non-National Forest lands to meet standards set by National Fire Protection Association (NFPA) 1144: Protection of Life and Property from Wildfire. This is consistent with Goal 10, LRMP, Phase II.

Treatments would be designed to protect hazards identified above. Treatments would be designed to break up the continuity of both surface fuel loading and vertical structure thus creating a mosaic pattern. This pattern will be especially critical in reducing the threat of a large scale stand replacement fire. Residual crown spacing should provide open space between trees thus reducing the likelihood of a crown fire's ability to sustain itself. Treatments resulting in denser tree spacing should be isolated by stands of thinner trees to limit crown fire potential. Treatments should also be placed adjacent to natural barriers such as meadows and non-coniferous stands to maximize the effectiveness of barriers and allow for increased tactical fire management opportunities.

Environmental Consequences

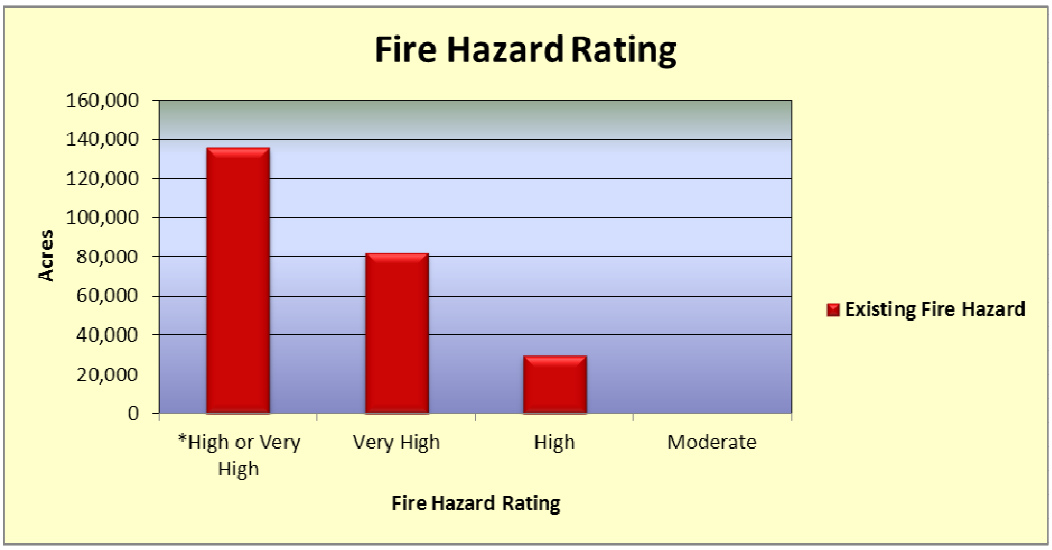
Alternative A - No Action

The no action alternative assumes that no change in management would occur within the project area. Management actions currently being practiced, including fire suppression would continue to be practiced. The only other changes that would occur on the landscape would be those that occur as a result of natural occurrences including Mountain Pine Beetle activity and wildland fire or those resulting from other project decisions.

Direct and Indirect Effects

The current mountain pine beetle outbreak is expected to run its course with much of the area possibly being heavily impacted by 2019. Changes to the fire hazard within the project area are expected resulting in substantial areas of dead trees. Based on personal observation, trees that die as a result of MPB infestation begin falling within 1 to 3 years. (USDA, Forest Service, 2009). In addition, within 3-5 years following beetle caused mortality 70%-90% of a stand are expected to be on the ground (Schmidt et al. 2009)

Figure 3-10 Alternative A Fire Hazard Rating



*High or Very High is dependent on diameter of trees in the stand.

Under the No Action alternative, limited vegetative management would take place. Change towards desired conditions as outlined in the Forest Plan would not occur. Objectives presented by the Healthy Forests Restoration Act, National Fire Plan, and the affected County Wildfire Protection Plans would not be met.

Fire risk would also increase with more people and resulting infrastructure moving in the WUI. As fire hazard and risk increase, the potential for a large stand replacing fire event would become more likely. Continuous stands of ponderosa pine would become denser and opportunity for human caused wildfires would increase. Damage to forest resources would correspond with fire size, intensity, and severity. Values-at-Risk in the WUI would also be threatened to a higher degree. The threat to life safety of the public and emergency services would also become more of an issue. The ability to safely engage a fire during high fire danger would become more difficult as time passes.

The continuing MPB epidemic would expand in the project area. Crown fire potential could increase in the short term with dry red needles versus green. A more likely scenario would be large areas of living trees transitioning to areas of substantial down woody debris over a three to five year period. Though the fuel profile and composition would change, the condition class of FRCC3 would not. This material would add to an already existing available fuel bed. Fire in this type of fuel model can result in severe fire effects as well as being highly resistant to control due increased receptive fuel beds increasing spotting potential. Residual trees, regeneration, and soils would be greatly impacted. Regenerating ponderosa pine would most likely be prolific. Areas with thick growth of pine regeneration would undergo yet another fuel type change. The areas of down woody debris, Fuel Model 10, could transition to areas that would burn more a like a shrub fuel model. When ponderosa pine regenerates itself in the Black Hills, it often grows like “dog hair” (overstocked with saplings) and can burn like a shrub. Fire intensity and rate of spread in this model are potentially very high and resistant to control. The ultimate result in many areas would most likely be of even-aged, dense stands of ponderosa pine creating the environment prime for large severe fires and MPB outbreaks. When untreated stands are impacted by MPB and deteriorate

to where surface fuel loading may be in excess of 40-50 tons per acre, coupled with future prolific regeneration increased fire potential may exist well into the future.

Although air quality would not be directly impacted under the no action alternative, there would not be any control over the timing or amount of emissions released into adjacent airsheds in the event of a wildfire. A large wildfire has the potential to make a much greater impact on adjacent communities and Type 1 airsheds, possibly exceeding National Air Quality Standards. The EPA addresses smoke from wildland fire under their natural events policy at http://www.epa.gov/ttn/caaa/t1/ memoranda/nepol.pdf (Phase II Amendment USDA Forest Service, 2005g).

Alternative B

Alternative B is designed to reduce the threat from recently detected infestations of MPB in high risk stands. Infested trees would be treated before the beetles disperse to other trees (stands). Some surrounding (non-infested) trees at risk of infestation may also be thinned to reduce stand densities and the associated threat to ecosystem components, including forest resources, from the existing (mountain pine beetle) epidemic and reduce the potential for large-scale wildfire.

Alternative B proposes approximately 41,140 acres of commercial and approximately 7,260 acres of non-commercial (POL) thinning over an approximate five to seven year period to remove MPB infested trees and associated trees to lower mountain pine beetle risk and wildfire hazard. Follow up treatments in the form of pile burning of non-merchantable material would be implemented in order to further reduce available biomass that could contribute to future wildland fires both crown fire and surface fire.

Commercial treatments are expected to result in an approximate 50-60 basal area (BA). These treatments are expected to reduce stand susceptibility to mountain pine beetles, as well as reducing the threat of crown fire initiation and spread. Non-Commercial thinning is also expected to result in reduced fire potential.

Direct and Indirect Effects

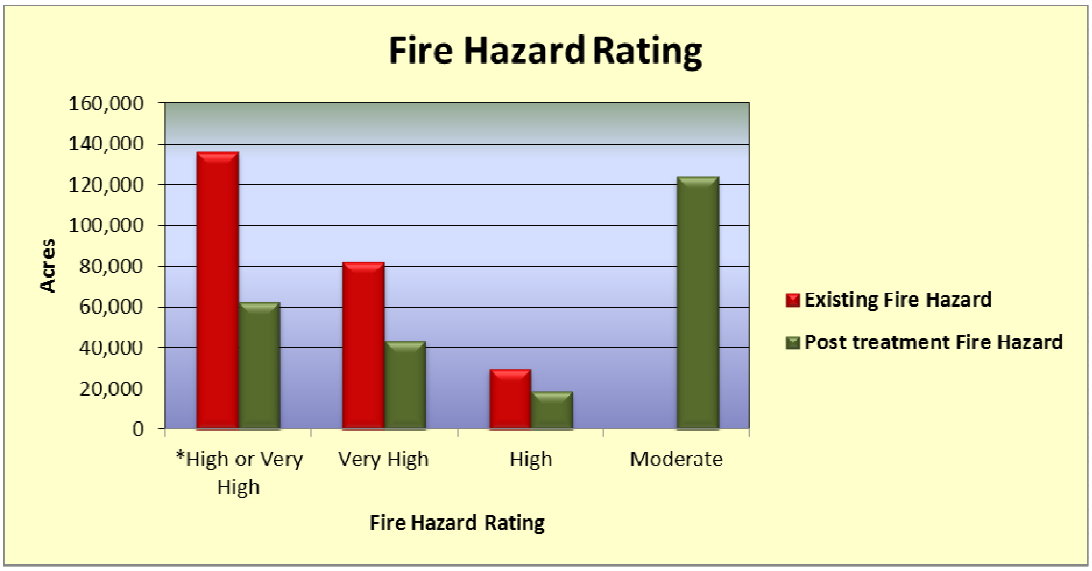
Treatments proposed under Alternative B are expected to result in a reduced MPB generated fuels and fire risk by reducing canopy cover. Resultant fire behavior post treatment is expected to be a fire behavior of low to mixed severity surface fire with isolated pockets of group torching, specifically in areas that have been whole tree harvested. The post treatment expected fire behavior is expected to provide less risk to the firefighter, public and developments. In addition a change in FRCC can be expected to move from a FRCC 3 to a FRCC 2.

Table 3-28 Existing and Alternative B Post Treatment Structural Stage and Fire Hazard Rating

Existing Structural Stage and Fire Hazard Rating	Post Treatment Structural Stage and Fire Hazard Rating	Approximate Percentage of Project Area
29,800 3B (High)	25,444 3B (High)	10.0%
	4,356 3A (Moderate)	1.7%
16,332 3C (Very High)	13,428 3C (Very High)	5.4%
	2,904 3A (Moderate)	1.2%
136,000 4B (High or Very High)	2,880 2 (Moderate)	1.2%
	25,919 4A (Moderate)	10.5%
	107,201 4B (High or Very High)	43.2%
66,300 4C (Very High)	1,234 2 (Moderate)	.5%
	11,107 4A (Moderate)	4.5%
	53,959 4C (Very High)	21.8%
TOTAL: 248,000 Acres	**248,000 Acres**	**100%**

*Assumed that post-treatment SS 4A will have trees greater than 9" DBH resulting in a Moderate Fire Hazard Rating.

Figure 3-11 Alternative B Fire Hazard Rating



*High or Very High is dependent on diameter of trees in the stand.

During pile burning activities, the main pollutants that would be emitted include: $PM_{2.5}$, PM_{10}, carbon monoxide and volatile organic compounds. PM_{10} emissions may also be present resulting from logging operations, log hauling and road construction/reconstruction or rehabilitation. During pile burning activities, the main pollutants that would be emitted include: $PM_{2.5}$, activities.

Smoke generated from pile burning may affect visibility and air quality, and may be noticed by nearby residents, recreational users, and adjacent communities and perhaps in sensitive areas such as the Class 1 airsheds in Wind Cave or Badlands National Parks depending on transport wind direction and mixing heights. Of the six criteria air pollutants identified by the EPA, particulate matter with diameters less than 2.5 microns ($PM_{2.5}$) is the pollutant of greatest concern from pile burning activities. Most of the mass of wildfire smoke (80-90%) falls into the $PM_{2.5}$ classification. A 1997 amendment to the Clean Air Act established a national goal of prevention of any future and remedying of any existing impairment of visibility in mandatory Class 1 federal areas where impairments result from human caused pollution.

Pile burning operations would result in short-term emissions to the atmosphere. Dust may also be generated through timber harvest activities including log hauling and road construction or reconstruction, adding fine particulate emissions locally. Due to the generally intensity of pile burning activities, fuel consumption is expected to be lower and overall emissions would be lower than those expected from a high intensity wildfire because significant biomass will be utilized as part of commercial harvest activities.

Any pile burning is subject to prescriptive elements as defined in an approved Prescribed Fire Plan. These prescriptive elements may include mixing height, transport windspeed and direction as well as the adjective smoke dispersal forecast. Monitoring of potential smoke impacts occurs at different levels during pile burning activities and may include on-site air monitoring stations, ocular estimation of visual smoke impacts or referencing of air monitoring sites at Wind Cave or Badlands National Parks or the monitoring site in Rapid City, SD. Secondly, the prescribed burn

planning process itself incorporates the Interagency Prescribed Fire Planning and Implementation Procedures Guide (July 2008) and undergoes technical review prior to Line Officer review and approval. Potential short-term effects will be minimized by project design criteria and by following applicable smoke permit conditions identified in the appropriate State Implementation plans. Public notification procedures prior to initiating a prescribed fire project will be specified in the approved burn plan.

This alternative would meet the Forest Plan Goal 10 by establishing and maintaining a mosaic of vegetative conditions to reduce occurrences of large-scale, high intensity fire, insect, and disease events, and facilitate insect and disease management and firefighting capabilities.

Alternative C

Alternative C was developed in response to public comments received during the scoping period. The alternative is a more proactive response to the purpose and need for action. Specifically, it responds to concerns about not treating more 'high risk' stands on a landscape basis, treating in advance of MPB, and addresses concerns about safety and access on roadways (ingress/egress).

Alternative C includes all aspects of Alternative B (Proposed Action). Integrated Pest Management techniques would occur on portions of approximately 248,000 acres to reduce the spread of MPB across NFS lands to manage and protect ecosystem components.

Alternative C proposes approximately 105,400 acres of commercial and approximately 18,600 acres of non-commercial (POL) thinning over an approximate five to seven year period to remove MPB infested trees to lower mountain pine beetle risk and wildfire hazard.

Commercial treatments are expected to result in an approximate 50-60 basal area (BA). These treatments are expected to reduce stand susceptibility to mountain pine beetles, as well as reducing the threat crown fire and MPB generated surface fuels. Non-Commercial thinning is also expected to result in reduced fire intensities.

Direct and Indirect Effects

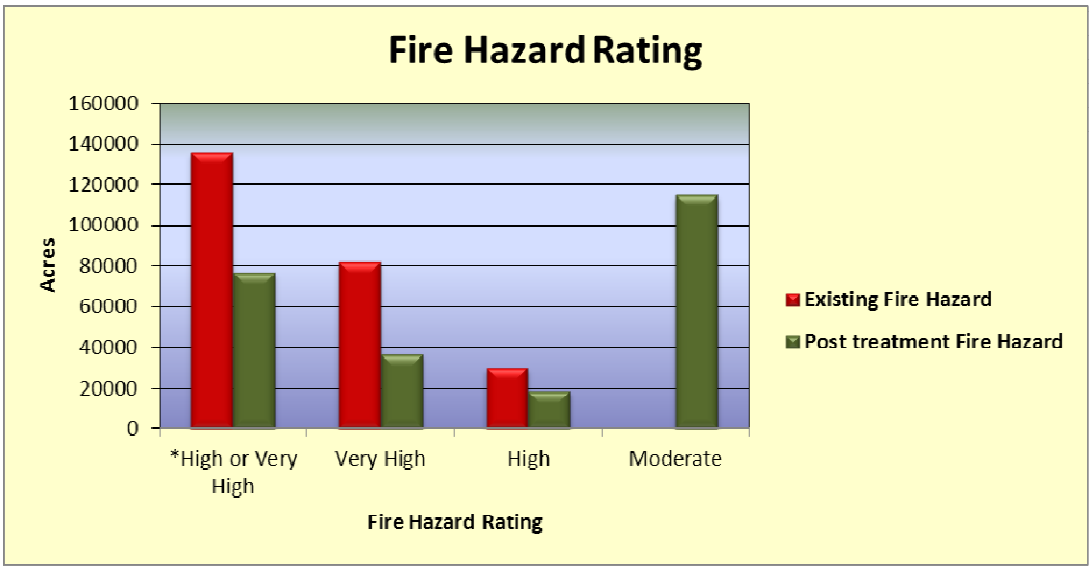
Treatments proposed under Alternative C are expected to result in a reduced risk of crown fire in treated stands by reducing canopy cover and future surface fuel loading resulting from MPB mortality. Resultant fire behavior post treatment are expected to result in fire behavior of low to mixed severity surface fire with isolated pockets of group torching, specifically in areas that have been whole tree harvested. The post treatment expected fire behavior would provide less risk to the firefighter, public and developments by removing available fuels that contribute to resistance to control. With an emphasis on treatments near road that may facilitate improved access/egress in the event of a catastrophic wildfire occurrence, risk to the public may be less than in Alternative B and the no action alternative. In addition a change in FRCC would move from a FRCC 3 to a FRCC 2.

Table 3-29 Existing and Alternative C Post Treatment Structural Stage and Fire Hazard Rating

Existing Structural Stage and Fire Hazard Rating	Post Treatment Structural Stage And Fire Hazard Rating	Approximate Percentage of Project Area
29,800 3B (High)	18,640 3B (High)	7.5%
	11,160 3A (Moderate)	4.5%
16,100 3C (Very High)	8,892 3C (Very High)	3.6%
	7,440 3A (Moderate)	3.0%
136,000 4B (High or Very High)	7,378 2 (Moderate)	2.9%
	66,202 4A (Moderate)	26.7%
	62,420 4B (High or Very High)	25.2%
66,100 4C (Very High)	3,162 2 (Moderate)	1.2%
	28,338 4A (Moderate)	11.4%
	34,600 4C (Very High)	14.0%
TOTAL: 248,000 Acres	**248,000 Acres**	**100%**

*Assume that post-treatment SS 4A will have trees greater than 9" DBH resulting in a Moderate Fire Hazard Rating.

Figure 3-12 Alternative C Fire Hazard Rating



*High or Very High is dependent on diameter of trees in the stand.

During pile burning activities, the main pollutants that would be emitted include: $PM_{2.5}$, PM_{10}, carbon monoxide and volatile organic compounds. PM_{10} emissions may also be present resulting from logging operations, log hauling and road construction/reconstruction or rehabilitation. During pile burning activities, the main pollutants that would be emitted include: $PM_{2.5}$, activities.

Smoke generated from pile burning may affect visibility and air quality, and may be noticed by nearby residents, recreational users, adjacent communities and perhaps in sensitive areas such as the Class 1 airsheds in Wind Cave or Badlands National Parks depending on transport wind direction and mixing heights. Of the six criteria air pollutants identified by the EPA, particulate matter with diameters less than 2.5 microns ($PM_{2.5}$) is the pollutant of greatest concern from pile

burning activities. Most of the mass of wildfire smoke (80-90%) falls into the $PM_{2.5}$ classification. A 1997 amendment to the Clean Air Act established a national goal of prevention of any future and remedying of any existing impairment of visibility in mandatory Class 1 federal areas where impairments result from human caused pollution.

Pile burning operations would result in short-term emissions to the atmosphere. Dust may also be generated through timber harvest activities including log hauling and road construction or reconstruction, adding fine particulate emissions locally. Due to the generally intensity of pile burning activities, fuel consumption is expected to be lower and overall emissions would be lower than those expected from a high intensity wildfire because significant biomass will be utilized as part of commercial harvest activities.

Any pile burning is subject to prescriptive elements as defined in an approved Prescribed Fire Plan. These prescriptive elements may include mixing height, transport windspeed and direction as well as the adjective smoke dispersal forecast. Monitoring of potential smoke impacts occurs at different levels during pile burning activities and may include on-site air monitoring stations, ocular estimation of visual smoke impacts or referencing of air monitoring sites at Wind Cave or Badlands National Parks or the monitoring site in Rapid City, SD. Secondly, the prescribed burn planning process itself incorporates the Interagency Prescribed Fire Planning and Implementation Procedures Guide (July 2008) and undergoes technical review prior to Line Officer review and approval. Potential short-term effects will be minimized by project design criteria and by following applicable smoke permit conditions identified in the appropriate State Implementation plans. Public notification procedures prior to initiating a prescribed fire project will be specified in the approved burn plan.

This alternative would meet the Forest Plan Goal 10 by establishing and maintaining a mosaic of vegetative conditions to reduce occurrences of large-scale, high intensity fire, insect, and disease events, and facilitate insect and disease management and firefighting capabilities.

Cumulative Effects for All Alternatives

In the Mountain Pine Beetle Response Project area past, present and reasonably foreseeable future actions as well as the MPB and past drought contribute to changes in fuel conditions and profiles. Past management activities may have created situations that could have increase and/or decreased the risk of large scale high intensity wildland fires. For example, wildfire suppression can lead to an accumulation in down and dead fuels, increased stocking levels and an increase in ladder fuels which all lead to an increase in fire hazard.. Had fires been allowed to spread across the landscape unchecked, instead of aggressive fire suppression over the last 100 years, stands would have burned at more frequent interval with expected lower intensities. This however has not been possible due to fractured ownership patterns that include interspersed private lands and at risk communities. Fuel conditions of today, favor wildfires of increased intensities.

There are numerous examples of past, present and foreseeable management activities across the forest and adjacent to the project area that have helped to reduce the fire hazard. These include the Prairie Project, Bugtown Timber Sale and many others.

Vegetative treatments identified on state and private lands within the cumulative affects area may serve to reduce and fire hazard from both crow fire and surface fire. In areas not being treated, the potential for sustained crown fire and expected fireline intensities can be reasonably expected to increase. These fuel conditions and expected fire behavior may result in forest fire suppression to not be met under certain weather conditions.

Wildland fires occurring outside of the potential treatment areas may also affect the project area under the right conditions. There are examples of fires making sustained, high intensity crown fire runs, some of these runs are estimated at nearly 12 miles (Jasper 2000). Although rare and requiring extreme conditions, a large scale, high intensity fire is more likely if no treatment is implemented. A fire starting in the project area under favorable conditions, would not only damage or destroy improvements within a given stand, but could have the potential to burn into or affect one of the 56 At-Risk Communities or private property within a fairly short time frame. A high intensity wildfire brings with it numerous risks and effects. Homes in the path of a wildfire are perhaps the most immediately recognized value at risk, however, severe wildfires put the numerous other important values at risk including: critical infrastructure, fish and wildlife habitat, firefighter and public health and safety, soil productivity, clean air, and functional fire-adapted ecosystems (Graham et al., 2004). Some of these values are also threatened by the secondary effects of wildfire, such as soil erosion, and the spread of exotic species (Graham et al., 2004).

Action alternatives are expected to have positive long term cumulative effects to both overstory and surface fuel loading and potential fire behavior. The proposed treatment combined with monitoring and foreseeable future projects would decrease the potential of large-scale, high intensity damage of wildfire as well as decrease fuel loading moving the project area to a more desirable condition. The proposed treatments would reduce stand density and canopy closure bringing the forest back to a more historical type condition. Adjacent area projects would also have an impact.

The smoke and other emissions that may be generated by activities planned under the selected alternative may contribute to local and regional pollutant loading. The cumulative effect of pile burning activities or other planned land management activities would be short-lived and once smoke and/or dust has dissipated, the impact is over and will have no further overlap in time or space with other pollutants that are generated by non-Forest Service activities. As a result, planned land management activities (including pile burning) are not expected to have long term or significant impacts to National Ambient Air Quality Standards throughout all alternatives and should not contribute to significant future impairments of visibility in Class 1 airsheds.

Approved burn plans for pile burning use design criteria. These design criteria have proven effective over the last ten years in maintaining smoke emissions at acceptable levels, as demonstrated by State monitoring which has shown only one temporary violation of $PM_{2.5}$ standards at the monitoring site in Rapid City that may have resulted from prescribed fire activity on the Black Hills National Forest. These design criteria have been shown to be effective and the same criteria can be expected to be effective under the action alternatives for this project.

Summary of Effects

Forest vegetative and fuels conditions in the Mountain Pine Beetle Response project area would continue to deviate from their historic range under Alternative A (No Action). With the expanding

MPB epidemic, large amounts of dead, dry fuels will be added to an already serious wildfire hazard. Currently 100% of the project area is rated at a high or very high wildfire hazard and this hazard will continue to increase if no action is taken to modify or treat the fuels. The end result could be high intensity wildfire over much of the project area that would remove much of the existing forest cover. This could cause significant negative effects to the ecosystem, area infrastructure, public and private lands, and threaten the lives of residents and firefighters.

Treatments planned in Alternatives B and C would help reduce the potential for a severe wildfire by moving the forest closer to a Condition Class 1 or 2 - i.e., conditions more closely approaching the natural (historical) range of variability of vegetation characteristics; fuel composition; wildfire frequency, severity and pattern; and other associated disturbances. This would be accomplished by thinning the ponderosa pine forest, removing or treating some of the surface fuels by pile burning.

Alternative C, followed by Alternative B, would have the greatest effect on reducing fire hazards. Both alternatives would treat the forest and manage the forest to a lower stand density. Treatments would be implemented on a landscape basis and designed so that they would complement existing or natural fuelbreak features such as hardwood stands, meadows, private land pastures, and moister habitats.

Fire Hazard is expected to be reduced significantly with Alternatives B and C, but conditions change quickly in a Fire Regime I forest, and fire hazard will eventually escalate post-treatment as the vegetation grows and the detritus once again accumulates. However, the fire hazard in twenty years is expected to be much lower with Alternative C or B than the no action alternative.

Table 3-30 Fire Hazard Rating Summary

Fire Hazard Rating	Alternative B		Alternative C	
	Acres	%	Acres	%
Low	0	0	0	0
Moderate	48,400	20%	124,000	50%
High/Very High	199,600	80%	124,000	50%

Air quality would be affected by both alternative B and C. Smoke generated by pile burning can be mitigated using the methods identified in Alternative B and C. Smoke generated by wildfire is usually greater and cannot be mitigated.

All action alternatives would meet the Forest Plan Goal 10 of establishing and maintaining a mosaic of vegetative conditions to reduce occurrences of catastrophic fire, insect, and disease events, and facilitate insect and disease management and firefighting capabilities, and Standard 4103, utilizing prescribed fire to achieve management objectives.

It is important to understand that fuel treatments would not prevent wildland fires from occurring. However, with fuel treatments, the risk of an extreme wildfire event would be greatly decreased. Fuel treatments would also need to occur in adjacent planning areas in order for treatments to be more effective over a landscape scale.

RANGE

Introduction

The Black Hills is a highly productive area from the standpoint of forage resources with an average of approximately 466 million pounds of forage produced across the Forest each year. At an average proper-use level of 50 percent, up to 233 million pounds of forage is available for harvest each year by livestock and wildlife (USDA Forest Service 1996d). Table 3-31 displays the allotment acres and improvements within the MPBR project.

Affected Environment

Table 3-31 Grazing Allotments and Developments within the MPBR Project Area

	Bearlodge	Hell Canyon	Mystic	Northern Hills	Forest
Allotments	22	40	24	27	113
Acres Alt B	31,571	90,318	42,482	67,997	232,368
Acres Alt C	31,571	90,318	42,482	73,499	237,871
Fence Miles	20	70	46	24	160*
Water Tank**	14	16	7	8	45
Storage Tank	5	9	2	2	18
Pond	12	76	20	1	109
Spring	11	11	9	9	40
Well	0	2	0	0	2
Total Water Developments					214
Pipeline Miles	.13	5.36	0.96	.98	7

*There is an additional 4 tenth of a mile of fence in Alternative C over B
** The number of water developments does not change between Alternatives nor does the length of pipelines.

The MPBR Area contains all or portions of 113 different grazing allotments and approximately 232,368 acres in Alternative B with an additional 5,503 acres included in Alternative C inside those allotments (see Appendix A for details). There are also, approximately 160 miles of fence, 214 water developments and approximately 7 miles of pipelines within the project area (see Appendix B for details). See Table 3-31 above for a breakdown by Ranger District for Acres, miles of fence and type and number of water development. Acreage derived from Geographic Information System (GIS) data is approximate.

Environmental Consequences

Alternative A - Direct/Indirect Effects

Term permitted grazing use would continue as authorized. No new vegetative treatments are planned except for those projects derived from previously approved environmental analysis. There would be no change in carrying capacity (Animal Unit Months (AUMs)) from Alternative A's

implementation. Range structures would be maintained and improved as necessary to continue cattle management at its current scope and intensity, subject to forest-wide standards and guidelines.

The current transportation system in Alternative A remains unchanged. Open and seasonally open motorized road miles remain unchanged. No roads are identified for decommissioning, and all routes remain in place. Permittees would continue to be provided administrative access to conduct range management activities (USDA Forest Service. 2010a). Past development of the transportation system from old timber sales has improved the access of permittees to manage their cattle and maintain or construct range improvements such as fences or water developments.

Meadows and hardwood stands would continue to be subject to conifer encroachment, and their individual size and landscape spread reduced in acreage and location. These reductions would continue unless some type of mechanical treatment action or wildfire of sufficient magnitude occurred. Ponderosa pine trees would continue to be infected and die from the mountain pine beetle infestation. Most of these dead trees eventually break up or fall over the next three to five years, often at accelerated rates with high winds (USDA Forest Service. 2010b). Historically, such tree breakage and wind throw has been shown to impede cattle access to primary and secondary rangelands. Fences and other developments could be damaged by falling trees and pasture rotations could be altered by damage and/or downfall blocking historic trails. Large areas are opened up to sunlight, and a variety of plants would appear including forbs, grasses, shrubs and invasive species. Tree downfall can block cattle access and the increased amounts of fine fuel growth are not grazed by domestic livestock.

Cumulative Effects

There are no additional anticipated cumulative effects that would impair or unduly influence short-term range management of the allotments within the MPBR Project Area other than effects discussed above, if Alternative A was selected. The current NEPA documents and the AMPs would indicate direction to be followed to improve or sustain desired range conditions and capacity. However, there are emerging threats to sustainable cattle grazing. The encroachment of woody vegetation on grazeable areas reduces available forage and potentially cuts back carrying capacity over time. Also the increased fuel load of pine-killed stands creates the potential for more forest fires that are larger, more intense and less predictable (Canada 2007). Any ignition may disrupt grazing use for some period of time to allow for resource recovery. Experience with large scale wildfires on the Black Hills have demonstrated that remaining black stems of trees that are not harvested would decay, fall over, and block access to vegetation by cattle and wildlife.

Alternative B and C - Direct/Indirect Effects Common to both Action Alternatives

The following effects throughout this section would be greater for Alternative C than for B because of the additional acres of vegetative treatment planned if Alternative C were selected. Under both action alternatives, term permitted grazing use would continue as authorized. There would likely be no change in permanent carrying capacity (Animal Unit Months (AUMs) as currently allocated since vegetative openings from treatments would only temporarily increase available forage for livestock. Any changes would be site specific to the allotment and situation and would be made in communication with the permittee. We would expect grazing patterns to change during this increase in forage (Uresk and Severson, 1988). Range structures would be maintained and improved as necessary to continue cattle management at its current scope and

intensity, subject to forest-wide standards and guidelines. Fences would still need brushing to remain open and accessible for repairs and maintenance, but not to the level as in Alternative A since commercial and non-commercial treatments are planned with the action alternatives which would likely clear fence lines to varying degrees. This means there may be slightly lower levels of repairs and maintenance needs with Alternative C when compared to Alternative B. Additional fences may be needed as natural barriers to cattle distribution are opened by mechanical treatments. Fencing and water developments do exist throughout the Project Area that would need protection from commercial and non-commercial treatment activities such as, cable operations, harvest machinery, and skidding. The same improvements would need protection from other proposed activities such as cut and chunk.

Under Alternative C and to a lesser degree Alternative B, large areas are opened up to sunlight, and a variety of plants generally appear, including forbs, grasses, trees, shrubs and invasive species. Aspen suckering when it occurs with the opening of the canopy may need protection for a time to establish. Down trees or jackstrawing, (Blue Valley Ranch 2011) can afford this protection. But, downed trees from tree breakage and wind throw has historically been shown to impede cattle access, movement between pastures, access to primary and secondary rangelands and cause roundup of livestock to be more difficult. This would likely be to a lesser degree than Alternative A. Cattle are more likely in the action alternatives to access more area and therefore reduce more fine fuels focused on the wildland urban interface than in Alternative A.

Proposed vegetative treatments may allow access to and allow congregation of cattle near private land. Private land may be unfenced, fenced but in need of maintenance or reconstruction, thus increasing permittee control needs and aggravating working relationships with nearby neighbors. In contrast, there would be ample adjacent areas with enhanced forage (after thinning and tree removal) to draw cattle away from private property.

Alternative B - Direct/Indirect Effects

There are 48,400 acres of vegetative commercial and non-commercial treatments planned within the 242,000 acre of PTA in this alternative. Alternative B's treatments would affect and increase herbaceous and shrub production over Alternative A since they create canopy openings with less needle cast. Vegetation is mechanically removed. These treatments would allow more sunlight to reach the ground underneath the remaining ponderosa pine trees, and increase production of grasses and browse for cattle and wildlife use. The initial quantity of this vegetation usually increases distribution of cattle throughout the project area (Uresk and Severson, 1988), into primary and secondary rangelands.

No new roads are planned in this alternative but as many as 5% (15 miles) of the existing temporary roads could be converted to system roads. Permittees would continue to be provided administrative access to conduct range management activities (USDA Forest Service. 2010a).

Alternative C - Direct/Indirect Effects

There are 124,000 acres of vegetative commercial and non-commercial treatments planned within the 248,000 acres of PTA in this alternative. Alternative C proposes treating more acres by commercial and non-commercial methods than Alternative B. It is anticipated that possibly more fence may be needed since less natural barriers to cattle spread would be intact after

harvest. These treatments would allow more sunlight to reach the ground underneath the remaining ponderosa pine trees, and increase production of grasses and browse for cattle and wildlife use. Alternative C's treatments would have more effect on total herbaceous and shrub production than Alternative B since more acres are treated, and when also compared to Alternative A. Vegetation is again mechanically removed. These treatments would increase production of grasses and browse for cattle and wildlife use. The initial quantity of this vegetation has been shown to increase distribution of cattle throughout the project area into primary and secondary rangelands (Uresk and Severson, 1988).

New roads are planned (up to 250 miles) in this alternative and as many as 15% (46 miles) of the existing temporary roads could be converted to system roads. The road system is adjusted in this alternative to meet existing and anticipated needs. Total forest road miles are increased to access additional areas and accomplish cable logging. Permittees would continue to be provided administrative access to conduct range management activities (USDA Forest Service. 2010). Road prisms (even if closed after harvest but not obliterated) from Alternative C may allow livestock trailing access previously ungrazed area, but terrain generally too steep for cattle and use is expected to be minimal.

Cumulative Effects for both Action Alternatives

There are no anticipated cumulative effects that would impair or unduly influence short-term range management of the allotments within the Project Area if either Action Alternative were selected. Increased forage production would promote wider distribution of livestock and may improve riparian conditions. Eventually temporary increases in forage production would subside as pine regeneration grows and shades out understory vegetation. The NEPA documents and AMPs associated with the respective allotments would indicate direction to be followed to improve or sustain range condition and capacity. However, there are still threats to cattle grazing such as the risk of large-scale wildfire. Any large acreage ignition may disrupt grazing use and damage or destroy range improvements. A large scale wildfire can also cause dead trees which would decay, fall over, and restrict access to vegetation by cattle and wildlife.

NOXIOUS and INVASIVE WEEDS

Introduction

Noxious weeds are typically non-native plants that adversely affect native plant communities by aggressively competing for nutrients, water, and sunlight (CWMA. 2002). Without treatment and monitoring weeds can quickly get out of hand and be an even larger problem than they currently are. As a result, sensitive plants, forage quantity and quality, and soil stability are negatively impacted. Background information regarding the status of noxious weeds on the Forest is presented in the 1996 Final EIS (USDA Forest Service. 1996b) and the Final Environmental Impact Statement for the Phase II Amendment (USDA Forest Service. 2005g).

Affected Environment

Ground disturbing activities within or adjacent to areas infested by noxious weeds can encourage the establishment and spread of noxious weeds. Canopy opening can also encourage establishment of weeds. Many noxious weeds out compete native and other desirable species because a) they are early successional species, b) they can be allelopathic, c) they produce

abundant seeds, d) they grow rapidly, or e) they have the ability to exploit the soil profile for nutrients and water. Many noxious weed species have no natural enemies and are not palatable to grazing animals (Sheley and Petroff. 1999. p.7). Left untreated, weeds can continue to spread, resulting in establishment of new weed populations in adjacent areas.

The monitoring report for the Black Hills National Forest prepared for the fiscal year 2009 suggested that there are about 180,000 acres of National Forest System land infested by various noxious weeds (USDA Forest Service. 2010b) within the boundaries of the Black Hills National Forest. Within the MPBR project area for Alternative B there are approximately 10,509 acres of known noxious weed infestations and Alternative C known infestations are approximately 10,990 acres (see Table 3-32 for details by species). Acreages derived from Geographic Information System (GIS) data are approximate. Many of the areas in the MPBR Project have not had soil baring or canopy opening disturbance in many years. The acres around these areas that have had disturbance can be more extensive and more heavily infested thus providing a ready seed source. Some areas contain multiple noxious weed species.

Table 3-32 Invasive and Noxious Weeds in the MPBR Project Area

Common Name	Scientific Name	Known Acres in the MPBR Project Area Alt B	Known Acres in the MPBR Project Area Alt C
Canada Thistle	*Cirsium arvense*	5177	5454
Houndstongue	*Cynoglossum officinale*	1948	1959
Common Mullein	*Verbascum thapsus*	1893	1899
Musk Thistle	*Carduus nutans*	680	682
Spotted Knapweed	*Centaurea maculosa*	191	191
Leafy Spurge	*Euphorbia esula*	119	119
Yellow Toadflax	*Linaria vulgaris*	157	159
Common Tansy	*Tanacetum vulgare*	133	227
Henbane	*Hyoscyamus spp*	12	12
St. Johnswort	*Hypericum perforatum*	103	189
Oxeye Daisy	*Chrysantheumum leucanthemum*	92	95
Dalmation Toadflax	*Linaria genistifolia*	3	3
Diffuse Knapweed	*Centaurea diffusa*	1	1
Total weed acres		10,509	10,990

Environmental Consequences

Introduction

Historically, disturbed areas such as roads, skid trails, landings and burn piles have been the area's most susceptible to infestation. A review of timber sales indicates that we can expect approximately 3.0 percent of the total commercially treated acres (USDA Forest Service 1996 p.III-192) in a timber sale to be infested by noxious weeds. As an example if the entire Alternative B's PTA of 242,000 acres had vegetative treatments we could expect more than 7,260 additional acres of weed establishment. For each road, an area including the width of the road and approximately five feet on either side of its running surface is capable of supporting noxious weeds until re-vegetation occurs (USDA Forest Service 1996b). In Alternative C where road construction would take place, new road construction and reconstruction would result in

approximately 0.12 acres of new weed infestation per mile of road. As an example if 50 miles of road were built you would have 6 acres infested because of road work.

The design criteria and mitigation will allow effective management of noxious weeds throughout project implementation. These criteria would meet Forest Plan Objectives 230 and 231 as they relate to control and prevention of noxious weeds. The effects analysis assumes that relevant weed prevention practices would be implemented though with current monetary trends that may be in jeopardy which would allow a much more rapid spread of weeds.

Alternative A - Direct and Indirect Effects
Mature stands of timber are common over the project area; they comprise large contiguous areas of forest that are similar structure. This provides the potential for wildfire and beetle infestation, both of which can play a role in the spread of noxious weeds. When the canopy cover is opened up due to beetle killed trees or wildfire, grass/forb communities may not be able to out compete noxious weeds in areas where infestations already exist. An increase in dead and down trees resulting from beetle kill could increase the potential for wildfires to spread and burn with increased intensity. This could lead to large areas of bare ground on which weeds could become established and compete with more desirable species. This hampers the ability of these communities to recover from intense fires. As a result, these infestations are likely to increase.

Under Alternative A, the existing inventory and treatment of noxious weeds would continue. In areas where bare soil is exposed, opportunities exist for the establishment of new infestations. Roads and trails would continue to be avenues for spread of noxious weeds. Seeds can collect in wheel-wells and grills of off-highway vehicles and may be dispersed as machines travel. Animals would continue to promote the spread of noxious weeds by providing a means of transport.

Cumulative Effects
No disturbance creating activities would occur as a result of the MPBR Project under Alternative A, so there would be no accumulation of effects with past, present or reasonably foreseeable future human actions.

Alternative B and C - Direct and Indirect Effects Common to both Action Alternatives
Noxious weed infestations are expected to increase under both these alternatives as well as the no action (Alternative A). Where there has been some form of soil disturbance or canopy opening, the potential for the establishment of noxious weeds exists. The potential for noxious weed establishment is even greater in disturbed areas adjacent to existing weed populations. The existing roads create a network of corridors through which seed dispersal can occur. Commercial and non-commercial timber harvest activities which may include cable logging, planned in Alternatives B and C through the opening of the canopy and soil disturbance often provide mechanisms for the introduction, establishment, and spread of noxious weeds. The movement of equipment in and out of these areas also facilitates weed establishment. We do not have a good way to predict the estimate of weed spread from the additional proposed actions except to say weeds would likely increase. The cut, piled and burn with equipment would most likely mimic the weed spread to a lesser degree due to soil disturbance of commercial/non-commercial harvest activities. The cut and

chunk, and cut and chip would create opening but would likely have less soil disturbance thus we would likely have a smaller percentage of these area infested.

Alternative B - Direct and Indirect Effects
Alternative B includes approximately 48,400 acres of commercial/non-commercial vegetation treatment within 242,000 acre PTA. All acres in the projects could be affected by cut and chunk, cut and chip, and cut and burn. Slopes less than 40% could be cut, piled and burned using equipment. No new roads are planned in this alternative but as many as 15 miles of the existing temporary roads could be converted to system roads.

The effects of the Proposed Action Alternative B are discussed in "Direct and Indirect Effects Common to both Action Alternatives" above. These effects are in addition to those. No new roads are proposed so no additional weeds would be expected through this work but the conversion of existing temp roads would likely add 2 acres of infestation. With 48,400 acres of commercial/non-commercial vegetation treatment we would expect approximately 1,452 additional acres increase in weeds plus the additional increases caused by other proposed treatments.

Alternative C - Direct and Indirect Effects
Alternative C includes approximately 124,000 acres of commercial/non-commercial vegetation treatment within the 248,000 acre PTA. All acres in the projects could be affected by cut and chunk, cut and chip, and cut and burn. Slopes less than 40% could be cut, piled and burned using equipment. In addition, this alternative proposes the construction both system and temporary, of up to 250 miles of Forest Service roads and as many as 46 miles of the temporary roads could be converted to system roads.

The effects of Alternative C are discussed in "Direct and Indirect Effects Common to both Action Alternatives" above. In addition, construction of roads would create disturbance increasing the likelihood of increased weeds. Roads also create a network of corridors through which seed dispersal can occur. Through the purposed 124,000 acres of commercial/non-commercial vegetation treatment, we would expect approximately 3720 acres increase in weeds. The 296 miles of additional and converted roads would be expected to increase weed acres by another 36 acres. A total of 3,756 acres plus the additional increases caused by other treatments would be expected.

Cumulative Effects
The cumulative effects analysis area for noxious weeds is the Black Hills National Forest. The time period considered for analysis is 20 years total; from 10 years in the past through 10 years into the future.

Previous and foreseeable activities such as timber harvest, off-road vehicle use, road construction and maintenance, and disturbed areas around water resources have resulted in a cumulative effect of infestation by several noxious weed species. Weeds appear to be scattered across the Forest more heavily in the north and central areas than in the southern hills and concentrations are known to exist in certain locations, such as disturbed areas. Activities and effects on private land appear to be much the same as those on National Forest System lands. The recently signed travel management plan for the Black Hills National Forest should reduce the amount of off road travel

that occurs away from designated routes. This should reduce the chances of weed infestations away from the designated travel routes.

Noxious weeds have been and would continue to be treated under previous and ongoing projects. An increase in infested acres would have negative impacts both ecologically and economically. An increase in acres of infestation means a direct increase in cost. Ecologically, noxious weeds indirectly affect wildlife and livestock as they displace native vegetation and reduce the ability of ecosystems to function properly. This impacts mostly grass/forb communities, specifically riparian areas, upland grasslands, and meadows. When these areas become infected with noxious weeds, forage for wildlife and livestock is reduced.

Alternative B or C would be expected to add to known weed infestations. Proposed design criteria and weed treatment would reduce the likelihood of introduction of new species and substantial spread of existing infestations. However, with the level of treatment proposed and probable resulting ground disturbance, weeds are likely to appear in new areas. The persistence of these new and existing infestations depends in large part on availability of funding for treatment.

WILDLIFE

Affected Environment
The effects of each alternative on Threatened, endangered and sensitive species, Management Indicator Species (MIS) and Species of Local Concern are evaluated in this section. The Project Area includes a variety of vegetation cover types and structural stages. These cover types and structural stages provide a diversity of habitat for wildlife within the Project Area. Refer to the Silviculture Section for more information on structural stages and the effects of the alternatives on each.

Snags and Down Woody Material: Snags are an important habitat component for cavity nesting and foraging birds and mammals. The majority of the snags on the Forest are ponderosa pine.

Forest Plan Objective 211 seeks to provide 3 hard snags greater than 9-inch dbh and 25 feet tall per acre, well dispersed across the Forest, 25 percent of which are greater than 14-inch dbh, within a management area in conifer-forested portion of the Forest (USDA-Forest Service 2006g).

Forest Plan Standard 2301 provides direction to retain all snags greater than 20-inch dbh unless they are a safety hazard. If snag densities within a project area are below Objective 211, retain all snags unless they are a safety hazard. If large snags (>14-inch dbh) are not available, retain snags in the largest size class available. This standard does not apply to areas salvaged under Objective 11-03. All soft snags should be retained unless they are a safety hazard (USDA-Forest Service 2006g).

Forest Plan Standard 2308 provides direction to retain and average of at least 50 linear feet per acre of course woody debris with a minimum diameter of 10 inches during vegetation management activities on ponderosa pine forested sites (USDA-Forest Service 2006g).

Wildfires and insect tree mortality result in more than 3 snags per acre greater than nine inches dbh Forest-wide with 23 percent of those being 14 inches dbh or greater (USDA-Forest Service

2010b). According to the most recent data, Management Areas 4.1 and 5.6 exceed Objective 211 (USDA-Forest Service 2010).

Pine beetles and recent fires have created more snags and downed wood in recent years in the project area. Areas where mountain pine beetles (MPB) are evident generally have higher snag and down woody material counts and snag clumping is common.

Riparian Habitat: Riparian habitat is located along the edges of streams. It is the transitional zone between the aquatic habitat and the upland terrestrial habitat. Riparian habitat is important to most terrestrial and aquatic species because of its association with water.

The Forest manages for high quality riparian communities by providing stable stream banks, retaining woody vegetation along streams and lakes, and providing large woody material for aquatic species (USDA-Forest Service 2006, Guideline 3212). The Forest provides riparian habitat diversity through vegetation treatments in conjunction with other habitat improvement activities (USDA-Forest Service 2006, Guideline 3211). In the water influence zone next to perennial and intermittent streams, lakes, and wetlands, only those actions that maintain or improve long-term stream health and riparian ecosystem condition are allowed (USDA-Forest Service 2006, Standard 1301). Long-term ground cover, soil structure, water budgets, and flow patterns in wetlands are maintained to sustain their ecological function, per 404 regulations (USDA-Forest Service 2006, Standard 1302). Log landing, decking areas and mechanical slash piling are prohibited within riparian areas unless the integrity of the riparian area can be protected (USDA-Forest Service 2006, Standard 1306). Vegetative type conversion should only be done in riparian areas to reestablish riparian vegetation for the protection and/or enhancement of those ecosystems (USDA-Forest Service 2006, Guideline 1303).

Management Indicator Species (MIS): The Forest Plan (USDA Forest Service 2006) lists MIS to be considered during project-level planning. All Forest-wide MIS have habitat or populations present within the project area. Some MIS species have other status (such as R2 sensitive), and additional analyses are provided for them in the Biological Assessment/Biological Evaluation (BA/BE). Full analyses and rationale are found in the project record. The MIS species carried forward in this document are:

White-tailed deer (*Odocoileus virginianus*)
Beaver (*Castor Canadensis*)
Black-backed woodpecker (*Picoides acticus*)
Brown creeper (*Certhia Americana*)
Golden-crowned kinglet (*Regulus satrapa*)
Grasshopper sparrow (*Ammodramus savannarum*)
Ruffed grouse (*Bonasa umbellus*)
Song sparrow (*Melospiza melodia*)

Monitoring of MIS is accomplished through coordinated efforts involving US Forest Service biologists, research, contracted monitoring surveys and State agencies. More information on MIS monitoring can be found in the Forest Monitoring and Evaluation Report (USDA-Forest Service 2009, 2010b).

White-tailed Deer: White-tailed deer occur throughout most of the United States and southern Canada and occupy a wide range of habitats. In the Black Hills, they are associated with forested habitat (conifer and hardwood) in close proximity to water (SAIC 2003). White-tailed deer are

mostly migratory in the Black Hills, using lower elevations in winter (Stefanich 1995). White-tailed deer move to low-elevation winter range from October to January, the timing of which depends on snow and forage conditions (Stefanich 1995; Griffin et al. 1999). Wooded draws and pine stands with closed canopies provide thermal cover while agricultural areas and recently logged and open stands with abundant shrubs are important for forage (DePerno et al. 2002). White-tailed deer in the Black Hills require a diversity of habitat types. Juxtaposition between cover and forage is crucial year-round. Hardwood stands, which provide abundant forage combined with screening cover, were best predictors of white-tailed deer diurnal, summer use (Stefanich 1995). Peak use of dense aspen habitats with dense, tall shrub cover indicated importance as fawning habitat in the northern and central Black Hills (DePerno et al. 2002). Kennedy (1992) also showed that aspen stands are highly selected during fawning season. Summer nocturnal habitat use is significantly different with use of open habitat types of meadows, riparian areas, and/or open pine relative to proximity of dense cover (Stefanich 1995). Wet meadows, riparian areas, and open stands of ponderosa pine also provide quality forage and water. Uresk and Severson (1998) found that open-canopy conditions are necessary to get understory shrubs. Closed-canopy stands with minimal understory vegetation represent cover.

Road construction and road density can affect deer habitat. High road densities (miles of road/square mile area) alter both human and animal behavior, which contribute to animal displacement and stress (SAIC 2003). Roads may cause a direct loss in habitat and increased vehicular volume may indirectly degrade habitat quality. In the 1990s up to 1,400 deer per year were killed in vehicle collisions in the Black Hills (Parrish et al. 1996).

Screening cover is defined as: being able to hide 90% of an adult deer or elk from human view at a distance of 200 feet or less (of the road). There are many collector and arterial roads in the project area where the screening cover requirement (Guideline 3203) applies. The project area consists of denser ponderosa pine stands (Structural Stages 3B, 3C, 4B, and 4C) that likely adequate screening for deer.

White-tailed deer are present throughout the project area. The Forest-wide habitat trend is stable or increasing. Open habitat that provides forage is increasing and screening cover is stable (USDA Forest Service 2010). The South Dakota Black Hills white-tailed deer population peaked in 2006 at 54,000 and has declined since then to 43,000 in 2009 (Huxell 2010). Wyoming Game and Fish Department models estimate that there are about 40,000 white-tailed deer in the Black Hills herd unit that includes both private and public lands (Sandrini 2007). The population may be beginning to grow based on field personnel observations (Sandrini 2007).

Beaver: Beavers are semi-aquatic and widely distributed in large rivers and lakes with constant water levels, marshes, small lakes, and streams with weak flows adequate for damming (Higgins et al. 2000, Boyle and Owens 2007). General habitat requirements of beavers include suitable riparian habitat dominated by stands of willow, aspen, or cottonwood (Olson and Hubert 1994). This species is an herbivore, preferring aspen, willow, cottonwood, and alder (Higgins et al. 2000). Beavers are adversely affected by predation, loss of food base due to wildfire or habitat overuse, and drought.

Riparian habitats have decreased in quality since European settlement, and the total amount of aspen has decreased over at least the past 30 years. Both of these indicate a long-term declining

habitat trend for beaver. More recent, shorter-term riparian trends are unclear. Small riparian protection projects on the Forest have improved riparian conditions in some areas (USDA Forest Service 2010b). See also the discussion on riparian habitat earlier in this section.

Historically, beaver were heavily trapped in the Black Hills. By the late 1880s, populations were low and restricted to remote areas (Parrish et al. 1996). Beaver have increased since then and are now widely distributed in South Dakota (Higgins et al. 2000).

Beaver abundance and distribution were monitored from October 22-26, 2007 using the protocol developed by Beck and Staley (2005). The average food cache density on the Forest was 0.0252 caches per kilometer (0.042 cache/mile) or about one cache for every 40 kilometers (24 miles) of perennial stream (USDA Forest Service 2009b). Overall, 20 of the 52 watersheds (38%) surveyed had beaver food caches present (USDA Forest Service 2009b).

Subsequently, no comparable trend data is available, but inferences can be made from past to present conditions regarding trends in the beaver population and its habitat. The long-term beaver population trend has increased in the Black Hills since heavy trapping has been moderated by hunting regulations. Riparian habitats have decreased in quality since European settlement, and the total amount of aspen has decreased over at least the past 30 years. Both of these indicate a long-term declining habitat trend for beaver.

There are 45,805 acres of aspen and 13,556 acres of bur oak on the Forest (USDA Forest Service 2010). There are small inclusions of hardwoods, such as aspen and bur oak, within the pine stands in the project area. Hardwoods are more abundant on the northern portions of the Black Hills and become sparse at the southern end of the Black Hills.

Black-backed Woodpecker: In the Black Hills, black-backed woodpecker distribution and abundance is closely associated with recent stand replacing fires (Panjabi 2001, 2003, 2004, 2005, Hutton et al. 2007, Giroir et al. 2007, White and Giroir 2009, White et al. 2010) and insect out-breaks (Bonnot et. al. 2009). They also occur at much lower densities throughout the remainder of the Forest (Mohren 2002, Panjabi 2001, 2003, 2004, 2005, Hutton et al. 2007, Giroir et al. 2007, White and Giroir 2009, White et al. 2010).

There are abundant MPB infested stands within the project area (Allen 2011). There are 159,000 acres of Structural Stage 4C and 118,000 acres of Structural stages 3B/ 3C within the project area. The addition of recent wildfires and insect tree mortality results in above 3 snags per acre (Forest Plan Objective) well dispersed across the Forest (USDA Forest Service 2010b).

Forest-wide habitat conditions have been favorable for the black-backed woodpecker over the past few years due to recent large fires and beetle outbreaks. Habitat is relatively abundant when compared to 10-25 years ago. In the past few years, the habitat trend appears to be stable as recently burned areas have declined (aged) and insect caused tree mortality continues to rapidly increase.

Black-backed woodpecker densities peaked after the 2000 Jasper Fire during the second post-fire year when one bird/36 acres (or 6.9 birds/km2) were observed (Panjabi 2003). Relative densities in burned habitat declined in the Jasper Fire as expected following a fire (Hutton et al. 2007). Forest-

wide densities of black-backed woodpeckers have spiked upward in 2009 (White et al. 2010), possibly due to MPB outbreaks.

Overall, habitat for this species is being provided, consistent with Objective 238b, Objective 221 and Objective 11.03. The "aging" of large burned areas, such as the Jasper Fire, into habitat less suitable for black-backed woodpeckers is likely being offset by the increasing acreage of insect-infested timber stands and the stable acreage of large diameter, older pine trees. Though more time is needed for additional stands to develop into structural stage 5 (USDA Forest Service 2010b).

Brown Creeper: The brown creeper is found in dense, mature and late successional coniferous forests (structural stages 4C and 5) in the summer and deciduous forests during the winter (Wiggins 2005). Forest characteristics preferred by creepers include large, unfragmented, mature and late successional stands with large trees and snags (Wiggins 2005a). At least 90 percent of brown-creeper observations have occurred in white spruce and mature and late successional pine habitats (structural stages 4C and 5) (Panjabi 2001, 2003, 2004, 2005, Beason et al. 2006, Hutton et al. 2007, Giroir et al. 2007, White and Giroir 2009, White et al. 2010). They are also found in lower densities in other structural stages of ponderosa pine (Panjabi 2001, 2003, 2004, 2005, Beason et al. 2006, Hutton et al. 2007, Giroir et al. 2007, White and Giroir 2009, White et al. 2010). Snags (at least 10 inches dbh) or live trees with loose bark or old woodpecker cavities are required for nesting (Wiggins 2005a). Optimal habitat within the project area is spruce and pine (structural stages 4C and 5).

Data suggests the brown creeper is well distributed throughout the Black Hills. Forest-wide habitat is relatively stable or slightly increasing (USDA-Forest Service 2010b).

Brown creeper populations appear stable on the Forest. Brown creepers have been monitored on the Black Hills since 2001 in cooperation with the RMBO (Panjabi 2001, 2003, 2004, 2005, Beason et al. 2006, Hutton et al. 2007, Giroir et al. 2007, White and Giroir 2009, White et al. 2010). Brown creepers are well distributed in low abundance throughout the Black Hills.

This species has been documented across the Forest and in the project area, and suitable habitat exists within the project area.. The project area contains 165,000 acres of mature (4C and 5) ponderosa pine habitat suitable to support brown creeper. There are 25,749 acres of white spruce cover type in the project area (USDA-Forest Service 2010b), and there are small inclusions and stringers of spruce within the ponderosa pine stands in the central and northern part of the project area. The Forest-wide habitat is stable (USDA-Forest Service 2010b).

Golden-crowned Kinglet: In the Black Hills, golden-crowned kinglets are found primarily in white spruce forests (Panjabi 2003, Giroir et al. 2007, White et al. 2010). Panjabi (2003) also found them in small numbers in mature ponderosa pine, aspen, and wet meadows, although these areas likely had a spruce component. Golden-crowned kinglets on the Black Hills are likely limited by the abundance, distribution and condition of white spruce habitat.

Golden-crowned kinglet habitat (white spruce) appears relatively stable or slowly increasing on the Forest (USDA Forest Service 2010b). Relative to ponderosa pine, spruce habitat is naturally patchy and of low abundance on the Black Hills. White spruce occurs at high elevations, on

north aspects, and in cool canyon bottoms of the Forest. According to the 2009 Monitoring Report, spruce habitat is found on 25,749 acres on the Forest (USDA Forest Service 2010). This exceeds Objective 239-LVD of 20,000 acres. The Forest is meeting Objective 238a based on the acres of preferred habitat.

In the short-term, the relative density of golden-crowned kinglets in 2007 was the lowest since the MBBH program began in 2001; however, relative densities rebounded considerably in 2009 in both late successional and white spruce habitats (White et al. 2010).

Suitable spruce habitat exists in the northern portion of the project area. Patches and stringers of spruce occur within the ponderosa pine stands in the project area.

Grasshopper Sparrow: Grasshopper sparrows are found in a variety of open grassland types (Slater 2004). Grasshopper sparrows occur widely in native mixed-grass prairies in the southern Black Hills, and locally further north in the central Black Hills (Panjabi 2005). Panjabi (2005) found them in the highest density in mixed-grass prairie habitat. They may also occur in other types of grasslands (Panjabi 2003).

There are currently 107,464 acres of grassland cover-type on the Forest (USDA-Forest Service 2010). Grassland cover-types have varied but remained fairly stable on the Forest since 1995. Projects across the Forest have been emphasizing meadow and grassland restoration through removal of pine encroachment. Some of this, particularly pine removal on the periphery of prairies, is likely contributing to an increased habitat trend for the grasshopper sparrow. However, changes in mapping and reporting methods might contribute to at least some of the difference (USDA-Forest Service 2010b).

Grasshopper sparrows have been monitored on the Black Hills since 2002 in cooperation with the RMBO (Panjabi 2003, 2005). The monitoring program was designed to statistically detect population trends over a longer time period than it has been implemented. However, a less rigorous analysis of the data suggests an upward Forest-wide population trend between 2002 and 2008 (USDA Forest Service 2009d). However, this may not be a trend, but instead a short-term phenomenon. According to Panjabi (2003), it is possible that numbers would decrease in future years as habitat becomes more suitable again on the Great Plains (USDA Forest Service 2007a).

Ruffed Grouse: Ruffed grouse are a year-round resident in the Black Hills and their presence roughly correlates to the distribution of aspen (Panjabi 2003). On the Forest, this species may require a variety of aspen structural stages to thrive, including late succession aspen for drumming logs and most other stages for buds and catkins in winter and spring months (Wiggins 2006). Ruffed grouse nesting habitat is closely associated with hardwoods; particularly aspen (McCaffery et al. 1997).

The long-term habitat trend for ruffed grouse is one of decline given the reduction of aspen acreage compared to historic condition. It is likely that there has been an associated population decline in ruffed grouse. There has been a slight increase in aspen acres over the past five years. The Forest continues to meet Objective 238a by maintaining aspen habitat (USDA Forest Service 2010b).

The project area (Forest) has 45,805 acres typed as aspen (USDA-Forest Service 2010b). Suitable habitat also occurs in the project area as small inclusions of aspen within pine dominated stands.

Song Sparrow: Song sparrows are found throughout much of the Black Hills, but they are more common in the northern part of the Forest (Panjabi 2001, 2003, 2004, 2005, Beason et al. 2006, Hutton et al. 2007, Giroir et al. 2007, White and Giroir 2009, White et al. 2010). In the Black Hills, song sparrow is found in the highest density in riparian habitat (Panjabi 2001, 2003, 2004, 2005, Beason et al. 2006, Hutton et al. 2007, Giroir et al. 2007, White and Giroir 2009, White et al. 2010). Panjabi also found them in white spruce adjacent to riparian stringers.

Data suggests a stable Forest-wide population trend since 2001 (USDA Forest Service 2009a). Data from the MBBH program show that the song sparrow is well distributed throughout the northern Black Hills and Bearlodge Mountains, with a more localized distribution in the central and southern Hills.

Riparian habitats have decreased in quality since the pre-European settlement era, indicating a long-term declining habitat trend. In the short term, small riparian protection projects have improved riparian conditions in some areas and contribute to achievement of Forest Plan Objective 238a (USDA Forest Service 2009). The project area contains suitable riparian habitat to support the song sparrow.

Threatened and Endangered Species: The only threatened, endangered, or proposed species located on or adjacent to the Forest is the black-footed ferret (*Mustela negripes*). This species was identified through informal consultation with the US Fish and Wildlife Service South Dakota and Wyoming Field Offices. Black-footed ferrets have been recently released in Wind Cave National Park in the southern Black Hills. There is no designated critical habitat for black-footed ferrets on the Forest.

The black-footed ferret is a nocturnal, solitary carnivore with the narrowest range of ecological tolerance of any North American predatory mammal (USDA-Forest Service 1996b Appendix H). In the Black Hills, as elsewhere, the key habitat component for black-footed ferrets is the distribution and abundance of prairie dogs (Forrest et al. 1985), its primary food source. Vacated prairie dog burrows also provide shelter.

There are about 400 acres of prairie dog towns in 10 towns on the Forest (USDA-Forest Service 2010b). Black-footted ferrets have been released as part of an experimental population in Wind Cave National Park adjacent to the Forest.

Region 2 (R2) Sensitive Species

Sensitive species (SS) are those plant and animal species identified by the Regional Forester for which population viability is a concern, as evidenced by:

- 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).

The most recent Region 2 SS wildlife list (FSM R-2 Supplement 2600-2011-1, effective June 10, 2011) was reviewed and species that may occur in or near the Black Hills were identified. A pre-field wildlife and fish review of the project area for all Region 2 SS was completed using Heritage database records, district data, literature reviews, communication with district personnel

and the Forest Plan to identify which SS occur within the project area or have potential habitat within the project area. All sensitive species on the Forest occur within the project area or have potential habitat within the project area and are carried forward in the effects analysis.

American peregrine falcon (*Falco peregrinus anatum*)
Bald eagle (Haliaeetus leucocephalus)
Northern goshawk (*Accipiter gentilis*)
Northern harrier (*Circus cyaneus*)
Burrowing owl (*Athene cunicularia*)
Flammulated Owl (*Otus flammeolus*)
Lewis's Woodpecker (*Melanerpes lewis*)
Black-backed Woodpecker *(Picoides arcticus*)
Grasshopper Sparrow (*Ammodramus savannarum*)
Loggerhead Shrike (*Lanius ludovicianus*)
Yellow-billed Cuckoo (*Coccyzus americanus*)
Long-billed Curlew (*Numenius americanus*)
Fringed Myotis (*Myotis thysanodes pahasapensis*)
Townsend's Big-eared Bat (*Plecotus townsendii*)
Hoary Bat (*Lasiurus cinereus*)
American Marten (*Martes americana*)
Rocky Mountain Bighorn Sheep (*Picoides dorsalis*)
Black-tailed Prairie Dog (*Cynomys ludovicianus)*
Northern leopard frog (*Rana pipiens*)
Black Hills redbelly snake (*Storeria occipitomaculata pahasapae*)
Regal Fritillary (*Speyeria idalia*)
Cooper's Mountain Snail (*Orechelix strigosa cooperi*)

The black-backed woodpecker and grasshopper sparrow are also designated as MIS and are discussed under the MIS section.

American Peregrine Falcon: In the Black Hills, the peregrine falcon is an uncommon spring and rare fall migrant and a rare winter visitor. Potential nest sites may occur in deep rocky canyons or other places with tall vertical cliffs (USDI Fish and Wildlife Service 1984). Historical records indicate nesting occurred in the Black Hills in the 1960s (ibid.). The peregrine has not been documented breeding in the Black Hills since that time despite efforts to reestablish it through cross-fostering and hacking during the late 1970s and late 1990s (USDA Forest Service 1979, Sharps and O'Brien 1985). Evaluation of potential peregrine habitat by the Peregrine Fund concluded that most of the Black Hills does not provide adequate nesting sites. The Monitoring Birds of the Black Hills program has not detected peregrines anywhere in the Black Hills since it began in 2001 (Giroir et al. 2007).

Open areas that could provide foraging habitat in the Black Hills include grasslands, shrublands, and structural stages with open canopies (1, 2, 3A, 4A). Currently, there are nearly 600,000 acres that meet these criteria on the Forest (USDA-Forest Service 2010b). The main factors that may limit occupation of the Black Hills by peregrines are the lack of tall, unbroken cliffs and isolation from established breeding populations. Forest Plan Standard 3204 protects known raptor nests. There are no known peregrine nests on the Forest.

Bald Eagle: Bald eagles are present in the Black Hills during winter, usually arriving in early November and leaving by March or April. Bald eagles are often associated with water. In the Black Hills, this species utilizes winter habitat where carrion is available (along highways and in big game winter range) and where there are open lakes and streams. An unsuccessful nesting attempt was reported adjacent to the Forest in the Southern Hills in spring 2004. In 2007, an

unsuccessful nest attempt occurred at Deerfield Lake on the Forest. This was the first nest attempt on the Forest in recent times. The nest was again active in 2008-2011 and appears to have successfully fledged young. Most suitable nesting habitat occurs around the major reservoirs or along major creeks in the Black Hills.

In 2006, a night roosting area was discovered at Pactola Reservoir. Approximately 18 – 22 eagles were observed at the roost on four separate occasions between late December 2005 and late January 2006. The roost covers at least 100 acres of mature to late-successional ponderosa pine forest on very steep slopes. Large trees and snags are abundant. The site is adjacent to Pactola Reservoir, parts of which were not frozen during the time of the discovery.

The bald eagle population is in an upward trend in South Dakota with successful nesting in twenty-two counties (South Dakota Game, Fish and Parks [SDGFP], 2012).

Suitable nesting habitat occurs in structural stage 4B and 4C stands near major lakes and creeks in the project area. Suitable roosting habitat occurs throughout the project area, especially in structural stages 4b and 4C.

Forest Plan Standard 3101 prohibits new disturbances not existing at the time of bald eagle nest initiation that may detrimentally influence nest success within one mile of bald eagle nests during the nesting season (February 1 through September 1). The distance may be reduced where forest characteristics or topography reduce the line-of-site distance from the nest, based on site-specific analysis. Standard 3101 protect traditional communal bald eagle winter roost sites. Restrict activities that may disturb bald eagles within one mile of communal roosting areas from November 1 through April 1. In stands being used by bald eagles on a transitory basis, avoid timber harvest activities when in use. Harvest may resume when birds have vacated the stands.

Northern Goshawk: Typical nest areas for goshawks in the northern Rocky Mountains are single storied, mature or late-successional coniferous forest, with high canopy closure, clear forest floors, on north-facing moderate slopes (Hayward and Escano 1989, Squires and Ruggiero 1996, Kennedy 2003). Goshawks tend to select stands that have relatively large trees and relatively high canopy closure (Kennedy, 2003). Reynolds et al. (1992) characterized the nest area as mature and old stands with canopy closure greater than 50 percent. Ponderosa-pine structural stages 4C and 5 (dense mature forest and late-succession), at least 30 acres in size, likely best meet these conditions in the Black Hills. Structural stage 4B (mature forest with 40 to 70 percent canopy closure) may also provide some additional nesting habitat. Goshawks return to the same territory year after year.

Goshawks use a mosaic of structural stages for foraging within their home range (Kennedy 2003). Goshawks hunt in diverse habitats from open-sage steppe to dense forests, including riparian areas. They are considered generalist predators, feeding mostly on prey that occupies the ground through lower canopy zones; often large bodied animals, especially young of the year, such as squirrels, rabbits, hares, passerines, woodpeckers, game birds, and corvids. Prey abundance and availability are important habitat attributes and potential limiting factors for goshawk populations (Reynolds et al. 2006). According to Reynolds et al. (1992), foraging habitat typically includes a diversity of

forest types and conditions including stands of young, mid-aged, mature, and late-successional trees. This roughly equates to structural stages 4B, 4C, and 5 on the Black Hills.

Snags, downed logs, and woody debris are an important component of the post-fledging family and foraging habitat. Typically, two snags per acre and three downed logs per acre are desired in the ponderosa-pine forest type (Reynolds et al. 1992). Nicholoff (2003) recommends three snags per acre for goshawks. The Forest currently exceeds the snag objective in the Forest Plan (3 snags per acre) (USDA Forest Service 2010b). Reynolds et al. (1992) suggests three large downed logs per acre (at least eight feet long) in ponderosa pine habitats. Nicholoff (2003) recommends five downed logs per acre at least eight feet long.

Structural stage objectives for Management Areas 4.1, 5.1, 5.4, 5.43 and 5.6 in the Forest Plan were designed to provide the balance of condition for goshawk foraging and nesting habitat.

Forest Plan Standard 3108 requires the identification of nest areas around all historically active nests. Each nest area should consist of 180 acres best suited for goshawk nesting within ½ mile of the nest. Vegetation management activities within nest areas are limited to those that maintain or enhance the stand's value for goshawk. Goshawk nest areas were identified by using R2veg data, aerial photos, field surveys and Forest Plan requirements. Each territory may consist of multiple historically active nests.

Forest Plan Standard 3111 minimizes additional human-caused noise and disruption beyond that occurring at the time of nest initiation (e.g., road traffic, timber harvests, construction activities) from April 1 through August 15, within one-half mile of all active goshawk nests up until the nest has failed or fledglings have dispersed.

Northern Harrier: The northern harrier is an uncommon migrant and summer resident in South Dakota. Harriers are relatively absent from the Black Hills (Slater and Rock 2005), but the species is occasionally observed here.

Harriers are open-country hawks that are commonly found in prairies, wetlands, marshes, meadows, croplands, and shrublands (Slater and Rock 2005). Associated topography is generally flat. Most nest sites are in undisturbed wetlands or grasslands dominated by thick vegetation (Slater and Rock 2005).

Large open areas are limited on the Forest, which probably constitute the most limiting factor for harriers on the Forest. Currently, there are approximately 107,400 acres of grasslands on the Forest (USDA-Forest Service 2010b), but much of this occurs in linear meadows or isolated patches that are likely too small to support birds for a full season or more. The most extensive grasslands occur in the southern Black Hills.

Forest Plan Standard 3204 provides direction to protect known raptor nests. There no known harrier nests on the Forest or in the project area.

Burrowing Owl: The western burrowing owl is a grassland specialist distributed throughout western North America, primarily in open areas with short vegetation and bare ground (Klute et al. 2003). Burrowing owl nesting habitat typically consists of level, open landscapes with sparse

grassland vegetation that either has low structure or is heavily grazed, either by cattle or prairie dogs (Klute et al. 2003, McDonald et al. 2004). They are dependent on burrowing mammals whose vacant burrows are used for nesting and roosting; the burrows of prairie dogs, particularly black-tailed prairie dogs, are of central importance (Johnson and Anderson 2002, Klute et al. 2003).

Habitat for burrowing owls on the Forest is limited; the availability of black-tailed prairie dog colonies may be the greatest limiting factor (Johnson and Anderson 2002; see also prairie dog discussion).

A burrowing owl was observed in 2004 and 7 were observed in 2006 by the Rocky Mountain Bird Observatory during ongoing breeding bird monitoring (USDA-Forest Service 2010b). The 2004 observation was associated with a prairie dog town on the Hell Canyon Ranger District. Two adults and three chicks were observed at two nests in 2007. Burrowing owl nests are protected by Forest Plan Standard 3204.

Flammulated Owl: Flammulated owls are associated primarily with ponderosa pine and Jeffrey pine habitats. In the Black Hills, only ponderosa pine is present. Flammulated owls select older seral stages for breeding and nesting (Hayward and Verner 1994). Interior and exterior forest edge seems to be a desirable if not a necessary component of flammulated owl habitat (Hayward and Verner 1994). Clumped tree distributions, multi-layered canopy, and a well-developed shrub component contribute to internal forest edge. Low-to-moderate canopy closure prevails in most sites used by the owl (Hayward and Verner 1994). The ponderosa pine structural stages corresponding most closely to potential flammulated owl nesting and foraging habitat on the Forest are 4A, 4B, and 5.

Flammulated owls appear to prefer denser vegetation for roosting (Hayward and Verner 1994). Across the species range, they have been found roosting in mixed conifer stands, thickets, and other conditions with high foliage density or multi-layered canopy that were in close proximity to nest sites (e.g., <300 feet). In Oregon and Colorado, the species did not select pure stands of ponderosa pine for roosting but instead used mixed conifer stands where pine was a component (Hayward and Verner 1994). Roosting habits are unknown in the Black Hills, but if range-wide patterns hold true here, the species may roost in spruce or in stands where pine and spruce co-occur.

In their summary of nest site characteristics across three studies in New Mexico and Oregon, Hayward and Verner (1994) stated that they occurred in snags that averaged between 19 and 28 inches dbh. Large snags such as these are rare in the Black Hills.
There have been two reports of flammulated owls in the Black Hills in the past 10 years that could be valid sightings. These could represent periodic use by transient individuals, or the beginning of a range expansion. A concerted effort was made to verify flammulated owls at the two recent observation areas and other seemingly suitable sites during 2003, but the species were not detected (Fauna West Wildlife Consultants 2003-09).

Forest Plan Standard 3204 protects known raptor nests. There no known flammulted owl nests on the Forest or in the project area.

Lewis's Woodpecker: The Lewis's woodpecker is an edge specialist that prefers open mature pine forests, mature cottonwood forests, and areas with large burned trees (Tobalske 1997). Burned stands are used most often after they have aged several years (Tobalske 1997). A well-developed

shrub layer is usually present (Anderson 2003, Abele et al. 2004). In the Black Hills, this woodpecker is most often observed in burned pine forests, but it could also be found in mature to late-successional ponderosa pine stands that have an open canopy (structural stages 4A and some 5).

Lewis's woodpeckers typically excavate nest cavities in soft ponderosa pine or cottonwood snags, although they will also re-use cavities made by other woodpecker species. Lewis's woodpeckers nest in large snags; review of several studies across the bird's range show snag sizes vary from 12 to 45 inches dbh (Anderson 2003). Snag (greater than 9 inches diameter) densities around nests in burned and logged areas in Idaho were 40 snags per acre and around nests in unlogged areas were 80 snags per acre (Anderson 2003).

Recent bird monitoring on the Black Hills has detected an average of 6 birds each year since 2001 (White and Giroir 2009). Breeding Bird Survey (BBS) data suggests that many populations of Lewis's woodpeckers may have declined since the 1960s (Sauer et al. 2011; Tobalske 1997).

Risks to Lewis's woodpeckers include activities that reduce open or old growth ponderosa pine forests and snags (e.g., fire suppression and clearcutting) (Anderson 2003). Loss of cottonwood riparian habitat and human encroachment on breeding and wintering habitat are also negative factors (Tobalske 1997), although little cottonwood habitat exists on the Forest.

The project area includes 307,000 acres of open, mature to old ponderosa pine forest (Structural stage 4A and 5). Pockets of open forest could also occur within the denser structural stages in the project area.

Black-backed Woodpecker: The black-backed woodpecker is discussed under the MIS section.

Grasshopper Sparrow: The grasshopper sparrow is discussed in the MIS section.

Loggerhead Shrike: The loggerhead shrike is a fairly common summer resident in Wyoming and South Dakota, with breeding records occurring over most of both states (Luce et al. 1999). The bird is rare or casual (out of normal range) in the Black Hills. Breeding records occur near the periphery of the Black Hills but not in the interior or at higher elevations. Wiggins (2005a) lists agricultural conversion, degradation or loss of nesting trees and shrubs, and over-grazing as potential threats to the species.

The loggerhead shrike is associated with open habitats that include scattered or clustered shrubs or trees. This includes some types of grasslands, shrublands, and savannas. Wiggins (2005a) describes nesting habitat as having trees, shrubs or low bushes and elevated perches for hunting and courtship activities. Foraging habitat includes areas of open, short vegetation with some bare areas and thorny trees or barbed-wire fence for impaling prey (Wiggins 2005a). These habitats are limited in the Black Hills but are provided mainly by mixed-grass prairies, mountain mahogany shrublands, and grassy or brushy areas with scattered juniper or ponderosa pine. The combination of habitat features described above is distributed primarily along the southern flank of the Black Hills, especially in the southwestern portion. Most of the interior Black Hills do not provide suitable habitat because tree density is too high.

Long-billed Curlew: Long-billed curlews are native prairie specialists, nesting primarily in shortgrass or mixed-grass prairie habitat with flat to rolling topography (Sedgwick 2006). They

prefer short vegetation and generally avoid habitats with trees, abundant shrubs, and tall, dense grass (Sedgwick 2006). Curlews may use taller, denser grass during brood rearing when shade and camouflage from predators are presumably more important for chicks (Sedgwick 2006). Long-billed curlews have been observed nesting in suitable habitat on the Black Hills, mostly the southern Black Hills, during annual bird monitoring efforts (USDA-Forest Service 2010b). A marginally significant decline has been observed in South Dakota (Sedgwick 2006).

Yellow-billed Cuckoo: In western South Dakota and eastern Wyoming, the species is a rare to uncommon breeder (Wiggins 2005c). The yellow-billed cuckoo is considered a riparian obligate species (Nicholoff 2003). Yellow-billed cuckoos prefer to nest in open woodlands with a dense understory and near water. They typically inhabit wooded river valleys in the Great Plains (Wiggins 2005c).

Breeding habitat in the Black Hills occurs mainly in low-elevation riparian areas. Habitat is very limited on the Forest and has most potential to occur where narrowleaf cottonwood or bur oak riparian corridors meet the Forest boundary at the edge of the Black Hills. Breeding has been documented in the Bear Lodge Mountains and likely occurs elsewhere at lower elevations (Panjabi 2003). The site was a mature, bur-oak woodland that had a well-defined understory and very large-diameter trees (Panjabi 2003). Yellow-billed cuckoos are extremely sensitive to habitat alterations (Nicholoff 2003, Wiggins 2005b). Major causes of degradation have included grazing, placer mining, cultivation, road development, dam construction, channel realignments, urbanization, and loss of riparian habitat (Wiggins 2005c).

Fringed Myotis: The Black Hills population of the fringed myotis is a disjunct population and recognized as belonging to a distinct subspecies, Myotis thysanodes pahasapensis. In the Black Hills, this species is known in Custer, Fall River, Lawrence, and Pennington counties of South Dakota and Crook and Weston County in Wyoming at an elevation between 3,800 and 6,200 feet (Schmidt 2003e). The fringed myotis is a year-round resident of the Black Hills. It can be found during the summer but is very difficult to locate during the winter (USDA-Forest Service 2000).

The fringed myotis occupies a variety of habitats including mid-elevation desert, grass, and woodland habitats and is found at higher elevations in spruce-fir and in mixed timber (Schmidt 2003e). In the Black Hills, it is one of the more commonly captured bats during summer mist-netting studies and tends to occur along ecotones between ponderosa pine and oak/juniper forests (Schmidt and Anderson 2003).
Little is known about hibernacula requirements for this species. The fringed myotis is known to hibernate in the "Heavenly Room" of Jewel Cave. Snags, caves, mines, and buildings may be used as roosts (Schmidt and Anderson 2003). In the Black Hills, maternity roosts recorded for this species include rock crevices and ponderosa pine snags (Cryan et al. 2001, Keinath 2004).

Riparian areas and water sources are important features of habitat. Open water is important because bats obtain water while flying. Riparian habitats are also important for insect production and provide foraging opportunities (USDA-Forest Service 2000a).

The fringed myotis is more closely associated with the forested environment than other bat species and may be fairly sensitive to forest management, particularly the availability of snags as roost sites

(USDA-Forest Service 2000). The fringed myotis has been documented using ponderosa pine snags for roosts in the Black Hills (Cryan et al. 2001) and in other regions (Rabe et al. 1998).

Forest Plan direction pertaining to snags and riparian areas were discussed earlier in this section. Forest Plan Standard 1401a provides direction to avoid ground disturbance within 100 feet of an opening of a natural cave. Where caves or abandoned mines serve as nurseries or hibernacula for bats, vegetative changes within 500 feet of the opening are allowed only if needed to maintain bat habitat or if topography or other features protect the openings from disturbance (Forest Plan Standard 3207).

Townsend's Big-eared Bat: Townsend's big-eared bat is a year-round resident in all South Dakota Black Hills counties and reported to be the most numerous bat species in Crook County, Wyoming (Schmidt 2003e). There are known maternity roosts of these bats in the Black Hill (USDA-Forest Service 2000a).

Townsend's big-eared bats occupy a variety of habitats but are closely associated with caves and mines (Schmidt 2003e, Gruver and Keinath 2006). They also use riparian areas for foraging, including wetlands and meadows (Pierson et al. 1999).

Key habitat components include suitable maternity roost sites and hibernacula. The bats utilize both caves and mines for hibernacula (Schmidt 2003e). In the Black Hills, maternity roost sites are often in steep drainages with nearly vertical walls. These bats also utilize caves with relatively warm domes or large flat ceilings (Schmidt 2003e).

Townsend's big-eared bats are especially susceptible to human disturbance during the active time of year (summer), more so than other bat species (USDA-Forest Service 2000). These bats are extremely sensitive to disturbances in the vicinity of their roosts, including loud noises such as those produced by motorized off-road vehicles, discharging of firearms, and other such activities (Schmidt 2003e).

Potential habitat exists in and near the project area n the form of caves and mines. Potential habitat also exists in snags and riparian areas.

Forest Plan direction pertaining to snags and riparian areas were discussed earlier in this section. Forest Plan Standard 1401a provides direction to avoid ground disturbance within 100 feet of an opening of a natural cave. Where caves or abandoned mines serve as nurseries or hibernacula for bats, vegetative changes within 500 feet of the opening are allowed only if needed to maintain bat habitat or if topography or other features protect the openings from disturbance (Forest Plan Standard 3207).

Hoary Bat: The hoary bat generally roosts in medium to large trees with dense foliage that hides them from above, with few branches below, and has ground cover of low reflectivity. They prefer open conifer and deciduous habitat mosaics, and uses habitat edges for feeding. (Tigner and Stukel 2003). This species feeds chiefly on large moths and to a lesser extent on other insects over clearings, along forest edges and near water where prey may be more abundant. Risks to this species is loss of suitable habitat during critical periods, reduced foraging habitat,

chemical spraying that reduces prey, human disturbance, and predation (South Dakota Game, Fish and Parks 2004). Rapidly changing habitat conditions associated with MPB and wind energy development are considered a substantive and imminent threat to the hoary bat (USDA Forest Service 2011).

In South Dakota, the hoary bat ranges throughout the state and has been documented breeding in Lawrence, Pennington, Custer and Fall River counties in the Black Hills (Higgins et al. 2000, Tigner and Stukel 2003).

Potential forest habitat exists throughout the project area. Snag habitat created by mountain pine beetle appears to be abundant (USDA Forest Service 2010). Water sources and riparian habitat that provide abundant prey species are found in the project area.

American Marten: The Black Hills supports an isolated population, with the nearest neighboring population in the Bighorn Mountains of Wyoming (Buskirk 2002). According to Fecske et al. (2003), the greatest marten concentrations in the Black Hills appear to be in the northern part of the Forest southwest of Deadwood (northern subpopulation) and in and around the Norbeck Wildlife Preserve (Norbeck subpopulation). These two dominant subpopulations are likely very important in maintaining species persistence in the Black Hills.

Martens are primarily associated with mature white spruce in the Black Hills (Fecske 2003). Key habitat elements are relatively dense forests with complex physical structure near the ground, abundant coarse woody debris, and lengthy fire-return intervals (Buskirk 2002). Martens prefer moist coniferous forest types with tree species that have branches on their lower boles. White spruce is the tree species on the Forest that provides this condition. There are currently 25,749 acres of white-spruce stands on the Forest (USDA Forest Service 2010b), mostly at high elevations, on north aspects, and in cool canyon bottoms. There are smaller inclusions of spruce within the ponderosa pines stands in the project area.

Coarse woody debris is an important component of marten habitat. Large logs and other structures provide protection from predators, access to the subnivean (i.e., beneath the snow) space where most winter prey are captured, and protective thermal conditions, especially during winter (Buskirk and Powell 1994). A variety of structures are used for dens, with trees, snags, logs, and rocks accounting for 70 percent of reported den structures (Buskirk and Ruggiero 1994). Forest Plan direction on down logs is provided earlier in this section.

American marten typically avoid dry ponderosa pine sites; however, due to the limited distribution of spruce in the Black Hills, most marten territories undoubtedly contain some portion of pine (Buskirk 2002). Mature and late-successional pine stands also help maintain connectivity between spruce stands. Martens are sensitive to habitat fragmentation and will not move through large, open canopy or non-forested areas. In areas identified as important connectivity corridors for marten, Forest Plan direction is to maintain canopy closure of at least 50 percent (Standard 3215).

Marten historically occurred within the Black Hills, but were thought to be trapped out by 1930. The South Dakota Department of Game, Fish, and Parks reintroduced a total of 125 individuals into the Black Hills during the 1980s and 1990s (Buskirk 2002). Fecske et al. (2003) estimated that 124

resident martens occur in the Black Hills in high quality habitat, with additional animals occurring at lower density within lower quality habitat. Although considerable mortality and reproduction have likely occurred here since reestablishment began, it appears the marten population trend was relatively stable in the Black Hills through 2003 (USDA-Forest Service 2004). The Forest is conserving marten habitat (spruce) but population trends since 2003 are unknown.

Rocky Mountain Bighorn Sheep: Rocky Mountain bighorn sheep typically inhabit alpine meadows, foothills, cliffs, and rock outcrops (Luce et al. 1999, Beecham et al. 2007). Alpine habitat is absent in the Black Hills. Merwin (2000) noted that bighorn sheep often selected areas with good visibility (less than 40 percent canopy closure) within suitable distance of water and escape terrain. Limits to persistence include limited availability of habitat on the Forest, vulnerability of habitat to residential development on adjacent private lands, and disturbance from recreation (Benzon and Halseth 1999).

There are 480,000 acres of ponderosa pine stands that provide good visibility (Structural Stages 1, 2, 3A, and 4A) within the project area. Sheep could move through some of the denser stands within the project area.

The Rocky Mountain bighorn sheep race was introduced to the Black Hills in 1924. The South Dakota Game, Fish, and Parks classify it as big game but hunting permits are limited (Huxoll 2010). The species occurs in small areas of the Black Hills with six sub-herds, occupying portions of Norbeck Wildlife Preserve, Custer State Park, Elk Mountain, Spring Creek, and Rapid Creek. Monitoring indicates that the bighorn sheep population estimate for the Black Hills proper has increased from 2004-2006 and has remained stable through 2009 (350 animals). The Forest is conserving habitat for the bighorn sheep consistent with Objective 221 based on the trend in bighorn sheep numbers (USDA Forest Service 2010b).

Black-tailed Prairie Dog: Black-tailed prairie dogs are associated with shortgrass and mixed-grass prairies but require sites with soils conducive to burrowing. Suitable prairie dog habitat on the Black Hills National Forest is limited to nonrocky grassland soils on the Hell Canyon Ranger District. The Forest manages for 200 to 300 acres of prairie dog towns in at least three separate towns (Forest Plan objective 237). There are currently 10 known prairie dog colonies on the Forest, covering approximately 400 acres of National Forest System land (USDA Forest Service 2010b). All the towns are in South Dakota. There are no prairie dog towns on the Wyoming portion of the Forest. The three largest towns are about 170, 110 and 40 acres in size. All other towns are less than 20 acres. Additional acres occur on adjacent private land. The potential for prairie dog expansion on the Forest is limited because prairie dog towns on the Forest quickly reach private land or encounter rocky soils that make burrowing difficult. Large areas (greater than 1,000 acres) of potentially suitable prairie dog habitat are not present on the Forest. The colonies are comparatively small and disjunct from adjacent known colonies. Prairie dog towns have remained stable or increased in size on the Forest regardless of recreational shooting and disease (USDA Forest Service 2010b).

Northern Leopard Frog: Northern leopard frogs are considered common in suitable habitat in the Black Hills (Smith 2003) and are found at all elevations, though systematic surveys have not

been done in the Black Hills to verify this (Smith 2003). They appear to be more common in the northern Black Hills (Smith 2003).

The northern leopard frog occurs in a wide variety of habitats including creeks, lakes, ephemeral wetlands, and ponds (Fischer et al. 1999; Smith 2003). Breeding habitat is limited to permanent water sources at least 6 inches in depth that do not freeze solid.

After maturing, sub-adult frogs migrate to suitable feeding sites that are usually adjacent uplands. These dispersal movements may be along riparian corridors or upslope areas. Adult frogs are highly mobile, moving at night or when vegetation is wet (Smith 2003). They have been found up to two miles from water (Smith 2003).

Limited data suggest that the Forest is conserving habitat for the leopard frog (Forest Plan Objective 221) (USDA Forest Service 2010). However, monitoring of index sites and anecdotal observations indicate possibly fewer leopard frogs than in the past (USDA Forest Service 2010b). Additional index site monitoring is needed to determine if this is a long-term trend. Suitable habitat exists for the northern leopard frog in riparian areas throughout the project area.

Black Hills Redbelly Snake: Black Hills redbelly snakes are associated with mesic sites such as wetlands, riparian areas, and wet meadows (Smith and Stephens 2003). Sites where the snake has been observed, range in elevation from 4,700 to 6,400 feet (Smith and Stephens 2003). There is some indication that redbelly snakes may feed on snails (and on the genus *Oreohelix*, preferentially), implying that habitat management aimed at snails may also benefit the Black Hills redbelly snake (Smith and Stephens 2003).

The most serious risk to redbelly snakes populations may be the loss of moist habitats (Smith and Stephens 2003). Suitable environments for redbelly snakes are thought to be abundant and broadly distributed across the Black Hills (USDA-Forest Service 2000). The northern Black Hills, being generally moister and more fire resistant than the rest of the Forest, likely provides more habitat than other districts on the Forest (USDA-Forest Service 2000). Stumps and downed woody material are important in maintaining moist conditions; as roots of stumps decay, they provide cover (USDA-Forest Service 2000, Smith and Stephens 2003). Forest wide, projects which enhance riparian and aspen habitat will improve habitat for the redbelly snake (USDA Forest Service 2010b).

Suitable habitat exists for the Black Hills redbelly snake throughout the project area. Den sites and hibernacula in the Black Hills are located within rock fissures (USDA-Forest Service 2000a). Forest Plan Standard 3116 provides direction to avoid creating barriers between redbelly snake hibernacula and wetlands. There are no known hibernacula in the project area, but this may be due to lack of surveys. Undiscovered hibernacula and den sites could occur throughout the project area.

Regal Fritillary: The Black Hills are at the western margin of the regal fritillary's range, possibly due to increased aridity further west (USDA Forest Service 2000a). The regal fritillary requires open prairies (Royer and Marrone 1992) and wet meadows (Selby 2007). In South Dakota, the fritillary is most likely to be found in native tall-grass prairies composed of big bluestem (Andropogon gerardii), western wheatgrass (Pascopyrum smithii), and green needlegrass (Stipa viridula) (Royer and Marrone 1992). Continuous prairie greater than 1,000 acres may be required for stable populations (Royer and

Marrone 1992). In smaller habitat patches, individuals would move in and out depending on habitat condition and size (Royer and Marrone 1992, USDA Forest Service 2000a). The Black Hills is primarily forested, and as such, contains only relatively small patches. The best habitats within the Black Hills occur in lower elevation prairies along the outer Forest boundary and in interior prairies, although tall-grass species are not predominant in the interior prairies.

Adult female regal fritillaries lay eggs near violets. During the following spring, the larvae feed exclusively on violet leaves. By late June or early July, juveniles transform to adults (Royer and Marrone 1992). Adults require a continuous source of nectar-producing flowers such as coneflowers, fleabanes, and thistles (Royer and Marrone 1992).

Habitat needs of regal fritillaries are considered prior to prescribed burning in meadows and grasslands (Forest Plan Guideline 3105).

Cooper's Mountain Snail: Anderson (2005) lists Cooper's Rocky Mountain Snail (Oreohelix cooperi) as the only Oreohelix in the Black Hills. Anderson (2005) also notes the taxonomy of this species is confusing with the species often classified as Oreohelix strigosa cooperi. Anderson et al. (2006) and Weaver et al. (2006) found only one species in the Black Hills, and referred to it as O. cooperi. For the purposes of this analysis, we consider the two species to be one and the same as suggested by Anderson et al (2006), but refer to it here as O. strigosa cooperi since that is the label used on Region 2 SS List.

The following discussion is based on information specific to the Black Hills (Frest and Johannes 2002). Cooper's snail was found on calcareous soils; most localities were lowland wooded areas and talus slopes, generally but not always with northern or eastern exposures. Many of the colonies, including most of the largest, are found in ponderosa pine with a partially closed canopy, a secondary deciduous tree component, and diverse understories. At some sites, white spruce was common. Riparian woodland communities, often in areas with adjacent steep rocky slope bases, were also found to contain some substantial colonies.

Litter is an important component for snails as food and cover. In general snails prefer a well-developed litter layer, but not thick or matted (Anderson 2005). In contrast to other land snails, Cooper's snail can thrive with little cover and thin litter (Anderson 2005). Oreohelix have been observed in a variety of litter types in the Black Hills, including coniferous needles litter, deciduous litter and areas of thin litter (Anderson 2005).

Timber harvest and grazing may affect snails by altering the amount of litter, soil moisture or temperature for snail colonies (Anderson 2005). Although fire is a natural disturbance, high intensity fire can potentially eliminate snail habitat (Anderson 2005). Forest management, including fire suppression, in the last century has led to fuel buildup, which may promote high intensity fires. Road construction and maintenance can also affect snails by eliminating habitat or killing snails. Roadside brushing or weed spraying can also damage snails or their habitat (Anderson 2005).

Known colonies of this snail are conserved by (a) retaining overstory sufficient to maintain moisture regimes, ground level temperatures and humidity; (b) retaining ground litter, especially deciduous litter; (c) avoiding burning, heavy grazing, off-highway vehicles (OHVs), heavy

equipment and other activities that may compact soils or alter vegetation composition and ground cover; (d) burning when snails are hibernating, usually below 50 degrees Fahrenheit, and using fast-moving fires to minimize effects to snails, and (e) controling invasive weeds, but using herbicides when snails are not on the surface, and treating individual plants rather than broadcast application (Standard 3103). Cooper's snail has been recorded within the project area and suitable habitat exists within the project area.

Species of Local Concern (SOLC)

Species of Local Concern (SOLC) are plant, fish and wildlife species (including subspecies or varieties) that do not meet the criteria for sensitive status. These could include species with declining trends in only a portion of Region 2, or those that are important components of diversity in a local area. The local area is defined as NFS lands within the Black Hills National Forest. (FSM 2620.5 Black Hills Supplement 2600-2011-1). All SOLC species on the Forest occur in the project area or habitat occurs in the project area. Therefore, all are carried forward and analyzed in this document.

Table 3-33 Habitat Descriptions for SOLC occurring within the Project Area.

Species of Local Concern	Habitat
Birds	
American Dipper (*Cinclus mexicanus*)	Swift-flowing montane streams; occur primarily in Spearfish Creek and its tributaries and Whitewood Creek in the Black Hills (Anderson 2002).
Black-and-White Warbler (*Mniotilta varia*)	Found primarily in bur oak woodlands and associated edges, mainly at lower elevations (Hutton et al. 2007).
Broad-winged Hawk (*Buteo platypterus*)	Primarily found in habitat with prominent deciduous component, but also found occasionally in late successional pine stands (Stephens and Anderson 2003).
Cooper's Hawk (*Accipiter cooperii*)	Ponderosa pine, white spruce, riparian, shrubland and burned areas (Stephens and Anderson 2002).
Northern Saw-whet Owl (*Aegolius acadicus*)	Forest habitat generalist; dense coniferous or mixed forest; prefers conifer stands and willow thickets for roosting; hunt along edges or openings in forest (Johnson and Anderson 2003).
Pygmy Nuthatch (*Sitta pygmaea*)	Mature ponderosa pine stands with large trees and snags (Ghalambor 2003).
Sharp-shinned Hawk (*Accipter striatus*)	A variety of forested areas, but nesting habitat typically restricted to dense young conifer stands (Stephens and Anderson 2002).
Mammals	
Long-eared Myotis (*Myotis evotis*)	Mostly coniferous montane habitats; roosts in snags; no known hibernacula in Black Hills (Schmidt 2003a).
Long-legged Myotis (*Myotis volans*)	Primarily in montane coniferous forests; uses caves and mines as hibernacula; roosts in abandoned buildings, rock crevices, under bark; in Black Hills occur primarily between 4500 and 6500' (Schmidt 2003b).
Meadow Jumping Mouse (*Zapus hudsonius campestris*)	Strongly associated with riparian habitats along small streams in meadows (Luce et al. 1999).
Mountain Goat (*Oreamnos americanus*)	Rugged terrain with cliffs, rock faces, ledges and talus slopes. Limited primarily to Black Elk Wilderness Area and Norbeck Wildlife Preserve (USDA Forest Service 2005).
Northern Flying Squirrel (*Glaucomys sabrinus*)	Optimal conditions are cool, moist, mature forest with abundant standing and down snags; typically dominated by conifers or mixed coniferous/deciduous forests (Wells-Gosling and Heanery 1984).

Species of Local Concern	Habitat
Northern Myotis (*Myotis septentrionalis*)	Dense ponderosa pine and mixed coniferous/deciduous forest; roosts in caves, mines, tunnels, and under bark of snags; elevation ranges between 4000 to 6500' in the Black Hills (Schmidt 2003c).
Small-footed Myotis (*Myotis ciliolabrum*)	Variable habitats, but usually associated with rocky areas like bluffs, dissected breaks, ridges, cliffs and major rock outcrops; Roosts include mines, caves, rock features, and under bark (Schmidt 2003d).
Invertebrates	
Atlantis Fritillary Butterfly (*Speyeria Atlantis pahasapa*)	Prefer wet meadows and boggy areas near springs and headwaters of small streams (Marrone 2002).
Tawny Crescent Butterfly (*Phyciodes batesii*)	Open meadows and riparian woodlands (Stefanich 2001).
Callused Vertigo Snail (*Vertigo arthuri*)	Moist, relatively undisturbed forest with diverse understories, deep litter, and abundant woody material. Calcareous or shist soils. (Frest and Johannes 2002, Anderson 2004a)
Frigid Ambersnail (*Catinella gelida*)	Limestone soils, usually in open ponderosa pine forest (sometimes spruce), often with a secondary deciduous tree and shrub component (Frest and Johannes 2002).
Mystery Vertigo Snail (*Vertigo paradoxa*)	On limestone or schist soils, usually in spruce forests (but sometimes pine) with relatively closed canopy, abundant litter, and well-developed understories (Frest and Johannes 2002, Anderson 2004b).
Striate Disc Snail (*Discus shimekii*)	Found in litter of rich mesic forests with limestone soils, generally on shaded, north-facing slope bases; often bordering or ranging slightly onto stream flood plains (Frest and Johannes 2002).

Migratory Birds

The USFWS Birds of Conservation Concern (BCC) (USDI Fish and Wildlife Service 2008) partitions North America into 37 Bird Conservation Regions. The Black Hills is included in BCR 17 – Badlands and Prairies. Of the 38 bird species found in BCR 17 (USDI Fish and Wildlife Service 2008), twenty species are not expected to occur in the Black Hills due to lack of habitat. Eleven are duplicated on the R2 sensitive species list, and are evaluated in the BA/BE if they have potential to occur in the Black Hills. There are seven remaining species that could potentially occur in the Black Hills: golden eagle, Swainson's hawk, prairie falcon, black-billed cuckoo, red-headed woodpecker, pinyon jay and dickcissel. Of these seven species, the golden eagle, red-headed woodpecker and black-billed cuckoo have the potential to occur within the treatnment areas. The Swainson's hawk, prairie falcon, pinyon jay and dickcissel will not be analyzed because suitable habitat is not present in the potential treatment area.

Golden Eagle: This eagle inhabits open country, from barren areas to open coniferous forests, primarily in hilly or mountainous regions, but is also found in deserts and grasslands. It prefers to nest on cliff ledges, but will occasionally use trees for nesting. The golden eagle utilizes hilltops, cliff ledges and trees for roosting. Within the Black Hills, this eagle prefers to nest on sandstone and limestone cliffs. Contiguously forested habitats, such as those found within most of the project area are not preferred by golden eagles, but they may be used for roosting or perching if suitable nesting or foraging habitat is nearby. Forest Plan direction provides direction to protect known golden eagle nests (Forest Plan Standard 3204).

Red-headed Woodpecker: Red-headed Woodpecker prefers open, park-like woodlands, including open ponderosa pine, but is most prevalent along riparian areas within forested areas. They use

more open and edge forest habitats than some other woodpeckers, but are still dependent on snags and decaying trees (Anderson 2003). They occur locally in the Black Hills, where they are generally uncommon to rare. At present, they occur in very low densities across the Forest except in burn areas where they are found in higher densities in 2009 (White et al. 2010). They are a generalist species feeding on mast, a wide variety of berries, as well as insects and other birds' young and they often appear in areas with insect outbreaks (Anderson 2003).

Black-billed Cuckoo: This species favors areas of upland woods that provide a variety of trees, bushes and vines. Also occurs in brushy pastures, hedgerows, open woodlands, thickets, and along wooded roadsides. Preferred habitat includes low, dense, shrubby vegetation . They will also inhabit open woods, avoiding extremely dense woods and high elevations (Haldeman 1980).

Environmental Consequences

Assumptions

- Treatments will follow Forest Plan standards and guidelines, WCP Handbook standards, BMPs and project design criteria during implementation.
- Treatments will occur in Management Areas proportional to the amount of potential treatment areas in those Management Areas.
- Commercial treatments will occur in Structural stages 4B and 4C because they are of commercial size, and will occur in 4B and 4C proportional to their availability.
- Non-commercial (POL) activities will occur in all structural stages in the potential treatment areas (3B, 3C, 4B, 4C) proportional to their availability.
- Insects will infest tree diameter classes (>5 inches dbh) proportional to their availability on the landscape.
- Vegetation treatments in the action alternatives will remove very large trees proportional to their availability on the landscape.

General Effects to Wildlife Habitat

Alternative A

MPB activities are expected to create more open forest conditions in ponderosa pine (Structural Stages 1, 2, 3A, 4A) across the Forest. Big game forage is expected to increase, but some of the forage may become inaccessible if the fallen dead trees form a barrier. If these open conditions occur in bighorn sheep use areas within suitable distance of water and escape terrain, bighorn sheep habitat is expected to be improved through improved visibility. If these open conditions occur at snail colonies, they could cause severe drying of sites, increase isolation. If fires occur in the increased fuel loads it could kill colonies that are burned over. Open forest conditions are also used by peregrine falcons and goshawks for foraging, saw-whet owls, Lewis's woodpeckers and northern flying squirrels. These species are expected to benefit from MPB activity.

Dense forest conditions (Structural Stages 3B, 3C, 4B, 4C and 5) are expected to decline in this alternative as a result of continued MPB outbreaks. Some existing goshawk nest areas are expected to be lost to MPB activity. Goshawk nesting habitat (pine structural stages 4B, 4C and 5) and habitat for other species that use dense, mature forest (flammulated owls, Black-backed

woodpeckers, American marten, broad-winged, sharp-shinned and Cooper's hawks, saw-whet owls, pygmy nuthatches and northern flying squirrels.) is expected to decline due to MPB activity.

MPB activities are expected to reduce large, mature ponderosa pine trees. These large trees serve as raptor roost trees, bat roosts, foraging habitat for brown creepers and pygmy nuthatches, and provide future large snags for woodpeckers and flying squirrels. MPB are not expected to remove all large, mature trees, but this habitat component for these species is expected to be reduced.

MPB activity could increase the risk of stand-replacing wildfire as infested trees fall down and add to the fuel load. Stand-replacing fire would create Black-backed and Lewis's woodpecker habitat while removing habitat for other sensitive species.

Aspen may increase over time in response to more open forest conditions. Deciduous trees such as aspen and oak may increase under if MPB areas have a deciduous component. Redbelly snakes, broad-winged hawks, Cooper's hawks and goshawks use hardwoods or prey on animals that use hardwood habitat. These species would benefit from increased aspen and hardwoods.

White spruce may increase if surrounding ponderosa pines are killed by MPB. These increases would be expected to occur slowly over several decades and can be expected to occur in areas where small inclusions of spruce occur within pine stands. Spruce habitat is not expected to change noticeably in the next 5 years. Flammulated owls, American marten, broad-winged hawks, Cooper's hawks and northern flying squirrels all use spruce as part of their habitat.

Connectivity between spruce habitat patches used by marten could be affected if MPB opens the canopy in these areas below 50% canopy closure. If a wildfire occurs, the increase in downed wood from MPB killed trees could increase the risk that spruce habitat and connecting pine habitat would burn.

Alternative B
MPB activity is expected to continue under Alternative B. The effects of MPB in Alternative B are expected to be similar to Alternative A in the untreated areas. Proposed treatments are expected to have the following direct and indirect effects.

Effects Common to All Vegetation Treatments
Structural stages 4B, 4C and 5 are expected to decline more than Alternative A as a result of mechanical treatments to control MPB. Alternatives B offers added flexibility over Alternative A in prioritizing treatments for MPB. If sanitation treatments occur near goshawk nests sooner in Alternative B, the risk of losing desirable vegetation characteristics at the nest sites may be reduced compared to Alternative A. Nesting habitat (pine structural stages 4B, 4C and 5) is expected to decline due to MPB and treatment activity.

Habitat for other species (flammulated owls, Black-backed woodpeckers, broad-winged, sharp-shinned and Cooper's hawks, saw-whet owls, pygmy nuthatches and northern flying squirrels) that use dense, mature forest conditions is expected to decline. These species may decline until the forest recovers from MPB and treatments.

Open forest conditions are expected to increase while dense forest conditions are expected to decline due to treatment activities. Open forest conditions are expected to be greater than Alternative A and less than Alternative C. Open forest conditions are used by peregrine falcons and goshawks for foraging, saw-whet owls, Lewis's woodpeckers and northern flying squirrels.

Open forest conditions that provide good visibility for bighorn sheep are expected to increase due to vegetation treatments. These open forage conditions may provide more forage than Alternative A because sanitation of infested trees is expected to reduce the number of snags that are likely to fall down in the future. If these open conditions occur in bighorn sheep use areas near water and escape terrain, bighorn sheep habitat could be improved. Treatments in Alternative B have more potential to improve bighorn sheep habitat than Alternative A.

Foraging habitat for bats would most likely improve under this alternative, through opening of pine stands by treatment activities. Insect populations may increase after canopy opening, thereby increasing available bat prey. Silvicultural treatments of timber harvest that benefit riparian habitat would also benefit bat insect prey, and thus bat foraging habitat.

Thinning treatments are expected to conserve habitat for woodpeckers, brown creepers, and pygmy nuthatch, and bats by conserving larger-diameter trees, which may eventually provide large-diameter snags. Alternative B is expected to lead to fewer mature and large trees and open forest conditions on the Forest than Alternative A and more than Alternative C.

Deciduous trees such as aspen and oak may increase under this alternative if MPB areas have a deciduous component. This could improve foraging habitat for redbelly snakes, broad-winged hawks, Cooper's hawks, goshawks and other species that use hardwoods or prey on animals that use hardwood habitat. The potential for hardwood to increase is greatest in Alternative C, followed by Alternative B and A, respectively.

Alternative B is expected to have more opportunities for spruce expansion than Alternative A because it includes treatments that are expected to create more open forest conditions. These increases would be expected to occur slowly over several decades and can be expected to occur in areas where small inclusions of spruce occur within pine stands. Spruce habitat is not expected to change noticeably in the next 5 years. Flammulated owls, American marten, broad-winged hawks, Cooper's hawks and northern flying squirrels all use spruce as part of their habitat.

Connectivity between spruce habitat patches could be reduced if MPB opens the canopy in pine stands adjacent to spruce areas below 50% canopy closure. Treatments would maintain 50% canopy cover in marten connectivity corridors (Standard 3215), but MPB may reduce the canopy closure below effective levels. Sanitation treatments are expected to occur in connecting corridors in Alternative B to help maintain canopy cover. Alternative B has more flexibility than Alternative A to sanitize MPB infestations in connective corridors and maintain their value to marten. Forest Plan standards pertaining to the retention of CWD (Standards 3117 and 2308a) would be followed. Habitat for marten prey associated with closed pine forest conditions would also decrease. If fuel loading is reduced adjacent to spruce by removal of infested trees, Spruce sites and connecting corridors may be less susceptible to wildfire.

The action alternatives conserve habitat for snails (Objective 221) by active management following Forest Plan direction. Active management, which lessens the risk of high intensity fire, would potentially benefit snails. Silvicultural treatments may dry out some mesic sites, while enhancing others.

Sanitation (cut/chunk, cut/pile/burn, cut/chip, commercial sanitation): Direct mortality of most adult birds and mammals is expected to be unlikely in due to their mobility. Undiscovered bird nests could be lost in all alternatives during treatment activities if they occur within treatment areas. Direct effects include limited potential for individual mortality due to tree felling. Cutting of occupied daytime bat roost trees may negatively impact individual bats, if a roost snag is determined to be a safety hazard and removed. Small mammals could be killed directly or die from lack of cover if they are using piles when the piles are burned.

Commercial Timber harvest: Effects are expected to be similar to sanitation activities except that commercial harvest involves more heavy equipment and hauling traffic. The added heavy equipment and road traffic has the potential to add more direct mortality of less mobile species such as land snails, amphibians, and reptiles. Unknown snail colonies may be impacted in treatment areas over time, however, most treatment areas do not occur in typical snail habitat. Known snail colonies would be conserved according to Forest Plan direction (Standard 3103). In addition, BMPs and Forest Plan Standards pertaining to watershed, soils, and road construction would help avoid some of these effects.

Road Construction/Use: No new roads would be constructed in this alternative so no habitat would be lost to road surface. Existing roads used for the project would be closed following project completion, so additional disturbance is not expected following project completion. Treatment and hauling activities may disturb many wildlife species during operations. Long term, disturbances from roads are not expected above the current level because new roads would be closed following harvest activities.

Semiochemical treatments (Spraying trees, pheromone traps): Tree spraying to repel MPB and the use of pheromone traps are not expected to reduce the overall MPB population on the Forest due to their cost and limited use. Tree spraying and pheromone traps are not expected to adversely affect species that prey on MPB, such as woodpeckers. These chemicals may kill other insects at the local area where used. This could lead to fewer insectivorous birds in these localized areas.

Habitat features such as goshawk nests, bat hibernacula, eagle and other raptor nests, snail colonies are known to be sensitive to changes in surrounding vegetation. If pheromone traps are placed in forested habitat features, they can be expected to increase the risk that those habitat features will be altered by MPB. Pheromone traps would not be placed in goshawk nest areas (Standard 3108), marten corridors (Standard 3215), and snail colonies (Standard 3103). Pheromone traps/baiting may be used near some of these features to draw MPB away from the site. This may help reduce effects of MPB on those sites.

Alternative C

MPB activity is expected to continue under Alternative C. The effects of MPB in Alternative C are expected to be similar to Alternatives A and B in the untreated areas. Proposed treatments

under Alternative C are expected to have similar effects as Alternative B except for the differences noted below.

Effects Common to All Vegetation Treatments

The effects of Alternative C are expected to be similar to Alternative B except that Alternative C would treat more acres and offer more flexibility on where to place treatments. The added flexibility offers more opportunities to protect known wildlife habitat features from MPB activity compared to Alternatives A and B.

Alternative C includes more vegetation treatments than Alternative B. Mature ponderosa pine stands with moderate-or-high canopy cover (structural stages 4B, 4C, and 5) is expected to decline more in Alternative C than in Alternatives A and B due to the added treatment activities. Habitat for species (flammulated owls, Black-backed woodpeckers, broad-winged, sharp-shinned and Cooper's hawks, saw-whet owls, pygmy nuthatches and northern flying squirrels) that use dense, mature forest conditions is expected to decline. These species may decline until the forest recovers from MPB and treatments.

Open forest conditions are expected to increase while dense forest conditions are expected to decline due to treatment activities. Open forest conditions are expected to be greater than Alternatives A and B. Open forest conditions are used by peregrine falcons and goshawks for foraging, saw-whet owls, Lewis's woodpeckers and northern flying squirrels.

Open forest conditions that provide good visibility for bighorn sheep are expected to increase due to vegetation treatments. These open forage conditions may provide more forage than Alternatives A and B because sanitation of infested trees is expected to reduce the number of snags that are likely to fall down in the future. If these open conditions occur in bighorn sheep use areas near water and escape terrain, bighorn sheep habitat could be improved. Alternative C has more potential to improve bighorn sheep habitat than Alternatives B and A.

Foraging habitat for bats would most likely improve under the action alternatives, through opening of pine stands by treatment activities. Insect populations may increase as the understory increases following logging and thinning, thereby increasing available bat prey. Silvicultural treatments of timber harvest that benefit riparian habitat would also benefit bat insect prey, and thus bat foraging habitat.

Thinning treatments are expected to conserve habitat for woodpeckers, brown creepers, and pygmy nuthatch, and bats by conserving larger-diameter trees, which may eventually provide large-diameter snags. Alternative C includes more treatment that reduce amount of mature forest than Alternative B. Alternative C is expected to have fewer large diameter trees and mature trees on the landscape than Alternatives A and B.

Deciduous trees such as aspen and oak may increase under this alternative if MPB areas have a deciduous component. This could improve foraging habitat for redbelly snakes, broad-winged hawks, Cooper's hawks, goshawks and other species that use hardwoods or prey on animals that use hardwood habitat. The potential for hardwood to increase is greatest in Alternative C, followed by Alternative B and A, respectively.

Alternative C is expected to have slightly more opportunities for spruce expansion than Alternatives B or A because it includes treatments that are expected to create more open forest conditions. These increases would be expected to occur slowly over several decades and can be expected to occur in areas where small inclusions of spruce occur within pine stands. Spruce habitat is not expected to change noticeably in the next 5 years. Flammulated owls, American marten, broad-winged hawks, Cooper's hawks and northern flying squirrels all use spruce as part of their habitat.

Treatments would maintain 50% canopy cover in marten connectivity corridors (Standard 3215), but MPB may reduce the canopy closure below effective levels similar to Alternative B. Sanitation treatments are expected to occur in connecting corridors in Alternative C to help maintain canopy cover. Alternative C has the most flexibility to sanitize MPB infestations in connective corridors and maintain their value to marten.

Sanitation (cut/chunk, cut/pile/burn, cut/chip, commercial sanitation): Direct mortality of most adult birds and mammals is expected to be unlikely in due to their mobility. Undiscovered bird nests could be lost in all alternatives during treatment activities if they occur within treatment areas. Direct effects include limited potential for individual mortality due to tree felling. Small mammals could be killed directly or die from lack of cover if they are using piles when the piles are burned. Cutting of occupied daytime bat roost trees may negatively impact individual bats, if a roost snag is determined to be a safety hazard and removed. Potential direct effects of Alternative C include mortality of unknown frog locations through the use of heavy equipment and falling of trees if activities are located within mesic areas or the surrounding uplands of breeding grounds.

Commercial Timber harvest: Effects are expected to be similar to sanitation activities except that commercial harvest involves more heavy equipment and hauling traffic. The added heavy equipment and road traffic has the potential to add more direct mortality of less mobile species such as land snails, amphibians, and reptiles. More small mammals could be killed directly or die from lack of cover if they are using slash piles when the piles are burned. Unknown snail colonies may be impacted in treatment areas over time, however, most treatment areas do not occur in typical snail habitat. Known snail colonies would be conserved according to Forest Plan direction (Standard 3103). In addition, BMPs and Forest Plan Standards pertaining to watershed, soils, and road construction would help avoid some of these effects.

The effects of alternative C are the same as Alternative B except that increased silvicultural treatments in Alternative C could mean increased avoidance of more areas when vegetation treatments are active. Direct mortality of unknown snail colonies could occur during timber harvest activities.

Known snail colonies would be conserved according to Forest Plan direction (Standard 3103) except in Spearfish Canyon (Management Area 4.2A).). Alternative C proposes timber harvest via cable logging and use of tractors and skidders in MA4.2A. Some road construction is expected associated with these activities. Due to the high occurrences of Cooper's mountainsnail in MA4.2A these actions would not be consistent with Standard 3103. Therefore, a Forest Plan amendment is proposed as part of Alternative C, to allow these actions to take place within MA4.2A. Approximately 2/3 of MA 4.2A is identified a potential treatment areas. If these areas are treated, as much as 2/3 of the available habitat could be affected. Treatments that open the

canopy, such as thinning and selection harvest, would be expected to open the canopy and cause the sites to dry from exposure to sun. Snails are known to be sensitive to site conditions and are not expected to use these areas until shade and moist conditions return. Ground disturbing activities such as tractors and skidders, and cable logging on snail colonies are expected kill snails and alter habitat. These activities are expected remove litter and expose bare soil, which would likely be unsuitable for snails until the litter layer developed.

Road Construction: It is estimated that Alternative C would construct 70 miles of new system roads. Newly constructed roads may have a temporary increase in potential vehicle caused mortality. Road construction is expected to reduce wildlife habitat by about five acres per mile of road (Rowland et al. 2004). Disturbance effects and mortality from vehicles is not expected to increase in the long term because newly constructed roads and other roads used during the project would be closed following project completion.

Known snail colonies would be conserved according to Forest Plan direction (Standard 3103) except in Spearfish Canyon (Management Area 4.2A). Alternative C proposes temporary road construction (no system roads constructed) in MA4.2A. Due to the high occurrences of Cooper's mountainsnail in MA4.2A these actions would not be consistent with Standard 3103. Therefore, a Forest Plan amendment is proposed as part of Alternative C, to allow these actions to take place within MA4.2A. Ground disturbing activities such as road construction on snail colonies are expected kill snails and alter habitat. These activities are expected remove litter and expose bare soil, which would likely be unsuitable for snails.

Semiochemical treatments (Spraying trees, pheromone traps): The effects of semiochemical treatments are expected to be the same as Alternative B.

Snags and Down Woody Material

Alternative A
Snags are expected to increase while MPB activity is high (short term) and decline as trees killed by MPB fall to the ground (long term). Down woody material is expected to increase as trees killed by MPB fall.

Harvesting and clearing of dead trees (snags) is not part of this alternative. In Alternative A, short term snag densities are expected to be the highest of any alternative in the next five to seven years due to high levels of MPB mortality (Allen 2011a). In the short term, snags are expected to remain above 3 snags per acre in a variety of diameters and heights (Forest Plan Objective 211). In the short-term, large areas of dead trees are expected to attract irruptive species such as the black-backed woodpecker, Lewis's woodpecker, and redheaded woodpecker. However, the snag density may decline if the tree mortality from insects decline and current insect killed trees fall. This alternative is expected to lead to increased down woody material as insect-killed trees fall.

Alternative B
Snags are expected to increase while MPB activity is high (short term) and decline as trees killed by MPB fall to the ground (long term). Down woody material is expected to increase as trees killed by MPB fall.

Harvesting and clearing of dead trees (snags) is not part of this alternative. However, snags may be cut because they pose a safety hazard to the public or to protect communities which are consistent with Forest Plan direction (Standard 2301 and 2305). This could include dead trees being removed to provide safe public egress in the event of a wildfire, removal of dead trees within close proximity of a high use recreation sites and in fuel breaks, especially within 200' of private land. However, the removal of snags for safety reasons is not expected to move overall snag densities in the project area below Objective 211. MPB mortality would continue to affect untreated stands so snag densities are expected to remain above Object 211 in the next five to seven years. In the long term, snag density is expected to decline as insect-killed trees fall and insect attacks decline. Treatments are expected to reduce the amount of large diameter trees on the Forest slightly more than MPB in Alternative A. Therefore the number of mature and large trees available for future snags is expected to be slightly less than Alternative A, and slightly more than Alternative C. Down woody material is expected to increase less than Alternative A and more than Alternative C.

Alternative C
Effects are expected to be the same as Alternative B except the number of mature and large trees available for future snags is expected to be less than Alternatives A and B. Down woody material is expected to be less than Alternatives A and B because fewer trees are expected to die from MPB.

Riparian Habitat

Alternative A
No treatments would occur in riparian areas. MPB are expected to kill pine trees near some riparian areas, which may promote shrub and hardwood development along some riparian areas.

Action Alternatives
Logging activities and treatment of logging slash may require ground disturbance, which has the potential to indirectly affect riparian and wetland ecosystems primarily through changes in sediment loads to creeks or wetlands. The larger the amount of ground disturbance and/or the closer proximity to wetland and riparian areas, the greater the potential for disturbed areas to be connected to the streams and riparian areas, and the greater potential to have an indirect impact to riparian and wetland habitats. Alternative C includes the most treatments, followed by Alternative B and Alternative A, respectively. Therefore, Alternative C has the most potential to affect riparian habitat, followed by Alternatives B and A, respectively.

Under the action alternatives, the riparian areas throughout the project area are not targeted for treatment and would be protected and avoided through Best Management Practices (BMPs) and buffers created by the water influence zone (WIZ). Forest Plan standards and guidelines will be followed in all alternatives. Forest-wide standards and guidelines protect riparian areas, water influence zones, and wetlands. Under all alternatives, long-term riparian ecosystem health and ecological function are expected to be maintained by not allowing actions that would be detrimental to riparian- ecosystem condition (Standards 1301, 1302). Riparian and wetland areas that contain emphasis species would be given additional protection from direct and indirect disturbances under all alternatives (Standard 3106). In all alternatives, log landings, decking

areas and mechanical-slash piling would not occur within riparian areas unless the integrity of riparian areas can be protected (Standard 1306).

Management Indicator Species (MIS)

White-tailed Deer

Alternative A
No direct mortality is expected because not management activities are included in this alternative.

Open forest conditions that provide forage (SS 1, 2, 3A, and 4A) are expected to increase due to MPB activity (Dymerski 2012). Dense forest conditions that provide screening cover (Structural Stages 3B, 3C, 4B, 4C and 5) are expected to decline as open forest condition increase. Aspen and other hardwood may increase as ponderosa pine dies from MPB. This could lead to an increase in forage and in fawning habitat. Increases in aspen are most likely to occur around existing aspen, meaning aspen distribution is expected to be similar to current conditions.

Habitat trend is expected to continue to remain stable or slightly increase. The juxtaposition of cover and forage will depend on the location of MPB attacks. The juxtaposition may influence how deer use the habitat – deer may not use some forage if lack of cover makes them more susceptible to predation.

Alternative B
Direct deer mortality is unlikely, but could happen if logging truck strike a deer during hauling activities.

Commercial treatments are expected to create more open forest conditions that provide forage. Open forest conditions that provide forage (SS 1, 2, 3A, and 4A) are also expected to increase due to MPB activity (Dymerski 2012). Dense forest conditions that provide screening cover are expected to decline as open forest conditions increase. Screening cover would be retained along arterial and collector roads in consistent with Guideline 3203, but MPB are expected to take some of those areas as well as other areas on the Forest. Aspen and other hardwood may increase as ponderosa pine dies from MPB. This could lead to an increase in forage and in fawning habitat. Increases in aspen are most likely to occur around existing aspen, meaning aspen distribution is expected to be similar to current conditions.

Open road densities are not expected to change because all new roads would be closed following the project.

Habitat trend is expected to continue to remain stable or slightly increase. The juxtaposition of cover and forage will depend on the location of MPB attacks and the location of commercial and non-commercial activities. The juxtaposition may influence how deer use the habitat – deer may not use some forage if lack of cover makes them more susceptible to predation.

Alternative C
Effects of Alternative C are expected to be the same as Alternative B, except for the following differences.

Commercial treatments in all alternatives are expected to create more acres of open forest conditions over the next five to seven years. Open forest conditions that provide forage is expected to increase more than Alternative B and screening cover is expected to decline more than Alternative B over the next five to seven years.

Alternative C includes approximately 70 miles of newly constructed roads. These newly constructed roads could remove an estimated 350 acres of forage habitat (5 acres per mile, Rowland et al. 2004).

Summary: Deer populations can be expected to remain stable similar to habitat trends over the long term. However, deer populations can be expected to have a delayed response to improved habitat until the forage responds to the changes in tree cover. Deer harvest levels are expected to continue and will also influence deer populations.

The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if standards are followed, and if conditions move towards structural stage objectives. Vegetation treatments in Alternatives B and C will follow applicable Forest Plan standards and guidelines. All alternatives conserve deer habitat (Object 238) by providing a diversity of forage and cover juxtaposed across the Forest. Conditions are expected to move towards or exceed structural stage objectives that provide forage for deer in all alternatives due to MPB activity and vegetation treatments. Vegetation treatments are not expected to reduce dense mature stands (4C) below objectives. Young dense stands (3C) that provide cover are expected to be at or below objectives. White-tailed deer are likely to persist on the Forest under all alternatives. Alternative A is expected to provide the best mix of screening habitat in close proximity to foraging habitat, followed by Alternatives B and C, respectively.

Beaver

Alternative A
In Alternative A, MPB activity is expected to lead to increased open forest conditions. Aspen and bur oak may increase as ponderosa pine dies from MPB. This could lead to an increase in food and dam building material if these occur close to streams. Alternative A is expected to have the least potential for hardwood increase because it is expected to have the fewest acres of open forest conditions. The changes can be expected to occur slowly as aspen and oak replace pine in some places. A benefit to beaver habitat would not be realized for several decades. Likewise, any increase in the beaver population would be slow. Aspen, burr oak and beaver would continue to be more abundant in the Northern Black Hills and sparse at the southern end of the Black Hills.

Alternative B
Alternative B conserves habitat for beaver (Objective 238) by contributing to riparian and hardwood objectives (Forest Plan Objective 201) and following Forest Plan standards and guidelines.

Forest-wide standards and guidelines protect riparian areas, water influence zones, and wetlands. Under the alternatives, long-term riparian ecosystem health and ecological function are expected to be maintained by not allowing actions that would be detrimental to riparian- ecosystem condition (Standards 1301, 1302).

Aspen and bur oak may increase in all alternatives as ponderosa pine dies from MPB or is removed by mechanical treatments (Objective 201). This could lead to an increase in food and dam building material if these occur close to streams. Alternative B is expected to have more potential for hardwood increases than Alternative A because it is expected to have more acres of open forest condition. Alternative B is expected to have less potential for hardwood increases than Alternative C because it is expected to have less acres of open forest condition.

The changes can be expected to occur slowly as aspen and oak replace pine in some places. A benefit to beaver habitat would not be realized for several decades. Likewise, any increase in the beaver population would be slow. Aspen, burr oak and beaver would continue to be more abundant in the Northern Black Hills and sparse at the southern end of the Black Hills. Beaver are expected to continue to persist on the Forest.

Alternative C
Effects are expected to be the same as Alternative B except that Alternative C is expected to have the most potential for hardwood increases because it is expected to have the most acres of open forest condition, followed by Alternatives B and A, respectively.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if standards are followed. All alternatives in this project follow Forest Plan riparian standards, contribute to aspen and bur oak objectives (201), and conserve habitat for beavers (Objective 238). Under All alternatives, beaver are likely to persist on the Forest.

Black-backed Woodpecker

Alternative A
MPB activity would continue to create snags across the Forest. Many high risk stands are expected to be affected by MPB. No infested trees would be removed, so they would remain available to woodpeckers. Snags are expected to be the highest in this alternative. In the next 5 years, snag densities are expected to remain above Forest Plan objective 211 due to the ongoing MPB outbreak. In the long term, snags are expected to decline as MPB killed trees fall down.

MPB activity could increase the risk of stand-replacing wildfire as infested trees fall down and add to the fuel load. Both beetle infestations and stand-replacing fire would create black-backed woodpecker habitat.

Alternative B
Alternative B could result in the loss of nests if occupied nest trees are cut during timber harvest or road construction. The mobility of adult birds would reduce the risk of direct mortalities.

Alternative B conserves habitat for black-backed woodpeckers (Objective 238, 221). All snags except those deemed safety hazards would be maintained (Standards 2301 and 2305). Many high insect risk stands are expected to be affected by MPB. In the absence of fire, areas of beetle outbreak might serve as the only substantial source of habitat in the Black Hills (Bonnot et. al. 2009). In the next 5 years, snag densities are expected to remain above Forest Plan objective 211

due to the ongoing MPB outbreak. In the long term, snags are expected to decline as MPB killed trees fall down.

Cutting of insect infested trees and hazardous snags is expected to reduce foraging habitat. Reducing insect populations via sanitation logging may reduce key food resources to black-backed woodpeckers during nesting. Alternative B is expected to reduce foraging habitat more than Alternative A and less than Alternative C.

Tree spraying to repel MPB is not expected to reduce the overall MPB population on the Forest due to its cost and limited use. Tree spraying is not expected to adversely affect black-backed woodpecker or their prey.

MPB activity could increase the risk of stand-replacing wildfire as infested trees fall down and add to the fuel load. Both beetle infestations and stand-replacing fire would create black-backed woodpecker habitat.

Alternatives B and C include timber harvest prescriptions that would reduce mature trees and stand density. Alternative B is expected to lead to fewer mature and large trees on the Forest than Alternatives A, and more than Alternative C.

Treatment and hauling activities may disturb Black-backed woodpeckers during operations. Long term, disturbances are not expected above the current level because new roads would be closed following harvest activities.

The impacts of timber treatment would be mitigated by Forest Plan standards and objectives for general snag protections, which are being met through specific design criteria in the project area. At the Forest level, habitat is expected to be maintained through structural stage objectives.

Alternative C
The effects of alternative are the same as Alternative B, except: Alternative C is expected to have fewer acres of live mature and old trees than Alternative B on the Forest because it includes more treatments that reduce amount of mature forest than Alternative B.

Cutting of insect infested trees and hazardous snags is expected be highest in Alternative C. Reducing insect populations via sanitation logging may reduce key food resources to black-backed woodpeckers during nesting. Alternative C is expected to reduce foraging habitat the most, followed by Alternatives B and A, respectively.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if standards are followed, and if conditions move towards structural stage objectives at the Forest level. All alternatives follow Forest Plan snag and downed wood standards. Open forest conditions are expected to increase in all alternatives. Treatments are not expected to reduce dense, mature pine forest below structural stage objectives. Black-backed woodpeckers are expected to persist on the Forest under all alternatives because snag standards will be followed and snags are expected to be abundant on the Forest over the next five to seven years. Thinning and sanitation treatments are expected to retain fewer mature

trees in Alternatives B and C, which is expected to lead to fewer large diameter snags in the future. In the long term, populations are expected to decline as MPB killed trees fall down.

Brown Creeper

Alternative A
Ponderosa pine structural stages 4C and 5 are expected to decline due to MPB activity. Ponderosa pine structural stages 4C and 5 are expected to decline less in Alterative A than in Alternatives B and C.

White spruce may increase if surrounding ponderosa pines on suitable sites are killed by MPB. These increases would be expected to occur slowly over several decades and can be expected to occur in areas where small inclusions of spruce occur within pine stands. Spruce habitat is not expected to change noticeably in the next 5 years.

Alternative B
Alternative B could result in the loss of nests if occupied nest trees are cut during timber harvest or road construction. The mobility of adult birds would reduce the risk of direct mortalities.

Ponderosa pine structural stages 4C and 5 are expected to decline due to MPB activity. Project activities designed to reduce stand susceptibility to MPB are also expected to reduce the amount of Structural Stage 4C by converting some of them to more open forest condition (SS 4A). Project activities are expected to reduce structural stage 4C more than Alternative A and less than Alternative C.

Alternative B includes timber harvest prescriptions that would reduce mature trees and stand density. Thinning may minimize the habitat fragmentation by maintaining more mature forest on the landscape, though that forest can be expected to be open. Alternative B is expected to retain more large and mature trees on the landscape than Alternative C, and less than Alternative A.

Tree spraying is not expected to affect brown creeper habitat or populations. Some localized effects are expected where treatments occur because the chemicals could kill non-targeted insects on which brown creepers feed. Spraying may protect some very large trees in campgrounds from MPB, which could benefit individual brown creepers in the long term, but is not expected to have any effect on Forest scale due to its cost and limited application.

White spruce may increase if surrounding ponderosa pines on suitable sites are killed by MPB or treated by mechanical methods. These increases would be expected to occur slowly over several decades and can be expected to occur in areas where small inclusions of spruce occur within pine stands. Spruce habitat is not expected to change noticeably in the next 5 years.

Brown Creeper populations are expected to decline as pine habitat components decline. Alternative B conserve habitat for brown creepers (Objective 238) by minimizing the loss of ponderosa pine habitat components to MPB.

Alternative C
Alternative C is expected to have the same effects as Alternative B, except the following: Structural stage 4C and 5 are expected to decline more in Alternative C that Alternative A and B due to increased acres treated.

Alternative C includes more treatments that reduce amount of mature forest than Alternative B Alternative C is expected to have fewer large diameter trees and mature trees on the landscape than Alternatives A and B, which could lead to fewer large snags in the future.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population of brown creeper if standards are followed, and if conditions move towards structural stage objectives at the Forest level. All alternatives in this project follow Forest Plan snag Standards 2301 and 2305, the spruce objective (239-LVD), and conserve habitat for brown creepers (Objective 238). Structural stage 4C is expected to decline in all alternatives, but is expected to be above objectives after five to seven years. Structural stage 5 is expected to continue to be below objectives in all alternatives. Structural Stage 4B is expected to be below objectives in MA 5.4 and 5.43. These reductions in structural stages increase the risk to persistence. Under All alternatives, brown creepers are likely to persist on the Forest because these structural stages are expected to remain above objectives in most Management Areas and spruce habitat is expected to remain in all alternatives. Brown creepers are most likely to persist in Alternative A because these structural stages occur in the greatest amounts, followed by Alternative B and C, respectively.

Golden-crowned Kinglet

Alternative A
White spruce may increase in all alternatives if surrounding ponderosa pines on suitable sites are killed by MPB. These increases would be expected to occur slowly over several decades and can be expected to occur in areas where small inclusions of spruce occur within pine stands. Spruce habitat is not expected to change noticeably in the next 5 years.

Alternative B
Alternative B could result in the loss of nests if occupied nest trees are cut during timber harvest or road construction. The mobility of adult birds would reduce the risk of direct mortalities.

Alternative B conserves habitat for golden-crowned kinglets (Objective 238). White spruce may increase in all alternatives if surrounding ponderosa pines are killed by MPB or treated by mechanical methods. Alternative B is expected to have more opportunities for spruce expansion than Alternative A because it includes treatments that are expected to create more open forest conditions. These increases would be expected to occur slowly over several decades and can be expected to occur in areas where small inclusions of spruce occur within pine stands. Spruce habitat is not expected to change noticeably in the next 5 years.

Alternative C
The effects of Alternative C are expected to be the same as Alternative B, except that Alternative C is expected to have more opportunities for spruce expansion than Alternatives A and B because it includes treatments that are expected to create more open forest conditions.

Summary: Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population of golden-crowned kinglets if standards are followed, and if conditions move towards the spruce objective (objective 239-LVD). All alternatives in this project follow applicable Forest Plan standards and none of the alternatives alter

spruce acres, thus the Forest is expected to continue to exceed the spruce objective. All alternatives contribute to conservation and maintenance of kinglet habitat (Forest plan Objective 238-c). Golden-crowned kinglets are likely to persist on the Forest.

Grasshopper Sparrow
All alternatives conserve habitat for grasshopper sparrows (Objectives 238, 221). None of the alternatives propose activities that would reduce or enhance grassland habitat (Objective 205). No direct or indirect effects are expected on grasshopper sparrows. Habitat and population trends are expected to be similar to current trends.

Ruffed Grouse

Alternative A
No direct effects are expected because no new activities would occur. Aspen and other hardwood may increase as ponderosa pine dies from MPB. This could lead to an increase in ruffed grouse habitat. Increases in aspen are most likely to occur around existing aspen, so aspen distribution is expected to be similar to current conditions.

Alternative B
Potential mortality of ruffed grouse and nest destruction could occur during timber and prescribed burning operations. The mobility of adult birds would reduce the risk of direct mortalities.

Aspen and other hardwood may increase in Alternative B as ponderosa pine dies from MPB or is removed by mechanical treatments. This could lead to an increase in ruffed grouse habitat. Alternative B may have more opportunities for grouse habitat increases that Alternative A because is expected to lead to more open conditions that may be more conducive to aspen regeneration. Increases in aspen are most likely to occur around existing aspen, so aspen distribution is expected to be similar to current conditions.

Alternative C
The effects of Alternative C are expected to be the same as Alternative B, except that Alternative C is expected to have more opportunities for aspen expansion than Alternatives A and B because it includes treatments that are expected to create more open forest conditions.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population of ruffed grouse if standards and guidelines are followed at the project level, and if conditions move towards aspen and hardwood objectives. All alternatives are expected to conserve grouse habitat (Objective 238) through increased aspen habitat (Objective 201), Forest-wide ruffed grouse populations are expected to remain stable over the next 5 years. Long term, populations could increase in all alternatives if aspen increases in response to more open Forest Conditions.

Song Sparrow

Alternative A
No direct effects are expected because no new treatments would occur in the alternative. MPB are expected to kill pine trees near some riparian areas, which may promote shrub and hardwood

development along some riparian areas. MPB activities may lead to more downed woody material near riparian areas as dead trees fall.

Alternative B
The risk of mortality to song sparrows is very low due to their mobility. Alternative B conserves riparian habitat for song sparrows (Objective 238). Under Alternative B, the riparian areas throughout the project area are not targeted for treatment and would be protected and avoided through Best Management Practices (BMPs) and buffers created by the water influence zone (WIZ). Forest Plan riparian standards and guidelines will be followed. Forest-wide standards and guidelines protect riparian areas, water influence zones, and wetlands. Long-term riparian ecosystem health and ecological function are expected to be maintained by not allowing actions that would be detrimental to riparian- ecosystem condition (Standards 1301, 1302). Riparian and wetland areas that contain emphasis species would be given additional protection from direct and indirect disturbances (Standard 3106). Log landings, decking areas, and mechanical-slash piling would not occur within riparian areas unless the integrity of riparian areas can be protected (Standard 1306). Similarly, song sparrow populations are expected to remain stable on the Forest.

Alternative C
The effects of alternative C are expected to be the same as Alternative B, except alternative C treats more acres, which could lead to a slight increase in direct mortality. Otherwise, standards, guidelines and BMPs conserve riparian habitat for song sparrows. Song sparrow populations and habitat are expected to remain stable on the Forest.

Summary: Population viability was evaluated in the Phase II Forest Plan Amendment FEIS. The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population of song sparrows if standards and guidelines are followed, and if conditions move towards riparian restoration objectives. All alternatives follow Forest Plan riparian standards and guidelines. All alternatives are expected to have little change (neutral effect) on riparian habitat for the song sparrow.

Threatened and Endangered Species

Black-footed Ferret
The only prairie dog town close to Wind Cave National Park that could have ferrets is the town in Section 2 of Norbeck Wildlife Preserve. None of the alternatives propose treatments or roads within prairie dog towns, including the one in Norbeck Wildlife Preserve. All alternatives are expected to have no effect on black-footed ferrets.

Region 2 (R2) Sensitive Species
This section contains the expected impacts from taking no action (Alternative A) and implementing the action alternatives (Alternatives B and C).

Summary of Determinations
The Determination language is set forth in Region 2 Supplement 2600-2011-1 to Forest Service Manual 2670. Determinations for each species were made as a result of the information gathered during the pre-field review, field reconnaissance, and effects analysis conducted in this report. The basis for each determination is potential habitat, expected occurrence, distribution, effects

from Forest activities, and proposed mitigation used to alleviate the potential effects resulting from Forest-management activities as well as the no action alternative. All species determinations apply only if the proposed project area design criteria are adopted and implemented. The following Region 2 Sensitive Species have a determination of "No Impact" for all alternatives:

American peregrine falcon
Northern harrier
Burrowing owl
Grasshopper sparrow
Loggerhead Shrike
Yellow-billed cuckoo
Long-billed curlew
Black-tailed prairie dog
Regal fritillary

The following Region 2 Sensitive Species have a determination of "may impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing" for all alternatives:

Bald eagle
Northern goshawk
Flammulated owl
Lewis's woodpecker
Black-backed woodpecker
Fringed myotis
Townsend's big-eared bat
Hoary bat
American marten
Rocky Mountain bighorn sheep
Northern leopard frog
Black Hills redbelly snake
Cooper's mountain snail

American Peregrine Falcon
None of the alternatives are expected to cause direct mortality of peregrines.

All alternatives conserve habitat for peregrines (Objective 221) through Forest Plan standards and guidelines. In all alternatives, potential nest sites are not expected to be affected because of the instability and inaccessibility of rock cliffs. If nests are discovered on the Forest, they would be protected using the best available information (Standard 3204). Open forest conditions suitable for foraging are expected to increase in all alternatives but considering the preponderance of unutilized habitat, it is unlikely that such changes would lead to more use by peregrines. None of the alternatives are expected to impact peregrine falcons.

Bald Eagle

Alternative A
No direct mortality is expected because no new activities would occur under this alternative. MPB activities are expected to reduce large, mature ponderosa pine trees that could serve as eagle roost trees. MPB would not remove all large, mature trees. Sufficient trees are expected to remain on the landscape, given the relatively few bald eagles that occur in the Black Hills during the winter. The primary winter food source, deer carrion, is expected to continue to be available.

Alternative B
No direct mortality is expected due to the mobility of eagles. Some individual wintering bald eagles may avoid areas when vegetation treatments are active.

Alternative B conserves habitat for bald eagles (Objective 221). The primary winter food source, deer carrion, is expected to continue to be available. In all alternatives, activities would be restricted

during sensitive periods near the communal roost at Pactola Reservoir (Standard 3101). Nests also would be protected through avoidance and timing in all alternatives (Standards 3204, 3101).

Alternative C
The effects of alternative C are the same as Alternative B except that increased silvicultural treatments in Alternative C could mean increased avoidance of more areas when vegetation treatments are active. Alternative C conserves bald eagle habitat (Objective 221) by following Forest Plan standards and guidelines.

Determination: All alternatives may impact individual eagles, but are not likely to result in a loss of viability in the Planning Area, no cause a trend toward federal listing. The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if standards are followed. All alternatives follow Forest Plan standards relevant to bald eagle protection.

Northern Goshawk

Alternative A
Direct mortality is expected to be unlikely because no new vegetation management activities would occur. Structural stages 4B, 4C and 5 are expected to decline this alternative as a result of continued MPB outbreaks. Some existing nest areas are expected to be lost to MPB activity. Nesting habitat (pine structural stages 4B, 4C and 5) is expected to decline due to MPB activity.

Alternative A is not expected to lead to additional disturbance to nesting goshawks because this alternative does not include silvicultural treatments, new road construction or additional open roads.

Open forest conditions are expected to increase while dense forest conditions are expected to decline due to MPB activities. Snags are expected to be abundant in the near future and decline as MPB attacks subside and trees fall. Downed woody material is expected to increase as snags fall, as long as a wildfire doesn't consume it. Aspen may increase over time in response to more open forest conditions.

Goshawks can be expected to shift their diet based prey availability. While the MPB are active, goshawks may shift their diet more towards snag dependant species such as woodpeckers. As the snags age and fall down, goshawk may be limited to forest generalists that use open pine conditions or other cover types such as rabbits, ground squirrels, robins, and jays. There may a period after the snags have fallen and before shrubs and aspen can respond that prey diversity and availability is reduced. Nesting habitat may also be reduced at this time. If this occurs, goshawk populations can be expected to decline. In the long term, as the shrubs, aspen and pine re-establish goshawk populations can be expected to rebound as associated prey and nest areas rebound to pre-epidemic levels.

Alternative B
Direct mortality is expected to be unlikely in due to the mobility of goshawks. Undiscovered nests could be lost in all alternatives during treatment activities if they occur within treatment areas.

Alternative B conserves nesting habitat for goshawks (Objective 221) by following Forest Plan standards. All known or newly discovered goshawk nests will be managed according to the Forest Plan (Standards 3108, 3111) to minimize disturbance and impacts to habitat. Structural stages 4B, 4C and 5 are expected to decline more than Alternative A as a result of mechanical treatments to control MPB. Alternatives B offers added flexibility over Alternative A in prioritizing treatments for MPB. If sanitation treatments occur near goshawk nests sooner in Alternative B, the risk of losing desirable vegetation characteristics at the nest sites may be reduced compared to Alternative A. Nesting habitat (pine structural stages 4B, 4C and 5) is expected to decline due to MPB and treatment activity.

Alternative B minimizes disturbance to nesting goshawks during project implementation by providing timing restrictions on logging activities (Standard 3111). No new roads would be constructed under this alternative. Existing roads used for the project would be closed following project completion, so additional disturbance is not expected following project completion.

Alternative B conserves foraging habitat for goshawks (Objective 221). Open forest conditions are expected to increase while dense forest conditions are expected to decline due to MPB and treatment activities. Open forest conditions are expected to be greater than Alternative A and less than Alternative C. Snags are expected to be abundant in the near future and decline as MPB attacks subside and trees fall. Downed woody material is expected to increase as snags fall, as long as a wildfire doesn't consume it. Aspen may increase over time in response to more open forest conditions.

Tree spraying to repel MPB is not expected to reduce the overall MPB population on the Forest due to its cost and limited use. Tree spraying is not expected to adversely affect goshawk or their prey.

Alternative C

The effects of Alternative C are expected to be similar to Alternative B except that Alternative C would treat more acres and offer more flexibility on where to place treatments. Nesting habitat is expected to decline more than Alternatives A and B. The added flexibility offers more opportunities to protect known goshawk nests from MPB activity compared to Alternatives A and B. Alternative C is expected to result in the most open forest conditions, followed by Alternative B and A, respectively. All vegetation management activities would conserve goshawk habitat by following Forest Plan standards and guidelines for goshawk nests, snags and down woody material.

Determination: All alternatives "may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing". Impacts of the action alternatives include the reduction of habitat and potential removal of unknown nests and disturbance by management activities. The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population of northern goshawk if standards are followed Forest-wide at the project level, and if conditions move towards the structural stage and late succession objectives at the Forest level. Alternatives B and C in this project follow applicable Forest Plan standards including goshawk Standards 3108 and 3111. Open forest structural stages (1, 2, 3A, 4A) are expected to increase in all alternatives due to MPB activity. These structural stages are highest in Alternative C, followed by Alternative B. Structural

Stages 3B and 3C are expected to be below objective for all alternatives. These structural stages are expected to be highest in Alternative A, followed by Alterative B and C, respectively. Structural Stage 4B is expected to be above objectives except MA 5.4 and 5.43 in all alternatives. Structural stage 4C is expected to be at or above objectives for all alternatives. Based on this information, goshawks are expected to persist on the forest because a mix of structural stages for foraging is expected in all alternatives and nesting habitat (4B, 4C, and 5) is expected to be available in all alternatives. Alternatives B and C offer flexibility to sanitize MPB infestations near goshawk nests, which is expected to help maintain existing nest areas. Goshawks can be expected to shift their diet based prey availability. While the MPB are active, goshawks may shift their diet more towards snag dependant species such as woodpeckers. As the snags age and fall down, goshawk may be limited to forest generalists that use open pine conditions or other cover types such as rabbits, ground squirrels, robins, and jays. There may a period after the snags have fallen and before shrubs and aspen can respond that prey diversity and availability is reduced. Nesting habitat may also be reduced at this time. If this occurs, goshawk populations can be expected to decline. In the long term, as the shrubs, aspen and pine re-establish goshawk populations can be expected to rebound as associated prey and nest areas rebound to pre-epidemic levels.

Northern Harrier
All alternatives conserve habitat for northern harriers (Objective 221). None of the alternatives propose treatments in prairies, shrublands, or other large open areas. Insects and treatments are not expected to create large, open grasslands of sufficient size to be used by harriers. All alternatives are expected to have no impact on northern harriers. **Determination: No Impact**

Burrowing Owl
All alternatives conserve habitat for burrowing owls. None of the alternatives propose treatments in prairies or prairie dog towns on the Forest. Insects and treatments are not expected to create large, open grasslands of sufficient size to be used by prairie dogs or burrowing owls. All alternatives are expected to have no direct or indirect impacts on burrowing owls. **Determination: No Impact**

Flammulated Owl
At present, there is no indication suggesting that flammulated owls are established or breeding in the Black Hills. If occasional flammulated owls occur in the Black Hills, all alternatives could have impacts on individuals from MPB activities and/or treatment activities.

All alternatives conserve potential habitat for flammulated owls (Objective 221). Mature and old ponderosa pine conditions are expected to decline in all alternatives due to MPB activity and proposed treatments. Spruce would continue to provide suitable habitat in all alternatives. Snags are expected to exceed Forest Plan objective 211 in the near future until they age and fall down. All snags except those deemed safety hazards would be maintained (Standards 2301 and 2305). All alternatives include timber harvest prescriptions that would reduce mature trees and stand density. Thinning treatments are expected to conserve habitat by conserving larger-diameter trees, which may eventually provide large-diameter snags. Pre-commercial thinning (post-sale) of small diameter stands could benefit this species.

Determination: All alternatives "may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing". Changes in

habitat from MPB and/or treatment activities could impact individual owls if they are in the Black Hills. However, there would likely be little impact on the number, reproduction, or survival of flammulated owls. This is because a large amount of currently unoccupied but suitable habitat would still be available for owl colonization. At present, there is no evidence suggesting that flammulated owls are established or breeding in the Black Hills

Lewis's Woodpecker

Alternative A
Alternative A is not expected to cause direct mortality of Lewis's woodpeckers because there would be no treatment activities.

Open, mature pine forests preferred by Lewis's woodpeckers are expected to increase due to MPB activity. MPB activity could increase the risk of stand-replacing wildfire as infested trees fall down and add to the fuel load. Both beetle infestations and stand-replacing fire would create woodpecker habitat. In the absence of wildfire, burned habitat is not expected to change.

MPB activity would continue to create snags across the Forest. No infested trees would be removed, so they would remain available to woodpeckers. Snags are expected to be the highest in this alternative. In the next 5 years, snag densities are expected to remain above Forest Plan objective 211 due to the ongoing MPB outbreak. In the long term, snags are expected to decline as MPB killed trees fall down.

Alternative B
Alternative B could result in the loss of nests if occupied nest trees are cut during timber harvest or road construction. The mobility of adult birds would reduce the risk of direct mortalities.

Alternative B conserves habitat for Lewis's woodpeckers (Objective 238, 221). All snags except those deemed safety hazards would be maintained (Standards 2301 and 2305). Many high insect risk stands are expected to be affected by MPB. In the absence of fire, areas of beetle outbreak might serve as the only substantial source of habitat in the Black Hills (Bonnot et. al. 2009). In the next 5 years, snag densities are expected to remain above Forest Plan objective 211 due to the ongoing MPB outbreak. In the long term, snags are expected to decline as MPB killed trees fall down.

MPB activity could increase the risk of stand-replacing wildfire as infested trees fall down and add to the fuel load. Stand-replacing fire would create Lewis's woodpecker habitat. Mechanical treatments are expected to reduce the potential for wildfires.

Tree spraying to repel MPB is not expected to reduce the overall MPB population on the Forest due to its cost and limited use. There could be localized reductions in insect populations if the chemicals kill non-targeted insects. Tree spraying is not expected to adversely affect populations of Lewis's woodpecker or their prey.

Alternative B includes timber harvest prescriptions that would reduce mature trees and stand density. Alternative B is expected to have to more mature and large trees, which provide potential future large snags, than Alternatives C, but fewer than Alternative A.

Treatment and hauling activities may disturb woodpeckers during operations. Long term, disturbances are not expected above the current level because new roads would be closed following harvest activities.

Alternative C
The effects of Alternative C are the same as Alternative B, except: Alternative C is expected to have fewer live mature and old trees on the Forest, which provide potential future large snags, than Alternative B because it treats more acres with commercial thinning. Alternative C includes more treatments that reduce the amount of mature forest than Alternative B. Open forest conditions preferred by Lewis's woodpeckers are expected to be the most abundant in Alternative C, followed by Alternative B and A, respectively.

Determination: All alternatives "may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing". The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if standards are followed, and if conditions move towards structural stage objectives at the Forest level. The action alternatives conserve habitat (Objective 221) by following Forest Plan snag standards. Structural stage 5 is expected to decline due to MPB activity and remain below objective. Open, mature forest conditions (structural stage 4A) are likely to increase and exceed objectives in all alternatives. Snags are expected to exceed Forest Plan objectives in all alternatives. Lewis's woodpeckers are expected to persist on the Forest because snags are expected to be abundant on the Forest over the next five to seven years and open, mature forest conditions are expected to be abundant in the long term.

Black-backed Woodpecker
Effects to black-backed woodpeckers are discussed in the MIS section.

Determination: All alternatives "may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing". The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if standards are followed, and if conditions move towards structural stage objectives at the Forest level. All alternatives follow Forest Plan snag and downed wood standards. Open forest conditions are expected to increase in all alternatives. Treatments are not expected to reduce dense, mature pine forest below structural stage objectives. Black-backed woodpeckers are expected to persist on the Forest under all alternatives because snag standards will be followed and snags are expected to be abundant on the Forest over the next five to seven years. Thinning and sanitation treatments are expected to retain fewer mature trees in Alternatives B and C, which is expected to lead to fewer large diameter snags in the future. In the long term, populations are expected to decline as MPB killed trees fall down.

Grasshopper Sparrow
The effects on grasshopper sparrows are discussed in the MIS section.

Determination: All alternatives are expected to have "no impact" on grasshopper sparrows. None of the alternatives propose activities that would reduce or enhance grassland habitat

(Objective 205). No direct or indirect effects are expected on grasshopper sparrows. Habitat and population trends are expected to be similar to current trends.

Loggerhead Shrike
Mixed grass prairies, mountain mahogany shrublands, and grassy or brushy areas are not expected to be affected by MPB in all alternatives. Vegetation management treatments are not proposed in these habitats in all alternatives. All alternatives are expected to have no impacts on loggerhead shrikes. **Determination: No impact.**

Long-billed Curlew
Native short-grass or mixed-grass prairies are not expected to be impacted by MPB or MPB treatment activities. All alternatives are expected to have no impacts on long-billed curlews or their habitat. **Determination: No impact.**

Yellow-billed Cuckoo
None or the alternatives are expected to cause direct mortality of yellow-billed cuckoos or increased disturbance because no new management activities are expected to occur in cottonwood or bur oak riparian areas. MPB activity is not expected to change the amount of cottonwood or bur oak riparian areas. All alternatives are expected to have no impacts on yellow-billed cuckoos. **Determination: No impact.**

Bats (Fringed Myotis, Townsend's Big-eared Bat, Hoary Bat)

Alternative A
Alternative A would have no direct effects because no new activities would occur. Roosting habitat in snags is likely to increase with MPB activity. There are also increased risks from wildfire and mountain pine beetle outbreaks under this alternative. Pine beetle outbreaks and wildfire at lower intensity levels could lead to an increase in snags, but current conditions favor high intensity, stand-replacing events that would not benefit these species.

MPB activity is expected to occur around some caves and mines that serve as bat roosts or hibernacula. If MPB activity occurs at the entrance to these sites, air flow patterns within the sites could be altered such that they become less suitable for bats.

Alternative B
Direct mortality is expected to be minimal in this alternative. Direct effects include limited potential for individual mortality due to tree felling and from collisions. Potential loss of occupied daytime roost trees may negatively impact individuals, if the snag is determined to be a safety hazard and removed. Risk is low because of their mobility and because they primarily roost in caves, mines and rock crevices. Due to the maneuverability of these species and their hours of activity (night time), collisions are possible, but unlikely. If collisions do occur, they are not likely to affect Forest-wide populations.

Ground disturbance would be avoided within 100 feet of natural cave openings (Standard 1401). Caves and their microclimate would be protected when implementing management activities near caves that are important bat nursery or hibernacula sites (Standard 3102). Vegetative changes

would be avoided within 500 feet of caves and mines that serve as nursery roosts or hibernacula unless needed to maintain bat habitat or if topography or other features protect the openings (Standard 3207). Sanitation near the openings may reduce the chance that MPB will alter air flow within the caves or mines.

Other indirect impacts include the potential loss of habitat due to the reduction of suitable roost snags if they are removed due to safety concerns or new road construction. The potential negative impact of the action alternatives on snags would be reduced by maintaining all snags in treatment areas except for those that pose a safety hazard. Alternative B is expected to have fewer snags than Alternative A and more snags than Alternative C due to MPB activity.

Foraging habitat for bats would most likely improve under the action alternatives through opening of pine stands by MPB and treatment activities. Insect populations may increase if understory vegetation increases after logging and thinning, thereby increasing available bat prey. Silvicultural treatments of timber harvest that benefit riparian habitat would also benefit bat insect prey, and thus bat foraging habitat.

Alternative C
The effects of Alternative C are expected to be similar to Alternative B except there would be more treatments and possibly more snags removed for safety reasons. Some snags may also be lost along corridors where new roads are being constructed. Alternative C is expected to have fewer snags than Alternatives A and B. Alternative C includes more silvicultural treatments which are expected lead to more open conditions which may lead to more food insect populations for bats than Alternatives B or A.

Determination: All alternatives "may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing". MPB could affect air flow near caves and mines, which could affect individual bats, in all alternatives. There is a potential loss of occupied daytime roost trees which could affect individuals under the action alternatives. The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would likely be adequate habitat for maintaining viable bat populations if Forest Plan standards are followed, and if conditions move towards the snag and structural stage objectives. All alternatives conserve habitat for bats (Objective 221) by following Forest Plan bat and snag Standards (2301, 3207, 3208, and 3209), maintaining riparian conditions, and avoiding disturbance at caves and mines. All alternatives are expected to reduce dense structural stages and increase open forest conditions. Structural stage 4C is expected to be above the objective for all alternatives. Structural stages are important for bats because more snags that provide potential roost sites are associated with certain structural stages. All alternatives are expected to have abundant snags (exceeding Objective 211) due to MPB activity. These bats are likely to persist on the Forest under all alternatives because of cave and mine protection and expected snag densities. Alternative A is expected to have more snags in the short term because of MPB activity, and Alternative A may have more snags in the long term because treatments in Alternative B and C are expected reduce mature forest on the landscape.

American Marten

Alternative A
Alternative A would have no direct effects on marten because no treatments would occur.

White spruce may increase in all alternatives if surrounding ponderosa pines are killed by MPB. These increases would be expected to occur slowly over several decades and can be expected to occur in areas where small inclusions of spruce occur within pine stands. Spruce habitat is not expected to change noticeably in the next 5 years. Closed canopy pine stands are expected to be reduced by MPB. Connectivity between spruce habitat patches could be affected if MPB opens the canopy in these areas below 50% canopy closure. If a wildfire occurs, the increase in downed wood from MPB killed trees could increase the risk that spruce habitat and connecting pine habitat will burn.

Alternative B

Direct effects in Alternative B include a limited potential for individual mortality due to timber felling, pile burning and vehicle traffic. Direct effects may occur if natal or maternal den sites are removed during project activities and young of the year are still in these dens. Individual martens could be killed directly or die from lack of cover if they are using slash piles when the piles are burned. These effects are not expected to occur at a scale that will effect Forest-wide populations.

Alternative B conserves habitat for martens (Objective 221). White spruce may increase in all alternatives if surrounding ponderosa pines are killed by MPB or treated by mechanical methods. Alternative B is expected to have more opportunities for spruce expansion than Alternative A because it includes treatments that are expected to create more open forest conditions. These increases would be expected to occur slowly over several decades and can be expected to occur in areas where small inclusions of spruce occur within pine stands. Spruce habitat is not expected to change noticeably in the next 5 years.

Mature ponderosa pine stands with moderate-or-high canopy cover (structural stages 4B, 4C, and 5) is expected to decline more in Alternative B than in Alternative A due to treatment activities. Treatments would maintain 50% canopy cover in connectivity corridors (Standard 3215), but MPB may reduce the canopy closure below effective levels. Sanitation treatments are expected to occur in connecting corridors in Alternative B to help maintain canopy cover. Alternative B has more flexibility than Alternative A to sanitize MPB infestations in connective corridors and maintain their value to marten. Forest Plan standards pertaining to the retention of CWD (Standards 3117 and 2308a) would be followed. Habitat for marten prey associated with closed pine forest conditions would also decrease. If fuel loading is reduced adjacent to spruce by removal of infested trees, Spruce sites and connecting corridors may be less susceptible to wildfire.

No new road would be constructed in this alternative so no habitat would be lost to road surface. Some disturbance effects to marten could occur during treatment operations. Disturbance effects and mortality from vehicles is not expected to increase in the long term because all system and temporary roads used in this alternative would be closed following project completion.

Alternative C

The effects of Alternative C are expected to be similar to Alternative B except that Alternative C includes new road construction and includes more treatment acres. More individual martens could be killed directly or die from lack of cover if they are using slash piles when the piles are burned due to increased treatments over Alternative B. Mature ponderosa pine stands with moderate-or-high canopy cover (structural stages 4B, 4C, and 5) is expected to decline more in Alternative C than in Alternatives A and B due to the added treatment activities. Treatments would maintain

50% canopy cover in connectivity corridors (Standard 3215), but MPB may reduce the canopy closure below effective levels similar to Alternative B. Sanitation treatments are expected to occur in connecting corridors in Alternative C to help maintain canopy cover. Alternative C has the most flexibility to sanitize MPB infestations in connective corridors and maintain their value to marten.

It is estimated that Alternative C would construct 70 miles of new roads. It is estimated that 8 miles of new road construction would occur in high value marten habitat areas as identified by Fescke (2003). If these roads occur in or adjacent to marten habitat, it would reduce habitat by about five acres per mile of road (Rowland et al. 2004). Treatment activities are expected to cause some disturbance to marten if they occur in or near spruce habitat. Disturbance effects and mortality from vehicles is not expected to increase in the long term because newly constructed roads and other roads used during the project would be closed following project completion.

Determination: All alternatives "may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing". The primary threats this project proposes to this species is fragmentation and loss of habitat and the slight chance of loss of natal or maternal dens. Spruce habitat is expected to remain stable, but connectivity corridors between spruce sites may decline in all alternatives due to MPB activity.

The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining viable population if standards are followed, and if conditions move towards the spruce objectives (objective 239-LVD). All alternatives in this project follow Forest Plan standards for marten including standards 3215, 3117, and 2308. None of the alternatives alter spruce acres, thus this project contributes to the spruce objective. MPB may reduce connectivity corridors which may reduce marten populations. Sanitation treatments are expected to occur in connecting corridors in Alternatives B and C to help maintain canopy cover. Alternative C has the most flexibility to sanitize MPB infestations in connective corridors and maintain their value to marten. MPB activity is expected to increase risks to marten persistence. Habitat is expected to be available in sufficient quantity and distribution so that marten are likely to persist on the Forest. The action alternatives offer flexibility to maintain connectivity corridors better than Alternative A.

Rocky Mountain Bighorn Sheep

Alternative A
No direct mortality is expected in Alternative A because there would be no treatments and associated machinery.
MPB activities are expected to create more open forest conditions across the Forest. If these open conditions occur in bighorn sheep use areas within suitable distance of water and escape terrain, habitat could be improved through improved visibility. Forage may also increase, but some of the forage may become inaccessible as the dead trees fall down.

Alternative B
Direct mortality of bighorn sheep could occur from vehicle accidents during treatment operations. Long term, vehicle accidents are not expected to increase over current levels because all roads used during the project that are not on the Forest Motorized Vehicle Use Map will be closed following project completion. Likewise, disturbance from vehicles are not expected to increase over current levels.

Open forest conditions that provide good visibility for bighorn sheep are expected to increase due to MPB activities and vegetation treatments. These open forage conditions may provide more forage than Alternative A because sanitation of infested trees is expected to reduce the number of snags that are likely to fall down in the future. If these open conditions occur in bighorn sheep use areas near water and escape terrain, bighorn sheep habitat could be improved. Alternative B has more potential to improve bighorn sheep habitat than Alternative A.

Alternative C
The effects of Alternative C are expected to be similar to Alternative B except that Alternative C is expected to create more open forest conditions and includes an estimated 70 miles of new road construction. This new road construction would remove about five acres of forage per mile of road if it occurs in bighorn sheep use areas. Alternative C has more potential for improving bighorn sheep than Alternative B and A because of the increased open forest conditions that are expected.

Determination: All alternatives "may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing". All alternatives conserve bighorn sheep habitat (Objective 221) by increasing open forest conditions. The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that bighorn sheep are likely to persist on the Forest if standards are followed Forest-wide at the project level, and if conditions move towards the structural stage objectives at the Forest level. All alternatives in this project follow applicable Forest Plan standards and guidelines. All alternatives are expected to increase open forest structural stages that provide good visibility preferred by bighorn sheep. Bighorn sheep habitat may improve under all alternatives. Bighorn sheep are expected to persist on the Forest in all alternatives.

Black-tailed Prairie Dog
None of the alternatives propose treatments within prairie dog towns. All alternatives are expected to have no effect on black-tailed prairie dogs.

Northern Leopard Frog

Alternative A
Alternative A would have no direct effects because no new activities would occur. Upland habitats could be altered if MPB occur on upland sites near water. This could affect individual frogs using these upland sites.

Alternative B
Potential direct effects of Alternative B include mortality of unknown frog locations through the use of heavy equipment and falling of trees activities are located within mesic areas or the surrounding uplands of breeding grounds. Because timber treatments do not focus upon riparian areas, most sites would be avoided. Roads can cause substantial direct mortality from road-kill events (Smith 2003, Smith and Keinath 2007). Additional direct impacts to northern leopard frog could include individual mortality of eggs, larvae, and adult frogs due to increased vehicle traffic, and newly constructed roads and stream crossings. There are no newly constructed roads in this alternative. Road mortality is expected to remain similar to existing conditions following the project because all roads used during project implementation that are not part of the Forest MVUM will be closed following project completion.

Riparian areas throughout the project area are not targeted for treatment and would be protected and avoided through Best Management Practices (BMPs) and buffers created by the water influence zone (WIZ). Forest Plan standards and guidelines will be followed in all alternatives. Forest-wide standards and guidelines protect riparian areas, water influence zones, and wetlands. Under all alternatives, long-term riparian ecosystem health and ecological function are expected to be maintained by not allowing actions that would be detrimental to riparian- ecosystem condition (Standards 1301, 1302). Riparian and wetland areas that contain emphasis species would be given additional protection from direct and indirect disturbances under all alternatives (Standard 3106). In all alternatives, log landings, decking areas, and mechanical-slash piling would not occur within riparian areas unless the integrity of riparian areas can be protected (Standard 1306).

Alternative C
The effects of Alternative C are expected to be similar to Alternative B, except that Alternative C includes more acres treated and more road construction. Newly constructed roads may have a temporary increase in potential vehicle caused mortality. Effects are expected to end upon project completion because all new roads will be closed following project completion. The increased treatment acres in Alternative C lead to an increased probability that frogs could be killed by vehicles and equipment during treatment operations.

Determination: All Alternatives "may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing". Impacts from the action alternatives include habitat disturbance or loss or direct mortality that may occur from timber management activities and road construction in riparian areas. MPB activities may affect upland sites adjacent to water. The action alternatives conserve habitat for leopard frogs (Objective 221) through implementation of riparian standards and guidelines.

Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would likely be adequate habitat for maintaining a viable population if Forest Plan standards are followed, and if conditions move towards riparian restoration objectives at the Forest level. This species is common in suitable habitat on the Forest. The action alternatives in this project follow Forest Plan riparian standards including Wildlife/Riparian Standard 3106. Implementation of WCPs and BMPs would maintain and protect aquatic, riparian and upslope areas in a condition and quantity that continues to support well-distributed, reproductive populations.

Black Hills Redbelly Snake

Alternative A
No direct mortality of redbelly snakes would occur with the no action alternative. The risk of wildfire and insect epidemics would increase. Large scale fires and insect epidemics could have a positive effect due to lush herbaceous growth coming from beneath dead standing trees and increases in microhabitat humidity. MPB activity may provide increased opportunity for aspen regeneration may lead to improved redbelly snake habitat. Negatively, MPB could also cause severe drying of sites and increase isolation (Smith and Stephens 2003).

Alternatives B and C
Direct mortality of unknown snake locations could occur during timber harvest, road construction (Alternative C only) and maintenance.

Soil compaction throughout the timber harvesting units could reduce prey availability. Forest Plan standards and guidelines pertaining to watershed, soils, and road construction would help avoid some of these effects. Buffer areas created for the Water Influence Zone (WIZ) would prevent most of the soil compaction issues unless the road is crossing the WIZ. BMPs would be utilized for all proposed stream crossings with Alternative C. This would help to prevent sedimentation into the stream channel due to road use. As a result of the hardwood enhancement treatments under the action alternatives, there would be an increase in the amount and quality of hardwood habitat (primarily aspen).

The miles of new road construction, road reconstruction and pre-use maintenance present an additional negative impact to redbelly snake. No new road construction would occur in Alternative B. For Alternative C, it is expected that 70 miles of new roads would be built, some of which may occur in mesic areas. All newly constructed roads would be closed following treatment activities. Existing roads used in both action alternatives would be closed following treatment activities unless the road is included as part of the open road system under the Forest-wide Travel Management Plan.

Determination: All alternatives "may adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing". Impacts from the action alternatives include loss of some preferred habitat as well as the potential direct mortality from management activities. Under the no action alternative, some preferred habitat could be altered by MPB.

The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if Forest Plan standards are followed and if conditions move towards riparian and hardwood objectives at the Forest level. All alternatives follow Forest Plan riparian, hardwood and redbelly snake standards including Wildlife/Riparian Standards 3106 and 3116. All alternatives contribute to riparian and hardwood objectives.

Regal Fritillary

None of the alternatives would affect mixed-grass or tall-grass prairies. All alternatives are expected to have no effect on regal fritillaries. **Determination: No Impact.**

Cooper's Mountain Snail

Alternative A

No direct mortality of snails are expected occur with the Alternative A. The risk of MPB and wildfire would increase. MPB are expected to open forest canopies and increase fuel loads as trees fall over. If these open conditions occur at snail colonies, they could cause severe drying of sites, increase isolation. If fires occur in the increased fuel loads it could kill colonies that are burned over.

Alternative B

Direct mortality of unknown snail colonies could occur during timber harvest and road maintenance. Alternative B conserves habitat for snails (Objective 221) by active management following Forest Plan direction. Active management, which lessens the risk of high intensity fire, would potentially benefit this snail. Silvicultural treatments may dry out some mesic sites, while enhancing others. Unknown snail colonies may be impacted in treatment areas over time, however, most treatment areas do not occur in typical snail habitat. Known snail colonies would be conserved

according to Forest Plan direction (Standard 3103). In addition, BMPs and Forest Plan Standards pertaining to watershed, soils, and road construction would help avoid some of these effects.

Alternative C
The effects of Alternative C are expected to be similar to Alternative B for most of the project area except that Alternative C includes vegetative treatments in Spearfish Canyon and includes 70 miles of road construction that could potentially affect snail colonies.

Known snail colonies would be conserved according to Forest Plan direction (Standard 3103) except in Spearfish Canyon (Management Area 4.2A). Alternative C proposes timber harvest via cable logging and use of tractors and skidders in MA4.2A. Some road construction is expected associated with these activities. Due to the high occurrences of Cooper's mountainsnail in MA4.2A these actions would not be consistent with Standard 3103. Therefore, a Forest Plan amendment is proposed as part of Alternative C, to allow these actions to take place within MA4.2A. Approximately 2/3 of MA 4.2A is identified a potential treatment areas. If these areas are treated, as much as 2/3 of the available habitat could be affected. Treatments that open the canopy, such as thinning and selection harvest, would be expected to open the canopy and cause the sites to dry from exposure to sun. Snails are known to be sensitive to site conditions and are not expected to use these areas until shade and moist conditions return. Ground disturbing activities such as road construction, tractors and skidders, and cable logging on snail colonies are expected kill snails and alter habitat. These activities are expected remove litter and expose bare soil, which would likely be unsuitable for snails until the litter layer developed.

Sanitation activities (cut and chunk, cut/pile/burn, cut/chip, hand cut/helicopter yarding) and tree spraying are consistent with Standard 3103. Sanitation activities would remove trees that are already dying so solar exposure would not be increased. They also may retain more shade in snail colonies by reducing the amount of trees killed by MPB. Tree spraying would also help maintain canopy cover.

Determination: All alternatives "may adversely impact individuals, but are not likely to result in a loss of species viability on the Planning Area, nor cause a trend toward federal listing". Impacts of the action alternatives include habitat loss and direct mortality that may occur from timber management activities and road construction in unknown colonies. Under the no action alternative, there is an increased chance of high intensity wildfire, which could cause severe drying of sites and increase colony isolation.

The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if Forest Plan standards are followed, including snail specific Standard 3103. Snail colonies are expected to be impacted by MPB in all alternatives. Unknown snail colonies may be impacted by treatments in Alternatives B and C. All known colonies would be managed consistent with Standard 3103 in Alternative B. Alternative B follows Forest Plan riparian, hardwood and snail standards including Standard 3103. This snail is likely to persist on the forest under Alternatives A and B.

Persistence is more uncertain in Alternative C. In Alternative C, snail colonies would be managed according to Standard 3103 on most of the Forest outside of MA 4.2A. There are numerous scattered colonies outside MA 4.2. These sites are expected to persist. Colonies in MA 4.2A are expected to decline substantially if potential treatment areas are treated with cable logging, road construction, tractor logging/skidding, and forest thinning. MA 4.2A has the highest density of

Cooper's mountainsnail on the Forest, so this activity is expected to affect the Forest-wide population. This species is expected to persist on the Forest, but reduced populations may make them more susceptible to natural disturbances.

Species of Local Concern (SOLC)

American Dipper

Alternative A
The likelihood of high intensity fire in the headwaters of Spearfish Creek or Whitewood Creek could increase under the no action alternative if MPB causes high tree mortality in these areas. Should a high intensity fire occur, water quality and riparian habitat could be negatively affected due to reduction of cover, increased erosion, and sedimentation.

Alternatives B and C
Alternatives B and C conserve dipper habitat (Objective 221) through treatments that are expected to reduce the risk of MPB near dipper streams. Under Alternatives B and C, management activities are expected to reduce the chance of MPB in the headwaters of Spearfish and Whitewood Creeks. Alternative C would have the most potential for reducing the risk of MPB and fires in these areas, followed by Alternative B. Potential impacts would be minimized through BMPs, WCPs, and Forest aquatic and riparian objectives, standards and guidelines. Forest Plan Standards would be followed in Alternatives B and C.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005) determined that there would be adequate habitat for maintaining a viable population if Forest Plan standards and BMPs are followed. The action alternatives follow all Forest Plan riparian standards and guidelines. This species is expected to continue to persist on the Forest under all alternatives.

Black-and-white Warbler

Alternative A
No direct impacts are expected under Alternative A because no new activities would occur. MPB are expected to lead more open forest conditions. If these open forest conditions occur at lower elevations near oak woodlands and riparian areas, this could improve habitat for this species.

Alternative B and C
Alternatives B and C include the potential for individual mortality due to management activities. MPB are expected to lead more open forest conditions. These alternatives conserve habitat for this species (Objective 221). If these open forest conditions occur at lower elevations near oak woodlands and riparian areas, this is expected to conserve, and could improve, habitat for this species (Objective 221). Alterative C has the most potential for improving habitat, followed by Alternatives B and A, respectively.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if Forest Plan standards and BMPs are followed. Forest Plan Standards and Guidelines for deciduous forests, hardwoods and riparian areas would be followed in Alternatives B and C. All alternatives may contribute to hardwood Objectives (Objective 201). This species is expected to persist under all alternatives. This species is most likely to persist under Alternative C, followed by Alternative B, because

treatment activities are expected create more open conditions forest-wide, which leads to the most potential for conserving or improving habitat.

Broad-winged Hawk and Cooper's Hawk

Alternative A
No direct impacts are expected under Alternative A because no new activities would occur. In ponderosa pine, structural stages 4B, 4C, and 5 correspond most closely to the nesting habitat preferences of both hawk species. These ponderosa pine structural stages are expected to decline due to MPB activity. Deciduous trees such as aspen and oak may increase under if MPB areas have a deciduous component. White spruce and shrubland habitat is not expected to change noticeably this alternative. Alternative A is expected to maintain more mature or old structural stage habitat preferred for nesting by these species (structural stage 4B, 4C and 5).

Alternative B and C
Direct impacts in Alternatives B and C include potential for individual mortality (nest loss or abandonment) to unknown nests due to management activities.

Ponderosa pine structural stages 4B, 4C, and 5 are expected to decline in both alternatives due to MPB activity and vegetation treatments. These conditions are expected to decline the most in Alternative C, followed by Alternative B, due to vegetation treatments designed to reduce MPB. Alternatives B and C conserve habitat for this species (Objective 221) by seeking to retain as much mature forest on the landscape as possible.

Deciduous trees such as aspen and oak may increase under all alternatives if MPB areas have a deciduous component. This could improve foraging habitat for both species. The potential for hardwood to increase is greatest in Alternative C, followed by Alternative B and A, respectively.

White spruce and shrubland habitat is not expected to change noticeably under any alternative. Alternatives B and C are expected to result in a reduction in preferred nesting habitat (4B, 4C and 5) within the project area, with Alternative C resulting the least amount of nesting habitat. Applicable Forest Plan standards and guidelines would be followed during this project including standard 3204.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if Forest Plan standards are followed and if conditions move towards structural stage and hardwood objectives. The action alternatives follow applicable Forest Plan standards and guidelines. All alternatives are expected to contribute to the hardwood objective (Objective 201). Structural stages that provide nesting habitat are expected to decline and structural stages and cover types that provide foraging habitat are expected to increase. Treatments are expected to maintain Structural Stages 4B and 4C above objectives in Management Areas with structural stage objectives. These hawks are expected to persist on the Forest in all alternatives. The adaptability of both of these species to forage in a variety of habitat types for a variety of prey species adds to the likelihood of their persistence.

Northern Saw-whet Owl

Alternative A
No direct impacts are expected under Alternative A because no new activities would occur. Structural stages 4C and 5 most closely resemble the preferred breeding and nesting habitat for

the saw-whet owl. Nesting habitat (i.e. mature, dense forest) is expected to decrease due to MPB activity. Large snags would likely increase in the short term and decline as snags fall down and MPB activity declines. Young, dense stands are expected to be susceptible to MPB and are expected to decline. There are increased risks from high intensity wildfire and mountain pine beetle outbreaks in Alternative A. Wildfire has the potential to reduce habitat. Foraging habitat is expected to increase in Alternative A as MPB activity creates more open forest conditions. Hardwoods could increase as MPB open the Forest, providing more habitat diversity.

Alternatives B and C

Direct impacts in Alternatives B and C include potential for individual mortality due to management activities. Nesting habitat (i.e. mature, dense forest) is expected to decrease in both alternatives due to MPB activity. Nesting Habitat is expected to decline the most in Alternative C, followed by Alternative B and A, respectively.

In both alternatives, large snags would likely increase in the short term and decline as snags fall down and MPB activity declines. All snags except those deemed safety hazards would be maintained, thereby assuring a long-term supply of snags. Young, dense stands are expected to decline due to MPB and non-commercial vegetation treatments. Young stands have the most potential to decline in Alternative C, Followed by Alternative B and A, respectively.

Wildfire has the potential to reduce habitat. Alternatives B and C are expected to reduce fuel loads through treatment activities. Alternative C would reduce the potential loss of habitat to wildfire the most.

Foraging habitat is expected to increase in Alternatives B and C as MPB and vegetation treatments create more open forest conditions and more forest edges. Riparian habitats would be protected from harvest treatments and hardwoods could increase, providing more habitat diversity.

Alternative C includes 70 miles of new that could present an additional negative impact to saw-whet owls, at least partially due to increased disturbance of nesting birds and a potential loss of snags along new road corridors and landing sites. Disturbance is expected to return to current levels following project completion because all roads not on the Forest Motorized Vehicle Use Map would be closed following treatments.

Alternatives B and C conserve habitat for this species (Objective 221) by following Forest Plan standards and guidelines. To help reduce disturbances to nesting and wintering raptors, Standard 3204 guide general protections at active raptor nests. Standard 3204 directs projects to consider recommendations from other federal and state agencies when designing management near known raptor nests. Both alternatives are consistent with Standard 3204.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if Forest Plan standards are followed. The action alternatives follow applicable Forest Plan standards and guidelines. The saw-whet owl is by far the most common and widespread owl on the Forest (Drilling 2010). Its ability to use a variety of habitats contributes to its ability to persist on the Forest. Saw-whet owls are expected to persist on the Forest under all alternatives.

Pygmy Nuthatch

Alternative A
No direct effects are anticipated under Alternative A because no activities would occur in the project area under this alternative. Preferred nesting and foraging habitat in mature, dense forest (4C) habitat is expected to decrease, while preferred nesting and foraging habitat in open pine sites (4A) is expected to increase, due to MPB activities. MPB-caused tree mortality in Alternative A could lead to stand-replacing wildfires and/or beetle infestation. Either of these events could reduce this species' preferred nesting and roosting habitat but would create snags.

Alternatives B and C
Direct impacts in Alternatives B and C include the potential for individual mortality due to management. Treatments could cause individual mortality if trees or snags that contain nests or roosting birds are cut.

Preferred nesting and foraging habitat in mature, dense forest (4C) habitat is expected to decrease in both alternatives, while preferred nesting and foraging habitat in open pine sites (4A) is expected to increase, due to treatment activities. Dense forest is expected to decrease the most in Alternative C, followed by Alternatives B and A respectively. Open sites are expected to increase the most in Alternative C, followed by Alternatives B and A, respectively. The open forest sites will continue to provide nesting and foraging habitat as long as large snags are retained. The availability of large trees is expected to be similar in all alternatives. Treatments in Alternatives B and C may make mature and large diameter trees less susceptible to MPB, which could improve the potential for future large diameter snags. This is expected to conserve habitat for the species (Objective 221). Alternatives B and C reduce the chance of wildfire and conserve large snag habitat (Objective 221) by removing MPB infested trees.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if Forest Plan standards are followed and conditions move towards the structural stage objectives. The action alternatives follow applicable Forest Plan standards and guidelines including snag standards. All alternatives are expected to move away from the open, mature and old structural stages (4A and 5) objective (except MA 5.43). Even though conditions move away from this objective, all alternatives are expected to be above the objective. This should be a benefit to pygmy nuthatches if trees and snags are retained. Alternative B and C are expected to have slightly fewer large trees, which are potential future large snags, due to thinning activities. All alternatives move towards dense, mature structural stage (4C) objectives. Pygmy nuthatches are expected to persist on the Forest under all alternatives. They are more likely to persist under Alternative A, followed by Alternative B, which are expected to retain more large trees and large snags on the landscape.

Sharp-shinned Hawk

Alternative A
No direct impacts are expected under Alternative A because no new activities would occur. Preferred nesting habitat (i.e. dense young forest, structural stages 3B and 3C) would likely decrease due to MPB activity. Foraging habitat (open habitat) may increase along with prey species associated with open habitat. There are increased risks from wildfire from mountain pine

beetle outbreaks with this alternative. Wildfire has the potential to reduce habitat. Spruce habitat could increase slightly over time under this alternative.

Alternatives B and C
Direct impacts include potential for individual mortality (including nest loss or abandonment) due to management activities. Indirect impacts include loss of nesting habitat and disturbances from timber harvest, mechanical thinning, and road construction (Alternative C). However, in time, other nesting habitat would be created and enhanced where mature trees are harvested, leaving younger trees to become established and dominate stands. Under both alternatives, preferred nesting habitat (3B and 3C) is expected to decrease due to MPB activity. Nesting habitat is expected to decline the most in Alternative C, because it has the potential to treat the most 3B and 3C stands, followed by Alternative B. Foraging habitat would likely remain stable with timber harvest and MPB providing a variety of structural stages and cover types in which diverse prey species exist. Spruce habitat is not targeted for treatment under the action alternatives. Any known or newly discovered nests would be protected through Standard 3204. Protection of known nests and the retention and creation of suitable habitat contribute to Objective 221.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if Forest Plan standards are followed and conditions move towards the structural stage objectives. The action alternatives follow applicable Forest Plan standards and guidelines. Foraging habitat is expected to remain stable. Treatments in the action alternatives are expected to move conditions away from the objectives for nesting habitat (structural stages 3B and 3C). MPB activity in Alternative A is also expected to move conditions away from objectives for these structural stages. This presents an increased risk to persistence over current conditions. This could lead to fewer sharp-shinned hawks until the forest can recover to following the MPB outbreak. In all alternatives, nesting habitat is expected to be available, though in lesser amounts. This species is expected to persist on the Forest under all alternatives.

Bats

Alternative A
Alternative A would have no direct effects because no new activities would occur. Roosting habitat in snags is likely to increase with MPB activity. There are also increased risks from wildfire and mountain pine beetle outbreaks under this alternative. Pine beetle outbreaks and wildfire at lower intensity levels could lead to an increase in snags, but current conditions favor high intensity, stand-replacing events that would not benefit these species.

MPB activity is expected to occur around some caves and mines that serve as bat roosts or hibernacula. If MPB activity occurs at the entrance to these sites, air flow patterns within the sites could be altered such that they become less suitable for bats.

Alternative B
Direct mortality is expected to be minimal in this alternative. Direct effects include limited potential for individual mortality due to tree felling and from collisions. Potential loss of occupied daytime roost trees may negatively impact individuals, if the snag is determined to be a

safety hazard and removed. Risk is low because of their mobility and because they primarily roost in caves, mines and rock crevices. Due to the maneuverability of these species and their hours of activity (night time), collisions are possible, but unlikely. If collisions do occur, they are not likely to affect Forest-wide populations.

Ground disturbance would be avoided within 100 feet of natural cave openings (Standard 1401). Caves and their microclimate would be protected when implementing management activities near caves that are important bat nursery or hibernacula sites (Standard 3102). Vegetative changes would be avoided within 500 feet of caves and mines that serve as nursery roosts or hibernacula unless needed to maintain bat habitat or if topography or other features protect the openings (Standard 3207). Sanitation near the openings may reduce the chance that MPB will alter air flow within the caves or mines.

Other indirect impacts include the potential loss of habitat due to the reduction of suitable roost snags if they are removed due to safety concerns or new road construction. The potential negative impact of the action alternatives on snags would be mitigated by maintaining all snags in treatment areas except for those that pose a safety hazard. Alternative B is expected to have fewer snags than Alternative A and more snags than Alternative C.

Foraging habitat for bats would most likely improve under the action alternatives, through opening of pine stands by treatment activities. Insect populations may increase after logging and thinning, thereby increasing available bat prey. Silvicultural treatments of timber harvest that benefit riparian habitat would also benefit bat insect prey, and thus bat foraging habitat.

Alternative C

The effects of Alternative C are expected to be similar to Alternative B except there would be more treatments and possibly more snags removed for safety reasons. Some snags may also be lost along corridors where new roads are being constructed. Alternative C is expected to have fewer snags than Alternatives A and B. Alternative C includes more silvicultural treatments which are expected lead to more open conditions which may lead to more food insect populations for bats than Alternatives B or A.

Summary: MPB could affect air flow near caves and mines, which could affect individual bats, in all alternatives. There is a potential loss of occupied daytime roost trees which could affect individuals under the action alternatives. The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would likely be adequate habitat for maintaining viable bat populations if Forest Plan standards are followed, and if conditions move towards the snag and structural stage objectives. All alternatives conserve habitat for bats (Objective 221) by following applicable Forest Plan standards including Bat and Snag Standards (2301, 3207, 3208, and 3209), maintaining riparian conditions, and avoiding disturbance at caves and mines. All alternatives are expected to reduce dense structural stages and increase open forest conditions. Structural stage 4C is expected to be at or above the objective for both action alternatives. Structural stages are important for bats because more snags that provide potential roost sites are associated with certain structural stages. All alternatives are expected to have abundant snags (exceeding Objective 211) due to MPB activity. These bats are likely to persist on the Forest under all alternatives because of

cave and mine protection and expected snag densities. Alternative A is expected to have the most snags because of MPB activity.

Meadow Jumping Mouse

Alternative A
No direct mortality is expected because no management actions would occur. MPB are expected to kill pine trees near some riparian areas, which may promote shrub and hardwood development along some riparian areas.

Alternatives B and C
Vehicle traffic from treatment activities could cause individual mortality. Mice could be killed directly or die from lack of cover if they are using piles adjacent to meadows when the piles are burned. These impacts are expected to occur to individuals and are not expected to lead to population declines.

Logging activities and treatment of logging slash may require ground disturbance, which has the potential to indirectly affect riparian and wetland ecosystems primarily through changes in sediment loads to creeks or wetlands and the introduction or spread of noxious weeds. The larger the amount of ground disturbance and/or the closer proximity to wetland and riparian areas, the greater the potential for disturbed areas to be connected to the streams and riparian areas, and the greater potential to have an indirect impact to riparian and wetland habitats used by jumping mice. Alternative C includes the most treatments, followed by Alternative B and Alternative A, respectively. Therefore, Alternative C has the most potential to affect riparian habitat, followed by Alternatives B and A, respectively.

Under the action alternatives, the riparian areas throughout the project area are not targeted for treatment and would be protected and avoided through Best Management Practices (BMPs) and buffers created by the water influence zone (WIZ). Forest Plan standards and guidelines will be followed in all alternatives. Forest-wide standards and guidelines protect riparian areas, water influence zones, and wetlands. Under all alternatives, long-term riparian ecosystem health and ecological function are expected to be maintained by not allowing actions that would be detrimental to riparian- ecosystem condition (Standards 1301, 1302). Riparian and wetland areas that contain emphasis species would be given additional protection from direct and indirect disturbances under all alternatives (Standard 3106). In all alternatives, log landings, decking areas and mechanical-slash piling would not occur within riparian areas unless the integrity of riparian areas can be protected (Standard 1306).

Summary: Management activities are expected to maintain or enhance of riparian habitat that would lead to increasing meadow jumping mouse populations within the project area, contributing to Objective 221. The Phase II Amendment FEIS (USDA Forest Service 2005) determined that there would likely be adequate habitat for maintaining viable bat populations if Forest Plan standards are followed, and if conditions move towards riparian objectives. The action alternatives follow standards and guidelines for riparian areas. All alternatives contribute to riparian (213) and hardwood (201) objectives. This species is expected to persist on the Forest.

Mountain Goat
Open forest conditions are expected to increase in all alternatives due to MPB activities. This could result in improved forage for mountain goats if MPB areas occur near escape terrain (cliffs) near Norbeck Wildlife Preserve. Alternatives B and C do not include treatments in Norbeck Wildlife Preserve. Treatments outside Norbeck could occur near escape terrain, especially if helicopters or non-commercial methods are used. This could provide additional forage over Alternative A. Alternative C has the most potential to improve mountain goat forage near escape terrain.

Mountain goats are expected to persist on the Forest under all alternatives. Forage could increase near escape terrain under all alternatives. No treatments are proposed in Norbeck Wildlife Preserve where the majority of goats occur.

Northern Flying Squirrel

Alternative A
No direct effects are expected in Alternative A because no treatments would occur in the project area. MPB activity is expected to reduce dense forest conditions and increase open forest conditions. Flying squirrels use a variety of forest conditions including moist dense sites and open dyer sites (Duckwitz 2001). Even though habitat may change, flying squirrels are expected to continue to occur in the various structural stages. MPB areas may lead to an increased chance of stand-replacing wildfire, which would reduce potential habitat for this species. White spruce habitat is not expected to change much in this alternative. Downed logs would be abundant at MPB-killed trees fall over.

Alternative B and C
Direct impacts include a risk of individual mortality due to tree felling. Timber harvest activities that occur within or near occupied flying squirrel nesting habitats during the breeding season could directly displace, harm, or kill young, non-mobile flying squirrels. Vehicle traffic from treatment activities could cause individual mortality. Squirrels could be killed directly or die from lack of cover if they are using slash piles when the piles are burned. These impacts are expected to occur to individuals and are not expected to lead to population declines.

Under Alternatives B and C, mature open ponderosa pine habitat (structural stage 4A) is expected to increase within the project area, with Alternative C increasing the most. Stands in structural stages 4B, 4C and 5 are expected to decrease correspondently under Alternatives B and C, with Alternative C decreasing the most. The flying squirrel also prefers spruce habitat which is not targeted for treatment during silvicultural treatments and spruce acreage would be maintained by Objective 239-LVD.

Flying squirrels require sufficient standing and downed snags. All non-hazard snags would be retained during management activities. The action alternatives would follow Forest Plan standards and guidelines pertaining to snags and downed wood. Abundant downed wood is expected to remain in both alternatives as MPB-killed trees fall over.

Summary: The no action alternative provides the most potential pine nesting habitat in structural stage 4C for the flying squirrel. Alternatives B and C would decrease preferred structural stage 4B and 4C habitat and increase preferred structural stage 4A habitat. No treatments are proposed in

preferred spruce habitat under the action alternatives. The Phase II Amendment FEIS (USDA Forest Service 2005) determined that there would likely be adequate habitat for maintaining viable bat populations if Forest Plan standards are followed, and if conditions move towards structural stage objectives. The action alternatives conserve habitat for flying squirrels (Objective 221) by following applicable Forest Plan Standards and Guidelines, including snag standards 2301a and 2305 and maintaining mature forest stands on the landscape. All alternatives open mature forest conditions (4A) and reduce dense, mature forest conditions (4C). All alternatives are expected to be above objective for open mature forest conditions and at or above objective for dense mature forest conditions. Flying squirrels are expected to persist under all alternatives. Treatments in Alternatives B and C are expected to retain slightly fewer mature forest stands and large trees on the landscape. Flying squirrels are most likely to persist under Alternative A, followed by Alternatives B and C, respectively.

Butterflies

Alternative A
This alternative is expected to have no direct effects because no new activities would occur. MPB activity is not expected to significantly increase meadow habitat.

Alternatives B and C
Potential direct effects of timber harvest activities under the action alternatives to both butterfly species include limited potential for individual mortality due to management activities adjacent to meadows and riparian areas. Direct mortality to adults and larvae from vehicle collisions could occur in the action alternatives. Treatments are not expected to increase the amount of meadows and riparian areas.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005) determined that there would likely be adequate habitat for maintaining viable bat populations if Forest Plan standards are followed and if conditions move towards riparian and meadow objectives. All alternatives conserve meadows and riparian areas habitat (Forest plan Objective 221) through Forest Plan standards and guidelines. None of the alternatives are expected to increase the amount of meadows and riparian areas in the project area. The Atlantis fritillary and tawny crescent are expected to continue to persist on the Forest.

Snails

Alternative A
No direct mortality of snails would occur with the no action alternative. The risk of MPB and wildfire would increase. MPB are expected to open forest canopies and increase fuel loads as trees fall over. If these open conditions occur at snail colonies, they could cause severe drying of sites, increase isolation. If fires occur in the increased fuel loads it could kill colonies that are burned over.

Alternative B
Direct mortality of unknown snail colonies could occur during timber harvest and road maintenance. Alternative B conserves habitat for snails (Objective 221) by active management following Forest Plan direction. Active management, which lessens the risk of high intensity fire, would potentially benefit this snail. Silvicultural treatments may dry out some mesic sites, while

enhancing others. Unknown snail colonies may be impacted in treatment areas over time, however, most treatment areas do not occur in typical snail habitat. Known snail colonies would be conserved according to Forest Plan direction (Standard 3103). In addition, BMPs and Forest Plan Standards pertaining to watershed, soils, and road construction would help avoid some of these effects.

Alternative C

The effects of Alternative C are expected to be similar to Alternative B for most of the project area except that Alternative C includes vegetative treatments in Spearfish Canyon and includes 70 miles of road construction that could potentially affect snail colonies.

Known snail colonies would be conserved according to Forest Plan direction (Standard 3103) except in Spearfish Canyon (Management Area 4.2A). Alternative C proposes timber harvest via cable logging and use of tractors and skidders in MA4.2A. Some road construction is expected associated with these activities. Due to the high occurrences of SOLC snails in MA4.2A these actions would not be consistent with Standard 3103. Therefore, a Forest Plan amendment is proposed as part of Alternative C, to allow these actions to take place within MA4.2A. Approximately 2/3 of MA 4.2A is identified a potential treatment areas. If these areas are treated, as much as 2/3 of the available habitat could be affected. Treatments that open the canopy, such as thinning and selection harvest, would be expected to open the canopy and cause the sites to dry from exposure to sun. Snails are known to be sensitive to site conditions and are not expected to use these areas until shade and moist conditions return. Ground disturbing activities such as road construction, tractors and skidders, and cable logging on snail colonies are expected kill snails and alter habitat. These activities are expected remove litter and expose bare soil, which would likely be unsuitable for snails until the litter layer developed.

Sanitation activities (cut and chunk, cut/pile/burn, cut/chip, hand cut/helicopter yarding) and tree spraying are consistent with Standard 3103. Sanitation activities would remove trees that are already dying so solar exposure would not be increased. They also may retain more shade in snail colonies by reducing the amount of trees killed by MPB. Tree spraying would also help maintain canopy cover.

Summary: The Phase II Amendment FEIS (USDA Forest Service 2005g) determined that there would be adequate habitat for maintaining a viable population if Forest Plan standards are followed, including snail specific Standard 3103. Snail colonies are expected to be impacted by MPB in all alternatives. Unknown snail colonies may be impacted by treatments in Alternatives B and C. All known colonies would be managed consistent with Standard 3103 in Alternative B. Alternative B follows Forest Plan riparian, hardwood and snail standards including Standard 3103. This snail is likely to persist on the forest under Alternatives A and B.

Persistence is more uncertain in Alternative C. In Alternative C, snail colonies would be managed according to Standard 3103 on most of the Forest outside of MA 4.2A. There are scattered colonies outside MA 4.2. These sites are expected to persist. Colonies in MA 4.2A are expected to decline substantially if potential treatment areas are treated with cable logging, road construction, tractor logging/skidding, and forest thinning. These species is expected to persist on the Forest, but reduced populations may make them more susceptible to natural disturbances.

Migratory Birds

Golden Eagle
Disturbance to nesting birds from timber harvest activities under the action alternatives may occur. Disturbance would likely be a temporary displacement during the treatment activities and would be localized to the activity location. Hunting success may increase due to the creation of more open habitat expected in treatment areas. Additionally, reduced pine overstory in proposed cutting areas will likely increase horizontal screening cover, which will benefit long-term (5-25 years) prey populations and survival and thus, the eagle indirectly. Enhanced habitat for prey species will benefit eagles. Potential nest trees may decrease in cutting units. However, nest trees are not limiting in the Black Hills. Nesting for this species is primarily on cliffs in the Black Hills, but nests are occasionally found in trees. Nesting habitat will be maintained by providing adequate numbers of trees across the project area.

Red-headed Woodpecker
Timber harvest may have an immediate impact if active nest trees are removed. Reducing the amount of mature forest stands with their snag component may negatively affect these birds. Snag densities are expected to be above Forest Plan Objective 211 in all alternatives due to MPB activity. The increase in open forest conditions expected in all alternatives could lead to more hardwood component which may be beneficial to red-headed woodpeckers due to their association with mast production (Anderson 2003). The action alternatives will retain all non-safety hazard snags per Forest Plan Standards and proposes to enhance 630 acres of aspen. The amount of preferred, open pine habitat (structural stage 4A) will increase in the project area with all alternatives.

Black-billed Cuckoo
Disturbance to nesting birds from timber harvest activities under the action alternatives may occur. Suitable habitat is expected to increase with MPB activity and proposed treatments. Thinning pine is expected to encourage more diversity and production in the understory, benefiting this bird.

Climate Change
The USFS has embraced the management challenges posed by climate change. The agency's "Strategic Framework for Responding to Climate Change" (Hayward et al. 2009) provides broad direction to guide future management and research to address climate change in all aspects of agency work. With this Framework, the agency has attempted to integrate climate change throughout its organizational structure. As a result, significant momentum is building from the individual Ranger District level up through the Washington Office to actively manage fish and wildlife habitat in a way that is mindful of climate change. It is assumed that climate change likely could lead to the loss of native species from extensive areas and result in increasingly scarce and fragmented populations in many others. Further changes within ecosystems could be triggered as invasive species, both plant and animal, fill the "holes" that are left as native species are lost. Increases in disturbance owing to fire, insects, and disease could accelerate the infiltration of invasive species. The loss of native ecosystems to invasive species affects many species as the effects of changing plant communities ripple through the ecosystems. As a result, many animal species could be lost as vegetation patterns change, associated changes in the food-web could cascade and further destabilize ecosystems. Until these changes are better understood, it would be difficult to reliably predict the environmental outcomes of forest

management activities (Ruggiero et al. 2008, Reid and Lisle 2008). The uncertainty associated with climate change and the potential risk associated with novel and untested management practices would require altogether new levels of institutional flexibility. The potential impacts to species on the Forest are becoming better understood and that effects of any one project such as this are not meaningfully measurable, especially at the scale of the project area.

Cumulative Effects

Cumulative effects are the additive incremental impacts from the action alternatives in relation to past, present and reasonably foreseeable future actions. Past actions are reflected in the existing condition. This analysis is bounded by the Forest Boundary and the 15 year period required for project implementation. Relevant actions on federal and non-federal land assessed in the analysis are discussed below.

The Forest has been affected by wildfires within the last 30 years. Prescribed burning has occurred or may occur on throughout the Forest. Several prescribed burns may occur within the next five years as identified in the Briggs, Cold Spring, Steamboat, Herman, Pactola, Buttes, Calumet and Vestal Project Areas. These burns are specifically designed to reduce ground fuels, pine regeneration, thin dense stands, and improve winter forage for big game. These burns have created an interspersion of openings and various tree densities while increasing the grass/forb understory. Pockets of snags are apparent in the burn areas, along with insect and disease components that normally follows a fire. None of the alternatives would incrementally add to the effects of these projects because no broadcast burning is included in the alternatives.

The MPB infestation is expected to increase due to the growing MPB population levels that are currently affecting the Black Hills. All alternatives would reduce areas of continuous pine structural stages, especially mature and late succession pine, thus reducing patch size of these stands. The MPB population has already had an impact across the Forest, increasing edge and changes to pine forest structure and size. Alternative A, due to stand densities, could increase the intensity and lengthen the duration of the current MPB epidemic. Alternative A would not move toward Forest Plan Goal 10. Alternative B and C would move toward Forest Goal 10 for managing insect outbreaks by reducing stand densities and reducing the susceptibility of those stands from MPB attack. However, in doing so these even-aged treatments along with continued MPB effects would create larger areas of structural stages 2, 3A, and 4A where stand and within stand heterogeneity is low. Because there is less competition with overstory, pine regeneration would flourish in the next 10-20 years. Combined with similar treatments in the analysis area, the treatments in Alternatives B and C could add to a loss of heterogeneity across the landscape, creating the same conditions (high fire hazard and high insect risk) in the next 20-30 years that could affect wildlife.

Limited use of pesticides (e.g., Carbaryl) to control the effects of mountain pine beetle in the recreation areas could occur for the next five to seven years, separate from the proposed action. Chemical treatments may also be used on private lands. These treatment would focused on maintaining mature pine overstory and provide public safety in high use recreation areas. Alternatives B and C would incrementally add to these effects by treating some high value areas and legacy trees with pesticides. Chemical treatments may result in localized reductions in insect

populations, which could reduce prey for insectivores. These effects are expected to be minimal because use of chemicals to control MPB is not effective on a large scale.

In areas not treated to reduce the susceptibility of MPB attack, increased fuel loading, and steep inaccessible slopes may create the conditions that increase the rate of spread, increase severity, and intensity of wildfires. A large stand-replacing wildfire, depending on the severity and intensity would be detrimental to soil, water, and ultimately loss of wildlife/aquatic habitat. Stand replacing wildfires may drastically alter or eliminate some species' habitat for long periods (e.g., >50 years). Alternative A due to the amount of standing dead and downed fuels created by MPB would add to the potential for this type of wildfire. Alternatives B and C could reduce the rate of spread, severity, and intensity of wildfires by decreasing fuel loadings, increasing natural and planned fuel breaks and open crown densities allowing for effective fire suppression. Fuel reduction treatments in the project area, along with areas adjacent to the Forest that reduce the potential for large-scale wildfire are expected to benefit most wildlife species, the exception would be the black-backed woodpecker and pygmy nuthatch that prefer standing dead/burned habitats.

Present and reasonably foreseeable commercial and non-commercial treatments are expected to occur on the Forest as part of the Briggs, Cold Spring, Steamboat, Herman, Pactola, Buttes, Calumet and Vestal Projects. The main emphasis of these projects is to protect communities, forest resources, and ecosystems from the on-going MPB epidemic and to reduce the potential for a large stand replacing wildfire. Post timber sale treatments such as thinning, noxious weed treatment, hardwood retention/restoration, and meadow restoration have been planned in the project area for the next five years as part of these projects. The result of these current and future vegetative management activities include moving much of the dense, mature pine forest toward more open stands structural stages. In addition, treatments to protect private land and communities from the effects of MPB and wildfire are planned and would likely continue as needed.

Alternative A is not expected to contribute directly to cumulative effects of past, present and reasonably foreseeable vegetative treatments in reducing mature, dense pine structural stages on the landscape. However, indirectly forest maturation and predicted MPB mortality estimates are expected to reduce mature, dense pine structural stages. The effects of this habitat loss would be dependent on the extent and duration of the beetle epidemic. Treatments associated with Alternatives B and C are expected to contribute to meeting Forest-wide objectives for early seral and open canopied pine structural stages (1, 2, 3A, and 4A) but are expected to contribute to a loss in denser stand conditions, especially in the older more mature structural stages (3B, 3C, 4B, 4C, and 5) on the landscape. Cumulatively, all alternatives would further reduce habitat for several wildlife species that require late-successional or dense mature stands in the analysis area, which could affect their distribution on the landscape. All alternatives whether indirectly or directly contribute to the distribution and restoration of other plant communities by varying degrees in the analysis area, increasing structural diversity and maintaining seral communities on the landscape. Alternative A is expected to maintain snag and CWD at the project scale and is expected to contribute to meeting snag and downed wood objectives short-term. Alternative A, based on predicted MPB effects, may not contribute to snag objectives long-term. Alternatives B and C could further reduce snag distribution and CWD in treated areas, especially adjacent to roads and private land if deemed a safety hazard. In addition, silviculture treatments may affect snag densities

(recruitment) by decreasing the number of low vigor trees available to become snags. However, the action alternatives are expected to contribute to maintaining large snags on the landscape long-term.

It is possible that areas on the Forest would be designated for firewood gathering. This could decrease snag abundance and availability mostly adjacent to accessible areas. However, firewood gathering is not expected to affect Forest-wide snag objectives.

Livestock grazing on Forest and private land would continue on the Forest. Although grazing practices have improved from historic conditions, impacts may occur, especially during drought conditions. Grazing allotment management plans incorporate wildlife habitat needs, protection of riparian habitats and moves toward meeting Forest Plan direction to maintain forage and cover for wildlife species. None of the alternatives would add any cumulative impacts to livestock use long-term.

Roads and trails can remove habitat, increase predation, create barriers, or decrease habitat quality for some species (e.g., fish, amphibians, reptiles, and land snails). Use of roads by humans can also increase disturbance to wildlife, particularly to nesting raptors. High road densities increase accessibility, and can facilitate recreation use, wildlife hunting, poaching, and illegal removal of snags. Road/trail densities have increased in the analysis area as a result of past vegetation management activities, private land development, and recreation. In addition, roads have been attributed to increasing sediments into streams.

Alternative A would not add any additional road/trails to the area that could open up previously inaccessible areas, therefore would not add any cumulative effect to the analysis area. Alternative B would not add new road/trails to the landscape, but would use existing roads and trail. Alternative C would add approximately 70 miles of roads/trails to the landscape which is expected to reduce the amount of vegetation available for wildlife habitat by about five acres per mile of road (Rowland et al. 2004). Alternatives A and B would not incrementally add to disturbance in the long term because all system and temporary roads not on the Forest Travel Map will be closed following treatments. All alternatives would maintain road/trail densities open to motorized vehicles, both year-round and seasonally.

Private land development is still occurring, and the trend is expected to continue into the future. Habitat changes associated with increased development are expected to decrease prime wildlife habitat (riparian areas and grasslands) and could influence wildlife distribution and their ability to move across the landscape. Providing secondary access roads (for evacuation during a fire) and clearing along these roads to maintain safe egress to private land could increase visibility of wildlife and affect movement patterns. As development increases, water availability could be reduced, either from wells or water impoundments reducing flows in streams. Low water tables could drastically change riparian communities and aquatic habitats. Species most affected are those associated with riparian components (e.g., fish, song sparrows, beavers) and grassland communities (e.g., grasshopper sparrows, big game). In addition, increased noise, domestic animals, and introduction of invasive species could occur, changing wildlife distribution and use. Roads on private land are expected to increase, as land is sub-divided. Roads that access private land and communities would likely be improved to allow easier, safer access to arterial roads that could increase mortality and decrease use in adjacent suitable habitat. Some vegetative treatments

are occurring on private land, mostly in conjunction with reducing MPB effects and increasing development opportunities. The amount of vegetative treatments on private land is expected to slightly reduce wildlife habitat on the landscape. Alternatives B and C are expected to contribute to these effects improving secondary access routes and by clearing roads and egress routes. Noise created by harvest activities are expected to be short-term and cause a slight change in wildlife distribution and use. However, once equipment leaves an area, wildlife use is expected to resume.

Activities on private land and MPB outbreaks are expected to impact snail colonies. Treatments in Alternative B and C are expected add impacts to undiscovered snail colonies. Alternative C is expected to add substantial impacts in Spearfish Canyon (MA 4.2A) with the addition of commercial cable logging, tractor logging/skidding, road construction and forest thinning.

FISHERIES

Affected Environment

Historically fish-species diversity was limited in the Black Hills, with native species including creek chub, fathead minnow, finescale dace, lake chub, longnose dace, longnose sucker, mountain sucker and white sucker (USDA Forest Service 2005g). The lake chub, finescale dace and mountain sucker are designated as Rocky Mountain Region sensitive fish species. The mountain sucker is also a Management Indicator Species (MIS) on the Black Hills National Forest. There are no federally threatened, endangered, proposed or candidate fish species nor any designated critical habitat present in the analysis area (U.S. Fish and Wildlife Service 2011a-f).

Non-native fish species provide recreational fishing opportunities. Trout were first stocked in the Black Hills in the late 1880s. Fisheries populations are managed by the South Dakota Department of Game, Fish and Parks and the Wyoming Game and Fish Department. Supplemental stocking of hatchery raised rainbow trout is done to meet angler satisfaction in waterbodies that receive high angler pressure. Brook trout and brown trout populations are generally self-sustaining, except under drought conditions on some streams. A variety of other non-native game fish or bait species are also now present due to illegal or incidental releases.

Environmental Consequences

Alternative A - Direct and Indirect Effects

The No Action Alternative assumes that no implementation of any elements of the action alternatives (Alternatives B or C) would take place within the MPB Response Project Area. Actions such as ongoing Forest protection efforts, fire suppression, noxious weed treatment, and recurring road maintenance on system roads would continue as directed by the Forest Plan. Vegetative management would not take place unless authorized by other decisions.

These past, present and reasonably foreseeable actions however may continue to directly or indirectly impact fisheries and their habitat (USDA Forest Service 2005g). Roads would continue to be a sediment source to streams and other waterbodies. Instream structures (culverts) at road-stream crossings may be barriers to fish passage. Some remedial actions that improve fish habitat may occur under other funded programs.

The loss of larger ponderosa pine trees (structural stages 3b, 3c, 4b and 4c) due to mountain pine beetle infestation is anticipated to be highest under this alternative. The effects of ponderosa pine overstory reduction on stream temperatures, flow regimes and water yield are contingent on a number of factors. These effects are disclosed in the hydrology section and are anticipated to be minor. The potential recruitment of large wood to increase aquatic habitat diversity is greatest under this alternative. The level of recruitment would be dependent on mountain pine beetle killed trees falling into or across streams or the transport of beetle-killed trees during high rainfall or flood events into waterbodies.

In general, this alternative has the highest fire/fuels hazard. Fire can remove riparian vegetation, increasing direct solar radiation to the stream surface and leading to warmer summer water temperatures (Mahlum et al. 2011, Sestrich et al. 2011). Fire can also consume vegetation and organic biomass on the forest floor, changing hydrologic flows, stream quality, and fish habitat suitability (Driscoll et al. 2004).

Many fish species have evolved with natural disturbances (fire, floods or drought) and their populations are resilient to these events given adequate connectivity to robust populations elsewhere in a basin. This resiliency, however, has been reduced in many watersheds through stream habitat loss, degradation or fragmentation. Therefore, the time period for fish populations to recover may increase, with the exception of waterbodies in which hatchery-reared fish are stocked.

Alternative B - Direct and Indirect Effects

Direct effects to fish relate to those inwater activities that may injure or kill fish (all life stages). These inwater activities relate primarily to the placement of structures at road-stream crossings. Design criteria to use structures, such as temporary bridges, that span the creek channel to maintain streambank stability and avoid the placement of culverts and roadfill in the stream along with the seasonal restriction to prohibit inwater activities during the fall spawning period for brook and brown trout should avoid adverse effects to fish during their spawning, egg incubation and emergence period, consistent with the watershed conservation practices.

Changes in sediment input, water quality and temperature, flow regimes and water yield constitute the indirect effects to fisheries via habitat modification. These effects are disclosed in the hydrology effects analysis. Activities including cut and chunk, cut and chip, cut-hand pile-burn and pesticide spraying are likely to have minimal ground disturbance with no detectable indirect effects on fish habitat. The application of pesticides (carbaryl or permethrin) is limited to campgrounds, administrative sites and legacy trees. Potential adverse impacts will be mitigated because these pesticides will be sprayed by a certified applicator at the approved concentration per label directions to avoid wind drift to waterbodies.

Land management activities, such as timber harvest and road development, pose threats to fish habitat if erosion rates and sediment delivery to streams are not managed and habitat diversity is diminished (USDA Forest Service 2005g). Alternative B proposes treatment of 48,400 acres (20 percent of the total acres identified). No new system or temporary roads are proposed in Alternative B, though some existing non-system routes could be used then designated as Level 1 (closed) system roads. Commercial and products other than lumber (POL) timber harvesting should only be a minimal contributor of sediment during implementation when design criteria, Forest Plan

standards and guidelines and watershed conservation practices are followed. This is due to the localized and minimal ground disturbance within 50 feet of streams and other waterbodies.

Maintenance and temporary use of roads within the WIZ and at stream crossings have the potential to increase sediment because the road surface is disturbed during operations and material on the road can be easily mobilized when it rains. There would be a slight increase in potential for localized sedimentation from Alternative B in the short term (<5 years) due to activities related to road crossings on streams. In the long term (>5 years) sediment potential should be reduced as roads are revegetated and sediment sources, also called connected disturbed areas (CDAs) are reduced during road improvement activities.

Alternative C - Direct and Indirect Effects

Many of the same types of activities occur as in Alternative B, with several exceptions. New road construction (250 miles) and treatment activities in Spearfish Canyon (6,000 acres) are proposed that do not occur in Alternative B. The risk of direct effects due to in-water activities (structure placement at road-stream crossings) is greater under Alternative C because of the additional miles of new road construction and conversion. Ultimately, these effects are mitigated through the implementation of design criteria to avoid in-water activities during fish spawning, egg incubation and emergence periods.

The potential magnitude and intensity of indirect effects is greater under Alternative C because it proposes more acres of treatment and more miles of road conversion. The amount of ground disturbance and acres of treatment near waterbodies is highest under this alternative and increases the potential for sediment to enter these waterbodies, which may adversely impact fisheries. The addition of 250 miles of new road has the potential to increase sediment input into waterbodies, but this is mitigated through design criteria that limits new road construction to cross streams at designated points and to avoid construction within the water influence zone next to perennial and intermittent streams. The higher miles of road conversion has the potential to improve fish habitat at road-stream crossings where sediment input or fish passage is currently a concern. Stream fragmentation is not increased because all instream structures at road-stream crossings need to pass all fish, consistent with Standard 1203.

Cumulative Effects

The cumulative effects analysis area is bounded in space as those watersheds with proposed treatment areas that have fish-bearing streams and reservoirs. The cumulative effects are bounded in time as the next 5-7 years. Both action alternatives attempt to reduce the fire/fuel hazard. Any reduction in the severity or acreage burned by a wildland fire would have a positive cumulative effect by reducing the potential short-term sediment pulse and water quality impacts that may affect fisheries. Alternative C would have the most positive benefit because it treats the most acres.

Ground disturbing activities (roads and timber harvest) have the potential to increase sediment input into fish habitat. Alternative C would have the greatest potential for a negative incremental effect because it treats the most acres and constructs/converts the most miles of roads. The implementation of design criteria, standards and guidelines and regional watershed conservation practices are proven to protect soil, water and riparian resources and meet State nonpoint source water pollution requirements. Therefore, habitat suitability in regards to food availability,

spawning habitat and cover (pool depth, quantity of large woody debris, streamside vegetation and overhanging banks, etc.) is not likely to be substantially affected. Alternatives B and C are predicted to meet water quality standards and maintain fisheries habitat at levels equal to or greater than the no action alternative. Subsequently, recreational fishing opportunities will be maintained consistent with Executive Orders 12962 and 13474. Proposed activities are not predicted to introduce new or spread existing aquatic nuisance species. Overall, both action alternatives will meet Forest Plan Objectives 217 and 219.

Under both action alternatives, stream connectivity should be maintained or improved because no new instream barriers would be constructed (Standard 1203) and existing instream barriers may be removed or repaired where non-system roads are converted to system roads. Alternative C converts the most road miles.

Current climate change models predict a warming trend in air temperature. Air temperatures are typically used as a surrogate for stream temperatures in regional bioclimatic assessments for coldwater fish but this is not a perfect correlation and creates significant uncertainty. Further, the confidence in the projections of air temperatures is greater than for precipitation projections, which adds more uncertainty. While it may become significantly warmer, total annual precipitation may or may not change. One scenario is that more precipitation may fall as rain rather than snow, resulting in a shift in the peak stream flow to earlier in the year. If stream temperatures increase or flows are reduced, the existing coldwater native and desirable non-native fish species (trout) may have to tolerate living in water temperatures that are less than optimal and/or in some instances the replacement of existing coldwater fish by species more tolerant of warmer water. Both action alternatives would have a minor cumulative effect on fisheries in regards to climate change because stream habitat connectivity is maintained or improved and stream flows or temperatures will not be substantially changed.

Special Status Species, Federally Threatened, Endangered or Proposed Species
There are no federally threatened, endangered or proposed fish species known to occur or likely to be affected by management activities in the analysis area nor any designated critical habitat (U.S. Fish and Wildlife Service 2011).

Region 2 Sensitive Species -- Fish
The finescale dace (Phoxinus neogaeus), lake chub (Couesius plumbeous) and mountain sucker (Catostomus platyrhynchus) are Region 2 sensitive species that are known to occur on the Black Hills National Forest. The mountain sucker is also designated a Management Indicator Species (MIS). This analysis assumed that all 3B, 3C, 4B and 4C ponderosa pine stands identified in the watersheds occupied by finescale dace, lake chub or mountain sucker are treated, which may overestimate the potential for adverse effects to these species, given that Alternatives B and C propose treating 20 percent and 50 percent, respectively, of the total acres identified in Alternative B (242,000 acres) and Alternative C (248,000 acres).

The finescale dace occurs in the Redwater Creek drainage on the Wyoming portion of the Forest. They seem to do best in standing water habitats, such as decadent beaver ponds, even to the point of being borderline habitat for most trout (McDowell 2004 pers comm.). This species has been transplanted to various sites on the Black Hills National Forest, but the only population that

persists is in Hemler Reservoir (USDA Forest Service 2006b), which is a small (2.5 acres), private impoundment on Redwater Creek authorized under a Forest Service Special Use Permit.

The lake chub occurs in Deerfield Reservoir, which is a 414-acre impoundment on Castle Creek completed in the late 1940s. The dam and water levels are regulated by the U.S. Bureau of Reclamation. The South Dakota Department of Game, Fish and Parks (SDGFP) manage the fisheries within the reservoir. The lake chub population in Deerfield Reservoir is in decline (USDA Forest Service 2010). Spawning occurs in the spring in shallow waters over cobble substrates, and eggs are given no parental care (Isaak et al. 2003). No spawning migrations upstream into Castle Creek or other tributaries to Deerfield Reservoir have been documented. Mountain suckers are native to the Black Hills and comprise the eastern-most extent of the species. Belica and Nibbelink (2006), Isaak et al. (2003) and Schultz and Bertrand (2012) assessed the status of the mountain sucker in the Rocky Mountain Region and the Black Hills. In the Black Hills, mountain sucker occur in streams with mostly rocky substrates, but not in lake or reservoir habitats. This species is found on the stream bottom and is closely associated with cover (exposed roots, undercut banks, logjams, and boulders). Mountain suckers are bottom feeders and their diet is primarily simple plants like diatoms and green algae. Mountain sucker adults spawn over gravel riffles and use lower velocity, deeper habitats during non-breeding periods and young-of-year mountain sucker require shallow low velocity habitats (Belica and Nibbelink 2006). In the Black Hills, the spawning period for mountain suckers is probably June and maybe early July (Shearer pers. comm. 2006). Schultz (2011) studied the environmental factors affecting long-term trends in mountain sucker populations and their thermal tolerance on the South Dakota portion of the Black Hills. Factors negatively affecting mountain sucker populations included non-native trout, recurrent droughts and stream fragmentation. Overall, results of this study indicate that the mountain sucker is currently not limited by water temperature in the Black Hills, but some areas that are currently suitable for mountain sucker may be lost due to climate change. Fisheries surveys indicate that the population trend for mountain sucker has declined since the 1960s (USDA Forest Service 2005g, 2009a, Schultz and Bertrand 2012).

Alternative A –Direct and Indirect Effects

The No Action Alternative assumes that no implementation of any elements of the action alternatives (Alternatives B or C) would take place within the MPB Response Project Area. Past, present and reasonably foreseeable actions however may directly or indirectly continue to impact the finescale dace, lake chub and mountain sucker. In general, this alternative has the highest fire/fuels hazard. Fire can remove riparian vegetation, increasing direct solar radiation to the stream surface and leading to warmer summer water temperatures. Fire can also consume vegetation and organic biomass on the forest floor, changing hydrologic flows, stream quality, and fish habitat suitability. Many native fish species have evolved with fire, and their populations are resilient to fire's effects given adequate connectivity to robust population segments elsewhere in a basin. This resiliency, however, has been reduced in many watersheds through stream habitat loss, degradation or fragmentation and the introduction of non-native fishes that threaten native and desirable non-native fish persistence through displacement, competition, predation or disease.

Alternatives B and C - Direct and Indirect Effects

Direct effects are associated with inwater activities, such as the placement or repair of culverts at road-stream crossings that immediately kill or injure fish. No inwater activities are proposed in Deerfield or Hemler reservoirs. Subsequently, there would be no direct effects to the lake chub or

finescale dace. There is the potential for some road work on non-system roads that are used for management access across streams occupied by the mountain sucker. The design criteria to keep heavy equipment out of streams during the mountain sucker spawning, egg incubation and emergence period will mitigate adverse direct effects at these stream crossings.

Activities including cut and chunk, cut and chip, cut-hand pile-burn and pesticide spraying are likely to have minimal ground disturbance with no detectable indirect impact on fish habitat. The application of pesticide is not anticipated to have an adverse impact because application is limited to campgrounds, administrative sites and legacy trees. Campgrounds at Deerfield Reservoir are located far enough away from the reservoir that overspray is not likely to affect the lake chub. Potential adverse impacts are further reduced because the pesticide will be sprayed by a certified applicator at the approved concentration following label directions to avoid wind drift to waterbodies.

Land management activities such as timber harvest and road development pose threats to fish habitat if erosion rates and sediment delivery to streams are not managed and habitat diversity is diminished (Isaak et al. 2003, USDA Forest Service 2005, Belica and Nibbelink 2006). Alternative B proposes treatment of 48,400 acres (20 percent of the total acres identified). No new system or temporary roads are proposed in Alternative B, though some existing non-system routes could be used then designated as Level 1 (closed) system roads.

Alternative C proposes the same types of treatment activities as Alternative B but on 50 percent (124,000 acres) of the total acres identified. Therefore, the magnitude and intensity of potential adverse effects due to sediment input into waterbodies is higher. In relation to timber harvest activities, the associated road network has been identified as the most substantial chronic source of long-term sediment input into streams and reservoirs (USDA Forest Service 2005). Alternative C has a higher probability of road-related work because it proposes up to 250 miles of system and temporary road construction and the predicted conversion of 46 miles of unauthorized routes/legacy road prisms to system roads.

Alternative C proposes treatment of 6,000 acres in Spearfish Canyon. There is a population of mountain sucker in Annie Creek, tributary to Spearfish Creek, which is not affected in Alternative B but may be in Alternative C. The Annie Creek watershed is relatively small (approximately 2,385 acres) and about 42 percent of the treatment acres (205 acres) are on slopes less than 40 percent and would likely use ground based harvest operations (tractor logged) or non-mechanized methods (cut and chunk, etc). Seventeen acres of proposed treatments occur within 100 feet (Water Influence Zone; WIZ) of Annie Creek, but due to the steeper slopes in this drainage the potential for sediment input is greater from upslope treatment activities. The design criteria to prohibit mechanized equipment zone within 50-feet of intermittent and perennial streams should reduce sediment input. Any sediment that enters Annie Creek would have a short-term impact because it is likely to be quickly transported out of the drainage due to the high stream gradient, the location of most treatments in the mid- and lower portions of the watershed and the short length of stream (1.2 miles) affected.

For all three species, the implementation of Forest Plan standards/guidelines (1105, 1106, 1112, 1113, 1114, 1115, 1116, 1301 and 1306) and regional watershed conservation practices (Management Measures 1, 3, 9, 10, 11 and 12) and design criteria (EIS Appendix B) in the water influence zone (100 feet of intermittent/perennial waterbodies) mitigate indirect adverse impacts. These conservation measures include maintaining some tree canopy for stream shade and bank

stability and reducing soil disturbance and sediment input into waterbodies. Any new instream structures placed at road-stream crossings will allow for the free movement of fish species consistent with Standard 1203.

Cumulative Effects
The cumulative effects analysis area is bounded in space as those watersheds occupied by finescale dace, lake chub or mountain sucker where treatments are proposed and is bounded in time as the next 5-7 years. Any sediment input into waterbodies would be additive to sediment input from ongoing natural erosion processes. The quantity of sediment input is not anticipated to be of a volume that fish habitat is substantially degraded. If a wildland fire were to occur, treatment activities are predicted to reduce fire severity resulting in less surface erosion and sediment transport to waterbodies. This would have a beneficial effect, especially in the case of the finescale dace where due to the relatively small size of Hemler Reservoir, a substantial amount of dace habitat could be lost due to sediment input after a wildland fire. The remediation of sediment sources at existing connected disturbed areas (CDA's) and existing fish passage barriers at road-stream crossings will have a positive cumulative effect on improving stream connectivity and reducing sediment input into streams that may benefit the mountain sucker. Alternatives B and C may have a positive incremental impact on habitat connectivity for the mountain sucker because no new instream barriers would be constructed and some existing barriers could be removed or fixed at road-stream crossings, but the finescale dace and lake chub will be largely unaffected. Both action alternatives meet the intent of Forest Plan Objective 221.

Determination: The determination for the finescale dace, lake chub and mountain sucker under the No Action Alternative is "may adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing."

Alternatives B and C would have "no impact" on the finescale dace and lake chub given the lack of direct effects and discountable indirect effects to Hemler and Deerfield reservoirs, respectively. The determination for the mountain sucker, under Alternatives B and C is "may adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing" due to the potential indirect, but minor, effects on habitat suitability.

Management Indicator Species – Fish
The mountain sucker is a Management Indicator Species (MIS) and it's also designated as a Region 2 sensitive fish species. Direct, indirect and cumulative effects to this species are analyzed in the Fisheries Biological Evaluation.

This MIS discussion focuses on this project's effects on this species Forestwide population and/or habitat trend and this project's consistency with the mountain sucker MIS objective in the Forest Plan (Objective 238d).

The Forest-wide population trend for mountain sucker is one of decline when comparing past to present abundance and distribution (USDA Forest Service 2010b, Schultz 2011). All alternatives will have a neutral effect on the Forest-wide population trend for the mountain sucker given the implementation of design criteria, Forest Plan standards and guidelines and regional watershed conservation practices to avoid adverse effects to aquatic and riparian habitat. Subsequently, habitat quality and connectivity will be maintained consistent with Objective 238d. Reducing the fire/fuels hazard resulting from the mountain pine beetle epidemic at the landscape level may

have some positive benefits to this species, but factors that are more likely contributing to the downward trend in the Forestwide mountain sucker population, such as the negative interactions with non-native fish (Schultz 2011), are outside the scope of these alternatives.

BOTANY

Affected Environment

The Black Hills National Forest is located within a unique ecoregion among 64 terrestrial ecoregions in the continental United States (Hall et al. 2002). The Black Hills ecoregion encompasses an area of 5,121 square miles (roughly 3 million acres). The varied topography, geology, and climate result in a corresponding variety in plant communities, including such diverse elements as western ponderosa pine (*Pinus ponderosa*) forests, grasslands of the Great Plains, and northern white spruce (*Picea glauca*) forests. Midwest hardwood types are well-represented by stands dominated by oak, ash, and elm. The Black Hills Community Inventory by the Nature Conservancy's Midwest Conservation Science Center at the Midwestern Resources Center was the first systematic classification to describe the vegetation of the Black Hills by adopting the standardized National Vegetation Classification (Marriott et al. 1999, Marriott & Faber-Langendoen 2000). Although further refinement of the Black Hills Community Inventory is needed, approximately 70 native plant communities have been described in the Black Hills.

The native plant communities of the Black Hills ecoregion is composed of a great diversity of plant species. The Black Hills has floristic influences from four of the North American biomes: Cordilleran Forest, Grassland, Eastern Deciduous Forest, and Northern Coniferous Forest. While approximately 30 percent of the plant taxa in the Black Hills have their main ranges to the west, Midwestern, eastern, and northern taxa are also significantly represented in the Black Hills flora (McIntosh 1931).

The majority of the plant species considered rare in the Black Hills are best described as boreal disjuncts (species that were isolated in the cooler, moister forest and riparian areas of the Black Hills as the glaciers retreated and the Great Plains environment became established). The next closest populations of these species to the populations found in the Black Hills are generally found in Canada and the northeastern United States.

Because the potential treatment areas for the Mountain Pine Beetle Response Project span so much of the Forest, the Black Hills National Forest in its entirety is considered the affected environment for this discussion.

No Botanical Areas or Research Natural Areas overlap with the Mountain Pine Beetle Response Project Area; however, all of the Botanical Areas and most of the Research Natural Areas (Canyon City is the only exception) are adjacent to the project boundary and can therefore potentially be impacted by the proposed treatment. Impacts to these special designation areas are addressed in the Mountain Pine Beetle Response Project Botany Report (contained in the project record).

There are 41 acres of montane grasslands recommended for conservation in the Survey of Black Hills Montane Grasslands (Marriott 2000) in the Mountain Pine Beetle Response Project Area. Impacts to this ecosystem are addressed in the Mountain Pine Beetle Response Project Botany Report (contained in the project record).

Species Considered and Evaluated - Federally Listed Plant Species.
The U.S. Fish and Wildlife Service (USFWS) website list for Threatened and Endangered species was accessed on February 3, 2012 for the states of South Dakota and Wyoming. As of this date, there were no threatened or endangered plant species known to occur within these states (USDI Fish & Wildlife Service 2012c, 2012f), nor were there any candidate or proposed threatened or endangered plant species known to occur in these states (USDI Fish & Wildlife Service 2012a, 2012b, 2012d, 2012e. 2012g).

Threatened, endangered, and proposed plant species which could potentially occur on the Black Hills National Forest were identified and addressed through informal consultation with the South Dakota and Wyoming Field Offices of USFWS during the Phase II Amendment development (USDA Forest Service 2005). Subsequently, these threatened, endangered, or proposed species do not need to be further analyzed and are not mentioned in subsequent sections.

Candidate species have sufficient information on their biological status and threats to warrant a proposal to list as endangered or threatened, but development of a listing regulation is precluded by other higher priority listing activities. Species that are candidates for listing under the Endangered Species Act (ESA) are automatically placed on the Region 2 Regional Forester's sensitive species list. The analysis and determination of effects for candidate species are included as part of the Biological Evaluation for sensitive species. The only candidate plant species known to occur on the BHNF, narrowleaf grapefern (*Botrychium lineare)*, was officially removed from the candidate list by the U.S. Fish and Wildlife Service (USDI Fish & Wildlife 2007). However, narrowleaf grapefern remains on the Region 2 sensitive plant list and is discussed under the Biological Evaluation for Region 2 sensitive species found later in this document.

No further analysis is needed for species not known or suspected to occur in the project area. It is my determination that implementation of any of the three alternatives as described *will not affect any threatened or endangered plant species or designated critical habitat.* Endangered Species Act Section 7 Consultation is not required for this project.

Region 2 Sensitive Plant Species

The Forest Service Manual defines sensitive species as those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidence by:

- 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 (Forest Service Manual 2670.5, 19).

All Region 2 sensitive plant species confirmed to occur in the Black Hills National Forest were considered in the evaluation. Known populations and potential habitat exists in the Mountain Pine Beetle Response Project Area for several Region 2 sensitive plant species. No further analysis is needed for species that are not known or suspected to occur within the project area, and for which no potential habitat is present. Table 1 in the Mountain Pine Beetle Response Project Botany Biological Evaluation documents the rationale for excluding a species from further analysis. Determinations for all other species are found below in the Determinations Section.

Analysis was conducted on the effects of the alternatives on Region 2 sensitive species that may occur or for which potentially suitable habitat occurs in the Mountain Pine Beetle Response Project area. This analysis considers management activities of all alternatives and associated mitigation measures as set forth in the Mountain Pine Beetle Response Plan Area Environmental Impact Statement. Prairie moonwort (*Botrychium campestre*), narrowleaf grapefern (*Botrychium lineare*), foxtail sedge (*Carex alopecoidea*), yellow lady slipper (*Cypripedium parviflorum*), ground cedar (*Lycopodium complanatum*), lesser round-leaved orchid (*Platanthera orbiculata*), autumn willow (*Salix serissima*), bloodroot (*Sanguinaria canadensis*), highbush cranberry (*Viburnum opulus* var. *americanum*), and great-spurred violet (*Viola selkirkii*) are the only Region 2 sensitive plant species confirmed to occur within the project area. In addition potential habitat for sage willow (*Salix candida*) and narrowleaf peatmoss (*Sphagnum angustifolium*) occur within the project area.

Table 3-34 Region 2 Sensitive Plant Species Having Suitable Habitat within the Project Area.

SCIENTIFIC NAME	COMMON NAME	KNOWN TO OCCUR IN PROJECT AREA	SUITABLE HABITAT
Botrychium campestre	Iowa moonwort	Y	+
Botrychium lineare	narrowleaf grapefern	Y	+
Carex alopecoidea	fox-tail sedge	Y	Y
Cypripedium parviflorum	yellow lady's slipper	Y	Y
Epipactis gigantea	Stream ochid	N	N
Lycopodium complanatum	trailing clubmoss	Y	Y
Platanthera orbiculata	large round-leaved orchid	Y	Y
Salix candida	sage willow	N	Y
Salix serissima	autumn willow	N	Y
Sanguinaria canadensis	bloodroot	Y	Y
Sphagnum angustifolium	narrowleaf peatmoss	N	Y
Viburnum opulus var. *americanum*	highbush cranberry	Y	Y
Viola selkirkii	great-spurred violet	Y	Y

+Based on limited knowledge of habitat requirements for this species, presence/absence of suitable habitat in the project area and the habitat category for analysis were not determined.

Species of Local Concern (SOLC)

A Species of Local Concern is described in the Forest Service Manual as plant, fish or wildlife species (including subspecies or varieties) that do not meet the criteria for sensitive status. These could include species with declining trends in only a portion of Region 2, or those that are important components of diversity in a local area. The local area is defined as NFS lands within the Black Hills National Forest (USDA Forest Service 2005g). The list of SOLC was updated in 2011 (USDA Forest Service 2011a).

Populations of narrowleaf broadlipped twayblade (*Listera convallarioides*), stiff clubmoss (*Lycopodium annotinum*), five-point miterwort (*Mitella pentandra*), sweet coltsfoot (*Petasites sagittatus*), northern hollyfern (*Polystichum lonchitis*), and greenleaf willow (*Salix lasiandra* var. *caudata*) were confirmed within treatment areas within the Mountain Pine Beetle Response Project Area. Habitat may be present in the project area for four additional plant Species of Local Concern.

The primary habitat for the ten plant Species of Local Concern which occur or have suitable habitat within the project area can be categorized as white spruce and hardwood dominated drainages and wet meadows. Any potentially suitable habitat that may exist overlaps with suitable habitat for Region 2 sensitive plant species. Therefore, design criteria exist in the Botany Biological Evaluation that includes potential habitat for plant Species of Local Concern as well. Refer to the "Effects Analysis" section in the Botany Biological Evaluation (held in the project record) for a discussion of possible direct, indirect and cumulative effects to these habitats. No further analysis is needed for species that are not known or suspected to occur in the project area, and for which no suitable habitat is present.

Table 3-35 Plant Species of Local Concern with Respect to the Project Area

SCIENTIFIC NAME	COMMON NAME	KNOWN TO OCCUR IN PROJECT AREA	SUITABLE HABITAT
Adiantum capillus-veneris	maidenhair fern	N	N
Botrychium multifidum	leathery grape-fern	N	Y
Carex bella	southwestern showy sedge	N	Y
Eleocharis rostellata	beaked spikerush	N	N
Gentiana puberulenta	downy gentian	N	Y
Listera convallarioides	Broadlipped twayblade	Y	Y
Lycopodium annotinum	Stiff clubmoss	Y	Y
Mitella pentandra	five-star miterwort	Y	Y
Oxyria digyna	alpine mountainsorrel	N	N
Petasites sagittatus	arrowleaf sweet coltsfoot	Y	Y
Pinus flexilis	limber pine	N	N
Polystichum lonchitis	northern hollyfern	Y	Y
Salix lasiandra var. *caudata*	greenleaf willow	Y	Y
Salix lucida	shining willow	N	Y

Environmental Consequences

Analysis was conducted on the effects of the proposed action on Black Hills National Forest Species of Local Concern that may occur or for which potentially suitable habitat occurs in the Mountain Pine Beetle Response Project area. This analysis considers management activities of all action alternatives and associated mitigation measures as set forth in the Mountain Pine Beetle Response Project Area Draft Environmental Impact Statement and can be found in the Mountain Pine Beetle Response Project Area Botany Specialist Report.

Effects of the Alternatives

For the purpose of this analysis, cumulative effects are bound in space by the Forest boundary because this is the area affected by Forest Service management decisions and contains most of the ponderosa pine population in the area. Cumulative effects are bound in time by twenty years (ten years prior and ten years into the future) because this encompasses the impacts caused by the most recent timber planning efforts and the foreseeable impact of the Mountain Pine Beetle Project.

Past, present, and foreseeable vegetation projects include Briggs (28,916 acres), Cold Springs (13,969 acres), Steamboat (24,596 acres), Herman (21,572 acres), Pactola (26,017 acres), Buttes (11,441 acres), Calumet (31,781 acres), and Vestal (43,516 acres). The Forest contains 113 grazing allotments that are contained within this project area (Mountain Pine Beetle Response

Project Range Report). Lawrence and Pennington Counties have agreements in place with the Forest Service to cut and chunk adjacent to private.

No field reconnaissance or survey was done specifically for this project; however, all botanical survey data on Black Hills National Forest were considered. Forestwide survey specifically for Region 2 sensitive plant species and Black Hills National Forest Species of Local Concern (SOLC) has occurred since 2001, although the list of Region 2 sensitive species has been revised several times, the most recent going into effect June 2011 (USDA Forest Service 2011a). The information gathered from these surveys provided information on distribution and habitat associations for species and helped determine effects of the alternatives. The focus of botanical surveys is on identifying and mapping community types and determining the probability of an area to support sensitive plant species in addition to locating and recording individual sensitive plant species. These surveys often focus on forested habitats, but cover most high potential sensitive plant habitat, including riparian and wetland areas. Areas to survey were stratified using a combination of aerial photographs, topographic maps, local knowledge, and professional judgment during field reconnaissance. Less intensive limited surveys were also conducted in lower potential sensitive plant species habitat. All botanical survey data is stored in the Black Hills National Forest Database and GIS (USDA Forest Service 2011b). Impacts and risks to sensitive plant species on the Forest were evaluated using the best available science and data.

Of the proposed treatment areas in both action alternatives, 106,700 acres have not been surveyed for botanical resources. Even in areas that have been surveyed for plants, it is recognized that Region 2 sensitive plants or plant SOLC are not always observed when present. Some reasons are that plants may not be in prime growth stage for identification, they may be in dormancy, or they may be difficult to see in surrounding vegetation.

Assumptions for Analysis

- Mountain pine beetle infestation will continue at a rate and pattern similar to the last ten years.
- The timber program on the Black Hills National Forest will continue at a volume and intensity similar to the last ten years (25,000 acres harvested per year).
- Temporary roads will be administratively closed after vegetation management activities, but will not be rehabilitated to the point where they no longer appear on the landscape. A loss of five acres of habitat will be associated with each mile of construction.
- Temporary roads will have limited design features to control erosion.
- Effects of management activities are well understood because they are the same techniques used in District level timber projects.
- Treatments will be fully funded for this project as will the standard post-harvest activities (noxious weed treatment and monitoring, Forestwide rare plant monitoring, etc.)
- Areas that have not been surveyed for botanical resources are occupied (as prescribed in FSM_R2_2670_2011-1)

Alternative A - Direct and Indirect Effects

Under Alternative A (no action) there would be no direct effects because implementation of elements of the proposed action would not take place. Ongoing forest protection efforts and recurring road maintenance on system roads would continue as directed by the Forest Plan. Also,

the timber project areas generated by the Districts (i.e. Briggs, Cold Springs, etc.) would continue as planned, as would analysis of future planned timber projects (Buttes, Calumet, etc.)

Alternative A would maintain Region 2 sensitive plant and plant SOLC habitat and protect biodiversity in the short-term, although over time there would be an increase in the amount of fuel in the area as trees are killed by mountain pine beetle and fall leading to an increased risk of large-scale wildfire. Low intensity fires, commonly associated with light fuels (grass and small diameter woody debris) generally do not burn continuously or with great heat through the moist drainages that are suitable habitat for most Region 2 sensitive species and plant SOLC and therefore do not have as large of an impact on these community types. When a fire burns in heavy fuels, the result is a smoldering fire. Although smoldering fires have lower temperatures than flaming fires, they move slower through an area causing more profound soil impacts and greater vegetative mortality (Neary et al. 1999). Lack of fire could also lead to changes to suitable habitat due to increased competition with both native and non-native species and changes in community types as they pass into late succession.

With Alternative A, mountain pine beetles could potentially infest ponderosa pine trees in and around Botanical Areas and Research Natural Areas (RNA). Mortality of ponderosa pines within RNA would not impact their eligibility as research areas because mountain pine beetles are a native animal and episodic mortality of pine trees has been occurring in the Black Hills for at least as long as recorded history (Shepperd & Battaglia 2002), and is therefore within the range of natural ecosystem variation. The Botanical Areas which contain stands of ponderosa pine could see a change in community types should mountain pine beetles infest these stands. Depending on site conditions, this change could be a temporary loss of ponderosa pine canopy, or coversion to another forest type, such as one dominated by white spruce, if soils, exposure, and moisture allow for establishment of other tree species. Generally, the values for which these areas were set aside are associated with hardwood stands, white spruce stands, wetlands, and meadows with ponderosa pine constituting only a small portion of the overstory; therefore the loss of mature ponderosa pine within these areas would cause limited impacts to the contributing ecosystems. Effects of this loss could include opening in the overstory allowing mid-story trees and shrubs expand into the created gap (Sheppard & Battaglia 2002). Expansion of non-native or exotic plant species into these gaps could occur as these species are usually pioneer species that thrive in disturbed areas. Mortality of larger areas of ponderosa pine in the surrounding landscape, in combination with smaller pockets of pine mortality within Botanical Areas and RNAs, could increase the water available locally until other plants establish in the area. To the extent that white spruce or hardwood forest types are promoted by mountain pine beetle mortality, RNAs and Botanical Areas could benefit, as the rare plants and rare community types supporting the special designations of these areas are strongly associated with forest types dominated by tree species other than ponderosa pine.

Alternative A - Cumulative Effects

If no action is taken on Mountain Pine Beetle Response Project and the timber program on the Forest continues at the same rate as it currently operates (see assumptions), most potential treatment areas in the Mountain Pine Beetle Response Project would eventually be treated, but without the efficiency built into the proposed action. Without speed and flexibility allowed by having analysis completed in advance mountain pine beetle caused mortality could be greater than if the infested stands were treated quickly.

With or without the proposed action, mountain pine beetles would most likely continue to cause ponderosa mortality. As the trees die, more sunlight would be allowed through to the understory changing the microclimate and ultimately the vegetation composition. In addition, dead and dying trees would increase the available fuel which, if the area burned, would cause a more intense fire. Fires with high intensity can change the characteristics of the soil making them unsuitable for certain sensitive plant species. Given the threats currently affecting the project area, the no action alternative, which may cause lesser impacts in the short-term, would result in greater impacts over time. The Districts would continue implementing the current and reasonably foreseeable timber sales which may decrease the impact of mountain pine beetle caused mortality in ponderosa pine, and therefore the impacts to the vegetative composition of the Forest.

Direct and Indirect Effects Common to Both Action Alternatives

Ten species of Region 2 sensitive plant species and six plant SOLC were located in the areas designated for treatment in both action alternatives, and two other species lie within close proximity to treatment areas. Since both alternatives prescribe the use of Integrated Pest Management techniques, the impacts of these activities would be the same for both alternatives.

Locations of Region 2 sensitive plants and plant SOLC by timber stand number are found in Appendix A of the Botany Report (held in the project record). The design criteria which limits the type of treatment an area can receive is slope. Slopes less than 40 percent can be treated using any of the methods defined in the description of alternatives. All of the Region 2 sensitive species or plant SOLC known to occur in the treatment areas occur on slopes less than 40 percent. On slopes greater than 40 percent, hand falling of trees followed by cut and chunk, cable logging, or helicopter logging can be used. Prairie moonwort, narrowleaf grapefern, foxtail sedge, yellow lady's slipper, trailing clubmoss, large round-leaved orchid, bloodroot, and highbush cranberry occur in stands that have greater than 40 percent slope. The potential habitat for lanceleaf peatmoss and sage willow is most likely found on slopes less than 40 percent.

Because any of the Integrated Pest Management Activities can occur on any proposed treatment area (as long as design criteria are met) with a slope less than 40 percent, and all of the known and suspected species can and do occur on slopes less than 40 percent, the effects of treatments on slopes less than 40 percent will be discussed in general (not species specific) terms.

The effects of hand falling trees on slopes greater than 40 percent would be similar to the effects of hand cutting on slopes less than 40 percent. Potential impacts include soil disturbance caused by personnel working on steep slopes and any slipping of trees after they are felled. Soil disturbance may lead to colonization by non-native or invasive plant species as well as rendering the area unsuitable for rare plant colonization. Crushing of above ground parts by falling trees is also possible. Cutting the felled trees into smaller logs (cut and chunk) or chipping them and spreading the chips across the forest floor could bury sensitive plants. Depending on how deep the debris is, this layer of debris could insulate underground parts of sensitive plants impeding the production of above ground parts. The carbon added to the ecosystem would be the same as if the infested tree had fallen naturally, so there would no net increase in available carbon.

The effects of falling trees and cutting them into smaller logs, chipping them, or piling them for burning mechanical or hand equipment on slopes less than 40 percent can include destruction of

individuals and suitable habitat during tree felling, skidding operations, burial and crushing of individuals by slash piles, and trampling by equipment and/or personnel. Opening of overstory and expansion of hardwood and meadow communities could occur when encroaching conifers are removed. Application of fire to piled woody debris may result in the burning of undetected individuals, however most species recover quickly after low- to moderate-intensity prescribed burns (Knapp et al. 2007).

In addition, pile burning removes existing understorey vegetation such as grasses and forbs, reducing competition, and opening up habitat for invasion by other species. These effects are magnified in areas experiencing intense burns, such as slash piles (Haskins & Gehring 2004). Once established, these exotic species can out-compete native vegetation causing a shift in the ecology of the area.

Because some Region 2 sensitive species and plant SOLC occur in meadows (prairie moonwort and narrowleaf grapefern), undetected individuals may experience impacts if materials removed from pine slopes are piled or decked in meadows. These impacts include burial by debris, which would eventually lead to mortality due to mechanical damage or lack of sunlight. If the piles are burned, the heat generated would cause mortality to both above ground and below ground parts. In addition, the soil may become hydrophobic and therefore alter the local infiltration rate of the soil (DeBano and Krammes 1966). Areas of hydrophobic soils would have a greater risk of erosion, including rill formation and raindrop splash (DeBano 2000). These areas also become likely places for non-native; invasive species to gain a foothold in the area (see the Mountain Pine Beetle Response Project Weed Report in the project record).

Heavy equipment associated with mechanical treatments can loosen and displace soil, which can then collect in drainages and other low-lying habitat which is suitable for Region 2 sensitive plant species and plant SOLC. Heavy equipment can also alter the microsite hydrology and fungal communities preventing dependant Region 2 sensitive species and plant SOLC (such as prairie moonwort, narrowleaf grapefern, yellow lady's slipper, and large round-leaved orchid) from establishing.

Other potential indirect effects result from greater use of existing roads for hauling resulting in an increase in dust pollution. Sensitive plant individuals that are undetected along roads could experience reduced photosynthetic capacity due to a coating of dust on the leaves. Also, removal of timber may also open access to areas previously protected from impacts by livestock and illegal off-road vehicle use. New use in areas increases not only the potential for collecting, trampling, and other losses of individuals, but also increases the chance for non-native species invasion. Equipment used during conversion and maintenance of roads could crush, burry, or dig up undetected individuals.

Dust Abatement: Use of dust abatement (water, magnesium chloride, calcium chloride, etc.) causes a decrease in airborne dust. Airborne dust can adhere to photosynthetic surfaces ultimately causing a decrease in the ability of an individual plant to grow. The addition of salt to dust abatement treatments allows the treatment to be effective for a longer period of time; however, high concentrations of ions in the soil matrix caused by the addition of magnesium chloride or calcium chloride can decrease plant growth and survival (Goodrich et al. 2009). These ions usually move down slope from treated roads, but impacts can be observed up slope

and relate to application rate (Goodrich et al. 2008, Piatt and Krause 1974). The distance from treated road surface that impacts to vegetation would impacted would increase with an increase in the surface area to which the treatment was applied, the application rate, and average precipitation (Goodrich et al. 2008, Goodrich et al. 2009). On average, chloride ions can move down slope from the site of application approximately six meters and magnesium can move three meters from application site regardless of the soil type (Goodrich et al. 2009).

Aspen (*Populus tremuloides*) growing down slope from application sites could show necrosis of leaf margins, crown damage, and mortality depending on the application rate and surface area treated upslope from the tree (Goodrich et al. 2009). In coniferous tree species, high concentrations of ions in needle tissue can cause an increase in susceptibility to agents such as fungus, insects, and mechanical damage caused by frost and snow (Goodrich et al. 2009). In grasses, germination generally decreases with increased concentration of magnesium ions present in the soil (Ryan et al. 1975). In members of the pea family (Fabaceae), increased concentration of salt ions causes leaf burning and a decrease in robustness (Gauch and Wadleigh 1944).

Salt based dust abatement treatments can result in an increase in sediment in roadside ditches. The amount of sediment increase varies with application rate, application frequency, area treated, and concentration of ions in the soil, the higher the concentration of ions, the deeper the sediment (Goodrich et al. 2009).

Another potential beneficial indirect effect of the proposed action is the introduction of disturbance, such as use of temporary roads and skid trails. These disturbed areas, if decommissioned, treated for invasive species, and left undisturbed for a decade could become potential habitat for Region 2 sensitive species such as narrowleaf grapefern and prairie moonwort as these species are associated with historically disturbed areas. In addition, the removal of fuels from the project area would decrease the chance of large-scale wildfire as discussed in the effects analysis for Alternative A.

Impacts to Habitat

Design Criteria require that consultation with a qualified, professional series botanist occur prior to ground disturbance in potential plant habitat. The hope is that this consultation would minimize impacts to the habitat and any occurrences of Region 2 sensitive plant species located in the potential habitat. If impacts of ground disturbance on potential habitat cannot be avoided, the possible impacts to the habitat itself are discussed below. Impacts to Region 2 sensitive species and plant SOLC are discussed separately.

White Spruce

Impacts to white spruce stands should be minimal because the treatment areas target ponderosa pine stands. Impacts to white spruce stands outside of treatment areas could occur if landings, log decks, roads, or debris piles need to be constructed in order to facilitate timber harvest. Potentially, infected ponderosa pine could be removed from white spruce stands that are found within larger ponderosa stands. If either of these potential impacts to white spruce stands occurs, impacts to the habitat include removal of white spruce and damage to standing white spruce, including damage to root structures, during felling and removal of ponderosa pine. Road construction in white spruce habitat could alter the local hydrology, create a vector for non-

native or invasive plant introduction, and create a source of erosion. In addition, magnesium chloride or calcium chloride would be used as a means of dust abatement. In addition to the impacts discussed in the Dust Abatement section, use of these chemicals can cause needle burn or mortality of white spruce along the road, particularly down slope and the risk increases with area treated, application rate and frequency, and distance from the treated surface (Goodrich et al. 2009). Changes in the overstory of white spruce stands would cause changes to the under and midstory, which in turn impact the habitat which certain Region 2 sensitive species and plant SOLC require to survive.

Hardwood Habitat Including Paper Birch, Aspen, and Bur Oak

Impacts to hardwood habitat including paper birch and bur oak would be limited because the treatment areas target ponderosa pine stands. Impacts to hardwood stands outside of the treatment areas could occur if landings, log decks, roads, or debris piles need to be constructed in order to facilitate timber harvest. Potentially, infected ponderosa pine could be removed from hardwood stands that are found within larger ponderosa stands. If either of these potential impacts to hardwood stands occurs, impacts to the habitat include removal of hardwoods and damage to standing hardwoods, including damage to root structures, during felling and removal of ponderosa pine. Road construction in hardwood stands could alter the local hydrology, create a vector for non-native or invasive plant introduction, and create a source of erosion. In addition, magnesium chloride or calcium chloride would be used as a means of dust abatement. In addition to the impacts discussed in the Dust Abatement section, use of these chemicals can cause leaf necrosis or mortality of hardwoods along the road (Piatt and Krause 1974), particularly down slope and the risk increases with area treated, application rate and frequency, and distance from the treated surface (Goodrich et al. 2009). Changes in the overstory of hardwood stands would cause changes to the under and midstory, which in turn impact the habitat which certain Region 2 sensitive species plant SOLC require to survive.

Riparian Habitat Including Wetlands and Fens

Plant species in wetlands, riparian areas, and seeps are likely to be impacted by changes in hydrology and water quality. Roads that currently exist in the water influence zone of wetlands can cause increased erosion, which can modify stream bank geometry and cause an increase in overland flow. Increases in overland flow will have the net effect of maximizing runoff and minimizing infiltration. While the increased runoff results in overall greater water yield, the storm water is delivered relatively quickly through surface processes rather than through sustained subsurface flows, which are often critical to wetland hydrology (Moore et al. 2006). The change in delivery of water would potentially change the normal wetland hydrology (e.g. decreasing site creasing oxygen available to plant roots and other essential soil organisms). Impacts to fens specifically are discussed in the Mountain Pine Beetle Response Project Botany Report.

While direct impacts to riparian habitat are possible, moist soils and riparian areas are protected during timber harvest and new road-building on National Forest land under Best Management Practices and Forest Service Manual 2509.25. In addition, magnesium chloride or calcium chloride would be used as a means of dust abatement. In addition to the impacts discussed in the Dust Abatement section, use of these chemicals can cause leaf necrosis or mortality of forbs and grasses along the road (Gauch and Wadleigh 1944, Ryan et al. 1975), particularly down slope and the risk increases with area treated, application rate and frequency, and distance from the

treated surface (Goodrich et al. 2009). Design Criteria prohibit the use of these chemicals within 500 feet of fens, which will decrease the impact on these wetlands.

Meadows

Impacts to meadows should be minimal because the treatment areas target ponderosa pine stands. Impacts to meadows outside of treatment areas could occur if landings, log decks, roads, or debris piles need to be constructed in order to facilitate timber harvest. Impacts to potential plant habitat if these activities occur within meadows include loss of habitat, alteration of local hydrology, and introduction of non-native or invasive plant species. Potentially, infected ponderosa pine could be removed from meadows that are found within or adjacent to larger ponderosa stands. If ponderosa pine trees are removed from meadows, equipment used during harvest could crush or uproot vegetation as well as cause short term soil compaction. Road construction, conversion, or maintenance in meadows could crush, burry, remove, or uproot vegetation. Roads can also create erosion channels that further impact soil structure and moisture, both of which are qualities that make meadows habitat for some Region 2 sensitive species and plant SOLC. In addition, magnesium chloride or calcium chloride would be used as a means of dust abatement. In addition to the impacts discussed in the Dust Abatement section, use of these chemicals can cause leaf necrosis or mortality of forbs and grasses along the road (Gauch and Wadleigh 1944, Ryan et al. 1975), particularly down slope and the risk increases with area treated, application rate and frequency, and distance from the treated surface (Goodrich et al. 2009). Changes in meadow habitat could alter the habitat quality such that certain Region 2 sensitive species and plant SOLC would no longer be able to survive.

Alternative B - Direct and Indirect Effects

Ten species of Region 2 sensitive species and six plant SOLC were located in areas proposed for treatment in Alternative B (See Appendix A of the Botany Report for location descriptions). See impacts common to both action alternatives above.

Cable logging is possible on slopes greater than 40 percent. Under Alternative B, this technique would not require construction of new roads. This decreases the overall disturbance this activity would have on the landscape. The impacts of falling trees on slopes greater than 40 percent is discussed in effects common to both action alternatives. The effects of cable logging specifically have to do with moving logs once they are felled and the impacts of constructing corridors. Cable logging generally requires construction of primary corridors parallel to slope through which logs are dragged either up or down the slope to a landing and processing equipment. Secondary corridors can be created perpendicular to the primary corridors (cross-slope) in order to move trees to the primary corridor. Corridor construction requires removal of all trees within a ten foot swath. Impact of this removal include opening the overstory so more light reaches the ground and potentially increasing the risk of erosion by making a direct path for water to travel down slope. Design criteria require one foot or more of snow before cable logging can be used. This greatly reduces the risk of soil disturbance and therefore disturbance of below ground parts of sensitive plants that could occur in corridors. If the full suspension technique of cable logging was used, logs would be fully suspended and not drug along the ground, greatly decreasing the impact to soil and below ground parts of sensitive plant species. Landings and areas needed to process the logs harvested would occur in areas previously disturbed (i.e. existing roads and landings) under Alternative B. Use of these areas should cause little impact to botanical resources because the areas already exist on the

landscape. These impacts would most likely be localized soil compaction, crushing or burial of sensitive plants (if present), and introduction or spread of non-native or invasive plant species.

Alternative C - Direct and Indirect Effects

Alternative C includes all actions described in Alternative B and the direct and indirect effects of these activities were discussed in the combined section previously. In addition to the treatments proposed in Alternative B, Alternative C includes treating Spearfish Canyon using the same Integrated Pest Management techniques as well as increasing the area that can be commercially or non-commercially harvested. The intent of Alternative C is to allow more aggressive treatment of the ponderosa pine stands prior to infestation, meaning that stands could be treated prior to infestation in order to prevent beetles from moving into the area as well as reducing potential fire hazard. Also, Alternative C allows for the construction of 250 miles of roads.

The impact to sensitive species with the addition of treatments in Spearfish Canyon is not well understood at this time. The results of the floristic inventory of this area are due at the end of January 2012 and will reveal a better picture of the botanical resources in this additional treatment area. Until this information has been reviewed, it will be assumed that the impacts to sensitive species in this area would be similar to those of the rest of the Forest.

Because the methods used to treat infested trees under Alternative C are the same as Alternative B, the impacts would be the same but at a larger scale because 6,000 more acres would be subject to treatment. In addition, areas that have not yet been infested with mountain pine beetles could be treated if conditions result in favorable mountain pine beetle habitat.

The conversion of temporary roads to systems roads would require the addition of erosion control measures to the existing road prism. The short term impacts of this maintenance would be possible mortality by crushing, burying, or removal of sensitive plants. Also, the sediments loosened during the construction would move down-slope. Removal of soils and sediments upslope creates disturbances that could result in colonization by invasive plant species as well as the collection of the sediments in waterways. Sediments moving through waterways, such as streams, can cause bank erosion or fill slow spots with sediment and become susceptible to non-native plant invasion. In the long term, however, the erosion control structures would prevent more soil and sediments than generated from construction from being flushed down-slope making the impacts to waterways greater. Implementation of "Best Management Practices" would limit, but not eliminate most of these impacts.

Construction of roads, as far as this analysis is concerned, means constructing a new road prism, resulting in a new scar on the landscape, this includes jump ups, or areas where existing roads are expanded in order to accommodate timber harvest (turn around areas, log decks, etc.). One of the assumptions of this analysis is that roads, once built, will remain on the landscape because this is the standard practice on the Black Hills National Forest (See Assumptions for Analysis section). The direct impact of roads and trails is loss of plant individuals, plant occurrences, and plant communities. Indirect impacts to plant species and plant communities include increased risk of invasive species introduction, leading to increased competition for resources, as well as alteration of local hydrology and habitat conditions (such as decrease in canopy cover or change in successional stage). Road construction can also lead to increased access for disturbance vectors (including

humans and livestock) which lead to increased disturbances such as trampling, cropping, and collecting. Other indirect effects include disruption of pollinators and increased dust pollution (causes increased sediment, also plugs stomata (gas exchange structures) on plant leaves). In some cases, there can be an increase in plant numbers adjacent to roads and trails from a nearby occurrence, mainly due to increased water availability from concentrated runoff; however, the road-edge habitat usually includes many non-native species and is not stable. These and other impacts from roads and trails generally do not support long-term success of road/trail-side occurrences.

All new proposed roads have not been completely surveyed at this time because the locations of these roads are unknown at this time. Also, these roads may occur outside of treatment areas disclosed in Map 2. The risk to sensitive plants that have not yet been documented would be lessened by the Design Criteria that requires a review of proposed new routes by an interdisciplinary team that includes a qualified (0430 series) botanist.

Species persistence for Region 2 sensitive plant species was evaluated in the Phase II Forest Plan Amendment. Each alternative in this project was evaluated as to whether it is consistent with Forest Plan objectives, standards and guidelines applicable to each species. Where changes are proposed to the Forest Plan as a part of this project, those changes were examined to determine whether they would influence probability of persistence as determined in the Phase II Amendment.

The loss of habitat to road construction is unknown, but is often estimated at 5 acres per linear mile (Rowland at al. 2004). Roads can promote habitat fragmentation for some species, breaking habitat into smaller patches and increase the ratio of edge to forest interior areas.

The construction of temporary roads also increases the areas open to cable logging. Cable logging is possible in Alternative C on slopes greater than 40 percent, regardless if roads already exist on the landscape. The impacts of falling trees on slopes greater than 40 percent is discussed in effects common to both action alternatives. The effects of cable logging specifically have to do with moving logs once they are felled and the impacts of constructing corridors. Cable logging generally requires construction of primary corridors parallel to slope through which logs are dragged either up or down the slope to a landing and processing equipment. Secondary corridors can be created perpendicular to the primary corridors (cross-slope) in order to move trees to the primary corridor. Corridor construction requires removal of all trees within a ten foot swath. Impact of this removal include opening the overstory so more light reaches the ground and potentially increasing the risk of erosion by making a direct path for water to travel down slope. Design criteria require one foot or more of snow before cable logging can be used. This greatly reduces the risk of soil disturbance and therefore disturbance of below ground parts of sensitive plants that could occur in corridors. If the full suspension technique of cable logging was used, logs would be fully suspended and not drug along the ground, greatly decreasing the impact to soil and below ground parts of sensitive plant species.

Landings and other flat surfaces required on ridge tops above units or in valleys below units harvested using the cable method could cause mortality during area preparation (clearing the site using heavy equipment) and changes in local hydrology caused by increasing the size of existing roads could make habitat down slope less suitable to sensitive species. Impacts would most likely be localized soil compaction, crushing or burial of sensitive plants (if present), and

introduction or spread of non-native or invasive plant species. Roads constructed above or on steep slopes also increase the possibility of mass movement (see Soils section).

Although Forest Plan direction and design criteria are in place to limit the risk of mass movement, it can still occur. Mass movement can threaten sensitive plant populations located above or below the movement area. If management activities occur on unstable slopes and mass movement occurs, the debris flow could bury sensitive plant populations located down slope. Movement of soils below a population of sensitive plant species has the potential to destabilize the substrate in which the population occurs and alter the hydrological environment, both of which could change the habitat making it no longer able to support the population of sensitive plants.

Alternatives B and C Cumulative Effects

Past, current, and reasonably foreseeable actions within the Mountain Pine Beetle Response Project Area are discussed in the beginning of this section.

Activities such as vegetation management, fuels management, livestock grazing, recreational activities and other management activities have occurred and will continue on the Forest. These activities will likely occur on private lands as well. All may affect Region 2 sensitive plant species and plant SOLC through direct mortality, habitat alteration, or spread of invasive species.

The annual impact to botanical resources on the Forest due to timber harvest activities would remain similar to previous years if the assumption that the volume taken from the Forest would remain the same as previous years holds true (see assumptions).

Private land within and adjacent to the project area would most likely experience treatments similar to those used on National Forest Lands. Thinning activities used to create defensible space and fuel breaks around private property and structures within the Mountain Pine Beetle Response Project Area are anticipated. Livestock grazing is also a current use on privately held land.

Management of national and state parks adjacent to the Forest is assumed to have a similar effect on Region 2 sensitive plant populations and plant SOLC. Other federal, state, and private lands offer suitable habitat for Region 2 sensitive plants and plant SOLC. In fact, only sage willow, autumn willow, and narrowleaf peatmoss have not been confirmed from other federal, state, and/or private lands adjacent to Black Hills National Forest.

Privately owned lands within the Black Hills Ecoregion may also provide suitable habitat, but resource management by companies and private citizens depends on a number of factors (e.g., desired goals, market prices, development potential) making it difficult to predict future trends in private habitat diversity and quality. Potential habitat for Region 2 sensitive plants may occur on private lands across the Black Hills. Continued urban development in the Black Hills will likely continue to affect habitat, including white spruce communities and paper birch/hazel forest, thereby increasing the importance of stands on Forest Service lands. Lawrence and Pennington Counties have signed an agreement with the Forest Service to cut and chunk adjacent to private property.

Because Alternative B excludes harvest from the botanically rich Spearfish Canyon and generally less aggressive harvest goals, it will have slightly less of a cumulative impact on Region 2 sensitive plant species and plant SOLC.

Determinations of Effect and Rationale

The determination of effects on Region 2 sensitive species and plant SOLC were made as the result of the information gathered in the pre-field review, field reconnaissance, survey results, and effects analysis for all action alternatives. The basis for these determinations was effects from proposed activities on known populations and impacts to populations that could occur in areas that are unsurveyed for Region 2 sensitive plant species. The determination language is set forth in Forest Service Manual 2670.

Objectives, standards, and guidelines have been identified in the Forest Plan Phase II to conserve Region 2 sensitive species and plant SOLC found on the Black Hills National Forest. This project will follow the objectives, standards, and guidelines that are applicable to those species and habitats found in the Mountain Pine Beetle Response Project Area.

The project area was partially surveyed for Region 2 sensitive plant species and plant SOLC and several populations were located and mapped; however 106,700 acres (44% of Alternative B and 43% of Alternative C) have not been surveyed for botanical resources. Forest Service Manual direction states that if resources presence is not known, and surveys are not feasible, then presence of Region 2 sensitive species and plant SOLC should be assumed (USDA Forest Service 2011a). Alternative B proposes a total of 48,400 acres of treatment and Alternative C proposes a total 124,000 acres of treatment. Since the exact location of treatments that will be implemented cannot be known at this time, the best surrogate is a comparison of case scenarios.

Most Region 2 sensitive species and plant SOLC found on the Black Hills National Forest are globally secure, with the exception of prairie moonwort and narrowleaf grapefern (NatureServe 2011). This, combined with the rangewide presence of these species, means that if all of the occurrences of these species on the Forest were extirpated, the species would most likely survive and most likely not cause a trend to Federal listing.

For Alternative B, 48,400 acres of treatment are permitted, 106,700 acres are unsurveyed and assumed occupied, and 10,702 acres known to be occupied. With this alternative, treatment could occur in all 10,702 acres of occupied habitat as well as impacts to known occurrences outside of proposed treatment areas. That being said, if all of the populations known to occur within the treatment areas (ignoring the populations outside of treatment areas, for which Design Criteria exist to limit the impact), viability on the Forest would decline for prairie moonwort, narrowleaf grapefern, foxtail sedge, yellow lady's slipper, bloodroot, and highbush cranberry simply because such a large percentage of the populations would be disturbed by treatment activities. Also, all of the proposed acres for treatment could occur in unsurveyed and assumed occupied habitat. If we assume that all 106,700 acres of unsurveyed habitat contain populations of Region 2 sensitive species or plant SOLC, treatment in these areas could remove 40 percent of the total known or assumed presence acres within the project area. Such a large impact would cause a decline in the viability of sensitive species within the project area and most likely on the Forest. This represents the "worst case scenario" for Region 2 sensitive plant species and plant

SOLC under Alternative B. Conversely, the treated acres could occur in the 124,500 acres without the potential for Region 2 sensitive species and plant SOLC conflict. This would be the "best case scenario" for Region 2 sensitive plant species and plant SOLC under Alternative B.

For Alternative C, 124,000 acres of treatment are permitted, 106,700 acres are unsurveyed and assumed occupied, and 12,250 acres known to be occupied. With this alternative, treatment could occur in all 12,250 acres of occupied habitat as well as impacts to known occurrences outside of proposed treatment areas. That being said, if all of the populations known to occur within the treatment areas (ignoring the populations outside of treatment areas, for which Design Criteria exist to limit the impact), viability on the Forest would decline for prairie moonwort, narrowleaf grapefern, foxtail sedge, yellow lady's slipper, bloodroot, and highbush cranberry simply because such a large percentage of the populations would be disturbed by treatment activities. Also, all of the proposed acres for treatment could occur in unsurveyed and assumed occupied habitat. If we assume that all 106,700 acres of unsurveyed habitat contain populations of Region 2 sensitive species and plant SOLC, treatment in these areas could remove 100 percent of the total known or assumed presence acres within the project area. Such a large impact would cause a decline in the viability of sensitive species within the project area and most likely on the Forest. This represents the "worst case scenario" for Region 2 sensitive plant species and plant SOLC under Alternative C. Conversely, the treated acres could occur in the 129,000 acres without the potential for Region 2 sensitive species and plant SOLC conflict. This would be the "best case scenario" for Region 2 sensitive plant species and plant SOLC under Alternative C.

Table 3-36 Comparison of Potential Treatment Impacts on Acres of Known and Assumed Occurrences of R2 Sensitive Plant Species

	Unsurveyed Acres	Known Sensitive Occupied Acres	Total Sensitive Acres	Treatment Acres	Scenario with the Most Impact*	Scenario with the Least Impact*
Alternative B	106,700 acres	10,702 acres	117,402 acres	48,400 acres	48,400 acres	0 acres
Alternative C	106,700 acres	12,250 acres	118,950 acres	124,000 acres	118,950 acres	0 acres

* to both assumed and confirmed present Region 2 sensitive species

Design criteria are described at the beginning of the Effects of the Alternatives section and are an integral part of the effects determination. Any deviation from these criteria will require further analysis and a revised effects determination. Some mitigation measures not included here are Forest Service standard operating procedures. An example would be the standard provisions of a Timber Sale Contract and road design specifications. Other mitigation measures not included here are additional Forest Plan Standards and Guidelines too numerous and lengthy to include here (including but not limited to those relating to water, soils, riparian areas, travel and transportation, noxious weeds, and livestock grazing). Project implementation will incorporate all Forest Plan Standards and Guidelines, with the exception of those identified for site-specific amendment in the Record of Decision.

Assuming the worst case scenario for both action alternatives (the conservative approach), with implementation of the Forest Plan Phase II Amendment and all of the standards and guidelines adopted therein, as well as project specific design criteria, a determination of "*Likely to result in a loss of viability in the Planning Area, or in a trend toward federal listing"* is made for the following species for both action alternatives:

Prairie moonwort *Botrychium campestre*

Narrowleaf grapefern	*Botrychium lineare*
Foxtail sedge	*Carex alopecoidea*
Yellow lady's slipper	*Cypripedium parviflorum*
Large round-leaf orchid	*Platanthera orbiculata*
Bloodroot	*Sanguinaria canadensis*
Highbush cranberry	*Viburnum opulus* var. *americanum*

A determination of "*May adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability range-wide*" is made for the following species for the proposed action:

Trailing clubmoss	*Lycopodium complanatum*
Sage willow	*Salix candida*
Autumn willow	*Salix serissima*
Great-spurred violet	*Viola selkirkii*

Recommended Conservation Measures to Avoid, Minimize, or Mitigate Adverse Effects
Design criteria are described at the beginning of the Effects of the Alternatives section and are an integral part of the effects determination described in the previous section. Any deviation from these criteria will require further analysis and a revised effects determination.

Additional mitigation would include avoiding treatment in the stands known to contain Region 2 sensitive plant species (listed in Appendix A of the Botany Report). In addition, survey for botanical resources would be conducted during an appropriate time of year to determine Region 2 sensitive species presence in stands unsurveyed for botanical resources (listed in Appendix B).

The mitigation measures included herein apply to both action alternatives. The determinations of effects for each species are contingent upon, to varying degrees, implementation of mitigation measures. If mitigation measures are fully implemented, along with the implementation of the Forest Plan Phase II Amendment and all of the standards and guidelines adopted therein, and project specific design criteria, a determination of "*May adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability range-wide*" is made for the following species for the proposed action:

Prairie moonwort	*Botrychium campestre*
Narrowleaf grapefern	*Botrychium lineare*
Foxtail sedge	*Carex alopecoidea*
Yellow lady's slipper	*Cypripedium parviflorum*
Trailing clubmoss	*Lycopodium complanatum*
Large round-leaf orchid	*Platanthera orbiculata*
Sage willow	*Salix candida*
Autumn willow	*Salix serissima*
Bloodroot	*Sanguinaria canadensis*
Highbush cranberry	*Viburnum opulus* var. *americanum*
Great-spurred violet	*Viola selkirkii*

SOCIAL ENVIRONMENT

This section will describe the affected environment and environmental consequences for each alternative to the Social Environment (Travel Management, Scenic Quality, Recreation Use, Heritage, and Social).

TRAVEL MANAGEMENT

Background
The Record of Decision (ROD) for the Black Hills National Forest Travel Management Plan was signed on May 7, 2010 and implementation began with publication of the Motorized Vehicle Use Map effective December 1, 2010. The Travel Management Plan will help meet the increasing demand for recreational travel opportunities and provide a range of quality experiences for other Forest users, while offering many recreational opportunities over time. The ROD designated 707 miles of system trails of various types Forest-wide, as well as 548 miles of roads open to all vehicles. These roads and trails were designated to provide diverse motorized recreation opportunities in off-highway settings rather than roaded settings, to meet user interests and best manage public safety risks, disperse users, and reduce crowding and conflicts with other users. Motorized cross-country travel is prohibited, other than for dispersed camping and game retrieval along selected routes.

The Travel Management Plan recognizes that the total number of off-highway vehicle miles included in the decision will not likely be available in a given year, with some trails being closed for project work or seasonal closures. The ROD also acknowledges that certain designated routes may not be available in any particular season or year because of contractor or timber purchaser operations, public safety, or resource concerns, leading to reduced miles available for OHV operation. See Transportation section for information on roads/trails.

SCENIC QUALITY

Affected Environment
The Pine Beetle Response Project Area is within the boundaries of the Black Hills National Forest. Scenery is important to people that live and work in the area, and to those visiting the area. The main difference between the Black Hills and the surrounding landscape (to the north, east, and south) is the vegetation, specifically trees, and the landform, canyons and 'hills'. People enjoy the natural beauty of these two landscape elements – whether it is the shade, the forest canopy above, or the green carpet of trees that blankets the hills – people value this forested landscape for its beauty.

Landscape Visibility is the portions of landscapes visible from travel ways and use areas are important to constituents for their scenic quality, aesthetic values, and landscape merits. Travel ways and use areas are identified and classified during the Forest-wide planning process, in order to determine which observer locations, and their importance, to use in the landscape visibility analysis. Concern Level 1 travel ways that lead to important scenic features, residential areas, resorts, recreation areas, unique natural phenomena, wilderness trailheads, national parks, state and county parks, attract higher percentage of users having high concern for scenic quality, thus increasing the importance of those travel ways *(USDA-FS 1995, Chapter 4, pg. 8).*

The majority of the views from roads in the planning area are limited to the Foreground and Middleground distances. Approximately 32% of the USFS lands within the planning area are viewed from Concern Level 1 Corridors (where people have the highest concern for scenery) including U.S. and State Highways, main trails (Mickelson, Centennial, and Black Elk Wilderness trails), recreation facilities (campgrounds picnic areas), and communities.

Approximately 59% of the USFS lands within the planning area is viewed from Concern Level 2 Corridors (where people have the moderate to high concern for scenery in this area) including: County Roads, other trails, and other private lands.

Scenic Integrity Objectives (SIO) are management objectives that were adopted from the scenic class values. Scenic Integrity is a measure of the degree to which a landscape is visually perceived to be "complete". The highest scenic integrity ratings are given to those landscapes that have little or no deviation from the character valued by constituents for its aesthetic appeal *(USDA-FS 1995, Chapter 2, pg. 1).* Within the Pine Beetle Response Planning Area, approximately 1% have a VERY HIGH SIO, 14% have a HIGH SIO, 41% a MODERATE SIO, 44% a LOW SIO, and less than 1% a VERY LOW SIO.

Existing Scenic Integrity represents the current status of a landscape. It is determined on the basis of visual changes that detract from the scenic quality of the area. Direct human alterations may be included if they have become accepted over time as positive landscape character values in the planning area. Existing scenic integrity is the current visual state, which is measured in degrees of deviation from the natural appearance of the landscape character type. These ratings give an indication of the present level of visual quality and visual evidence of management activities. The frame of reference for measuring achievement of scenic integrity levels is the valued attributes of the existing landscape character unit being viewed. In natural or natural appearing character, this is limited to natural or natural appearing vegetative patterns, features of water and rock, and landforms.

Since the 1874 arrival of the Custer Expedition, which traveled through this area, the region has been recognized as a scenic wonderland. The construction of the roads and highways were avenues for commerce to come into the area, and also provided access for the citizens of this nation to see the scenic wonders of this area. The construction of recreation facilities including lakes (thru man-made dams), campgrounds and trails, also marked this area as a destination. The national designations of the Peter Norbeck Scenic Byway, and the on-going work at Crazy Horse Memorial, Spearfish Canyon Scenic Byway, the Mickelson Trail, Mount Rushmore National Memorial, Harney Peak, and other features have focused national attention upon the natural scenic qualities of the surrounding area.

Apparent human alterations in the form of recreation facilities (campground, boating facilities, picnic areas, etc.), open roads and trails (such as the Peter Norbeck Scenic Byway, Mickelson Trail and Centennial Trail, US, State, and County Highways, etc.) that provide access for commerce, to homes and recreation facilities, have generally been accepted over time as part of the positive cultural landscape character attributes. Within the planning area, forested areas are predominantly populated by Ponderosa Pine, Oak, Aspen and other hardwoods, and Spruce (generally limited to streams and wet areas) communities. Water features are limited to narrow,

quiet, low-flow intermittent streams. Lakes and ponds are not natural features in the region, as a result all the lakes within the Forest are all human-made, and receive a high level of summer use.

Diversity contributes to scenic qualities of an area including: large tree character, hardwoods, spring and fall color, visibility of wildlife, and wildflowers. Although vegetation removal treatments can create some of the textural diversity, in some cases fire is needed to stimulate the vegetation variety (color and texture). With the continued suppression of wildfires, only management ignited fires, under specific conditions, can stimulate these desired results. Prior to 2000, these fires have been limited, resulting in dense forest stands that choke out many plant species, limit tree growth – so desired large-tree characteristics are not developing, and are contributing to the high levels of tree mortality from the Mountain Pine Beetle insect. Specifically, Covington and Moore (Brown and Sieg, 1996), reviewing their own and many other studies, list post-settlement changes in ponderosa pine community structure and function can be directly or indirectly attributed to fire exclusion. These changes include: 1) overstocked patches of saplings and pole-sized trees; 2) reduced tree growth and increased mortality, especially of the older trees in a stand; 3) stagnated nutrient cycling; 4) increased irruptions of insects and diseases; 5) higher fuel loads, including increased vertical fuel continuity ("ladder fuels"); 6) decreased stream flows; and 7) less wildlife habitat for species dependent upon herbaceous vegetation.

Over the past ten years, vegetation treatments in the form of overstory removals and seed cuts, that the general public accepts to be 'created openings' have occurred on approx. 40,000 acres of the 865,000 acres of the 'suitable timber base' (USDA-FS 1997b), or 5%. It can take from 20 to 35 years for trees to grow up and fill in these areas, so they no longer appear as created openings. Other vegetation treatments have also occurred that reduced the density of the trees across the landscape (i.e. - commercial thinning).

Communities and private land are interspersed with National Forest lands, creating a challenging wildland fire – urban interface condition across the Black Hills landscape. As a result, wildfires have been rapidly extinguished, limiting the role natural wildfire has in this fire-dependent ecosystem. When wildfires escape beyond initial containment, large areas often burn in the thousands of acres and kill the many of the mature trees. As a result, the diversity of vegetation and stand structure is limited to that accomplished through prescribed fires and cutting/removal of vegetation. Large wildfires have occurred within the Forest over the past 11 years. Approx. 10% of the forested areas have moved from dense forest conditions to open grassland and open-canopy forest conditions due to wildland fires.

Mountain Pine Beetle activity has rapidly expanded over the past 11 years in the Black Hills National Forest. Mountain Pine Beetle (MPB) activity has resulted in the death of pine trees. To date, over 400,000 acres have been affected by MPB (*USDA-FS 2012*).

Overall the appearance of trees attacked by MPB changes from green, to light green as the tree slowly dies, during these phases the tree still appears 'alive' to most observers. The "red" stage is the most visible – when the tree is dead and the needles are red in color. Eventually, the needles will fall off (usually 1-2 years), and the trees appear gray in the landscape. Currently the MPB are spreading into more heavily traveled portions of the Forest and are much more visibly to the general public. In addition, due to the limitations of logging equipment to less than 40% slopes, vegetation

is going un-managed and natural processes are taking place on these steeper slopes. Trees are evident in the green / red / gray stages across the Forest. Trees killed and down from MPB activity is not readily apparent along hiking trails, except in the Black Elk Wilderness. However, this will change within the next 2-7 years, as trees on steep slopes (greater than 40% slope), visible from US and State Highways, are coming under attack of MPB. A landscape covered by green forest was identified as the single best predictor of public acceptance of Scenic Integrity (Visual Quality Classes), in a Canadian Public Perception study of Mountain Pine Beetle Attack. Across a landscape, as the green forest diminishes and turns red, then grey, the public will less like the landscape they are viewing (*British Columbia Ministry of Forests and Range 2010*). Generally the MPB killed trees were mostly evident from county and Forest roads. Within the past few years this activity has become more evident in the landscapes when viewed from communities, recreation facilities (i.e. – campgrounds – public and private), trails, highways, and private lands outside communities, from Federal, State, County highways, recreation areas, Mickelson Trail, communities and private lands surrounding them. The majority of the concentrated MPB activity has been from Deadwood to Custer, and west toward the Wyoming border. During the 2011 MPB survey, an additional 23,680 acres were found to be effected from the previous year (*USDA-FS 2012*).

Environmental Consequences

Analysis Method

Scenery assessment illustrates how the features of the landscape can be inventoried and analyzed so managers can compare and evaluate vegetation management treatments based on an understanding of how people value their environment.

Four primary steps were followed in the scenery assessment of the Planning Area, including: 1) Identify the *landscape character;* 2) Identify the key scenic features (identified in *scenic class* and *scenic attractiveness* Forest GIS layers), and *landscape visibility* of the area (such as from Level 1 and 2 corridors); 3) Compare the *existing scenic integrity* with the Black Hills National Forest LRMP *Scenic Integrity Objectives* assigned to this area; 4) Evaluate the expected level of *scenic integrity* resulting from the Alternatives. Where needed, determine design criteria to meet scenic integrity objectives. All National Forest land within each planning area is analyzed following these steps.

Due to the time of year, access, and the scale of this project, field review was conducted on only a few potential treatment locations. Review was conducted of areas that are representative of topography found across the Forest that includes areas where MPB attacked pine trees, where no vegetation treatment occurred, as well as locations where MPB treatments occurred - and their effectiveness at meeting Scenic Integrity Objectives (given the level of MPB activity prior to the vegetation treatments). These findings are the basis for the Scenic analysis of the proposed treatments in the Action Alternatives.

Alternative A - Direct / Indirect Effects

Between vegetation management, wildfires, and MPB activity, the appearance of the Black Hills National Forest has been very dynamic. An example of the level of change is evident in the following two pictures. In 2009 approximately one-tenth of the vegetation on this mountain had MPB activity. Two and one half years later, more than one-half the vegetation on the mountain had been killed by MPB activity.

Figure 3-13, February, 2009 – Hwy. 16/385 looking north (approx. 1500 ft. north of the entrance into Crazy Horse Memorial.) Mountain top in photo is approx. one-mile in distance. Trees killed by Mountain Pine Beetle appear red-brown along the horizon – right slope of the mountain *(S.Keegan).*

Figure 3-13 MPB Activity Middleground

Figure 3-14, September, 2011 – Hwy. 16/385 looking north (from approx. the same location as the previous photo). Subsequent spread of Mountain Pine Beetle – evident from the appearance of the red-brown beetle-killed trees in the photos – in the past 2 ½ years *(S.Keegan).*

Figure 3-14 MPB No Treatment Middleground

The effect of Mountain Pine Beetle activity (killing mature trees) is spreading across the Forest (planning area) and readily apparent from roads and trails, and is expected to continue.

Groups of insect killed trees would allow openings in the dense canopy that will provide opportunities for new vegetation growth. This new growth will provide visual diversity of texture and color in the landscape. Where large areas of insect-killed and down trees are present there is a potential for rapid development of a wildfire. Should that occur, visually we can expect to see open areas where, due to high temperatures close to the ground, pioneer species will likely be the first plants to re-colonizes these areas with vegetation, as there would be limited seed sources. In these locations, immediately after the fire, the burned areas will appear as forms in the landscape, particularly when snow covered. During non-snow covered periods, differences in live tree / dead trees/ pioneer species will visually be evident through variations in color and texture from coarse (live trees) to fine (pioneer species). Where fire does not occur, the down material will create a strong horizontal element and light color in the landscape, particularly evident in the Immediate Foreground and Foreground views. In the Middleground, the color will dominate the landscape. Examples of this were readily apparent in the Battle Creek fire (2002) and the Jasper Fire (2001) areas along Highway 16, and are only now beginning to dissipate. In each distance zone, the landforms themselves will be evident in the landscape. Variety of vegetation, and color, will be limited and will evolve slowly over time. Once any new vegetation grows up above the level of the down material, variations in color and texture will be evident – creating patterns in the landscape.

Existing conditions and natural processes of trees growing and regenerating will continue. Projections by the Regional Insect and Disease Scientist are that the Mountain Pine Beetle activity would continue to spread within the Black Hills National Forest. Locations would include visible areas with a High, Moderate, or Low SIO. Areas on the Forest that have shown wide spread levels of MPB activity appear to have 70-90% of the larger (commercial-sized) trees killed. Where MPB activity continues, vegetation patterns across the landscape would continue to change from densely forested, with few openings, to an open landscape with few clumps of scattered trees.

Within 3-5 years the trees snap off, or fall, creating openings in the forest. In the foreground and middleground, the color and texture of the down trees will dominate the landscape. In the background, the forms of these open areas will dominate the landscape. The remaining trees will likely provide the seed source for new trees. Seedlings will spout over time. A dense canopy of seedlings, approx. 10 feet tall, covering these same areas can be expected in 20-30 years. Long term as the new forest grows up through the dead/down decaying trees; the new growth will help these areas to blend into the landscape. This is a natural process, but it will likely be widespread across the Forest.

During this time, the dead/down trees will breakdown, providing a receptive fuel bed for wildfires. The densely growing seedlings will provide vertical fuel structure. This combination will supply a wildfire with a readily available fuel source. Wildfires would have the ability to rapidly spread during hot and dry conditions. When fires burn for a long period of time and concentrate the heat in one location – such as under a pile of dead/down logs, the structure of the soil can be broken down (observed in the Jasper Fire area), as well as sterilized. This damage can allow the soil to be easily eroded, contribute to a loss of nutrients, inhibit native plant growth, and encourage non-

native species (see Soils section). The effects of erosion create soil-vegetation color contrasts that can be short or long-term, and detrimental to the scenic integrity of an area.

Cumulative Effects

Wildland fire is an essential ecological process in this ecosystem, which should increase plant and scenic diversity. However, due to the private lands and homes scattered throughout the project area, fires would continue to be extinguished as quickly as possible. No prescribed broadcast burning would occur within the potential treatment areas. Outside the potential treatment areas, prescribed broadcast burning would continue to be used in controlled conditions, to achieve those ecological processes, while protecting adjacent private lands. As a result, the forest will continue to grow densely, becoming thicker and reducing visible open space. Views into the forest would become more limited as the trees grow more densely – reducing visual diversity, including wildflowers, shrubs, hardwoods, and open meadows. Should wildfires burn into stands of densely packed growing trees, smaller trees can act as "ladder fuels" moving the fire up into the crowns of the trees, resulting in groups of fire killed trees. If fires spread beyond initial containment, such as in drought and / or high wind conditions, they can spread into hillsides of densely packed trees. [Although the average life expectancy of a dead tree (snag) is 15 years (Lentile 2000a, pg.25), fire-killed trees life expectancy has been observed at less than 10 years (Jasper, Battle Creek, and other large fires).] As a result, large open hillsides could be evident within 10 years of an event.

With Mountain Pine Beetle killed trees, the amount of dead and down material would provide a large quantity of 'fuel'. The effect of a wildland fire in this material would be similar to that observed in long duration burning, as observed in other large fires. Where there was not a large quantity of fuel, plant germination was observed to have occurred within 7 days of the fire when seeds were present in the soil/duff layer. With the wide spread MPB activity evident, should wildfires occur, and spread into areas of large quantities of fuel, results similar to those observed, would be evident over large areas – open areas that would take time to re-establish plants. If this type of an event occurred, the form of the land would dominate the view. Rock formations that this area is noted for would be more visible (see the Battle Creek Fire area). During periods when the ground is snow covered, these areas will be highly visible in the landscape. Positive vegetative elements that provide color, variety, and texture in the landscape, including large trees would no longer be present. The scenic quality would be greatly reduced until vegetation patterns are re-established in the landscape.

In areas where no disturbance occurs, the vegetation will grow into a thick dense forest, with competition for light, water, and nutrients. In some areas, the dense conifers are out-competing the hardwoods for these necessary components for plant growth. This dense vegetation provides the greatest potential for disturbance (fire or insect) that could rapidly change the visual appearance of the vegetation across the landscape. The dense vegetation may shade out shrubs, wildflowers and other low growing plants – reducing visual diversity.

Alternatives, B and C - Effects Common to Both Action

When vegetation treatments occur in an area <u>before</u> the MPB becomes widely established and can affect a high percentage of the trees, options exist to treat the vegetation in a manner than still maintains a natural appearance. An example of this is evident along Highway 16/385, approx. 2 miles north of Custer, vegetation was thinned (Goat Timber Sale) to meet timber

objectives while being sensitive to view from the highway. The treated area mimics natural vegetation patterns (approx. 60 BA) that can be found along a forest/meadow ecosystem. The slash was cleaned up to a normal level, and the overall result meets a High SIO (note: the less dense spacing of the trees has moved the treated area toward an ecological condition as if fire had played its natural role), and at the same time meets the basal area thinning recommendation to reduce the potential effect of MPB infestation.

When vegetation treatments occur in an area after the MPB becomes widely established and affects a high percentage of the trees, options to treat the vegetation are limited, and the results generally do not maintain a natural appearance. An example of this is evident along Highway 16/385, approx. 5 miles north of Custer, vegetation was treated (Atlantic Bug project) in an attempt curtail the MPB activity and maintain some live trees in the landscape - by removing live trees that have been infested with MPBs ("green hits"). Unfortunately, almost all the trees had MPB in them. The photos below are "before" and "after" treatment. [Note: the camera angle and location in the "before" picture does not display many dead ('red') trees, as the majority are located beyond the trees along the edge of the highway corridor; however, many of the live ("green") trees in the photo are infected with MPBs.]

Figure 3-15 Before Treatment of MPB Stand

February, 2009 – Hwy. 16/385 looking northwest (approx. 1.3 miles north of the entrance into Crazy Horse Memorial.) into the Atlantic Bug project area. Trees attacked by Mountain Pine Beetle still appear green in the immediate foreground *(S.Keegan, USFS).*

Figure 3-16 Post Treatment of MPB Stand

September, 2011 – Hwy. 16/385 looking northwest, from approx. same location as previous photo. Removal of MPB attacked trees *(S.Keegan).*

Another example of a vegetation treatment that occurred in an area before the MPB became widely established was also along Highway 16/385 approx. 7 miles north of Custer (Quincy Bug). This project was also aimed at removing live trees that were under attack from MPB. This area was in the early stages of the MPB activity, the stands were able to be thinned before

the majority of trees were attacked by the MPB. After treatment, this area still has a natural appearance. Figures 3-17 and 3-18 below are photos of that project. Note: the camera angle and location display one forest stand where the MPB activity has limited visibility - some dead ('red') trees are evident, and many of the live ("green") trees in the photo are infected with MPBs. "Before" Treatment Figure 3-17, November, 2009 – Mtn. Pine Beetle have killed trees (red trees) and moved into the surrounding forest (*S.Keegan).*

Figure 3-17 MPB Activity Before Thinning

After Treatment Figure 3-18, September, 2011 – Trees with MPB have been removed, and the tree density has been lowered to a 60 Basal Area (*S.Keegan).*

Figure 3-18 Thinning Recently Infested Trees

Thinning trees to an even spacing can result in a managed, un-natural appearance. Thinning trees to an un-even spacing can result in a natural appearance that is in harmony with the landscape character, often resulting in a higher SIO being achieved. Treatments where more large trees remain, generally maintain a natural appearing landscape character. Treatments that leave few large trees would be the most visible. Both Alternatives B and C would treat recently infected trees in the Proposed Treatment Areas (PTA), prior to the MPB killing large numbers of trees. Alternative B would treat only the infected trees, allowing the potential for MPB to become established in an adjacent area that is not treated. Alternative C would treat the infected trees, and potentially the rest of the surrounding forest, with a goal to limit future MPB infestation in the same area and maintain the visually desirable trees - though widely spaced - over the forested landscape. At the same time, the removal of trees would limit the large quantity of fuel that would occur – if the trees remained and the MPB killed them. The treatments may enhance the large tree component, when present, by reducing competition for nutrients, and reduce susceptibility to MPB attacks. A variety of vegetation structure, smaller and larger trees, increasing numbers of hardwoods, grasses and shrubs should result from this thinning. Overall, the variety of vegetation, at the stand level, should be very positive from a scenery standpoint. The resulting more open forest structure should promote views into the forest to view large diameter trees, spring and fall color, and wildlife.

Direct Effects

"In general a specific integrity level can be achieved by decreasing the visual contrast of the deviation being viewed. Several approaches may meet integrity levels:

- Usually the most effective way is to repeat form, line, color, texture, pattern and scale common to the valued landscape character being viewed. For example, in natural or natural appearing landscapes such deviations as created openings can sometimes be added by repeating size, shape, edge effect, surface color and pattern from natural openings common to the landscape character….
- If repetition is accurate and well designed the deviation may blend so well the change is not evident (HIGH). It may only borrow well enough to be noticeable but visually subordinate (MODERATE).
- Another approach is to borrow form, line, color, texture, pattern and scale from similar but different valued landscapes outside that being viewed. For example, it may be possible to borrow the size, shape, edge effect, surface color, and pattern of natural openings and repeat them in continuous textured landscapes where they do not presently exist….
- Because these are introduced elements from landscape character outside the one being viewed these are usually evident (MODERATE) if not dominant (LOW) (USDA-FS 1995a, Chapter 2, pg. 5).

Naturally healthy forests necessarily are comprised of deadfall, dead standing trees, insect infestations, windfall, various intensity wildfire events, and effects from tree disease (i.e. – natural openings from tree root rot), can all create patterns in the vegetation that is readily apparent in the viewed landscape.

Fire has been excluded from its natural role, openings have been limited to meadows – some quite large. The National Forest lands (the planning area) is densely populated with trees

(predominantly ponderosa pine). These treatments, should follow natural insect patterns, and create vegetative patterns that will likely be natural in appearance.

Commercial treatment prescriptions would result in the removal of trees [generally 5-inch and greater Diameter Breast Height (DBH)] within a stand. Commercial thinning can result in a uniform appearance of the remaining forest stand (both in size and spacing). The vertical lines of the remaining tree boles will be more evident. The visibility of larger diameter trees will add variety of color (orange and black bark on the tree boles), and allow more light on the understory. When higher numbers of larger trees remain, a natural appearance can still be achieved. The understory, trees generally less than 5-inch DBH, where present, would still be present and potentially help blend treatments into the viewed landscape by reducing vegetation and color contrasts in summer and winter. In the Foreground and Middleground, textural differences will be the most evident. In the Background, textural changes may be evident, but form, lighting (shadows), time of day (sun orientation), and seasonal (color) differences can have the greatest effect on how evident vegetation treatments will appear.

Sanitation treatment removes trees currently infested with mountain pine beetle. The forest after treatment could be very open to a somewhat closed canopy, a range of 10 to 70 BA. A 10 BA results in a heavily managed appearance, that meets a LOW SIO (or less), depending upon the size of the unit. While a 70 BA results in a natural appearing condition meets a High SIO. When treatment is in an area with widespread MPB activity, a Low SIO will likely be achieved. When then treatment is in an area with isolated pockets of MPB activity, a High SIO could be achieved. The visual effect is totally dependent upon the amount of MPB activity present. The results of this treatment cannot be projected due to the unknown level of MPB activity in a given area to be treated.

Cut and Chunk treatment cuts down trees currently infested with mountain pine beetle, and cuts them into chunks (i.e. 12”-18” long pieces), and leaves the pieces scattered on the forest floor. This is a labor intensive treatment utilizing chainsaws - no large mechanical equipment will be present. As a result no soil displacement or geometric patterns in the vegetation would be created. However the ‘chunks’ would be evident. The color of the cut wood is a pale white-yellow; when sunlight shines on the fresh cut wood, it has been observed to be highly visible in the immediate foreground. This effect may be highly visible for 1-2 years, until the surface of the wood weathers to a dull gray, which may be less conspicuous in color. This treatment will likely be used in areas where there are few MPB infected trees, and on slopes greater than 40% which could include widespread areas of MPB infected trees. It is on the steep slopes that this treatment has the greatest potential to be highly visible. In these locations, the gray weathered pieces of cut up chunks could be evident when understory trees are widely scattered. The visual effect is totally dependent upon the amount of MPB activity, and the understory, present. The results of this treatment cannot be projected.

Roads - Reconstruction, whether ‘System’ or ‘Non-system - temporary’, has the same effect on the scenic landscape. Road reconstruction smoothes the road surface removes vegetation and debris, cleans associated ditches, and can widen the road surface. If the existing cut and fill slopes is not treated/changed: on flat ground the only apparent change would potentially be the color of the exposed earth, on steep ground the loss of vegetation along the road cut or fill slope

can result in the road once again dominating the landscape. Any road reconstruction along the edge of private land has the potential to be highly visible.

Logging systems – Ground based logging methods include using skidders and dozers to move logs to landing site. Skidding logs on, or across, slopes can remove vegetation and displace soil leaving trails that can be quite visible – creating lines or unusual color contrasts in the landscape. These skid trails will be evident until cleanup activities (slash treatment and seeded areas germinate) are completed. Skidding is normally limited in operation to dry or frozen conditions, which reduces potential for soil disturbance. On gently rolling terrain, disturbance is generally kept to a minimum – however it is dependent upon the quantity of logs moved along the same skid trail.

The Skyline Logging method is used in steep terrain where ground based logging systems (skidders, forwarders, etc.) cannot be used. This system removes trees in corridors. Depending upon whether the logs can be fully suspended in the air, or must drag the logs up the slope, will determine the level of impact of this logging system. In locations where the logs are fully suspended, there are no impacts to the soil or ground vegetation from the logging system, except at the landing site. In locations where logs are not fully suspended, but dragged up the slope, soil is disturbed in vertical 'lines' that normally are highly evident, last for a long duration, and do not mimic natural patterns in the landscape. Long skyline corridors, bringing up a large quantity of logs in each corridor, can result in earth being displaced down to mineral soil than can create strong color contrasts with the surrounding vegetation. The openings created in the vegetation (due to the limitations of the logging system) can be geometric in shape if the majority of the vegetation is removed from the landscape (less than 50BA). The roads, where the skyline logging equipment is operated from, is located at the top of the logged unit, and can also be highly visible. Visibility of the drag marks and the road is totally dependent upon the amount of vegetation remaining across the landscape. In areas where 60 BA or higher is maintained on the landscape, and skyline corridors are kept to a minimum width, impacts from this logging system can be kept to a minimum. Limited remaining vegetation, and logs being dragged up the slope, can create color contrasts and vegetation patterns that can be visible for a long duration (10 – 30 years). In locations where the viewer is directly in-line with the skyline corridors, there is a high probability - in the best of conditions, some effects will still be obvious. If this method is employed in locations where widespread Mountain Pine Beetle activity is occurring, and full suspension cannot be achieved, this logging system will result in a high level of visual impacts and only a Low or Very Low SIO could be achieved. If this method is employed in locations where scattered Mountain Pine Beetle activity is occurring and a 50 BA or greater can be maintained and full suspension can be achieved, this logging system could result in a moderate level of visual impacts and a Moderate SIO could be achieved.

Helicopter logging method can be used in any terrain, but for this project it would likely only be employed in steep terrain. This system creates no additional impacts (i.e. – soil disturbance color contrasts or linear openings in the vegetation) beyond openings creates by removing the vegetation and the log landing site. This method removes the trees directly from where they've fallen. The shape of treatments (textural changes) created in the vegetation thru helicopter logging is not limited like other loggings systems. Ground-based systems normally do not operate on slopes 40% or greater. The upper edge of a unit logged with a ground based can result in a straight horizontal edge where it encountered a steeper slope. Skyline systems result in straight edges along the edges of treated areas, often creating a square pattern in the vegetation

when 40 BA, or less, is remaining. This pattern is most evident when snow is present on the ground. As a result, helicopter logging has the greatest potential to mimic natural vegetative patterns in the landscape, and meet the desired future condition in recreation areas and other areas of high scenic importance. Helicopter logging, completed in approximately February 2011, on St. Elmo Peak in a location highly visible from US Hwy. 16/385, appear as natural (irregularly shaped) openings and a variety of stand densities (texture) were achieved. The logged area is so natural in appearance most people would not realize any vegetation management occurred. This logging method was also used in Custer State Park with similar results. In both cases a high level of Scenic Integrity was achieved as soon as the logging was completed. Due to the cost of this logging system, it is rarely used, and only employed in locations with high resource sensitivity.

Log landings - locations where logs are brought, piled, and then loaded onto trucks and removed from the site. The size of these landings and amount of disturbance (vegetation removed and often soil displaced) will vary by location, depending upon the type of logging system employed (forwarder, etc.) and the volume of logs being brought to that landing. Once logging is completed, these landing sites are cleared of debris and reseeded. Based upon observations of past activities, the length of time before the site appears as a natural opening is generally 1 to 4 years, depending upon the level of disturbance, any remaining debris (slash), and how quickly grasses take over the site.

By-products of vegetation removal - tops and limbs not utilized for commercial products or fuel are left on the ground, or piled throughout the area of the vegetation treatment. Stumps would likely be evident throughout the treatment areas. As a result of the treatment, slash is in quantities usually well above natural levels - creating strong contrasts (the slash reflects light) in color and texture. On steep slopes stumps can be highly evident, as they too will reflect light; on flat terrain grasses can grow up and hide them. With both byproducts, it is the quantity present that determines how natural the forest will appear after treatment. Additional slash treatments such as piling and burning, crushing, or moving to a large landing for treatment, can all greatly reduce the visual impact from the slash.

When slash is hand piled, it is usually then burned within 1-2 years. Burning of slash is dependent upon weather condition and aids in containing the fire. Generally, these conditions occur within two years of the time the slash is placed on the ground. Once the dried slash is burned, circular burn marks are clearly evident on the ground. Normally, these burn marks are no longer visible once new grasses and other vegetation grow up the following spring. Once all clean-up has occurred, areas that were piled and burned generally meet a Moderate to High SIO.

When slash is machine piled, it is usually then burned within 1-3 years. Machine piling has the potential to displace soil and grass vegetation. Since the piles are larger, the area affected by the radiant heat is also greater. After piles are burned, unconsumed slash is normally buried, soil is raked in, and the disturbed area is re-seeded. One growing season after the seeding is completed; usually the only evidence of the machine pile is the grass covered opening. Once all clean-up has occurred, areas where machine piling occurred generally meet a Moderate SIO.

When Whole Tree Yarding is employed, the tops and limbs are removed and stacked at the landing site, creating large decks of tops and limbs, potentially 100-400 feet long. These piles are burned. As part of the cleanup personnel come in and mix these areas with soil and reseed them. Approximately two years after this work is completed, the areas appear as open grassy areas, and meet a Moderate to High SIO – depending upon the size of the opening.

Lop and Scattering tops and limbs can leave large quantities of down material across the landscape – at levels much higher than natural occur (except when there is a large quantity of trees that are killed by insect, disease, or fire). This slash treatment creates negative visual elements in the landscape that dominates the foreground. This treatment method meets a Low SIO in the foreground of trails and roadways (see photo below), and a Low to Moderate SIO in the middleground.

Concentrations of treatments – There are concentrations of potential treatments areas along major highways, where the public has a high interest in scenery, can be found in various areas around the Forest. Examples include: US Hwy16 between the Keystone 'Wye' and Three Forks, US Hwy 16A between Keystone Wye and Keystone, Hwy 40 between Keystone and Hayward, US Hwy 385 between Custer and Wind Cave National Park, Centennial Trail between Elk Creek and Forbes Gulch, US Hwy 85 between I-90 and Deadwood, around Cook Lake and Campground, Crow Peak Trail, Mickelson Trail between Rapid Creek and Irish Creek, Rimrock and Little Spearfish Trails. Treatments in these areas occur when MPB activity is low, changes in the vegetation patterns would be limited and a natural appearing condition could be maintained. If MPB activity is high, changes in the vegetation patterns from the treatments will likely be readily apparent, and, due to the concentration of units, may dominate the landscape.

In each alternative, any of the proposed treatments could be used on any unit. In these Alternatives, the goal of the vegetative treatments is to remove the MPB infested trees from the forest; however, this may not be possible in all areas due to steep slopes, rocky terrain, or too few trees to make removal economically viable. As a result, more 'cut and chunk' treatments would occur in these areas, and more down trees would remain on the landscape. How well these treatments blend into the characteristic landscape, and meet the Scenic Integrity Objective (SIO), is based upon the slope, aspect, scale of the treatment and the vegetation remaining on the site.

Indirect Effects

Skidding logs on, or across, steep slopes can remove vegetation and displace soil creating opportunities for noxious weeds and invasive plants to become established in treated areas. Burning piles of tree tops and limbs can sterilize the soil, also creating opportunities for their establishment. These invasive plants often have shapes that distinctive (i.e. – Mullen) and are recognized by the general public non-natives that are competing with native plants. These plants are often readily apparent in the Immediate Foreground. As the quantity of these weeds increase in the landscape, they out-compete native plants, resulting in the visual quality decreasing. Efforts are made to minimize this potential, so it is difficult to predict where, how wide spread, and the duration this will effect scenery.

Thinning and reducing the overall density of ponderosa pine vegetation can lead to an increase in the amount of grasses, forbs, shrubs, and hardwoods increasing in the landscape. This could

increase the variety of colors evident now, and in the future, across the landscape. In addition, there is a potential for hardwoods to increase in thinned stands (other than where we are specifically managing to encourage hardwoods), creating a greater amount of fall color in across the landscape.

Alternative B - Direct Effects
Within the 242,000 acres of possible treatment locations:

Areas seen from Level 1 Roads: 71,697 acres or 1/3 the area
Areas seen from Level 2 Roads: 135,269 acres (note: portions of these acres are also visible from Level 1 Roads) or ½ the area
Scenic Attractiveness: Distinctive 14%, Typical 39%, Indistinctive 47%
Scenic Class: Class 1 - 13%, Class 2 - 51%, Class 3 - 23%, and Class 4 - 13%.
Scenic Integrity Objectives: High 12% (or 2% of the Forest), Moderate 42% (or 8% of the Forest), Low 46% (or 9% of the Forest)

Commercial Thin treatment will result in maintaining the majority of the large overstory trees, while reducing the overall density of pine trees. This treatment would reduce susceptibility of stands to MPB infestation by reducing overall basal area within sites. Remaining stand densities will vary from 40 to 70 ft2/ac Basal Area (BA). In the foreground distance zone, a 40 BA generally achieves a Low SIO, while in a middleground and background distance zones it can achieve a Moderate SIO, depending upon the size/scale to the unit, topography and viewer location residual large tree component and hardwoods present. Areas of up 1,000 acres can be thinned in these Action Alternatives. In the all distance zones, a 70 BA should achieve a High SIO. When a unit has a range of BAs, the variety in vegetation textural differences, can create a more natural appearing vegetated landscape.

Products Other Than Logs (POL) Thinning removes 5 to 8.5-inch diameter trees and will open up views into the Forest, as the spacing of the trees would range from 18 to 22 feet. This treatment often leaves a moderate level of vegetation debris on the forest floor, reducing grasses and shrubs, and dominating Foreground views. Once the slash is cleaned up, this treatment should meet a Low to Moderate SIO, depending upon the size of the unit and proximity of the viewer. In the middleground and background, large diameter trees should be more dominant in this landscape also resulting in a Moderate to High SIO.

This Alternative proposes to treat 20% of the above acreage (242,000), or 48,000 acres, over a five to seven year period. This represents less than 4% of the Black Hills National Forest. This is a rate of 9600 acres per year. In 2011, areas affected by the MPB more than doubled this rate (approximately 21,000 acres) (USDA-FS 2011a).

This Alternative would utilize existing system roads and temporary roads. As a result to no new road templates would be constructed in the landscape. Given the mortality of the vegetation, due to the MPB activity, existing roads will be more evident in the landscape. Use of existing roads to implement this alternative, will likely remove any grass, shrubs, and trees that have grown into the road template over time from the original road construction. The color contrast of the road surface will be evident, and the 'line' created by the linear form of the road template will again be evident in the landscape.

Summary: Twelve percent of the potential treatment areas have an assigned High Scenic Integrity Objective. 42% of the potential treatment areas have an assigned Moderate Scenic Integrity Objective. More than half the treatment areas are readily apparent from roads, recreation facilities and communities. If MPB get into these areas, and treatment can take place when the MPB activity is low, the result will likely reduce further potential MPB activity as the Basal Area is reduced and comes in line with the recommendations.

Effects of vegetation management will be evident however they should replicate textural patterns that borrow from natural patterns in other portions of the planning, and surrounding, area. Locations where the MPB activity is high, and effect areas larger than 5 acres, treatments could dominate the landscape. This will be most apparent in Foreground views and treatments will likely not meet the assigned SIO. As the high level of MPB activity will continue to kill the trees in the area, we may see 10% of the trees survive (Allen 2011a). The primary differences, that affect the scenic resource - between Alternative A and B, include:

- Alternative B would remove MPB infected trees creating openings that are rapidly apparent, while Alternative A will create openings slowly over time. This may also facilitate new seedlings rapidly filling in these open areas.
- Alternative B may preserve some trees on the landscape, potentially at a higher rate than Alternative A. As seen in the Bugtown project, a forested landscape was able to be maintained that provides vegetative color and texture that is in character with scenery in the Black Hills.
- Slash will be created by both Alternatives in approximately the same amount on the landscape; however, Alternative B will reduce the level of slash present by piling and burning a large portion of it. The heavier levels of slash, turning gray over time, in Alternative A, will form a uniform appearance that will visually dominate the landscape; while the lower levels that would occur through Alternative B would break up the continuity of slash and create opportunities for other vegetation (grass, flowers, shrubs, and seedlings) to be more evident in the landscape.

Short-term effects that will be evident in the landscape include displaced soil (until vegetation is re-established in seeded areas such as closed roads, skid trails, decking areas, and landings
.
Long-Term effects include those from skyline logging, when full suspension cannot be achieved. Trees in thinned areas may not receive additional MPB activity, hence maintaining a forest landscape in treated areas. With the removal of pine trees, a greater quantity and variety of hardwoods may be evident in the landscape, until new ponderosa pine vegetation becomes established (20-30 years).

The proposed treatments within this Alternative have the potential to preserve some trees in areas that are valued for their scenic beauty. The benefits of treating forested areas to reduce the potential of further tree mortality, due to MPB activity, is greater than the negative effects that occur with most logging activity - from a Scenic Resource perspective. Skyline logging is the one activity with the greatest potential for negative effects on the Scenery, particularly in the Foreground and Middleground distance zones. This logging system would not meet the High or Moderate SIO. Aside from the effects of this logging system, the Scenic Resource could receive greater long-term benefits from this Alternative, than Alternative A.

Alternative C - Direct Effects
Within the 248,000 possible treatment acres:

Areas seen from Level 1 Roads: 74,665 acres
Areas seen from Level 2 Roads: 137,273 (note: portions of these acres are also visible from Level 1 Roads)
Scenic Attractiveness: Distinctive 15%, Typical 39%, Indistinctive 49%
Scenic Class: Class 1 - 15%, Class 2 - 50%, Class 3 - 25%, and Class 4 - 11%.
Scenic Integrity Objectives: High 13% (or 3% of the Forest), Moderate 42% (or 8% of the Forest), Low 45% (or 9% of the Forest)

The effects of this Alternative are similar to Alternative B, with three key differences that effect the Scenic Resource: 1) new road construction, 2) inclusion of Spearfish Canyon Management Area – MA 4.2A, and 3) thinning of vegetation across the landscape may occur.

Roads – Construction. 'System' or 'Nonsystem' new road construction has the same effect on the scenic landscape. A 'road prism', created thru cutting and filling material, to create a linear flat surface for vehicles and equipment to travel on. The grade along this linear surface is determined by the type of vehicles, but general does not exceed 18% along the centerline. As a result, when a road is viewed from across a canyon, it often appears as a horizontal 'line' crossing the landform. The steeper the side-slope, the taller the cut and fill slopes, the more vegetation is removed, and the greater the potential of soil–vegetation color contrasts to dominate the landscape. On flatter side-slopes, with low cut and fill slopes (i.e. – 1-2 feet), there is less potential for soil-vegetation color to dominant the viewed landscape. When the viewer is in a superior position looking down on the road, the surface material can provide a strong color contrast to the surrounding vegetation that dominates the landscape. Roads construction could occur, with a potential of 250 miles of roads being constructed. When new roads are constructed along a ridge line or mid-slope, and the vegetation will be skyline logged below, the potential for color contrast and the "line" of the new road introduced, to dominate the landscape is high. Review of old roads in the Black Hills, the road prism is still evident more than 60 years later. Only when trees grow over the prism is it hidden from view. When roads are constructed in the foreground or near middleground, at the top of units, on steep side slopes they could be evident long term. In rolling terrain, the topography may hide roads from view. Given the mortality of the vegetation due to the MPB activity, new roads, as well as existing roads previously hidden from view, could be evident in the landscape. With the removal of vegetation, and mortality from MPB, existing and new roads could become visible in all distance zones, including areas of High, Moderate, and/or Low Scenic Integrity.

In Spearfish Canyon Management Area – MA 4.2A, Forest Plan direction dictates: "In areas where there are special features, design roads and trails to blend with the landscape …" Standard 4.2A-9101 *(USDA-FS 2006, pg. III-53, 56).* This Alternative would allow skyline logging. Under situations where the access road for the skyline equipment would be constructed on flat terrain, the road could be built to meet this standard. In situations where the access road for the skyline equipment would be constructed on a side slope, the road could not be built to meet this standard. To utilize this method, roads would need to be constructed along the canyon rim or within the canyon, potentially in highly visible locations. Depending upon the location needing treatment, the road constructed to provide access for the equipment for this logging method may not comply with this Forest Plan Standard. In this case a Forest Plan Amendment would be needed to allow road construction in highly visible areas to access some potential treatment areas.

The Desired Future Condition for Spearfish Canyon Management Area – MA 4.2A states: "Management activities are likely to be less evident, be of short duration and be more natural in appearance than in many other areas of the Forest". Roads constructed on steep side slopes are highly evident, and can be visually evident for 70 years or more (as observed along Highway 244 and other locations within the Black Hills National Forest). Due to the nature of the soils, vegetation, and slopes (see Soil and Botany sections), the potential to return a road prism to the original landscape appearance may be low. The soil color contrast from the construction and re-contouring may still dominate the landscape. As well as re-contouring to the original landform may not be possible in all locations (i.e. – full bench construction), which could also dominate the landscape. This would not move the area toward the Desired Future Condition. To reduce these long term effects, roads constructed within the Spearfish Canyon area could be re-contoured and put back to mimic their original condition. The success of this rehabilitation effort would depend on ability to put back the soil into the original contours, the soil type and ability to quickly re-establish grass and plants to mimic the original ground cover vegetation. Consider the following additional Design Criterion for Spearfish Canyon Management Area – MA 4.2A, and the surrounding area viewed from the Spearfish Canyon Scenic Byway:

> Roads prisms and landings constructed for skyline logging should be re-contoured and returned to their natural condition, when logging activities are complete. These re-contoured roadways should be re-vegetated with grass and plants native to the area, in a manner similar to their original condition.

This Alternative proposes to treat 50% of the potential treatment area, or 124,000 acres over a 5 year period. This represents approx. 10% of the Black Hills National Forest. This is a rate of 24,800 acres per year. Areas affected by the MPB increased by 23,680 acres from 2010 to 2011. The rate of potential treatment in this Alternative would be similar to the current rate of MPB spread (USDA-FS 2012e).

Summary: Thirteen percent of the potential treatment areas have an assigned High Scenic Integrity Objective. Forty-two percent of the potential treatment areas have an assigned Moderate Scenic Integrity Objective. Alternative C adds the Spearfish Canyon Management area as a potential treatment area, an area highly valued by the local and regional community for its natural scenic beauty. The construction of roads to provide access for skyline logging, to remove MPB attacked trees or thin timber stands, in Spearfish Canyon could create long-term negative impacts to the scenic resource, by introducing horizontal 'lines' and soil 'color' contrasts that could dominate the viewed landscape and detract from the existing natural appearance. Vertical 'lines' from dragging logs up the canyon walls could also be evident if full suspension skyline logging cannot be achieved. These drag marks could also be visible for a long term depending upon soil type, steepness of slope, and potential for erosion. These effects could be readily apparent from the Scenic Byway and private lands both within and adjacent to the Management Area. The use of helicopter logging method has the potential to alleviate these concerns by removing MPB infested or thinned trees, without constructing roads or dragging trees up the slopes. Helicopter logging has the greatest potential to meet the High Scenic Integrity Objective assigned to this Management Area, as observed on St. Elmo Peak and Custer State Park. Due to the potential long term impacts of road construction and skyline logging, that

could impact the natural scenic beauty of Spearfish Canyon (Management Area - 4.2A) in some areas, a Forest Plan Amendment could be required to utilize skyline logging in some situations.

Like Alternative B, effects of vegetation management would be evident however they should replicate textural patterns that borrow from natural patterns in other portions of the planning, and surrounding, area. This Alternative has a greater potential to treat Foreground and Middleground views than Alternative B. The primary differences, that affect the scenic resource - between Alternative C and B, include:

- Alternative C could remove MPB infected trees creating openings, similar to Alternative B. In addition, under Alternative C, vegetation in the surrounding area could be thinned up to 1000 acres. This effort could reduce the Basal Area to a level that may reduce further attacks by MPB in the remaining trees, and preserve some 'green' vegetation on the landscape.
- Alternative C could remove a larger amount of slash over a larger area, potentially breaking up the continuity of slash that may be present across the landscape. This Alternative could also provide opportunities for other vegetation (grass, flowers, shrubs, seedlings) on a wider scale than Alternative B.

Short-term effects (slash soil displacement, etc.) could be similar to Alternative B, but on a wider scale. Long-term vegetation effects should be similar to Alternative B in areas where existing MPB infested trees are removed. However, in areas where MPB is not widespread and the stands are thinned, positive long-term benefits may be achieved if MPB does not attack these remaining trees, and a forested setting can be maintained. Long term negative effects from road construction and skyline logging could be evident in Spearfish Canyon.

The scale of the proposed treatments within this Alternative has a greater potential to preserve some trees over a wider area that is valued for its scenic beauty, than Alternative B. The benefits of treating (thinning) forested areas to reduce further tree mortality from MPB (in areas of high scenic importance) and potentially preserve green trees on the landscape could be greater, than the negative effects that can occur with most logging activity - from a Scenic Resource perspective. Skyline logging is the one activity with potential for greater negative effects on the Scenery, particularly in the Foreground and Middleground distance zones, which would include all of Spearfish Canyon. Areas logged with this logging system, likely would not meet the High or Moderate SIOs, due to the limited vegetation treatment options because of the MPB activity. The Scenic Resource could receive greater long-term benefits with this Alternative, than Alternative B. However, if this Alternative is selected, I recommend only allowing skyline logging in Spearfish Canyon when access roads could be constructed on flat terrain and full suspension of the logs can be achieved - to protect the unique scenic character of the Canyon.

Cumulative Effects

Understanding past, present and reasonably foreseeable actions, is necessary in order to evaluate potential cumulative effects of the various alternatives.

Methodology includes:

1) Review activities that are known to have occurred, or planned, within the planning area.
2) Review past activities in the field and determine their effect on scenery.

3) Review planned activities - the location both on topographic maps and aerial photos, then determine the potential cumulative effects.

The boundary on the ground for analyzing cumulative effects is primarily that of the planning area. This identified area is the landscape that is evident in the foreground and middle ground from the main travel routes, with particular attention to recreation facilities, recreation trails, and the communities, due to viewer's stationary position or slower pace while moving through the landscape.

The time boundary for this analysis extends from 1980 (when the start of recent vegetation management activities took place) to 2048 [completion of management activities (approx. 2018), followed by 5 years for pine seedlings to become established, and approx. 25 years for trees to grow up and visually 'fill' open areas]. This time period includes known management activities, and activities that are planned but have yet to be accomplished.

Fire suppression over the past century has played a role in the increased density of the vegetation on the forest. Likewise, much of the Forest was pre-commercially thinned by the Civilian Conservation Corp in the 1930's and 1940s; however we do not know what portions of the Forest that effort included. The construction of the Needles Highway (SD 89) in 1919 and the Iron Mountain Road (US 16A) in 1933, the road up Spearfish Canyon (US 14A), the carving of Mount Rushmore and Crazy Horse, the establishment of numerous national parks in the surrounding area, has focused the public's attention on the Black Hills, its communities, and established the area as a recreation destination, for its natural scenic beauty.

Large wildfires have occurred within the Forest Boundary on a frequent basis, since 2000. The effects of the large fires are readily apparent from major highways and communities. These fires have introduced large landscape-level changes in the vegetation. From vast created openings due to stand replacing fires, to a 'patchwork' matrix of open and forested areas. The fires have shown that this ponderosa pine ecosystem is fire-dependant, and not static, but dynamic. Due to the intermix of private land and National Forest lands, and the better understanding of the fire potential in this ecosystem, the need and desire to manage the vegetation in the wildland urban interface, for public safety, has greatly increased. Vegetation treatments to reduce high fire severity (see Fire and Fuels section) have included shaded fuelbreaks, thinning mature and understory trees, removing dead and down fuel mechanically, and prescribed fire, together have changed the appearance of the Forest and near private lands, over the past 10 years. The 2000, the Forest was a fairly uniform appearance of dense vegetation (in forested areas) along main highways and around private lands. The combination of vegetation treatments and wildfire over the past 11 years have created a variety of vegetation conditions that are much more evident to the local and visiting public - potentially modifying how people think the Black Hills should "look". When people view the Illingworth photos taken during the 1874 Custer Expedition *(Grafe and Horsted 2002),* and the view the variety of vegetation conditions today, they may realize how dynamic this ecosystem can be. The 'scenery', the landforms maybe static, but the vegetation can be dynamic, in the level of change that can occur to the scenic resource.

From 2000 to 20011, commercial vegetation treatments have been conducted across the Forest. Generally the treatments have met their assigned SIO. Approx. 5% of the suitable timber has been treated with overstory removals or seed cuts that are the most visually evident treatments, from a

scenery perspective. Some vegetation treatments that were implemented to reduce the further spread of MPB did not meet their assigned Scenic Integrity Objectives, due to the high level of MPB activity and tree mortality already present. Due to the adjacent seed source around these areas, new trees should become established, and have a visual impact in approx. 15-25 years. Then a forested appearance may again be evident. In other areas that were treated ahead of the MPB (i.e. Bugtown project), have maintained a natural appearance and appear to have limited potential for further MPB activity. The desired scenic character of the forest still exists in these areas.

Reasonably foreseeable (commercial, non-commercial, prescribed fire) vegetative projects within the Forest include projects where NEPA has been completed. This includes the following projects: Briggs (28,916 FONSI), Cold Springs (13,969 ROD), Steamboat (24,596 ROD), Herman (21,572 Preparing FONSI), Pactola (26,017 ROD). Other projects where NEPA is in progress -Buttes (11,441 Preparing for Scoping), Calumet (31,781 Scoped), Vestal (43,516 FEIS).

Other foreseeable actions include vegetation treatments that extend across property lines, such as with Custer State Park and private land owners, to address MPB activity. As a result, natural appearing vegetation textures may be evident across land ownership boundaries.

The visual effects of the MPB activity is quite evident between Custer and Hill City, in the central portion of the Black Hills (Deerfield area), in to the northern portion, and in isolated pockets throughout the Forest. The general spread of MPB, could become more widespread and visually dominant along US and State highways in the coming years. In some areas which remain untreated, such as slopes 40% or greater, the full range of effects from the MPB could be evident. The 'red-needle' stage (tree recently died), is the most visually dominant, and generally lasts 1-2 years, becoming less dominant as the needles fall. As the trees decay and fall, openings would be created. These openings could change the character from a uniform appearing landscape 'carpeted' with pine trees, to a complex matrix of openings, decaying dead trees, live 'green' pine trees, and expanding areas of hardwood trees.

Under Alternatives B and C, the range of potential treatments could produce a variety of vegetation conditions – some natural appearing, while others 'managed' in appearance, or, as if fire may have play its natural role. Due to the insect activity, and treatments adjacent to private land, the current view of the forest from individual homes could change from their current condition. Views of these treatments could be evident from Concern Level 1 and/or 2 routes (US, State, County Highways, trails), due to the juxtaposition and topography of potential treatment areas. There are concentrations of potential treatments areas along major highways, where the public has a high interest in scenery, in various areas around the Forest. Examples include: US Hwy16 between the Keystone 'Wye' and Three Forks, US Hwy 16A between Keystone Wye and Keystone, Hwy 40 between Keystone and Hayward, US Hwy 385 between Custer and Wind Cave National Park, Centennial Trail between Elk Creek and Forbes Gulch, US Hwy 85 between I-90 and Deadwood, around Cook Lake and Campground, Crow Peak Trail, Mickelson Trail between Rapid Creek and Irish Creek, Rimrock and Little Spearfish Trails. If treatments in these areas occur when MPB activity is scattered, and limited additional MPB recurs, changes in the vegetation patterns could be limited and a natural appearing condition could be maintained. If MPB activity is concentrated, or re-occurs in previously treated areas,

changes in the vegetation patterns from the treatments could be readily apparent, and, due to the concentration of treatment areas, may dominate the landscape.

Trees of 5-inch DBH or greater could be removed. The removal of 12-inch diameter trees would take approx. 120 years to replace from seed. ["It takes approx. 120 years to grow a 12-inch diameter ponderosa pine tree, equating to 1/10th of an inch (of growth in diameter) per year on average" (*Cook 2006*).] After vegetation treatment is completed, the resulting appearance may change little for the first 10 years. Any treatments would result in fewer trees across the landscape – but the risk of MPB infestation and fire to the remaining trees may be reduced. In potential treatment areas, MPB-killed trees could be present. These trees would not be removed (unless needed for safety reasons during logging operations) but would follow a natural decay process. Pockets of MPB-killed trees could create an opening in the fabric of vegetation, in less than 10 years. In 10 years, vegetation across entire landforms may transition from open areas (MPB-killed pockets), to scattered trees (treatment areas), to dense stands (untreated areas).

Forest wide, Alternative B could comprise approx. 40% of the vegetation treatment over the next 5-7, while Alternative C could comprise 84%. The rate of potential treatment, per year, under Alternative B would be approximately 9600 acres [less than half the rate of MPB spread this past year, 23,680 acres (USDA-FS 2012e), while under Alternative C it would be 24,800 acres. Visible effects of the MPB may continue in any case, though under Alternative B, potential treatment might only treat approximately half the current level of MPB annual expansion; while under Alternative C, potential treatment might keep pace with the rate of MPB annual expansion.

Alternative B would generally modify the vegetation in pockets across the landscape – surrounding MPB active areas, while the surrounding area would not be treated. Vegetation across the landscape could take on an appearance similar to 'moth-eaten holes in fabric'. Alternative C could modify the vegetation similar to Alternative B, and in addition, thin the vegetation across the landform. In both Alternatives, management activities could be readily apparent. The variety of treatments could create a variety of vegetation patterns, colors, and may improve opportunities to view hardwoods and wildlife. Due to the wide-scale breadth of the MPB beetle activity, and level of tree mortality, the forest is rapidly changing from a dense forest with few large openings (from wildfire), to large landscape-wide areas where 90% or more of the trees are dead (Deerfield area). With this rapid and dynamic vegetation change due to the MPB, what we consider the "natural appearance" for this landscape may also need to change. The treatments proposed are an effort to maintain some of the desired forest character that has helped defines the natural beauty of this landscape. These treatments will take time to appear natural – but long term, if hardwoods do increase, they will improve the visual diversity in the landscape. Piling and burning, will reduce fuel levels toward natural levels – a positive ecological and scenic characteristic associated with frequent fires in a pine ecosystem, and potentially make these areas less prone to high severity fires (when they do occur).

Alternative B treatments could meet a variety of Scenic Integrity Objectives from Low to High, one to three years after being completed. However in some areas, due to the high levels of MPB activity prior to treatment, the SIOs for these areas likely may not be met. In addition, additional MPB activity may occur in dense stands surrounding original treatment areas – perpetuating MPB effects or additional treatment effects. In locations where skyline logging occurs, SIOs may not be met.

Alternative C treatments could meet a variety of Scenic Integrity Objectives from Low to High, one to three years after being completed. However in some areas, due to the high levels of MPB activity prior to treatment, the SIOs for these areas may not be met. When skyline logging is used in these areas, SIOs may not be met. In Spearfish Canyon, skyline logging, and the roads constructed for access, could dominate the landscape and take away from the outstanding natural scenic beauty the Canyon is known for.

RECREATION USE

Introduction:
The project area encompasses the entire Black Hills National Forest in Wyoming and South Dakota, excluding the congressionally-designated Norbeck Wildlife Preserve, Black Elk Wilderness, Research Natural Areas (RNA's), and designated botanical areas.

The arrival of the Civilian Conservation Corp in the 1930's helped to improve roads, bridges, and trails to access the area and improve the resources of the region. By the 1960's, campgrounds, picnic areas, and other recreational activities, such as cabins and hiking trails, had been developed to provide places for people to recreate.

Today, visitors to the Black Hills of South Dakota and Wyoming enjoy a variety of recreational opportunities such as developed and dispersed camping, picnicking, driving along scenic byways, hiking, mountain biking, horseback riding, wilderness experience opportunities, fishing and hunting opportunities, rock climbing, water-related activities, winter activities, interpretive and educational sites, fire lookout towers, and observation sites. Motorized users of the Black Hills make use of an extensive road and trail system with a variety of off-highway vehicles; such as all-terrain vehicles, utility vehicles, jeeps, and off-highway motorcycles as well as highway legal vehicles, such as passenger cars, trucks, vans, buses, motor homes, and touring motorcycles.

From a recreation standpoint the setting is ideal for recreational activities in the Black Hills National Forest. It provides mostly un-fragmented and undeveloped public lands for recreating in a forested setting. For the most part there are very few paved roads and limited commercial services. Terrain is varied across the project area, at times flat or rolling and park-like with broad open meadows interspersed with aspen and pine stands. The northern part of the project area experiences heavy winter snowfall. This makes it excellent for winter recreation, but limits passenger vehicle access and may limit timber harvest activities during the winter season. This area offers the most consistent conditions for a groomed snowmobile trail system on the Forest. It is relatively easy to experience a sense of solitude in this primarily motorized area. There is evidence of historic and continuing management actions, mainly timber harvesting and grazing, which blend with the natural setting.

Primary recreational use of the project area combines both dispersed and developed recreation opportunities, and includes driving for pleasure, fishing, hunting, horseback riding, motorized and non-motorized trail use, snowmobiling, and dispersed and developed camping primarily associated with a vehicle.

There are several developed recreation campgrounds in or adjacent to proposed treatment areas and two developed recreation complexes associated with water; Cook Lake on the Sundance Ranger District, and Deerfield Reservoir located on the Mystic Ranger District. These complexes are part of Management Area 8.2, covering approximately 339 acres. These developed recreation complexes, along with seven isolated developed campgrounds are operated under a campground concession special use permit during the high use full service season (Memorial Day to Labor Day). Other small isolated developed campgrounds in high priority treatment areas, but not in Management Area 8.2, include Comanche, Oreville, Ditch Creek, Custer Camp, Rod and Gun, Timon, Reuter, and Beaver Creek. All are concession operated except Beaver Creek.

Recreation use field surveys , mostly associated with the National Visitor Use Monitoring (NVUM) effort and the Forest's Outfitter Guide Needs assessment, were conducted forestwide beginning in 2003, again in 2009, and during the summer of 2010 and 2011.

The Black Hills National Forest Travel Management Plan included extensive field surveys during analysis, which include GIS map data of all motorized system trails in the project area. Other information used for this analysis was obtained from occupancy and use information from the Forest's concession permittee, Forest Recreation Management, Inc. out of Hill City, SD, and personal observations by recreation personnel working on a regular annual field basis in the project area.

Desired Future Condition: Generally, few signs of people away from roads or trails are evident. There is little or no evidence of recent human activity or development. Overall, the landscapes of these areas are scenic and natural. Management provides for a variety of uncrowded, motorized recreational activities in areas that appear natural. Challenging off-highway motorized opportunities exist on area trails.

Vegetation may be altered through a variety of management activities, including the use of prescribed fire from management and natural ignitions in order to enhance recreational opportunities, to provide vistas for people to view surrounding areas, or to meet objectives for wildlife habitat. Altered areas are small and are not generally evident to people visiting the area.

Affected Environment:
The project area is an important part of the Black Hills area, a key recreation destination in South Dakota and Wyoming. The natural and cultural diversity which characterizes the project area provides the basis for a wide variety of recreational activities and is vital to the area's recreation and tourism industries. Interspersed within and in close proximity to the project area are four National Park units including Devil's Tower National Monument, Mount Rushmore National Memorial, Jewel Cave National Monument, and Wind Cave National Park. Custer State Park along with historic towns and settlements also lie within and adjacent to the area.

Since the Black Hills National Forest is a popular recreational destination, visitors to the project area utilize motorized access to a high degree. In 2004, the National Visitor Use Monitoring (NVUM) survey for the Black Hills estimated that 1.2 million people visit the National Forest annually. "Driving for pleasure" was identified as one of the top five activities, and as the second highest reason people visit the Forest.

In 2006, based on the NVUM survey information, the Forest Supervisor developed a recreation strategy for the Forest, characterized by a recreation "niche" statement. "Access for the Ages", focusing the Forest's recreation management on user-friendly family recreation, specialized campgrounds, roaded recreation opportunities, and system trails connecting communities, was formulated.

Visitors to the project area enjoy recreational opportunities including developed and dispersed camping, picnicking, hiking, mountain biking, horseback riding, fishing and hunting opportunities, rock climbing, water-related activities, winter activities, interpretive and educational sites, fire lookout towers, other observation sites, and on- and off-highway motorized use.

To provide a variety of recreational experiences for the visitor, the Forest utilizes a classification system, referred to as the Recreation Opportunity Spectrum (ROS), in its planning efforts. ROS is a planning and management tool that categorizes recreation opportunities into six settings, ranging from primitive to urban. The Forest Land and Resource Management Plan (Forest Plan) identified four of the six settings for its management emphasis including primitive, semi-primitive non-motorized, semi-primitive motorized and roaded natural. The roaded natural category was further expanded to add another category called roaded natural non-motorized to provide the Forest with additional diversity. A breakdown of acres and percent of the proposed treatment area within each of the ROS classifications can be found in the table 3-37 below. Within ROS classes, visitors can expect to find a variety of recreational activities, including developed and dispersed, motorized and non-motorized opportunities.

Table 3-37 ROS Classification Acres and Percent

Management Area	Acres	Description	ROS class & Percent of all Action Alternatives
3.31	4,411	Backcountry Motorized	SPM 1.6%
3.32	3,120	Backcountry Non-Motorized	SPNM 1.0%
4.1	4,184	Limited Motorized Use and Forest Products	RNNM 2.2%
4.2A *(Alternative C only)*	5,583	Spearfish Canyon	RN less than .05%
5.1	103,965	Resource Production Emphasis	RN 45.4%
5.1A	21,360	Southern Hills	RN 6.8%
5.2A	2,604	Fort Meade VA Hospital Watershed	RN, SPNM less than .01%
5.4	91,691	Big Game Winter Range	RN 37.6%
5.43	4,642	Big Game and Resource Production	RN 1.4%
5.6	7,085	Forest Product, Recreation, Big Game	RN 2.9%
8.2	339	Developed Recreation	RN less than .01%

Developed Recreation: All but four of the Forest's 30 campgrounds are managed by a private company under a recreation concessionaire special use permit from mid-May to mid-September annually.

These facilities are designed for semi-primitive family camping opportunities and many have some American Disability Act accessible site designs. Most day use areas and picnic sites are operated for the same season, mid-May to mid-September, by the recreation concessionaire.

Hunting and Fishing: Hunting and fishing are also popular dispersed recreation activities in the project area. Trout fishermen are frequently observed at Spring Creek, Rapid Creek, Spearfish Creek, Iron Creek, Palmer Creek, Grizzly Creek, Horsethief Lake and Lakota Lake, and other points throughout the project area. The outdoor undeveloped setting of the Project Area provides both motorized and non-motorized quality hunting opportunities not commonly found in other areas surrounding the Black Hills.

The area is popular with fall big game and fall/spring turkey hunters. Weekend hunting parties typically overnight camp at some of the isolated campgrounds or along roadsides where disperse camping is allowed. District recreation personnel knowledgeable of the project area report there are occasional weekend horse camps each summer. These are small 2 to 4 horse riding groups, camping beside the road, who ride the roads, two tracks, and trails found in the Forest. Mountain bike riders are observed riding during the day on the multitude of roads in the Jasper Fire Burn Area and other portions of the project area. This is evidenced by vehicles with bike racks, parked at trailheads and road turnouts.

Campfires are allowed at dispersed camp sites in the Forest in Wyoming. Campfires are not allowed at dispersed camp sites in the Forest on the South Dakota side; they are only allowed in developed campgrounds or day use sites with fire rings.

System Trails: There are several hundred miles of National Forest system trails throughout the project area, both motorized and non-motorized. The Centennial Trail and the Mickelson Trail, both designated as National Recreation Trails, are located in the project area. Both are long distance through-routes approximately 100 miles long. Both begin in the southern Black Hills and end in the northern Black Hills. The Centennial Trail, with segments managed by several land management agencies including the Black Hills National Forest, begins in Wind Cave National Park and ends at Bear Butte State Park north of Sturgis, SD. The Mickelson Trail, managed and administered by the State of South Dakota and following an abandoned railroad grade, begins near Edgemont, SD and ends at Deadwood, SD.

Two other of the Forest's non-motorized system trails are designated as National Recreation Trails (NRT), the Flume and Lost Cabin trails. NRT designation for trails located on National Forest land comes from the Secretary of Agriculture, and recognizes their unique values to provide the highest quality hiking experience. National Recreation Trail designation is a recognition given to existing trails that have been nominated and meet the requirements for connecting people to local resources and improving their quality of life. The National Trail System Act of 1968 authorized the NRT designations, which are now part of a continuing effort to promote community partnerships and to foster innovative ways to encourage physical fitness.

The system trails in the project area require regular annual trail maintenance and reconstruction. Maintenance is conducted by district trail crews and volunteers working mainly during the summer months. Occasionally, trail contracts are awarded to re-construct priority sections of trails in need of improvement to meet Forest Service standards.

In Wyoming, the motorized trail system is managed to accommodate Off Highway Vehicle's (OHV) less than 50 inches in width. In South Dakota, the motorized trail system has a variety of

trail types that are managed to accommodate either Off Highway Vehicle (OHV) less than 62 inches in width, highway legal vehicles such as pickups or sedans, off-highway motorcycles, 4-wheel drive rock crawler jeeps, and snowmobiles. The snowmobile trail system is closed by regulation to wheeled traffic from December 15th to March 30th annually.

The project area was part of the Black Hills National Forest Travel Management Planning effort, implemented in December 2010. Motorized OHV system trails have been designated, marked and mapped in the project area. In January each year, the Forest's detailed Motor Vehicle Use Map (MVUM) which identifies, open system roads and motorized trails, is published. Also in January, the Forest's annual motorized trail permit, for use in South Dakota, becomes available and is required for use of the motorized trail system in South Dakota. The Forest's motorized trails in Wyoming are enrolled in that state's ORV trail program. Use of the Forest's Wyoming motorized trails is limited to ORV's 50 inches or less in width and requires purchase and display of a Wyoming ORV sticker annually.

The states of South Dakota and Wyoming snowmobile trail systems incorporate several hundred miles of very popular and regionally important snowmobile trails located on National Forest land in the project area.

National Scenic Byways: The Forest has two national byways within its boundary, the Peter Norbeck National Scenic Byway in the southern part of the Forest and the Spearfish Canyon National Forest Scenic Byway in the northern part. Driving these byways for pleasure is one of the most popular recreation activities in the project area and of economic importance to nearby communities. Over three million visitors annually drive the Peter Norbeck Scenic Byway as the main access from Highway 244 to Mount Rushmore Memorial.

Spearfish Canyon Scenic Byway is a 20-mile drive popular with the traveling public. It provides spectacular scenery, historic mining remnants, and an all-season paved highway. This Byway, designated by the Chief of the Forest Service in 1989, allows public access to numerous outdoor recreational activities. This section of U.S. Highway 14A, from the city of Spearfish to Cheyenne Crossing, receives high recreational use throughout the year, but especially during the summer and fall.

The scenery along Spearfish Canyon is unique and often spectacular. The narrow canyon walls rise sharply from the stream and highway carved from the bottom of the canyon. A forest of white spruce, ponderosa pine, aspen, birch and oak covers most of the hillsides and parts of the canyon walls. Above these slopes, the skyline is topped with an extensive ridge of vertical limestone cliffs and rim rock.

Spearfish Canyon is historically important to the northern Black Hills because it has provided mineral ore to the local mines, railway passenger transportation, and hydroelectric power and drinking water to nearby communities. Remnants of some of these mines and mining communities are still present and can be viewed

Recreation Special Uses: Recreation special use permits authorize the private use of public lands. The Forest administers several hundred recreation special use permits across the project area, including 159 privately owned recreation cabins; three resorts including Sheridan Lake and Pactola Lake marinas and Wonderland Cave, and three organizational camps. These recreation special use permits, involving privately owned structures, are authorized for successive twenty year periods. The Forest also authorizes outfitter guide activities such as hunting, fishing, horseback riding, nature hikes, mountain biking, cave tours, scuba diving, and several other outdoor pursuits

throughout the project area. Recreation event permits are issued for temporary use activities such as jamborees, mountain man rendezvous, school and college courses, youth camps, challenge and endurance races, and motorized and non-motorized trail events, to name just a few.

Summary: The project area is a key tourist attraction for the Black Hills area and provides an important recreation setting in all seasons, whether it is summer OHV use, fall big game hunting, winter snowmobiling, or spring turkey hunting. Some developed recreation camping occurs at all of the developed campgrounds to a moderate and at times high level of use.

Environmental Consequences

Alternative A:

Developed Recreation: Generally, the effects for Alternative A are visual due to the known mountain pine beetle infestation in the project area. This area is experiencing extensive overstory mortality of ponderosa pine. Red (dead) trees are currently visible. These will eventually lose needles, becoming less visible from a distance and the dead trees will likely fall to the ground in three to five years.

Recreation sites currently receive regular tree inspections for public safety. During this process trees deemed unsafe are removed before the recreation site is opened to the public or the site is closed to the public until the tree hazard is removed. There has been an increase in hazard tree removal due to mountain pine beetle mortality in many of the campgrounds over the last three to five years. This process is likely to increase as mountain pine beetle populations continue to expand into recreation sites. The effects to the public are increased short term closures to recreation sites to mitigate and remove hazardous trees and the loss of site vegetation, shade, privacy screening, and the mature forested setting many recreationists seek.

Trails: Effects of Alternative A on trails would be an increased amount of maintenance required to remove trees along and across system trails in the short term, three to five years. It is projected that the area will experience extensive overstory mortality. In the past five years, some experience with high tree mortality from mountain pine beetles along several system trails has already been seen. These effects include:

- Increased effort by trail crews to clear trails of fallen dead bug-hit trees. It appears that there is very little increase for the first one to two years after trees are hit by mountain pine beetles. Within three to five years however most of the mountain pine beetle hit trees fall to the ground. After five years the incidence of dead trees falling to the grounds slows dramatically.
- Effects to the public during the period of trees blocking trails include that most trail users walk over or drive around trees across trails and more horse riders carry an axe or bow saw with them to minimally clear trails themselves. Less physically capable or prepared trail users tend to turn around and return to the trailhead when faced with a tree blocking a trail.
- Trail workers spend more time performing maintenance, opening and clearing trails during the period of high-incidence of falling dead trees across trails.
- Increased information provided to the public is required via electronic and trailhead postings so they know to expect a higher incidence of blocked trails.

- An increase of the chance for a catastrophic wind event that would fall a large amount of dead and dying trees at one time requiring trail closures until the area was cleared.
- Trail users stay on the cleared trails more often versus cross country travel in high tree mortality areas because cross-country travel is more difficult due to the presence of deadfall.

Recreation Special Uses: The Black Hills National Forest has 45 permitted outfitter and guides and numerous temporary recreation use permits issued each year that use all or portions of the project area. With the implementation of the No Action alternative, the future of recreation special uses would be similar to the trail systems. The more mountain pine beetle tree mortality, the more trees could fall across system roads and trails, and into permit areas of operation. These permit holders use sections of the roads and trails in the project area to offer a service to visitors of the Black Hills National Forest. Many permittees also assist with trail maintenance in partnership with the Forest Service. If there is an increase in trail deadfall there will be more need for trail and tree clearing partnerships. The effect of widespread mountain pine beetle tree mortality to the trail system may cause a shift to other less affected areas and trails within the project area.

Recreation Residences: There are 159 recreation residence cabins under special use permit, three resorts, and three organizational camps located throughout the project area. Many of the special use permit holders will notice the impact of a No Action alternative. The effects will be similar to that experienced already by recreation residence permit holders in Sunday Gulch Recreation Residence Tract where mountain pine beetles have been prevalent for the past six years. This has resulted in extensive tree mortality of the overstory and loss of a forested setting around these privately owned recreation residences. Expected impacts to permittees include:

- Increased requirements based on Forest Service permit inspections for permit holders to remove dead and dying trees deemed hazardous to private property, life, and to prevent increased wildfire risk. The required removal of hazard trees has resulted in increased direct costs to permittees.
- More power outages and electric line maintenance required to prevent deadfall across utility lines where they are present.
- More deadfall blocking access roads and parking areas to recreation residences particularly during the winter months when traffic volumes are low and road maintenance is minimal.
- Increased risk of deadfall causing damage to the privately owned structures and risk to life and property.
- In and around some permit areas, permittees may see a change in tree type from ponderosa pine to more aspen and shrub species (spruce will be the climax species).

Common to All Action Alternatives B and C

Developed Recreation: Timber harvest operations may increase noise, dust, and traffic from the logging operation and post sale activities from August 1to May 1. This effect would be considered short- term (less than five years). Vegetative treatments and post sale activities, including herbicide spraying, within and immediately adjacent to all developed recreation sites will discourage and display recreation use temporarily. Developed recreation site features could be damaged and there could be an accumulation of debris in and around campsites. Recreation

site access and interior road surfaces might be rutted.

There would be changes to the landscape during the life of the project. Effects would come from the mountain pine beetle epidemic, as well, as the timber harvest activities, changing the appearance of the landscape.

As the incidence and risk from mountain pine beetle mortality increases in developed recreation settings there could be more alternative prevention techniques employed to save individual and groups of trees within recreation sites. Non-timber harvest methods could include techniques such as individual tree insecticide spraying; single tree removal of infested trees before flight and the use of semiochemical baiting. The effects to the public could be an increase in the amount of very short term recreation site closures to accomplish this type of work.

Trails: Motorized system trail locations could be used temporarily as access routes for treatment activities; non-motorized system trails are to be protected during presale, sale, and post sale activities, following Forest Standard 9301. Proposed activities could directly impact the existing motorized trail system, depending on the exact location and timing of treatment activities. The proposed post-harvest activities include re-contouring for water drainage, seeding and re-installing motorized system trail structures back to a pre-treatment condition. Additional work to restore affected motorized system trails to a more sustainable trail design beyond pre-treatment conditions is dependent on the availability of additional trail maintenance funds. Converting temporary roads back to a motorized trail condition will take time to re-vegetate; repair drainage structures removed or destroyed, and control soil erosion that occurred related to hauling. Although these effects are temporary, this could detract from the recreational value of the trails during this time. Affected motorized system trails would need to be closed for the duration of the timber sale and post sale activities. For safety reasons, hikers and equestrian users would encounter temporary reroutes of protected non-motorized system trail sections in and adjacent to active treatment units, especially while harvest activities are taking place during the summer season. Typically the reroute would only be needed for a short duration, either one or two field seasons of use from the start of a treatment activity. Use of the protected non-motorized trail sections would quickly resume back to pre-treatment original condition without any restoration work needed, as compared to use of a motorized trail section.

Centennial Trail # 89 is part of the National Recreation Trails program. This national recognition is reserved for an elite class of trails. The Centennial Trail begins at Wind Cave National Park and ends at Bear Butte State Park for a total 111 miles. With possible trail and trailhead closures, this would mean that there would be a need for trail users to be provided a temporary reroute to complete the Centennial Trail through-hike.

Recreation Special Uses: Outfitters and Guides - The project area has 45 permitted outfitter and guide special use permits. These permits allow many types of outdoor activities, including services such as guided hunting, fishing, horseback riding, nature hikes, mountain biking, cave tours, scuba diving, and several other outdoor pursuits throughout the project area and taking place in all four seasons. Recreation event permits are issued for temporary use activities such as jamborees, mountain man rendezvous, school and college courses, youth camps, challenge and endurance runs, and motorized and non-motorized trail events, to name just a few.

Direct effects to these permittees are similar to the direct effects to the Trail System. All affected trail sections may be closed to the outfitters season of operation, usually from May to September. It is possible that commercial and public trail use may be curtailed on affected trails based upon trail condition inspections, (i.e. education of service days for outfitter and guides, closed trails for resource protection), because of poor trail conditions caused by vegetative management activities during the winter months.

Reconstruction efforts to bring a motorized route back to system trail condition after vegetative treatments will require some short term trail closures to accomplish this work.

Recreation Residences, Resorts, and Organizational Camps - The activities proposed in the action alternatives would not occur on designated recreation residence lots. Treatment activities would occur adjacent to some recreation residence lots. Vegetative treatment noise and dust, logging traffic and smoke from prescribed burns or burning of slash piles would occur, but only during implementation of the activity. Evidence of mechanical treatments, such as skid trails, slash piles, temporary haul roads and landings would be visible from some lots; however, these impacts would decrease over time as disturbed ground is revegetated.

Increased harvest equipment and vehicles on Forest system roads which provide access to recreation residences, resorts, and organizational camps would displace and inconvenience some permittees and clients.

Alternative A and B - Direct and Indirect Effects
Timber harvest operations and treatment activities may increase noise, dust, and traffic from the logging operation from August 1to May 1, as described in common to all alternatives. Trailheads, picnic grounds, and some system trails would be closed temporarily during harvest operations.

Cumulative Effects
The cumulative impact area for this analysis is the project area. The time boundary for the cumulative effects analysis is estimated from 2000 to 2020. Past, present and future activities within the Pine Beetle Response Project area boundary include timber thinning and other treatment activities, including road construction and reconstruction.

Use of system motorized trail locations as temporary roads for hauling or skidding timber would negatively impact use of those system trails due to the length of time necessary to reconstruct them back to a system trail. Temporary roads and skid trails may encourage the public to use unauthorized areas for various recreational activities.

Any past, present or foreseeable future activity that causes soil disturbance has the potential to cause erosion control problems for the trail system, which could cause short-term cumulative effects. Erosion causes trail maintenance to increase.
Although the project would take several years to complete, there would be no adverse long-term cumulative effects to the recreation resource as a result of implementing any of the alternatives, including no action. Long term cumulative effects are completing the vegetation treatments for preventing additional Mountain Pine Beetle tree mortality, benefiting the recreation resource.

HERITAGE

Introduction
Cultural resources provide information about past human behavior and activities. They are found in a variety of physical forms that include, but are not limited to, material objects, archaeological sites, historic architecture, traditional cultural properties, and cultural landscapes. Cultural resources also include sacred sites which may include non-tangible properties not represented by artifacts or other cultural features or objects. Cultural resources are non-renewable assets that frequently consist of ephemeral materials susceptible to irreparable destruction or deterioration.

Methods: A variety of methods have been employed in this analysis, each of which contribute in unique ways toward the objective of identifying historic properties and sacred sites that may be susceptible to adverse effects as a result of the undertaking. The following subsections outline the different means employed to reach the conclusions drawn for this analysis.

Assumptions: The following assumptions apply in our assessment of effects to cultural resources as a result of the MPBRP:

- Cultural resources are managed according to existing laws, regulations, agency policies, and programmatic agreements.
- The Mountain Pine Beetle epidemic will continue at current levels or increase over time on National Forest System lands managed by the Forest.
- All cultural resources identified within the area of potential effect for all alternatives are considered historic properties for the purposes of this undertaking, unless they have previously been determined not eligible for the National Register of Historic Places in consultation with the SHPO or through other agreed on procedures (36 CFR §60.4; 36 CFR §800).

Historic Properties: The effects analysis in the Cultural Resources section refers repeatedly to the concept of a "historic property". The term, where employed, has a specific meaning under the NHPA:

> *(l)(1) Historic property means any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.* (36 CFR §800.16(l)(1))

According to the definition above, not all cultural resources qualify as historic properties, consequently, not all cultural resources are subject to protection measures or mitigation treatments. A note on Traditional Cultural Properties (TCP) is warranted. A TCP consists of a cultural property that is eligible for inclusion in the National Register of Historic Places because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community. The entity evaluated for eligibility for inclusion in the NRHP must be a tangible

property; that is, a district, site, building, structure, or object as defined in 36 CFR 64.4. (U.S. Department of the Interior 1994). TCPs are managed under the authority of the NHPA.

Because TCPs are managed under the same authority (NHPA) as historic properties and TCPs are, by definition, also eligible to the NRHP, the term "historic properties", where employed throughout this document, is inclusive of TCPs.

Area of Potential Effect: The Area of Potential Effect (APE) must be identified before an assessment of effects can be completed. An APE is defined in the NHPA implementing regulations as:

> *… the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.* (36 CFR §800.16(d))

The Forest has identified roughly 250,000 acres that qualify as potential treatment areas (PTA) where activities designed to reduce Mountain Pine Beetle infestation may occur (i.e., at-risk stands where environmental conditions result in favorable mountain pine beetle habitat). Activities indirectly associated with treatment prescriptions, however, may occur well beyond the boundaries of the polygons that have been identified as timber stands particularly susceptible to Mountain Pine Beetle (MPB) infestation. It may be necessary, for example, to construct or modify access roads in order to access the infested timber stands. Other activities that may occur beyond the polygons identified include, but are not limited to, the development of landings and staging areas.

Due to the relatively unpredictable spread of the Mountain Pine Beetle, it is not possible to specifically identify where either direct or indirect activities may be located. Consequently, for purposes of this undertaking, the APE incorporates the majority of the 1.2 million acres of federal lands that constitute the Black Hills National Forest. Exceptions may include planning areas that are currently under National Environmental Policy Act (NEPA) analysis, areas where forest management activities are already planned as a result of recent NEPA decisions, and/or locations designated as special management areas, e.g, Resource Natural Areas and Botanical Areas.

Records Inventory: It is standard practice to conduct a review of existing records prior to initiating field survey, an exercise often referred to in the vernacular as a "Level I" or "Class I" inventory. Complete literature reviews will be conducted during the implementation phase once specific project areas have been identified—and according to stipulations included in the programmatic agreement developed for this project. All previously recorded sites within the specific project areas will be identified, and site records and project reports will be referenced from the Forest's extensive paper files. Heritage Resources personnel will also access the Archaeological Resources Management System (ARMS) database managed by the Archaeological Research Center, Rapid City, SD, and the Wyoming Cultural Resources Office (WYCRO) database. The data archived in those repositories will then be compared with the Forest's data and any necessary updates or corrections will be completed.

For purposes of this specialist report, the Heritage Program's GIS spatial database was referenced to quantify the number of historic properties currently known to exist within the project area. The

same geodatabase provided information needed to determine which areas of the project area had previously been surveyed for cultural resources and which had not. I-Web, the U.S. Forest Service's official database for tracking cultural resources, was also used to obtain site and survey information.

Field Survey: No new field survey has yet been conducted for this project. Without knowing specific locations where treatment activities will be located, field reconnaissance has not yet been prescribed. Field survey will be completed prior to implementation activities and according to stipulations and conditions in the programmatic agreement being developed for the project. In those cases where programmatic agreement stipulations may not apply, applicable cultural resources laws, rules, and directives will be followed.

Traditional Knowledge: Input from Tribal representatives is an important component of this project. Certain types of cultural resources can be difficult to identify by means of standard archaeological survey. Traditional knowledge can provide unique insight into physical features or geographic areas that are of particular spiritual or sacred significance to Native American cultures.

Tribal input has been solicited throughout the course of this project. Tribes have been notified of NEPA-related actions coincident with all public scoping and consultation efforts. Tribal governments have been asked to review the project proposal and the proposed treatments in order to solicit indigenous knowledge of spiritual-use areas, traditional cultural properties, or sacred sites that may not be readily identifiable. The need for active management of pine beetle infested areas has also been presented to Tribal representatives at formal government-to-government meetings hosted by the Forest (summary provided below). Regarding Section 106 of the NHPA, Tribal authorities have been invited to voice their concerns and share traditional knowledge by participating in the development of a programmatic agreement that will be used to comply with NHPA mandates for this project (see next section).

Programmatic Agreement: The Forest is developing a Programmatic Agreement (PA) with the Wyoming and South Dakota SHPOs in order to fulfill the Forest's Section 106 obligations for this project. A PA is desirable because of the multi-state scope and similar and repetitive nature of the project (pursuant to 36 CFR §800.14(b)(1)(i)). A PA is also warranted because the effects of the project cannot be fully determined prior to signing an Environmental Impact Statement (EIS) Record of Decision (pursuant to 36 CFR §800.14(b)(1)(ii)).

A PA is a legal document that can result in a number of benefits to the signing parties. They may, for example:

- Streamline the consultation process by eliminating the need for case-by-case consultation for routine and/or repetitive activities. This would be particularly beneficial to the MPBRP since similar treatments would be prescribed repeatedly for infected stands as they are identified;
- Provide a negotiated list of exempt undertakings, or undertakings that are likely to have minimal or no effects on historic properties;
- Standardize methodologies, treatments, protection, and monitoring measures;
- Save state and federal agencies and tribal governments money by reducing the amount of time and effort needed for consultation and review efforts.

The Forest extended an invitation to all Tribes that have expressed a historical or traditional interest in the Black Hills to participate in the development of the PA. One Tribe has formally accepted the Forest's invitation. As of March 2012, a draft of the PA is being written, but it has not yet been signed or executed.

Indicators

The "at risk" category used in this analysis consists of historic properties and sacred sites with *identified* or *potential* direct, indirect, or cumulative adverse effects. The NHPA implementing regulations define an adverse effect:

> *An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative.* (36 CFR §800.5(a)(1))

The Forest has identified one primary indicator that is used to determine the potential for adverse effects to historic properties and sacred sites: The number of at-risk historic properties and/or sacred sites within the Area of Potential Effect.

Affected Environment

The purpose of this section is to summarize the existing condition based on the most current data available. In the vernacular of the cultural resources legal framework cited above, the affected environment will, by definition, be located within the Area of Potential Effect. It has been established, based on criteria cited above, that the APE for this project cannot currently be delineated with certainty. The APE may ultimately incorporate any portion of the 1.2 million acres of NFS lands. Of that number, however, 248,000 acres have been identified as higher probability areas due to timber stand conditions that are more favorable for MPB infestation. The potential affected environment for cultural resources can, therefore, be presented in two tiers: 1) higher probability areas where activities directly associated with MPB treatments are more likely to occur and 2) lower probability areas where any activities associated with MPB treatments are expected to be of a more indirect nature, e.g., access roads and staging areas. The manner in which the data are presented in this section reflects this division.

To date, a total of 2,094 historic properties have been identified forestwide on NFS lands managed by the Black Hills National Forest. That number includes only those properties 1) listed in or determined eligible for the NRHP, and 2) those properties whose NRHP significance has not yet been formally evaluated. The total excludes all isolated finds (not eligible for the NRHP by definition) and those cultural resources formally determined not eligible for the NRHP with SHPO concurrence (pursuant to 36 CFR §63).

Of the 2,094 historic properties identified to date, 538 are located within the 242,000 acres specifically identified in Alternative B as timber stands particularly susceptible to MPB

infestation. Nine additional historic properties have been identified in the Alternative C APE, increasing the total number of previously identified historic properties located in those 248,000 acres to 547.

Table 3-38 Historic Properties Identified To-Date within Project Area.

Previously Identified Historic Properties in Area of Potential Effect*														
Alternative B (242,000 acres of high probability)					***Alternative C*** (248,000 acres of high probability)					***Forestwide*** (roughly 1.2 million acres)				
Pre-contact	Post-contact	Multi-component	Undetermined	**Total**	Pre-contact	Post-contact	Multi-component	Undetermined	**Total**	Pre-contact	Post-contact	Multi-component	Undetermined	**Total**
258	221	37	22	**538**	258	229	38	22	**547**	963	880	145	106	**2,094**

* Categorized according to the general time period ascribed to each site.

The APE includes several sacred sites and traditional cultural properties that have been identified by various American Indian tribes.

Ultimately, the quantity of historic properties that exist within the APE will be greater than the 2,094 cited in Table 3. While a relatively large percentage of the Black Hills National Forest has been surveyed for cultural resources, a number of areas remain un-inventoried. Approximately 70 percent of the 248,000 acres identified as high-probability stands for MPB infestation have been surveyed for cultural resources. The percentage of the entire forest that has been surveyed is roughly the same, between 70 and 75 percent. In some cases, the methods and reporting criteria utilized by personnel that conducted the older field surveys may not be adequate based on contemporary standards. Consequently, it may be necessary to resurvey certain areas in order to obtain current and more accurate data.

The type of historic properties that are found in the affected environment include a large variety of both post Euro-American contact and pre-contact cultural resources. A partial list of sites types dating to the period prior to Euro-American contact includes rock art (in the form of pictographs and petroglyphs), lithic quarries, artifact scatters, stone circles, and other Native American architectural features such as rock cairns and rock alignments. Equally important are sacred sites identified by Native American communities. The post-contact period materials are dominated by mining-related features such as prospector pits, mine shafts, drifts, and structures. Logging features such as long, linear flumes built to transport water and industrial materials are not uncommon. Other cultural resources identified on Forest lands attest to the presence of homestead-era settlements and cattle ranching.

The disclosure of sensitive data related to the specific location and/or character of a historic property is regulated pursuant to stipulations in 36 CFR §800.11(c) and Section 304 of the NHPA, in addition to 43 CFR §7.18 and Section 9 of the Archaeological Resources Protection Act. Accordingly, information disclosing cultural resource site types and locations are not available for general distribution.

Environmental Consequences

Section 106 of the NHPA requires federal land-managing agencies to take into account the effects of their undertakings on historic properties (defined above). In this section, we identify

those activities associated with the project proposal that may have the potential to adversely affect historic properties and sacred sites. Due to the current undelineated geographic scope of the APE, however, it is not possible to quantify or predict with confidence which specific historic properties may be affected. Location-specific site identification and effects analyses will be completed during the implementation phase. Consultation with the corresponding SHPOs will be conducted as per stipulations in the PA being developed for the project. Tribal consultation will be completed for any areas that may be targeted for MPB treatment prescriptions, although it may be more practical and expeditious to consult on multiple timber stands in a single consultation package.

A variety of vegetative treatment options have been proposed in the action alternatives, each of which would maximize efficiency under different environmental or topographic conditions. Each treatment is designed to play a specific role in the effort to reduce the spread of MPB across NFS lands. A breakdown of the techniques proposed in each alternative is provided in Table 2-2 in Chapter 2.

The techniques proposed in both action alternatives (but often with disparate stipulations) include the following:

- cut and chunk, chipping, and cut-pile-burn, and cut-pile-burn with equipment would be scattered across the landscape and generally adjacent to or along private property and roads.
- Insecticide spraying (i.e. carbaryl) would generally occur in developed campgrounds, FS facilities, and on scattered legacy trees and would use chemicals appropriate for a forested environment.
- Semiochemical use would be limited along the 'leading edge' of the BHNF MPB Strategy. Semiochemical techniques to attract MPB may occur generally southwest of Custer, SD adjacent to Custer State Park and generally west of Spearfish, SD towards the SD-WY State line; north of Sundance in cooperation and coordination with Forest Health entomologists and the States of SD and WY.
- Helicopter and cable logging would occur in areas of high value and generally on slopes greater than 40 percent. Cable units would utilize existing roads.
- Generally, commercial and non-commercial treatments to remove infested trees with associated thinning to remove recently infested and non-infested trees would occur across the landscape on slopes less than 40 percent on up to 1,000 contiguous acres.

Both action alternatives would also permit different combinations of road maintenance, road construction, or road upgrades necessary to implement certain treatment options. These associated activities also have a potential to result in adverse effects to historic properties:

- Conversion of existing, unauthorized roads/routes to system roads.
- Construction of new system and/or temporary roads. Unlike Alternative B, a limited amount of new road construction would be permitted under Alternative C. While this is not technically a treatment, it is a ground-disturbing activity with the potential to result in adverse effects to historic properties and sacred sites.

The effects analysis that follows lacks specific quantitative data regarding the number of historic properties and sacred sites present in the APE and, more importantly, the number of properties considered at-risk. This omission is unavoidable due the fact that no specific activity areas can be identified for MPB treatment. Under other circumstances it would be possible to provide

good-faith estimates of the number of historic properties currently identified—and potentially at-risk—under each alternative. *By necessity, the analysis that follows provides a relative, as opposed to, quantitative assessment of the action alternatives.*

Alternative A – Direct/Indirect Effects
The Forest would undertake no treatment activities under the No Action alternative, however, the No Action alternative would not meet the stated purpose and need. Alternative A has the potential to have both favorable and unfavorable effects on historic properties and sacred sites.

The potential for direct effects on historic properties and sacred sites due to ground-disturbing implementation activities would be eliminated in the No Action alternative.

The potential for indirect effects to historic properties and sacred sites is significant should the No Action alternative be selected. Taking no action to reduce the MPB infestation would result in a substantial increase in tree mortality and subsequent fuel loads on the forest floor, thereby escalating the threat of large-scale wild fire. The intense heat produced by wildl fires sustained by heavy fuels loads can result in adverse effects to historic properties, including the potential for complete obliteration (Sturdevant 2009). The latter is particularly true of rock art (Tratebas et al. 2004) and historic structures. The ignition of ground fuels can also create post-fire soil and sediment conditions unfavorable to the preservation of historic properties. When surface vegetation is incinerated, a common byproduct is increased soil erosion. Hydrologic regimes change, resulting in the exposure and transportation of previously undisturbed soils which can entrain and relocate subsurface cultural artifacts. In addition to the artifact assemblages suffering possible physical deformation or destruction, the stratigraphic context - of critical importance for accurate archaeological interpretations - is disturbed or destroyed.

Alternatives B and C
Alternatives B and C each outline actions that the Forest would take to combat the MPB epidemic. The alternatives are analyzed concurrently, but distinctions are emphasized. All of the treatments prescribed for the action alternatives are enumerated in Table 2-xx in Chapter 2.

Alternative B is designed to reduce the threat from recently detected MPB infestations. The alternative is reactive in the sense that infested trees would be treated once infected stands are identified - but before the beetles disperse to other trees. Some surrounding (non-infested) trees at risk of infestation may also be thinned under Alternative B. The extra acreage would be justified to reduce stand densities and the associated threat to ecosystem components, including forest resources. The additional thinning would also reduce the potential for large-scale wild fire.

Alternative C constitutes a more proactive response to the Forest's published Purpose and Need (USDA Forest Service 2011). The alternative specifically responds to public comments which advocate a more aggressive approach in which the Forest treats high-risk stands on a landscape basis. Alternative C would permit treatment of timber stands *in advance* of visible MPB infestations. More liberal prescriptions regarding construction of new road would also address concerns about safety and roadways access.

The quantity of acres considered particularly susceptible to MPB infestation differs somewhat between the action alternatives. A total 242,000 acres has been identified in Alternative B as opposed to 248,000 acres in Alternative C.

One notable difference between the two action alternatives is the number of acres of timber harvest that would be permitted. The cap for Alternative B would be up to 48,400 acres over a five-year period in contrast to Alternative C which expands the limit to 124,000 acres over the same period. The corresponding volume of sawtimber and products other than logs (POL) that could be harvested is significantly less in Alternative B (14,520 CCF) than Alternative C (37,200 CCF).

Another difference between the two action alternatives involves cable logging; the maximum acreage available for cable logging in Alternative B - although no limit is prescribed - would be less than Alternative C due to the prohibition on the construction of any new access roads (a crucial component of cable logging). The acreage that would be available for cable logging in Alternative C (again, no limit is prescribed) would be greater than Alternative B because the construction of new access roads would be permitted.

Although new road construction would be prohibited under Alternative B, as many as 5 percent of non-system temporary roads may be converted to system roads to provide additional access to infected timber stands. A certain degree of ground disturbance may be anticipated in order to bring temporary (non-system) roads up to USFS standards. Alternative C increases the maximum to 15 percent for the same purpose. New road construction would be permitted under Alternative C, up to a maximum of 250 miles. Substantial ground disturbance would be anticipated for new road construction.

Direct Effects

Based solely on the quantity of acres identified as high-probably areas for beetle infestation, the potential for direct effects between the two action alternatives would be minimal. Alternative B does not include Spearfish Canyon, but the probability of identifying cultural resources on the steep slopes of the canyon would be low. To date, only nine additional historic properties have been identified in Alternative C compared with Alternative B (Table 3).

The treatment options proposed for the two action alternatives, as opposed to the total quantity of acres, constitute the greatest differences in potential adverse effects. The greatest difference between the two action alternatives is the maximum number of acres (and by extension, volume CCF) where commercial and non-commercial timber harvest would be permitted. Compared with the No Action Alternative, Alternative B has significantly greater potential to directly affect historic properties and sacred sites. When action alternatives are compared, Alternative B has significantly fewer opportunities for direct effects. Alternative B would limit the acres available for sawtimber and POL harvest to 20 percent (48,400) of the total 242,000 acres. Alternative C would make nearly 3x (124,000) the number of acres available for treatment. The potential for direct effects to historic properties is greater in Alternative C because the treatment options are more aggressive.

Of the two action alternatives, Alternative B would also provide fewer opportunities for direct effects due to 1) the lower number of acres where cable logging would be permitted, 2) the prohibition on new road construction, and 3) the lower limit on the number of existing roads that could be converted

to system roads. Each of these activities necessitates some degree of ground disturbance with a corresponding potential to disturb historic properties and Native American sacred sites.

Should Alternative B be selected, the areas targeted for MPB treatment would be subject to review by Heritage Resources staff to determine the potential for adverse effects. In all likelihood, past experience suggests it would be possible to develop and implement protection measures for the majority of the historic properties located in the APE, thereby eliminating the potential for adverse effects. Nevertheless, the risk of direct effects to historic properties due to treatment prescriptions would be fewer in Alternative B than action Alternative C. Stipulations in the anticipated PA will outline options and procedures for protecting historic properties and sacred sites. Where such preventative measures cannot be identified and an imminent threat to those properties is anticipated, the terms of the PA would no longer apply and the Forest would follow mandates outlined in 36 CFR §800.6 which are designed to resolve adverse affects.

Indirect Effects

In contrast to direct effects, the indirect effects of selecting Alternative B over Alternative C have the potential to result in greater potential risk to historic properties. Although the actual ground disturbance due to treatment prescriptions would be fewer in Alternative B, the number of acres left untreated for MPB infestation would be significantly greater than it would under Alternative C. Assuming beetle infestations continue at current or elevated rates, the number of mortality trees that may be anticipated under Alternative B would be significantly greater, eventually resulting in a corresponding increase in fuel loads and, by extension, greater potential for damage to historic properties as a result of catastrophic wild fire.

Cumulative Effects

Past, present, and reasonably foreseeable future activities within the analysis area include vegetation management projects, recreation, road construction and maintenance, range improvement projects, mining activities, and a host of other projects, each of which are anticipated on NFS lands. These activities have occurred in the past, are ongoing, and in all likelihood will continue to occur in the foreseeable future.

The geographic scope of the cumulative effects analysis is limited to the Forest's administrative boundary because impacts to cultural resources accumulate at their specific locations, irrespective of actions in surrounding areas.

Cumulative effects are not anticipated under the action alternatives because the NHPA and 36 CFR §800 regulations outline procedures for protecting historic properties from impacts caused by federal actions (undertakings). Adverse effects can frequently be avoided or minimized through the implementation of appropriate site-specific protection measures through consultation with the ACHP, the appropriate SHPOs, Tribal governments, and the public as appropriate.

A total of 2,094 historic properties have been identified on the Forest as of early 2012. Additional cultural resources not yet identified unquestionably exist. It has been estimated that 11,000 cultural sites (archaeological and historic) may exist on the Forest (USDA Forest Service 2005:III-409), producing a theoretical site density of one site for every 110 acres. If present trends are maintained, roughly 15–25% of the sites identified on the Forest may be eligible for the NRHP. Based on these

data, an estimated 2,750 historic properties may ultimately exist on public lands within the Forest boundaries. Any further attempts to quantify cumulative effects would be highly speculative.

Consultation

Advisory Council on Historic Preservation: The Forest informed the ACHP of its intent to develop a Programmatic Agreement (PA) with the Wyoming and South Dakota State Historic Preservation Officers (SHPOs) in order to fulfill the Forest's Section 106 obligations for the Mountain Pine Beetle (MPB) epidemic. The letter was dated November 18, 2011. The ACHP responded to the Forest's invitation on December 8. The ACHP concluded that Appendix A, *Criteria for Council Involvement in Reviewing Individual Section 106 Cases*, of the regulations, "Protection of Historic Properties" (36 CFR Part 800), does not apply to this undertaking. Consequently, the ACHP would not be participating in the development of the PA at the present time.

State Historic Preservation Officers: The Forest has consulted on this project with the SD and WY SHPOs multiple times as a result of the mutual agreement to develop a PA for this undertaking. At the time of this writing, the PA had not been completed, but consultation with both SHPOs will continue until the agreement is executed. Consultation with the SD and WY SHPOs will continue during the implementation phase based on the stipulations outlined in the PA.

Tribal Consultation: The Forest regularly consults with Tribal governments regarding projects authorized under the NHPA and the NEPA. Sixteen different Tribes from five states have expressed traditional cultural, spiritual, or geographical interests in the Black Hills.

Tribal consultation has been conducted for this project on a number of occasions and via multiple means. The Forest typically organizes two meetings annually with Tribal representatives to discuss project proposals that may be of interest to Tribal authorities. The MPBRP was on the agenda for two separate meetings, each of which were hosted by the Wakpa Sica Reconciliation Center in Ft. Pierre, SD. The first meeting was held on June 22, 2011, prior to the Notice of Intent being published in the Federal Register (August 8, 2011). A second meeting was held on September 15, 2011, after the Notice of Intent was distributed.

Tribal governments were subsequently consulted again when it was determined that a programmatic agreement would be necessary for the MPBRP. Letters of invitation to participate in the development of the PA were sent on November 14, 2011. One response was received by the Forest. A representative of the Yankton Sioux Tribe responded with email dated December 14, 2011, stating that they would like to participate. No other comments were received. Although the PA has not yet been completed at the time of this writing, consultation on the contents will continue with all interested Tribes.

The PA developed for this undertaking will primarily affect consultation between the Forest and the South Dakota and Wyoming SHPOs. Tribal authorities will continue to be consulted when specific project locations associated with MPB treatments have been identified. This will permit Tribal representatives to submit location-specific comments where desirable.

Standard 7103 of the Forest's LRMP recognize American Indian traditions of gathering herbs, medicinal and edible plants, and other materials for religious purposes and it makes provisions for those who wish to gather such plants and materials. Section 8105 of the 2008 Farm Bill authorizes the Secretary of Agriculture to provide free of charge to federally recognized Indian tribes any trees, portions of trees, or forest products from NFS lands for non-commercial traditional and cultural purposes. Section 8104 of the same Bill grants the Secretary of Agriculture the authority to temporarily close specifically identified NFS land from public access to protect the privacy of tribal activities for traditional and cultural purposes. Continued Tribal consultation during the implementation phase of the MPBRP will ensure that these practices continue with the least amount of interruptions.

Tribal consultation for the MPBRP will continue throughout the planning phase while the EIS is being developed. Tribal officials will also be completed during the implementation phase when more specific data is available as to project locations and potential effects to historic properties and sacred sites.

Public Consultation: The public was informed of the Forest's intent to develop a PA via legal notices published in the Custer Chronicle newspaper (November 16, 2011) and the Rapid City Journal (November 18, 2011) newspapers. The purpose of the PA was briefly outlined and members of the public were invited to solicit comments and/or express their interest in participating in the development of the PA. The Forest also posted a similar notice on the Forest's external website under the MPBRP project folder. No responses were received from the general public.

SOCIAL

Affected Environment

The MPBR Project includes seven counties within the analysis area: Custer, Fall River, Lawrence, Meade, and Pennington Counties in South Dakota; and Crook and Weston Counties in Wyoming. Rapid City is the regional trade center and second largest city in South Dakota. The project area encompasses 56 'at risk' communities, approximately 300,000 acres of private lands, subdivisions, and businesses. Forest resources play an important role for the people living in and adjacent to the project area. The Forest provides great scenery and abundant dispersed recreation in a setting that is close to town, or for some, right out their back door. Social and Economic elements are summarized in the Economic Affected Environment section in the Phase II FEIS (USDA Forest Service 2005a), which includes a description of employment, income, recreation, and tourism.

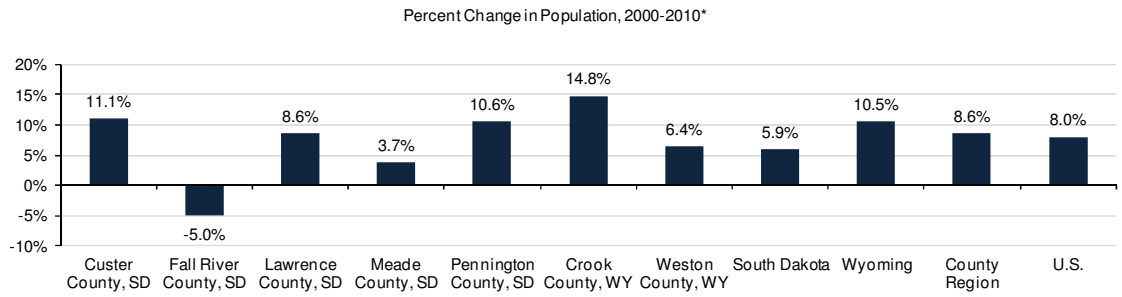
Population Demographics

Population is an important variable to consider because the ability to attract and retain individuals to live and work within an area is critical to the survival of a community and its economy. Population statistics only account for permanent residents. However, seasonal workers, who are often missed in the April census count, and second home owners who are not counted, are temporary residents that are also important to the local economy and community.

The examination of population trends is important to the understanding of the overall nature of an area. The use and occupation of the Black Hills is increasing due to population growth and a fairly diverse and flexible economy. In general, the resident population for the seven counties

has been increasing from approximately 162,000 in 2000 to 176,000 in 2010, 8.6 % increase. All counties except Fall River County, SD, show population growth between 3 and 15 percent over the 10 year period. Fall River County, SD saw a 5% decline in population (Figure 3-17).

Figure 3-19 Percent Change in Population 2000-2010



Ethnicity

Population changes relate not only to the number of residents in the region but also to their ethnicity. The seven counties within the analysis area demonstrate low ethnic diversity with the exception of Pennington County, SD. Rapid City, located in Pennington County, has a greater level of diversity often associated with larger cities. Table 3-39 below represents the average population by county and study area by race for 2010.

Table 3-39 Population by Race

Population by Race, 2010*

	Custer County, SD	Fall River County, SD	Lawrence County, SD	Meade County, SD	Pennington County, SD	Crook County, WY	Weston County, WY	South Dakota	Wyoming	County Region	U.S.
Total Population	8,085	7,078	23,670	25,156	97,922	6,761	7,066	799,462	545,579	175,738	303,965,272
White alone	7,668	6,442	22,396	23,116	82,275	6,735	6,696	692,330	498,326	155,328	224,895,700
Black or African American alone	0	51	0	156	1,041	0	4	8,874	4,135	1,252	37,978,752
American Indian alone	284	228	631	573	8,367	11	46	68,215	12,786	10,140	2,480,465
Asian alone	0	67	225	188	1,137	6	60	7,126	4,138	1,683	14,185,493
Native Hawaiian & Other Pacific Is. alone	0	1	0	0	0	3	3	241	242	7	491,673
Some other race alone	0	70	72	341	845	0	129	7,125	11,752	1,457	16,603,808
Two or more races	133	219	346	782	4,257	6	128	15,551	14,200	5,871	7,329,381
Percent of Total											
White alone	94.8%	91.0%	94.6%	91.9%	84.0%	99.6%	94.8%	86.6%	91.3%	88.4%	74.0%
Black or African American alone	0.0%	0.7%	0.0%	0.6%	1.1%	0.0%	0.1%	1.1%	0.8%	0.7%	12.5%
American Indian alone	3.5%	3.2%	2.7%	2.3%	8.5%	0.2%	0.7%	8.5%	2.3%	5.8%	0.8%
Asian alone	0.0%	0.9%	1.0%	0.7%	1.2%	0.1%	0.8%	0.9%	0.8%	1.0%	4.7%
Native Hawaiian & Other Pacific Is. alone	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Some other race alone	0.0%	1.0%	0.3%	1.4%	0.9%	0.0%	1.8%	0.9%	2.2%	0.8%	5.5%
Two or more races	1.6%	3.1%	1.5%	3.1%	4.3%	0.1%	1.8%	1.9%	2.6%	3.3%	2.4%

In accordance with environmental justice direction, this information was used to determine if the study area includes minority populations that may require additional outreach. Minority populations are identified where either: (a) the minority population of the study area exceeds 50 percent or, (b) the minority population percentage of the study area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. With the low level of ethnic diversity within the study area, no minority populations have been identified in accordance to environmental justice thresholds.

Wildland-Urban Interface

Most of the MPBR Project Area within the seven counties is categorized as wildland urban interface (CWPP's). Through the collaborative efforts of the CWPP's, 56 at-risk-communities are identified, totaling approximately 27,000 structures (see Fire/Fuels Section).

Individuals that chose to live within the WUI or secluded areas are lured by solitude and the opportunity of being close to nature. Problems brought about by the influx of people are not just wildfire-related. Development of subdivisions and private lands within the project area are complete with forest insect/disease outbreaks, vegetation management, and urban forestry concerns (i.e. electricity, roads, etc.). Many new residents moving to the area carry expectations of urban services with them. Residents with tenure have a strong tradition of multiple-use of resources and expect a balance of goods and services from these resources. Wherever there are people living in or adjacent to wildland areas there is a concern about the threat of wildfire.

Communities by nature of their location, play a key role in mitigating wildfire hazard. The resources, authorities and people share in the responsibility with adjacent landowners and managers, for developing healthy and disaster resilient communities. Without significant action by communities to mitigate hazards (i.e. homes, yards and private forested lands that are highly ignitable), there would continue to be high probability for large-scale wildfire in the wildland urban interface in spite of actions on Federal lands.

These same communities are also concerned with the mountain pine beetle epidemic that is currently expanding within and adjacent to the project area. As trees are killed, they fall to the ground adding dead, dry fuels within an area already rated as having high wildfire hazard. These dead falling trees also have the potential to damage fences, structures, power lines, and block access.

Subdivisions and home construction building permits on private lands within and adjacent to the project area have increased steadily and demands for public access roads and utility lines across the project area will continue to exert additional pressure on the Forest and the need for WUI treatments. Housing characteristics for the seven counties indicate approximately 88 percent of the housing units are occupied. An estimated five percent of housing units are for seasonal, recreational, or occasional use, often a proxy or indicator of second home ownership. From 2006-2010, Fall River County, SD had the highest estimated percent of vacant housing (23%), and Pennington County, SD had the lowest (9%) (ACS, Census 2011). The housing market, compared to the National level, has remained strong for most of the seven counties.

Human Health and Safety

Public safety is more often affected by the choices people make on their own while visiting the project area, or by the consequences of natural events, like wildfires, flooding, wind and hail storms. Despite being in close proximity to many communities, the project area is rural forested and in places semi-remote. Hazards exist in the form of natural and human-caused conditions. Wild animals and insects, like ticks which may carry lyme disease, are present. Weather-related events can be life threatening, and probability of a wildfire is a risk every month the year. Most human activities in the Forest, including hunting, hiking, mountain biking, boating, and driving a vehicle, carry some inherent risk.

Vegetative treatments that reduce the existing MBP epidemic and potential of a large scale wildfire from occurring also help to protect human health and safety. Fuel treatment areas are marked and signed to make travelers aware of individuals and actions associated with the activity. Smoke from hand pile and/or equipment pile burning and wildfire could be a nuisance and may pose a threat to human health and safety.

There is an extensive road system throughout most of the project area for fire suppression. A main concern is the ability of the Forest Service and local volunteer fire departments to gain road access, that important arterial and access roads are not closed, in order to suppress most fires while they are still small in size (see Fire/Fuels Report discussion on access).

Income

The sources of a region's personal income provide some insight into the economy of the area. For additional identification of potential environmental justice concerns, low-income populations in the project area are considered. Table 3-40 and 3-41 highlight income information related to poverty and use of programs for low-income individuals and families.

Table 3-40 Demographics Indicators for Low-Income Populations for the Project Area

Percent Below Poverty Level by Age & Family Type~, 2010*

	Custer County, SD	Fall River County, SD	Lawrence County, SD	Meade County, SD	Pennington County, SD	Crook County, WY	Weston County, WY	South Dakota	Wyoming	County Region	U.S.
People	9.7%	17.4%	15.3%	10.1%	14.0%	7.8%	7.9%	13.7%	9.8%	13.1%	13.8%
Under 18 years	**10.9%**	**11.3%**	15.8%	12.1%	20.7%	**10.8%**	**10.1%**	17.3%	12.4%	17.4%	19.2%
65 years and older	11.7%	21.3%	8.1%	10.1%	7.6%	8.0%	**10.1%**	11.3%	6.3%	9.0%	9.5%
Families	4.3%	11.4%	8.4%	6.6%	9.4%	6.5%	5.8%	8.7%	6.2%	8.4%	10.1%
Families with related children < 18 years	**7.8%**	**19.3%**	15.5%	8.3%	16.9%	**10.8%**	**13.2%**	13.9%	10.6%	14.9%	15.7%
Married couple families	**3.3%**	**3.3%**	2.2%	5.2%	3.0%	**3.6%**	**1.0%**	3.8%	2.9%	3.2%	4.9%
with children < 18 years	**4.8%**	**1.8%**	**3.9%**	6.2%	5.1%	**3.9%**	**1.3%**	5.1%	4.4%	4.8%	7.0%
Female householder, no husband present	**11.2%**	**45.0%**	41.8%	17.8%	29.6%	**28.6%**	**30.5%**	31.6%	26.1%	30.0%	28.9%
with children < 18 years	**12.5%**	**53.5%**	46.1%	**18.6%**	36.2%	**33.7%**	**45.9%**	37.8%	32.5%	35.7%	37.4%

~Percent below poverty level by age and family type is calculated by dividing the number of people by demographic in poverty by the total population of that demographic.

Table 3-41 Household Earnings

Number of Households Receiving Earnings, by Source, 2010*

	Custer County, SD	Fall River County, SD	Lawrence County, SD	Meade County, SD	Pennington County, SD	Crook County, WY	Weston County, WY	South Dakota	Wyoming	County Region	U.S.
Total households:	3,654	3,014	10,651	9,714	39,939	2,769	3,097	315,468	217,688	72,838	114,235,996
Labor earnings	2,703	2,122	8,263	8,030	32,905	2,177	2,452	257,172	181,426	58,652	91,045,812
Social Security (SS)	1,241	1,071	3,223	2,611	10,671	827	955	88,860	56,410	20,599	31,387,932
Retirement income	746	544	2,012	1,518	7,275	547	524	42,832	35,555	13,166	19,998,762
Supplemental Security Income (SSI)	**65**	**51**	135	330	1,226	43	81	8,561	5,459	1,931	4,626,547
Cash public assistance income	**24**	**69**	207	172	1,091	**66**	**32**	7,883	3,618	1,661	2,816,127
Food Stamp/SNAP	123	278	657	632	4,686	100	88	26,885	10,764	6,564	10,583,720
Percent of Total^											
Labor earnings	74.0%	70.4%	77.6%	82.7%	82.4%	78.6%	79.2%	81.5%	83.3%	80.5%	79.7%
Social Security (SS)	34.0%	35.5%	30.3%	26.9%	26.7%	29.9%	30.8%	28.2%	25.9%	28.3%	27.5%
Retirement income	20.4%	18.0%	18.9%	15.6%	18.2%	19.8%	16.9%	13.6%	16.3%	18.1%	17.5%
Supplemental Security Income (SSI)	**1.8%**	**1.7%**	1.3%	3.4%	3.1%	1.6%	2.6%	2.7%	2.5%	2.7%	4.0%
Cash public assistance income	**0.7%**	**2.3%**	1.9%	1.8%	2.7%	**2.4%**	**1.0%**	2.5%	1.7%	2.3%	2.5%
Food Stamp/SNAP	3.4%	9.2%	6.2%	6.5%	11.7%	3.6%	2.8%	8.5%	4.9%	9.0%	9.3%

^ Total may add to more than 100% due to households receiving more than 1 source of income.
* The data in this table are calculated by ACS using annual surveys conducted during 2006-2010 and are representative of average characteristics during this period.

For this analysis, the project area population has been compared to both the States of Wyoming, South Dakota and to National averages. Review of poverty statistics and income sources within the project area counties is similar to the States and national statistics. It is unlikely the project area includes low-income populations.

Economic Elements

The majority of employment and income in South Dakota and Wyoming is nonagricultural. Employment for the seven counties is relatively diverse and therefore less vulnerable to economic disruptions. The area is less reliant on manufacturing and professional/technical services and somewhat more reliant on accommodation and food services (tourism). Table 3-43 is representative of employment by industry for the period 2006-2010.

Table 3-42 Employment by Industry

Employment by Industry, 2010*

	Custer County, SD	Fall River County, SD	Lawrence County, SD	Meade County, SD	Pennington County, SD	Crook County, WY	Weston County, WY	South Dakota	Wyoming	County Region	U.S.
Civilian employed population > 16 years	3,792	3,010	12,182	12,058	49,340	3,215	3,707	410,156	284,148	87,304	141,833,331
Agriculture, forestry, fishing & hunting, mining	*572*	*341*	*585*	*870*	1,194	839	921	29,841	34,195	5,322	2,634,188
Construction	*315*	*111*	*1,160*	*971*	4,035	*384*	*345*	26,665	24,932	7,321	10,115,885
Manufacturing	*152*	***59***	*669*	*922*	3,252	*156*	*290*	41,192	14,729	5,500	15,581,149
Wholesale trade	***22***	***22***	*114*	*312*	*1,267*	***45***	*124*	11,625	6,254	1,906	4,344,743
Retail trade	*174*	*237*	*1,269*	1,625	6,352	*255*	*421*	47,928	32,270	10,333	16,293,522
Transportation, warehousing, and utilities	*260*	*164*	*324*	*663*	2,022	*275*	*142*	17,169	18,264	3,850	7,183,907
Information	***54***	***77***	*295*	*144*	*1,383*	***41***	***29***	7,954	4,468	2,023	3,368,676
Finance and insurance, and real estate	*232*	***74***	*723*	*702*	3,369	***21***	*86*	32,576	12,078	5,207	9,931,900
Prof., scientific, mgmt., admin., & waste mgmt.	*186*	*122*	*724*	*805*	4,143	*176*	*163*	24,101	18,422	6,319	14,772,322
Education, health care, & social assistance	933	857	2,966	2,510	11,442	*589*	687	96,312	61,322	19,984	31,277,542
Arts, entertain., rec., accomodation, & food	*406*	*418*	2,319	*1,106*	5,888	*258*	*115*	36,121	27,291	10,510	12,566,228
Other services, except public administration	*159*	*191*	*537*	*651*	2,456	*52*	*118*	18,233	12,200	4,164	6,899,223
Public administration	*327*	*337*	*497*	*777*	2,537	*124*	*266*	20,439	17,723	4,865	6,864,046
Percent of Total											
Agriculture, forestry, fishing & hunting, mining	*15.1%*	*11.3%*	*4.8%*	*7.2%*	2.4%	26.1%	24.8%	7.3%	12.0%	6.1%	1.9%
Construction	*8.3%*	*3.7%*	*9.5%*	*8.1%*	8.2%	*11.9%*	*9.3%*	6.5%	8.8%	8.4%	7.1%
Manufacturing	*4.0%*	***2.0%***	*5.5%*	*7.6%*	6.6%	*4.9%*	*7.8%*	10.0%	5.2%	6.3%	11.0%
Wholesale trade	***0.6%***	***0.7%***	*0.9%*	*2.6%*	2.6%	***1.4%***	*3.3%*	2.8%	2.2%	2.2%	3.1%
Retail trade	*4.6%*	*7.9%*	*10.4%*	13.5%	12.9%	*7.9%*	*11.4%*	11.7%	11.4%	11.8%	11.5%
Transportation, warehousing, and utilities	*6.9%*	*5.4%*	*2.7%*	*5.5%*	4.1%	*8.6%*	*3.8%*	4.2%	6.4%	4.4%	5.1%
Information	***1.4%***	***2.6%***	*2.4%*	*1.2%*	*2.8%*	***1.3%***	***0.8%***	1.9%	1.6%	2.3%	2.4%
Finance and insurance, and real estate	*6.1%*	***2.5%***	*5.9%*	*5.8%*	6.8%	***0.7%***	*2.3%*	7.9%	4.3%	6.0%	7.0%
Prof., scientific, mgmt., admin., & waste mgmt.	*4.9%*	*4.1%*	*5.9%*	*6.7%*	8.4%	*5.5%*	*4.4%*	5.9%	6.5%	7.2%	10.4%
Education, health care, & social assistance	*24.6%*	28.5%	24.3%	20.8%	23.2%	18.3%	18.5%	23.5%	21.6%	22.9%	22.1%
Arts, entertain., rec., accomodation, & food	*10.7%*	*13.9%*	19.0%	*9.2%*	11.9%	*8.0%*	*3.1%*	8.8%	9.6%	12.0%	8.9%
Other services, except public administration	*4.2%*	***6.3%***	*4.4%*	*5.4%*	5.0%	*1.6%*	*3.2%*	4.4%	4.3%	4.8%	4.9%
Public administration	*8.6%*	*11.2%*	*4.1%*	*6.4%*	5.1%	*3.9%*	*7.2%*	5.0%	6.2%	5.6%	4.8%

Table 3-44 highlights the timber economy related jobs with the project area counties in comparisons to the States and US averages. In 2009, Crook County, WY had the largest percent of total timber employment (10.4%), and Fall River County, SD had the smallest (0%).

Table 3-43 Employment by Wood Product Industries

Employment in Timber, 2009

	Custer County, SD	Fall River County, SD	Lawrence County, SD	Meade County, SD	Pennington County, SD	Crook County, WY	Weston County, WY	South Dakota	Wyoming	County Region	U.S.
Total Private Employment	1,341	2,096	9,888	5,115	44,419	1,513	1,564	330,517	214,715	65,936	114,509,626
Timber	*15*	0	*101*	*26*	*423*	*158*	*16*	*2,050*	*529*	*739*	849,891
Growing & Harvesting	*9*	0	*26*	*2*	*18*	*28*	*9*	*61*	*75*	*92*	63,679
Forestry & Logging	*9*	0	*25*	*2*	*15*	*28*	*9*	*54*	68	*88*	53,003
Support Activities for Forestry	0	0	*1*	0	*3*	0	0	*7*	*7*	*4*	10,676
Sawmills & Paper Mills	*4*	0	*29*	*9*	*385*	*99*	0	*664*	*365*	*526*	272,319
Sawmills & Wood Preservation	*4*	0	*29*	*7*	*190*	*99*	0	*238*	224	*329*	84,238
Pulp, Paper, & Paperboard Mills	0	0	0	0	0	0	0	0	0	0	116,264
Veneer, Plywood, & Engineered Wood	0	0	0	*2*	*195*	0	0	426	*141*	*197*	71,817
Wood Products Manufacturing	*2*	0	*46*	*15*	*20*	*31*	*7*	*1,325*	*89*	*121*	513,893
Other Wood Product Mfg.	*2*	0	*46*	*15*	*20*	*31*	*7*	545	84	*121*	229,786
Converted Paper Product Mfg.	0	0	0	0	0	0	0	749	*2*	0	264,987
Gum & Wood Chemical Mfg.	0	0	0	0	0	0	0	0	0	0	2,620
Wood Cabinet Mfg.	0	0	0	0	0	0	0	0	*3*	0	1,798
Wood Office Furniture Mfg.	0	0	0	0	0	0	0	*31*	0	0	14,702
Non-Timber	*1,326*	2,096	*9,787*	*5,089*	*43,996*	*1,355*	*1,548*	*328,467*	*214,186*	*65,197*	113,659,735
Percent of Total											
Timber	*1.1%*	0.0%	*1.0%*	*0.5%*	*1.0%*	*10.4%*	*1.0%*	*0.6%*	*0.2%*	*1.1%*	0.7%
Growing & Harvesting	*0.7%*	0.0%	*0.3%*	*0.0%*	*0.0%*	*1.9%*	*0.6%*	*0.0%*	*0.0%*	*0.1%*	0.1%
Forestry & Logging	*0.7%*	0.0%	*0.3%*	*0.0%*	*0.0%*	*1.9%*	*0.6%*	*0.0%*	0.0%	*0.1%*	0.0%
Support Activities for Forestry	0.0%	0.0%	*0.0%*	0.0%	*0.0%*	0.0%	0.0%	*0.0%*	*0.0%*	*0.0%*	0.0%
Sawmills & Paper Mills	*0.3%*	0.0%	*0.3%*	*0.2%*	*0.9%*	*6.5%*	0.0%	*0.2%*	*0.2%*	*0.8%*	0.2%
Sawmills & Wood Preservation	*0.3%*	0.0%	*0.3%*	*0.1%*	*0.4%*	*6.5%*	0.0%	*0.1%*	0.1%	*0.5%*	0.1%
Pulp, Paper, & Paperboard Mills	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Veneer, Plywood, & Engineered Wood	0.0%	0.0%	0.0%	*0.0%*	*0.4%*	0.0%	0.0%	0.1%	*0.1%*	*0.3%*	0.1%
Wood Products Manufacturing	*0.1%*	0.0%	*0.5%*	*0.3%*	*0.0%*	*2.0%*	*0.4%*	*0.4%*	*0.0%*	*0.2%*	0.4%
Other Wood Product Mfg.	*0.1%*	0.0%	*0.5%*	*0.3%*	*0.0%*	*2.0%*	*0.4%*	0.2%	0.0%	*0.2%*	0.2%
Converted Paper Product Mfg.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	*0.0%*	0.0%	0.2%
Gum & Wood Chemical Mfg.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wood Cabinet Mfg.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	*0.0%*	0.0%	0.0%
Wood Office Furniture Mfg.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	*0.0%*	0.0%	0.0%	0.0%
Non-Timber	*98.9%*	100.0%	*99.0%*	*99.5%*	*99.0%*	*89.6%*	*99.0%*	*99.4%*	*99.8%*	*98.9%*	99.3%

Table 3-43 does not include employment data for government, agriculture, railroads, or the self-employed because these are not reported by County Business Patterns. Estimates for data that were not disclosed are shown in italics.

Timber harvest on the Black Hills National Forest averages 20,000 - 25,000 acres per year. This level is influenced by the national lumber market economic conditions, lumber mill capacity, and timber industry structure. The Forest has approximately 800,000 acres of suitable timberlands. Harvesting of 25,000 acres annually is approximately four percent of the suitable timberlands or

two percent of the total NFS lands. Therefore, on an annual basis, a large portion of the Forest is not scheduled for commercial timber harvest.

Today, the Black Hills National Forest is one of the top timber-producing forests in the National Forest System. This timber supply is a substantial component of the support of local and regional communities, as well as, contributing to the project area's supply of goods and services.

Several communities in the Black Hills region, Spearfish and Hill City, South Dakota, and Hulett, Wyoming, are home to lumber mills that provide jobs and are an important component of the local economy. These mills rely on timber from the Black Hills National Forest to continue operations. At the same time, the Black Hills National Forest relies on the local infrastructure of these mills in order to implement forest health and safety vegetation treatments. Without the commercial infrastructure, much of the work the forest would like to implement would become too costly to complete.

Although population growth is bringing in more people with new and different ideas, there is little evidence that attitudes or lifestyles are changing in a major way. The beauty of the area brings in new residents and those with tenure are tied to the way the Forest is already managed, either by employment such as the logging or ranching industries, in the retail trade and service sectors or people are outdoor-oriented and have developed varied and specific outdoor user expectations (hunting, fishing, biking, off-road use and tourist based activities). Some residents in the area consider the forest resources and forest health as an important part of their quality of life. Visitors, both local and non-local use the area for a wide range of dispersed recreation activities including, hunting, fishing, boating, camping, wildlife viewing, and off-road vehicle use (see Recreation Section).

Environmental Consequences

Alternative A – No Action

Direct and Indirect Effects

Under this alternative there would be no reduction to current insect or fire/fuels hazards or changes to roads/access relative to implementing any proposed actions in the MPBR project area.

The mountain pine beetle epidemic is expanding within and adjacent to the MPBR project area. This epidemic is killing large numbers of mature pine trees, changing vegetation structure and wildlife habitat on a landscape scale. As trees are killed they fall to the ground adding dead, dry fuels within an area already rated as having high wildfire hazard. The mountain pine beetle is at epidemic levels across parts of this area right now and is going to continue to increase across the entire project area over the next few years (USDA Forest Service, 2010d).

A great deal of attention has also been focused on the increasing size and severity of wildfires occurring on forested lands, particularly pine forests of the west. Recent wildfires on the Black Hills National Forest have demonstrated that these fires are larger, hotter and more lethal to vegetation and soils than historic fires in ponderosa pine ecosystems. Additionally, these wildfires

are more dangerous or damaging to human settlements, property, and values because of settlement patterns of humans within these environments.

A large, uncontrolled fire could threaten the numerous subdivisions and homes previously described within the surrounding wildland-urban interface. These homes may have dense and continuous vegetation surrounding them, inadequate space between flammable fuels, lack of fire-resistant landscaping, and woodpiles or other flammable debris near structures. Although not noted for loss of life in the Black Hills to date, fires in the wildland/urban interface are responsible for extremely large property losses (Alabaugh Canyon Fire, 2007 included one human fatality, 33 homes lost, and a burn over of firefighters).

If a large scale wildfire were to happen, aesthetics, privacy, and economic property values in the burned area would likely be considerably diminished in the short-term. Also, highways and roads, transmission lines, and municipal watersheds values could be affected by large-scale wildfires. As vegetation grows back and burned dead timber falls and deteriorates, the long-term (beyond 10-15 years) effects of the wildfire on property values would be lessened. Sense of loss of amenities and property values gradually fades. People become accustomed over time to changes in scenery and other impacts like loss or damage to structures. Large amounts of smoke could affect numerous communities during a fire event. Smoke from such a wildfire would present health problems to elderly and persons with respiratory problems (see Fire and Fuels section).

There would be no effect to access and travel beyond current impacts, as management activities would not change. The Black Hills National Forest issued a forest-wide Travel Management Plan (USDA Forest Service, 2010) designating routes for motorized use (see Transportation section).

Much of the social impact related to any of the alternatives would likely be indirect or increase an already existing trend. Mill closures would reduce the number of wood industry jobs and limit the infrastructure for processing that would pay for WUI projects. While closure of specific mills cannot be predicted, a stable and adequate timber supply would assist mills to remain in business and create more stability for area families dependent on wood product industries.

With no commercial harvest, revenues would not be gained by industry, and no outgoing costs from the Forest Service would be associated with this alternative. No benefits would be gained from treatments in terms of reduction of wildfire hazard or increased safety for firefighters. Those that are interested in the seeing the forest resource respond to the beetle infestation through natural processes would benefit under the limited actions of this alternative. Costs in the future that could be associated with the limited action include reduction of commercial timber value, loss of private property, forest infrastructure, forest resources including fish and wildlife habitat, and scenery or recreation resources.

Alternatives B and C

Direct and Indirect Effects

Under alternatives B and C, forest vegetation would be treated to reduce the rapidly expanding MPB epidemic and fire and fuel hazards within the MPBR Project Area. Alternatives B would include commercial timber harvest on up to 48,400 acres (403,162 CCF) and Alternative C

would include commercial timber harvest on up to 124,000 acres (1,032,920 CCF), which would continue to provide Forest products to local timber operations.

Table 3-44 includes a net present value and a benefits cost ratio analysis for alternatives B and C. These two analyses are forms of financial efficiency analysis. This type of analysis only accounts for monetarily valued benefits and costs. In this case, the costs are the amount of budget dollars the Forest Service allocates to implement vegetation treatments, and the benefits, or revenues include the value of any resulting commercial timber. There are other values that affect the socioeconomic environment that may not be quantified, but are important to the decision making process. Accounting for these values allows for a total economic valuation. These additional values include the benefits of safety provided through treatments, or the costs to resource that result from treatments such as changes to habitat, scenery, or recreational opportunities.

Table 3-44 Financial Efficiency Measures for Alternative B and C (2011 Dollars)

	Alternative B	Alternative C
	- - - - millions of dollars- - - - -	
Net Present Value	-$25.651	-$67.071
Benefit-Cost Ratio	0.08	0.08
Present Value Revenues	$2.198	$5.631
Present Value Costs	-$27.849	-$72.702

The figures in table 3-45 only address the revenues and financial costs associated with the project, and do not account for other benefits and costs of the future treatments not valued in the marketplace. Both action alternatives have negative NPV, with alternative C significantly more negative due to the larger area and thus greater associated costs. Both alternatives do have some associated revenues in terms of commercial timber harvest, but because these treatments are completed for the primary purpose of limiting the spread of the beetle and reducing wildfire hazard, not every area will produce enough commercial timber to offset the cost. The non-monetary benefits that are summarized here and provided for in detail in other resource chapters balance out the cost of the projects.

The reduced MPB risk and wildfire hazard in the treatment areas and the completion of fuel breaks along private lands and roads would reduce the potential for large scale wildfire and would increase the likelihood that firefighters would be suppressing, from defensible positions, low to moderate intensity fires that may threaten private property, at-risk communities and forest resources versus a high intensity one.

Cumulative Effects

The population will continue to grow in the future. The majority of this growth is expected on private lands in and near the forested areas located outside, but near established towns and communities.

The wood products industry is dependent on Forest timber supply and would be directly affected by changes in forest management. Communities with large wood-production facilities would have economic ripples through all businesses supporting or supported by the wood production. Some small operations may be able to develop a new niche for production or find another supply source, and this may cause greater competition among firms searching for supply. Alternatives B and C demonstrate the greatest potential for increasing timber sales and positive cumulative

economic impacts associated with the wood products industry. Therefore, Alternatives B and C are most likely to support existing timber mils, while Alternative A is least likely.

Fuel treatments that reduce the potential for large-scale wildfire occurrence help to protect human health and safety. Since no vegetative treatments occur with Alternative A, this alternative would be the least effective in protecting human health and safety. In fact, the potential for a serious incident would increase with increased fuel loadings and fire behavior under the No Action Alternative. Fuel reduction work done without some revenue from product removal would cause a substantial increase in contracting costs. Such conditions may result in few projects, higher concerns for the WUI, and potential loss of other resource values from insect and fire events. Both Alternatives B and C reduce insect and fire hazards in the short-term. Alternative B would provide slightly fewer benefits in the long-term to protecting human health, well-being, and safety than Alternative C (see Fire and Fuels, and Vegetation sections). Vegetative projects that have not been completed or currently ongoing would continue to provide timber to the local mills in the foreseeable future.

Environmental Justice

Executive Order 12898 (February 11, 1994) directs Federal agencies to focus attention on the human health and environmental conditions in minority communities and low-income communities. The purpose of the Executive Order is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.

No low-income or minority populations in the project area were identified as defined by Executive Order 12898.

Civil Rights

No civil rights effects associated with age, race, creed, color, national origin, or sex have been identified.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road. For further discussion of the effects on the resources listed below, see Chapter 3 under the respective resource topics.

There are no **irreversible commitments** of resources with any of the alternatives analyzed.

Irretrievable commitments of resources include the following:

Soil productivity and **timber productivity** is lost where road construction is planned in Alternative C (about 250 miles).

Air quality would be temporarily impacted (lost) to varying degrees by smoke generated from burning hand/equipment piles and dust from road use resulting from implementation of the action alternatives.

Wildlife habitat loss or modification for certain wildlife species is likely under the action alternatives. As vegetation recovers, habitat would eventually return over various periods of time depending on the amount of vegetation treatment and/or disturbance.

Noxious and invasive weeds resulting from alternative implementation could potentially have an irretrievable commitment of resources if allowed to persist. Infestation can impact native plant communities that lead to losses in wildlife habitat, soil productivity, soil erosion, forage for grazing, and vegetative diversity.

Scenic conditions would be modified to varying degrees depending on the action alternative implemented.

SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). For further discussion of the effects on the resources listed below, see Chapter 3 under the respective resource topics.

Actions under Alternatives B and C are implemented using design measures that protect soil productivity. Any decrease in long-term soil productivity resulting from actions will be negligible.

As provided for by the Forest Plan, minimum management requirements guide implementation of the action alternatives. Adherence to these requirements ensures that long-term productivity of the land is not impaired by short-term uses. Monitoring specified in this EIS and the Forest Plan validates that the management requirements and mitigation are effective in protecting long-term productivity.

UNAVOIDABLE ADVERSE EFFECTS

The following is a description of adverse effects that are unavoidable with implementation of action alternatives. For further discussion of the effects on the resources listed below, see Chapter 3 under the respective resource topics.

Forest Insect and Disease would continue in the project area, at epidemic levels, in some areas and endemic levels in others.

Wildlife habitat for certain species would be adversely affected to varying levels with implementation of the action alternatives. The Wildlife section of this EIS discloses those effects.

Air quality would be adversely affected on a temporary/seasonal basis as a result of planned burning of hand/equipment piles and dust from roads and activities.

Scenic quality would be affected adversely for some observers by the various levels of vegetation treatment and other actions planned.

Fire/Fuels hazard would be increased during the short-term in some areas as a result of slash created from vegetation treatment. With disposal treatment this hazard will be reduced. There exists a higher long-term potential for large-scale wildfire under Alternative A versus the action alternatives.

Soils can be eroded wherever vegetation and soils are disturbed. Compaction can occur where vehicles and equipment are used.

Heritage resources can be disturbed or destroyed where human or natural activities take place.

CHAPTER 4 BIBLIOGRAPY/REFERENCES

36 Code of Federal Regulations, Part 200 to Part 299.

Abele, S. C., V. A. Saab, and E. O. Garton. 2004. Lewis's Woodpecker (Melanerpes lewis): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/lewisswoodpecker.pdf. [Accessed January 2011].

Abella, S. R, W. W. Covington, P. Z. Fule, L. B. Lentile, A J. Sanches Meador, and P. Morgan. 2007. Past, present, and future old growth in frequent –fire conifer forests of the western United States. Ecology and Society 12(2): 16 [Online] http://www.ecologyandsociety.org/vol12/iss2/art16/ (Accessed January 9, 2011)

Addison, E. 1991. Rainfall/runoff relationships and modeling of changes in water yield from timber harvest in the Black Hills of South Dakota. South Dakota School of Mines and Technology. Rapid City SD. 103pp. Thesis

Alberta Forests, Lands and Wildlife, Forest Service. 1986. Mountain Pine Beetle control program 1980-1986, a success story. Edmonton AB.

Alexander, R.R. 1987. Silvicultural Systems, Cutting Methods, and Cultural Practices for Black Hills Ponderosa Pine. Gen. Tech. Rep. RM-139. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 32pp.

Allen, Kurt A. 2010. Evaluation of Mountain Pine Beetle Activity in the Pactola Area of the Black Hills National Forest, USDA Forest Service, Rocky Mountain Region, Forest Health Management, Rapid City Service Center. Rapid City SD.

Allen, Kurt A. 2011a. Evaluation of No Action Alternative across the Pine Beetle Response Project. USDA Forest Service, Rocky Mountain Region, Forest Health management Rapid City Service Center, Rapid City, SD.

Allen, Kurt A. 2011b. Forest Service Forest Health report rcsc_4_12 for Pine Beetle Response Project, Black Hills National Forest. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

Allen, Kurt A. 2011c. Personal communication. Entomologist, Rocky Mountain Research Station. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Rapid City, SD. September, 2011.

Anderson, Hal E. 1982. Aids to determining Fuel Models for Estimating Fire Behavior. USDA Forest Service, General Technical Report, INT-122. 22pp. US Department of Agriculture, Intermountain Forest and Range Experiment Station. Ogden UT.

Anderson, M.T. 1980. Water quality and quantity of three adjacent Black Hills watersheds. South Dakota School of Mines and Technology. Rapid City SD. 159pp. Thesis.

Anderson, T. 2002. Conservation assessment for the American dipper in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. 35pp. Available at: http://fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012057.pdf [Accessed January 20, 2012].

Anderson, T. 2003. Conservation assessment for the woodpeckers in the Black Hills National Forest, South Dakota and Wyoming. USDA Forest Service, Black Hills National Forest. Custer, SD. 176pp. Available: http://fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012579.pdf (Accessed January 20, 2012]

Anderson, T. 2004a. Callused Vertigo (*Vertigo arthuri*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/callusedvertigo.pdf [Accessed February 2, 2012].

Anderson, T. 2004b. Mystery Vertigo (*Vertigo paradoxa*): a technical conservation assessment. November 4, 2004. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/mysteryvertigo.pdf [Accessed February 2, 2012].

Anderson, T. 2005. *Oreohelix strigosa cooperi* (Cooper's Rocky Mountain Snail): a technical conservation assessment. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/coopersrockymountainsnail.pdf [Accessed January 2011].

Anderson, T.K. 2003b. Land Snail Survey of Wind Cave National Park, Final Report. USDI National Park Service, Wind Cave National Park. Contract #P1505020021. April 2003. 57pp.

Anderson, T., R. Guralnick, and K. Weaver. 2006. Endemism and population relationships of the Black Hills Oreohelix snails. Final report. February 2006.

Arcese, P., M.K. Sogge, A.B. Marr, and M.A. Patten. 2002. Song sparrow (*Melospiza melodia*). In: The Birds of North America, No. 704. A. Poole and F. Gill, editors. The Birds of North America, Inc. Philadelphia PA.

Arno, Stephen F., Joe H. Scott, and Michael G. Hartwell. 1995. Age-Class Structure of Old Growth Ponderosa Pine / Douglas-Fir Stands and Its Relationship to Fire History. Research Paper INT-RP-481. US Department of Agriculture, Forest Service, Intermountain Research Station. Ogden UT. Available at: http://www.fs.fed.us/pnw/pubs/journals/standstructure.pdf

Backlund, D. 2007. The American dipper, *Cinclus mexicanus*, in the Black Hills of South Dakota: Past and present. South Dakota Department of Game, Fish and Parks. Available at: http://www.sdgfp.info/Wildlife/Diversity/dipper/index.htm [Accessed January 2011].

Baker, M.D., and M.J. Lacki. 2006. Day-roosting habitat of female long-legged myotis in ponderosa pine forests. Journal of Wildlife Management, 70(1): 207-215.

Baker, M.B., Jr. 1986. Effects of ponderosa pine treatments on water yield in Arizona. Water Resources Research, 22(1): 67-73.

Bastias, Brigitte A., Zhihong Xu, and John W.G. Cairney. 2006. Influence of long-term repeated prescribed burning on mycelial communities of ectomycorrhizal fungi. New Phytologist, 172: 149-158.

Battaglia, B.A., S.A. Smith, and W.D. Sheppard. 2008. Can prescribed fire be used to maintain fuel treatment effectiveness over time in the Black Hills ponderosa pine forests? Forest Ecology and Management, 256: 2029-2038.

Beason, J., K. Hutton, A. Panjabi, R. Sparks, and D. Hanni. 2006. Monitoring the Birds of the Black Hills: 2005 Field Season Report. Technical Report, M-MBBH05-01. Rocky Mountain Bird Observatory. Brighton CO. 113 pp. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5114240.pdf

Beck, J.L., and D.M. Staley. 2005. Monitoring Protocol for American Beaver (*Castor canadensis*): Examples from the Bighorn and Black Hills National Forests. US Department of Agriculture, Forest Service, Rocky Mountain Region.

Beckner, Craig. 2007. Personal communication with Mark Vedder, RMS regarding effect of pine needles on forage quality and palatability for livestock use.

Beecham, J.J. Jr., C.P. Collins, and T.D. Reynolds. 2007. Rocky Mountain Bighorn Sheep (*Ovis canadensis*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/rockymountainbighornsheep.pdf [Accessed February 2, 2012].

Belica, L.T., and N.P. Nibbelink. 2006. Mountain Sucker (*Catostomus platyrhynchus*): a technical conservation assessment. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/mountainsucker.pdf

Belsky, A. Joy, and Dana M. Blumenthal. 1997. Effects of Livestock Grazing on Stand Dynamics and Soils in the Upland Forests of the Interior West. Conservation Biology, 11(2): 315-327.

Benzon, T.A., and R. Halseth. 1999. Reintroduction of Rocky Mountain bighorn sheep in the Black Hills, South Dakota, 1986–1994. Completion Report No. 99-12. South Dakota Department of Game, Fish and Parks. Pierre, SD. July 1999.

Black, S.H., D. Kulakowski, B.R. Noon, and D. DellaSala. 2010. Insects and Roadless Forests: A Scientific Review of Causes, Consequences and Management Alternatives. National Center for Conservation Science and Policy. Ashland OR.

Black Hills Forest Resource Association & South Dakota Department of Environment and Natural Resources. 2005. 2004 Field Audit Report: Implementation Monitoring and Evaluation of South Dakota Forestry Best Management Practices. Rapid City & Pierre, SD.

Black Hills Forest Resource Association, South Dakota Department of Agriculture – Division of Resource Conservation & Forestry and Lawrence County Conservation District. 2009. 2009 Field Audit Report: Implementation Monitoring and Evaluation of South Dakota Forestry Best Management Practices. Rapid City, Pierre and Spearfish, SD.

Blakesly, J.A., G. Girior, and C. White. 2008. Population densities and trend detection of avian species on the Black Hills National Forest. Technical Report, M-MBBH07-02. Rocky Mountain Bird Observatory. Brighton CO. 45pp.

Blue Valley Ranch. 2011. Blue Valley Ranch, Conservation for wildlife and agricultural on line Blue Valley Ranch, Kremmling, Grand County CO. Available at: http://bluevalleyranch.com/explore_aspen.php

Boldt, Charles E., and James L. Van Deusen. 1974. Silviculture of ponderosa pine in the Black Hills: the status of our knowledge. Research Paper, RM-124.: US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 45pp.
Bonnot, T.W., J.J. Millspaugh, and M.A. Rumble. 2009. Multi-scale nest-site selection by black-backed woodpeckers in outbreaks of mountain pine beetles. Forest Ecology and Management, 259(2): 220-228.

Boyle, S., and S. Owens. 2007. North American Beaver (*Castor canadensis*): a technical conservation assessment. February 6, 2007. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/northamericanbeaver.pdf [Accessed February 2, 2012].

Breece, C.R., T.E. Kolb, B.G. Dickson, J.D. McMillan, and K.M. Clancy. 2008. Prescribed fire effects on bark beetle activity and tree mortality in southwestern ponderosa pine forests. Forest Ecology and Management, 255: 119-128.

British Columbia Ministry of Forests and Range. 2002. Predicting the Visual Impacts of Retention Cutting, Forest Practices Branch. Victoria BC. Available at: http://www.for.gov.bc.ca/hfd/pubs/Docs/Mr/Rec035.htm

British Columbia Ministry of Forests and Range. 2006. The Public Response to Harvest Practices in British Columbia at the Landscape and Stand Level, Forest Practices Branch. Victoria BC. Available at: http://www.for.gov.bc.ca/hfd/pubs/Docs/Mr/Rec/Rec038.pdf

British Columbia Ministry of Forests and Range. 2010. Visual impact of mountain pine beetle attack and resulting salvage operations in British Columbia: a public perception study. Forest Practices Branch. Victoria BC. Available at: http://www.for.gov.bc.ca/hfd/pubs/Docs/Mr/Rec/Rec041.pdf

Brooks, K.N., P.F. Ffolliott, H.M. Gregersen, and L.F. DeBano. 1997. Hydrology and the Management of Watersheds. Iowa State University Press. Ames IA. Pages 338-339.

Brown, J. 2010. Personal communication. Regarding the presence of Chytrid in swab samples taken from the Black Hills National Forest. Graduate Student, University of South Dakota, Biology Department. Vermillion SD.

Brown, Peter M. 2001. Landscape Age Structure of Ponderosa Pine Stands, Limestone Plateau, Black Hills National Forest: Final Report. Challenge Cost Share Agreement No. CCS-11020399-23 between Rocky Mountain Tree Ring Research, Inc. and Black Hills National Forest, U.S. Department of Agriculture-Forest Service. Available at: ftp://ftp.ncdc.noaa.gov/pub/data/paleo/firehistory/firescar/northamerica/supplemental/bh_age_finalreport_text.pdf

Brown, Peter M. 2006. Climate Effects on Fire Regimes and Tree Recruitment in Black Hills Ponderosa Pine Forests. Ecology, 87(10): 2500-2510.

Brown, Peter M., and Blaine Cook. 2006. Early settlement forest structure in Black Hills ponderosa pine forests. Forest Ecology and Management 223:1-31-3, 284-290, Elsevier, 2006.

Brown, Peter M., and Carolyn Hull Sieg. 1996. Fire History in the Interior Ponderosa Pine Communities of the Black Hills, South Dakota, USA. International Journal of Wildland Fire, 6(3): 97-105, USA. Available at: http://www.publish.csiro.au/?act=view_fileandfile_id=WF9960097.pdf

Brown, Peter M., and Carolyn Hull Sieg. 1999. Historical variability in fire at the ponderosa pine – northern Great Plains prairie ecotone, southeastern Black Hills, South Dakota. Ecoscience, 6(4): 539-547

Brown, Peter M., Cody L. Wienk and Amy J. Symstad. 2008. Fire and Forest History at Mount Rushmore. Ecological Applications, 18(8): 1984-1999.

Brown, Thomas C., and Terry C. Daniel. 1986. Predicting Scenic Beauty of Timber Stands. Forest Science, 32(2): 471-487. Available at: http://gis.fs.fed.us/rm/value/docs/scenic-beauty-prediction.pdf
Bull, E., and B.C. Wales. 2001. Effects of disturbance on birds of conservation concern in eastern Oregon and Washington. Northwest Science, 75(Special Issue): 166-173.

Bunkers, M.J. 2007. Personal communication, December 10, 2007. NOAA, National Weather Service. Rapid City SD.

Burns, K., and B. Cook. 2006. Forest Plan implementation clarification on goshawk management. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

Buseck, R.S., D.A. Keinath, and E. Everett. 2005. Species assessment for the black-tailed prairie dog (*Cynomys ludovicianus*) in Wyoming. Prepared for the USDI Bureau of Land Management, Wyoming State Office. Cheyenne WY. 62pp.

Buskirk, S.W. 2002. Conservation assessment for the American marten in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. 51pp. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012366.pdf [Accessed January 2011].

Buskirk, S.W., and R.A. Powell. 1994. Habitat ecology of fishers and American martens. In: Martens, sables, and fishers: Biology and Conservation. (S.W. Buskirk, A.S. Harestad, M.G. Raphael, compilers and editors.) Cornell University Press. Ithaca NY. pp. 283–296.

Buskirk, S.W., and L.F. Ruggiero. 1994. Chapter 2: American Marten. In: Ruggiero, L.F,: K.B.: Aubry, S. W. Buskirk, L .J. Lyon, and W. J. Zielinski, technical editors. The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States. General Technical Report, RM-254. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. p. 7-37.

Busse, M.D. 2006. USFS Pacific Southwest Research Station. Personal email communication to Jessica Gould regarding minimum soil and duff moisture levels to prevent detrimental soil heating during prescribed burning. October 2006. 2p.

Busse, Matt D., Steven A. Simon, and Gregg M. Riegel. 2000. Tree-Growth and Understory Reponses to Low-Severity Prescribed Burning in Thinned Pinus Ponderosa Forests of Central Oregon. Forest Science, 46(2): 258-268.

Butler, Robert W. 1992. Great Blue Heron (*Ardea herodias*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/025 [Accessed January 27, 2011].

Canada. 2007. Mountain Pine Beetle Management Strategy (December 2007). ISBN No.978-0-7785-6545-1 Pub No. T/154 Alberta Sustainable Resource Development.

Canadian Forest Service and British Columbia Ministry of Forests. 1996. Clear Cutting and Visual Quality - A Public Perception Study, Forest Resource Development Agreement II Report. Victoria BC. Available at: http://www.for.gov.bc.ca/hfd/pubs/Docs/Frr/Frr270.htm

Canadian Ministry of Forests with USDA Forest Service. Land Management Handbook, ISSN 0229-1622:18. Research Branch, Ministry of Forests. Victoria BC. 220pp.

Carter, J.M., D.G. Driscoll, J.E. Williamson and V.A. Lindquist. 2002. Atlas of Water Resources in the Black Hills Area, South Dakota. Hydrologic Investigations Atlas HA-747. US Geological Survey. Reston VA. Available at: http://www.fws.gove/mountain-praire/species/mammals/preble/peer/USGSZapusInformationReview.pdf.

Carter, J.M., D.G. Driscoll, and J.F. Sawyer. 2003. Ground-Water Resources in the Black Hills Area, South Dakota. Water Resources Investigation Report 03-4049. US Geological Survey. Rapid City SD.

Carter, U.S. President Jimmy. 1977a. Executive Order 11988 - Floodplain Management. Available at: http://www.epa.gov/owow/wetlands/regs/eo11988.html

Carter, U.S. President Jimmy. 1977b. Executive Order 11990 - Protection of Wetlands. Available at: http://www.epa.gov/owow/wetlands/regs/eo11990.html

Chatwin, S.C., D.E. Howes, J.W. Schwab, and D.N. Swanston. 1994. A Guide for Management of the Landslide-Prone Terrain in the Pacific Northwest. Second Edition.

Cline, R.G., H.F. Haupt, and G.S. Campbell. 1977. Potential water yield response following clear-cut harvesting on north and south slopes in northern Idaho. Research Paper, INT-191. US Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. Ogden UT. 16 p.

Collins, C.P., and T.D. Reynolds. 2005. Ferruginous Hawk (*Buteo regalis*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/ferruginoushawk.pdf [Accessed January 2010].

Colorado State University Extension Office. 2008. Canada thistle facts sheet. Revised 2008. http://search.colostate.edu/search-csu.aspx?cx=001074770120494240330%3Annxeddf6qe0&sa=Search&cof=FORID%3A11&q=seed+viability+canada+thistle#1184

Cook, Blaine. 2006. Personal communication. Forest Silviculturist. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. December 2006.

Cook, Blaine, and Kurt Allen. 2008. Black Hills National Forest – Timber Harvesting Effects on the Mountain Pine Beetle. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. US Department of the Interior, Fish and Wildlife Service, Washington DC. Northern Prairie Wildlife Research Center, Jamestown ND. Available at: http://www.npwrc.usgs.gov/resource/wetlands/classwet/index.htm (Version 04DEC1998).

Crookston, Nicholas L. 1990. User's guide to the event monitor: part of Prognosis Model version 6. General Technical Report, INT-275. US Department of Agriculture, Forest Service, Intermountain Research Station. Ogden UT. 21pp.

Cryan, P.M. 2004. Synthesis of existing information on meadow jumping mice (*Zapus hudsonius*) in the northern Great Plains. Information Review Compiled for the USDI Fish and Wildlife Service, Region 6. Denver CO. 27pp.

Cryan, Paul, Michael Bogan, and G. Yanega. 2001. Roosting Habits of Four Bat Species in the Black Hills of South Dakota. Acta Chiropterologica, 3:43-52.

Cryan, P.M., and L.E. Ellison. 2005. Distributional survey of the meadow jumping mouse (*Zapus hudsonius*) in the northern Great Plains: Trapping Report, summer 2005. Administrative report compiled for the US Fish and Wildlife Service, Region 6. Denver CO.

CWMA. 2002. Troublesome Weeds of the Rocky Mountain West. Colorado Weed Management Association. 7th edition. Granby CO.

DeBano, L.F. 2000. The role of fire and soil heating on water repellency in wildland environments: a review. Journal of Hydrology, 231-232: 195-206.

DeBano, L.F., and J.S. Krammes. 1966. Water Repellent Soils and Their Relation to Wildfire Temperature. Bulletin of the International Association of Scientific Hydrology, 11(2): 14-19.

DeBano, L.F., D.G. Neary, and P.F. Ffolliott. 1998. Fire's Effects on Ecosystems. John Wiley and Sons. New York NY. 333pp.

DeBlander, L.T. 2002. Forest resources of the Black Hills National Forest. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Ogden Utah. 13pp.

Dechant, J.A., M.L. Sondreal, D.H. Johnson, L.D. Igl, C.M. Goldade, M.P. Nenneman, and B.R. Euliss. 1992 (revised 2002). Effects of management practices on grassland birds; Grasshopper Sparrow. Northern Prairie Wildlife Research Center. Jamestown ND. 28pp.

DeKeyser, S. et. al. 2009. Are Changes in Species Composition on Central North Dakota Rangelands Due to Non-Use Management? Rangelands, 31(6): 16-19.

DePerno, C.S., J.A. Jenks, S.L. Griffin, L.A. Rice, and K.F. Higgins. 2002. White-tailed Deer Habitats in the Central Black Hills. Journal of Range Management, 55(May): 242-252.

Dewitt E., A. Redden, A.B. Wilson, D. Busher, and J.S. Dersch. 1986. US Geological Survey Bulletin 1580, Mineral Resource Potential and Geology of the Black Hills National Forest, South Dakota and Wyoming. Washington DC.

Diaz, Nancy, and Dean Apostol. 1993. Forest Landscape Analysis and Design. US Department of Agriculture, Forest Service.

Dixon, Gary E. 2003. Essential FVS: A user's guide to the Forest Vegetation Simulator. Internal Report. US Department of Agriculture, Forest Service, Forest Management Service Center. Fort Collins CO. 193p.

Doran, J.W., and T.B. Parkin. 1994. Defining and Assessing Soil Quality. In J.W. Doran et al (Editors), Defining Soil Quality for a Sustainable Environment. SSSA Spec. Pub. 35. SSSA. Madison WI.

Drilling, Nancy E. 2010. 2009 Black Hills Owl Surveys. Technical Report, M-SDBBA2-03. Rocky Mountain Bird Observatory. Brighton CO. 13pp.

Driscoll, Daniel G., J.M. Carter, and D.O. Ohlen. 2004. Hydrologic effects of the 1988 Galena Fire, Black Hills area, South Dakota: U.S. Geological Survey Water-Resources Investigations Report 03-4323, 67pp. Available at : http://pubs.usgs.gov/wri/wri034323/#pdf

Driscoll, Daniel G., J.M. Carter, J.E. Williamson, and L.D. Putnam. 2002. Hydrology of the Black Hills Area, South Dakota. Water Resources Investigation Report 02-4094. USDI, US Geological Survey. 150pp. Available at: http://pubs.usgs.gov/wri/wri024094

Driscoll, Daniel G., Ghaith R. Hamade, and Scott J. Kenner. 2000. Summary of Precipitation Data for the Black Hills Area of South Dakota, Water Years 1931-98. Open–File Report 00-329. USDI, US Geological Survey. 151pp.

Duckwitz, Jeremy J. 2001. Small mammal survey of Wind Cave National Park. Master's Thesis, Wildlife and Fisheries Sciences. South Dakota State University. Brookings SD.

Dymerski, A. 2012. Aerial Detection Survey Results for the Black Hills, 2011. Report No. RCSC_8_12_blkh_ads_2011. US Department of Agriculture, Forest Service, Rocky Mountain Region, Forest Health Management. Rapid City SD. January 20, 2011.

EPA. 2005. National Management Measures to Control Nonpoint Source Pollution from Forestry. EPA Office of Water Report EPA-841-B-05-001. Washington DC.

EPA. 2008a. National Pollutant Discharge Elimination System. Clean Water Act. Available at: http://cfpub.epa.gov/npdes/cwa/cfm?program_is=45

EPA. 2008b. Wetlands. Floodplain Management. Executive Order 11988. Available at: http://www.epa.gov/owow/wetlands/regs/eo11988.html

EPA. 2008c. Wetlands. Protection of Wetlands. Executive Order 11990. Available at: http://www.epa.gov/owow/wetlands/regs/eo11990.html

EPA. 2009. What is a Watershed? Available at: http://water.epa.gov/type/watersheds/whatis.cfm

EPA. 2010. Floodplain Management. Executive Order No. 11988. Available at: http://water.epa.gov/lawsregs/guidance/wetlands/eo11988.cfm [Accessed 3 February 2012].

EPA. 2011a. National Pollutant Discharge Elimination System. Clean Water Act. Available at: http://www.epa.gov/lawsregs/laws/cwa.html

EPA. 2011b. Our Waters. Available at: http://water.epa.gov/type

EPA. 2012a. Laws and Regulations. Clean Water Act. Available at: http://www.epa.gov/lawsregs/laws/cwa.html [Accessed February 2012].

EPA. 2012b. Pollution Prevention. Best Management Practices.

www.epa.gov/ebtpages/pollbestmanagementpractices.html [Accessed 1 February 2012].

EPA. 2012c. Wetlands. Protection of Wetlands. Executive Order No. 11990. http://water.epa.gov/lawsregs/guidance/wetlands/eo11990.cfm [Accessed 3 February 2012].

Erikson and White 2008

Evans, M., and J. Warburton. 2007. Geomorphology of Upland Peat: Erosion, Form, and landscape Change. Blackwell Publishing. Malden MA. 288pp.

Everett, A.M. 2004. 2004 Field Audit Report: Implementation Monitoring and Evaluation of South Dakota Forestry Best Management Practices. Black Hills National Forest Resource Association. Rapid City SD. 33pp.

Fauna West Wildlife Consultants. 2003-2009. Survey results for small forest owls, the northern goshawk, and other raptors of interest in the Black Hills, South Dakota. Reports prepared for South Dakota Department of Game, Fish and Parks. Pierre SD.

Feck, J., and R.O. Hall Jr. 2004. Response of American dipper (*Cinclus mexicanus*) to variation in stream water quality. Freshwater Biology, 49: 1123-1137.

Fecske, D.M. 2003. Distribution and abundance of American martens and cougars in the Black Hills of South Dakota and Wyoming. Dissertation: Doctor of Philosophy, South Dakota State University. 170pp.

Fecske, D.M., J.A. Jenks, C. Kopplin, and T.L. Serfass. 2003. A landscape analysis for American martens (*Martes americana*) in the Black Hills, South Dakota. Draft publication dated October 10, 2003.

Federal Emergency Management Agency (FEMA). 1998. National Flood Insurance Program, Q3 Flood Data. GIS data on CD-ROM for South Dakota. Available at http://www.fema.gov

Federal Registry, Vol. 66, No.3, Thursday, January 4, 2001, Notices.

Fellows, S.D., and S.L. Jones. 2009. Status assessment and conservation action plan for the long-billed curlew (*Numenius americanus*). USDI Fish and Wildlife Service, Biological Technical Publication, FWS/BTP-R6012-2009. Washington DC. 98pp.

Fettig, C.J., K.D. Klepzig, R.F. Billings, A.S. Munson, T.E. Nebeker, J.F. Negron, and J.T. Nowak. 2007. The effectiveness of vegetation management practices for prevention and control of bark beetle infestations in coniferous forests of the western and southern United States. Forest Ecology and Management, 238: 24-53.

Finch, D.M. 1992. Threatened, endangered, and vulnerable species of terrestrial vertebrates in the Rocky Mountain Region. General Technical Report, RM-215. US Department of Agriculture, Forest Service, Rocky Mountain Region. Denver CO.

Finch, D.M., J.L. Ganey, W. Yong, R.T. Kimball, and R. Sallabanks. 1997. Effects and interactions of fire, logging, and grazing. General Technical Report, RM-GTR-292. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Pp. 103-136.

Fischer, T.D., D.C. Backlund, K.F. Higgins, and D.E. Naugle. 1999. A field guide to South Dakota Amphibians. South Dakota State University. Brookings SD. SDAES Bull.

Ford, R.C. 1988. Black Hills Stream Inventory and Classification 1984 and 1985. South Dakota Department of Game, Fish and Parks. Report No. 88-1.

Forrest, S.C., T.W. Clark, L. Richardson, and T.M. Campbell, III. 1985. Black footed-ferret habitat: Some management and reintroduction considerations. Technical Bulletin No. 2. Wyoming Bureau of Land Management, Wildlife.

Foster, G.R. 1982. Modeling the erosion process. In: Haan, C.T., H.P. Johnson, and D.L. Brakensiek (editors), Hydrologic Modeling of Small Watersheds. Chapter Eight. American Society of Agricultural Engineers. Saint Joseph MI.

Frest, T.J., and E.J. Johannes. 1993. Land snail survey of the Black Hills National Forest, South Dakota and Wyoming. Unpublished. Report prepared for US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

Frest, T.J. and E.J. Johannes. 2002. Land Snail Survey of the Black Hills National Forest, South Dakota and Wyoming, Summary Report, 1991-2001. Final Report Contract # 43-67TO-8-1085. United States Department of Agriculture, Forest Service, Black Hills National Forest. 127pp. plus appendices.

Frid, A., and L.M. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology, 6(1):11. 16pp.

Gary, H.L. 1975. Watershed management problems and opportunities for the Colorado Front Range ponderosa pine zone: The Status of our Knowledge. Research Paper, RM-139. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 32pp.

Gauch, Hugh G., and Cecil H. Wadleigh. 1944. Effects of High Salt Concentrations on Growth of Bean Plants. Botanical Gazette, 105(3): 379-387.

Ghalambor, C. 2003. Conservation Assessment of the Pygmy Nuthatch in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Rocky Mountain Region, Black Hills National Forest. kAvailable at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012475.pdf [Accessed February 2, 2012].

Ghalambor, C.K., and R.C. Dobbs. 2006. Pygmy Nuthatch (*Sitta pygmaea*): a technical conservation assessment. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/pygmynuthatch.pdf [Accessed January 2011].

Giroir, G., C. White, and R. Sparks. 2007. Monitoring the Birds of the Black Hills: 2007 Field Season Report. Technical Report, M-MBBH07-01. Rocky Mountain Bird Observatory. Brighton CO. 8+1 pp. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5114242.pdf [Accessed February 13, 2012].

Godwin, D.C, and J.R. Miner. 1996. The Potential of Off-Stream Livestock Watering to Reduce Water Quality Impacts. Bioresource Technology, 58(3):285-290.

Goodrich, Betsy A., Ronda D. Koski, and William R. Jacobi. 2008. Roadside Vegetation Health Condition and Magnesium Chloride ($MgCl_2$) Dust Suppressant Use in Two Colorado, US Counties. Arboriculture and Urban Forestry, 34(4): 252-259.

Goodrich, Betsy A., Ronda D. Koski, and William R. Jacobi. 2009. Condition of Soils and Vegetation Along Roads Treated with Magnesium Chloride for Dust Suppression. Water, Air, and Pollution, 198: 165-188.

Gould, J.J. 2003. Hydrologic Modeling of High-Intensity, Short-Duration Rainfall on Burned Ponderosa Pine Forested Watersheds Existing in Highly Permeable Geology within the Black Hills of South Dakota. M.S. Thesis. South Dakota School of Mines and Technology. Rapid City SD. 121pp.

Gove, Philip B. 1966. Webster's Third New International Dictionary of the English Language, Unabridged. G. & C. Merriam Company. Springfield MA.

Grafe, Ernest, and Paul Horsted. 2002. Exploring With Custer: The 1874 Black Hills Expedition. Golden Valley Press – Dakota Photographic, LLC. Custer SD. 285pp.

Graham, Russell T., and Theresa B. Jain. 2005a. Application of free selection in mixed forests of the inland northwestern United States. Forest Ecology and Management, 209:131-145.

Graham, Russell T., and Theresa B. Jain. 2005b. Ponderosa Pine Ecosystems. General Technical Report, PSW-GTR-198. US Department of Agriculture, Forest Service. 32pp.

Graham, Russell T., Alan E. Harvey, Theresa B. Jain, and Jonalea R. Tonn. 1999. The Effects of Thinning and Similar Stand Treatments on Fire Behavior in Western Forests. General Technical Report, PNW-GTR-463. US Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland OR. 27pp.

Graham, Russell T., Alan E. Harvey, M.F. Jurgensen, Theresa B. Jain, Jonalea R. Tonn, and D.S. Page-Dumroese. 1994. Managing Coarse Woody Debris in Forests of the Rocky Mountains. INT-RP-477. US Department of Agriculture, Forest Service, Intermountain Research Station. Odgen UT.

Graham, Russell T., Sarah McCaffrey, and Theresa B. Jain, technical editors. 2004 Science Basis for Changing Forest Structure to Modify Wildfire Behavior and Severity. General Technical Report, RMRS-GTR-120. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins CO. 43pp. Available at: http://www.fs.fed.us/rm/pubs/rmrs_gtr120.pdf

Graves, Henry S. 1899. The Black Hills Forest Reserve. In: The nineteenth annual report of the survey, 1897-1998. Part V. Forest Reserves. United States Geological Survey. Washington DC.

Griebel, R., K. Burns, and S. Deisch. 2007. Focus species. Norbeck Wildlife Preserve. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. 54pp Available at: http://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5114246.pdf [Accessed January 2011].

Griffin, S.L., L.A. Rice, C.S. DePerno and J.A. Jenks. 1999. Seasonal Movements and Home Ranges of White-tailed Deer in the Central Black Hills, South Dakota and Wyoming, 1993-1997. Completion Report No. 99-03. South Dakota Department of Game, Fish and Parks. Pierre SD. 61pp.

Grimm, E.C. 2000. Paleoenvironmental Data from Iron Bogs in the Black Hills of South Dakota: Ironclad Evidence for Environmental Change. Poster Presentation. American Quaternary Association Meeting, May 22-24, 2000. University of Arkansas. Fayetteville AR.

Griscom, H., D. Keinath, and J. Handley. 2008. Five year study of factors affecting jumping mice (*Zapus*) on the Medicine Bow National Forest, Wyoming, USA. Five Year Project Report: 2008. Wyoming Natural Diversity Database, University of Wyoming. Laramie WY.

Gruver, J.C. and D.A. Keinath. 2006. Townsend's Big-eared Bat (*Corynorhinus townsendii*): a technical conservation assessment. October 25, 2006. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/townsendsbigearedbat.pdf [Accessed February 2, 2012].

Gucinski, H., M.J. Furniss, R.R. Ziemer, and M.H. Brooks. 2000. Forest Roads: A Synthesis of Scientific Information. US Department of Agriculture, Forest Service.

Haldeman, J.R. 1980. Non-game Bird Habitat Relationships in the Black Hills National Forest. Final Report to the Black Hills National Forest, RQ R2-79-269. 233pp.

Hall, J., H.J. Marriott, and J.K. Perot. 2002. Ecoregional Conservation in the Black Hills. The Nature Conservancy, Midwest Conservation Science Center, Midwestern Resource Office. Minneapolis MN.

Hann, Wendel, Doug Havlina, Ayn Shlisky, et al. 2003. Interagency and The Nature Conservancy fire regime condition class website. US Department of Agriculture, Forest Service, US Department of the Interior, The Nature Conservancy, and Systems for Environmental Management. Available at: http://frames.nbii.gov/portal/server.pt?open=512&objID=309&&PageID=1397&mode=2&in_hi_userid=2&cached=true

Hansen, C., J. Millspaugh, and M.A. Rumble. 2008. Factors affecting the probability of detecting ruffed grouse in the Black Hills National Forest. Progress Report One. January 24, 2008. Forest Service Agreement Number: 05-JV-11221609-239.

Harper, Kristine L. 2010. A Level III Cultural Resource Survey of the Pactola Analysis Area, R2008020300056, in Pennington and Lawrence Counties, South Dakota. US Department of Agriculture, Forest Service, Black Hills National Forest, Mystic Ranger District, Rapid City SD. Manuscript on file at the Black Hills National Forest, Custer SD.

Haskins, Kristin E., and Catherine A. Gehring. 2004. Long-term effects of burning slash on plant communities and arbuscular mycorrhizae in a semi-arid woodland. Journal of Applied Ecology, 41: 379-388.

Hayward, G.D., C.H. Flather, E. Uloth, H.D. Safford, and D.A. Cleaves. 2009. Managing fish and wildlife habitat in the face of climate change: USDA Forest Service perspective. Transaction of the 74th North American Wildlife and Natural Resource Conference. Wildlife Management Institute Publications Department March 16-19, 2009. p. 98-109.

Hayward, G.D. and J. Verner, Technical Editors. 1994. Flammulated, boreal, and great gray owls in the United States: A technical conservations assessment. General Technical Report, RM-253, US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO.

Heidel, B. 2007. Wyoming Plant Species of Concern. Wyoming Natural Diversity Database (WYNDD). University of Wyoming. Laramie WY.

Higgins, K.E., E. Dowd Stukel, J.M. Goulet, and D.C. Backlund. 2000. Wild Mammals of South Dakota. South Dakota Department of Game, Fish and Parks. Pierre SD. 278pp.

High Plains Regional Climate Center (HPRCC). 2008. Available at: http://www.hprcc.unl.edu/data/historical/index.php?state=sd&action=select_state&submit=Select+State [Accessed November 11, 2008].

Hoeft, D. 1985. Soil Map Descriptions and Interpretations Notebook.

Hoeft, D. 1988a. Black Hills National Forest Ecological Land Units Study. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. 68pp, plus Appendices.

Hoeft, D. 1988b. Land Classification System and Soils Information, Black Hills National Forest.

Hoffman, George R., and Robert R. Alexander. 1987. Forest vegetation of the Black Hills National Forest of South Dakota and Wyoming: a habitat type classification. Research Paper, RM-276. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 48pp.

Hopkins, A.D. 1905. The Black Hills Beetle. US Department of Agriculture, Bureau of Entomology, Bulletin No. 56, p.13.

Horsted, Paul. 2006. The Black Hills: Yesterday & Today. Golden Valley Press. Custer SD. 304pp.

Hough, M. 2008. Research techniques, habitat use, and ecology of northern flying squirrels, and research techniques and distribution of red squirrels in the Black Hills National Forest and Northeastern South Dakota. Master of Science Thesis, South Dakota State University. 132pp.

Hoxie, J. and Engelskirger, C. 2009. 2009 Field Audit Report: Implementation Monitoring and Evaluation of South Dakota Forestry Best Management Practices. Black Hills Forest Resource Association, South Dakota Department of Environment and Natural Resources, Lawrence County Conservation District. Rapid City SD. 18pp.

Hubbard, J.E. 2012. Letter to Regional Foresters, Station Directors, Area Director, IITF Director. 2150. National Pollutant Discharge Elimination System Interim Guidance. USDA Forest Service. Washington Office. Washington DC.

Hungerford, R.D., W.H. Frandsen, and K.C. Ryan. 1992. Heat Transfer into the Duff and Organic Soil. Final Project Report. FWS Agreement No. 14-48-0009-92-962. US Department of Agriculture, Forest Service, Intermountain Research Station, Fire Sciences Laboratory. Missoula MT. 52pp.

Hunter, M.E., W.D. Shepperd, J.E. Lentile, J.E. Lundquist, M.G. Andreu, J.L. Butler, and F.W. Smith. 2007. A comprehensive guide to fuels treatment practices for ponderosa pine in the Black Hills, Colorado Front Range, and Southwest. General Technical Report, RMRS-GTR-198. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins CO. Available at: http://www.fs.fed.us/rm/pubs/rmrs_gtr198.pdf

Hurley, K. 2004. North American Wild Sheep and Goat Council Position Statement on Helicopter-supported recreation and mountain goats. Biennial Symposium of the Northern Wild Sheep and Goat Council, 14:131-136.

Hutto, R.L. 2008. The ecological importance of severe wildfires: Some like it hot. Ecological Applications, 18:1827–1834.

Hutton, K., J. Beason, G. Giroir, R. Sparks, and D. Hanni. 2007. Monitoring the Birds of the Black Hills: 2006 Field Season Report. Technical Report, M-MBBH06-01. Rocky Mountain Bird Observatory. Brighton CO. 71pp. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5114241.pdf

Huxoll, C. 2010. Big game harvest projections, 2009 annual report. South Dakota Game Report No. 2010-01. South Dakota Department of Game, Fish and Parks. Pierre SD. Available at: http://gfp.sd.gov/hunting/harvest/default.aspx [Accessed January 2011].

Isaak, D.J., W.A. Hubert, C.R. Berry, Jr. 2003. Conservation assessment for lake chub, mountain sucker, and finescale dace in the Black Hills National Forest, South Dakota and Wyoming. US

Department of Agriculture, Forest Service, Rocky Mountain Region, Black Hills National Forest. Custer SD. Available at:
http://www.fs.fed.us/r2/blackhills/projects/planning/assessments/chub_sucker_dace.pdf and http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012156.pdf

Jackson, Robert J. 1988. Prescribed Fire and the Protection of Heritage Resources. A Heritage Resources Management Module Prepared for the USDA Forest Service, Pacific Southwest Region, National Forests of the Sierra Nevada. Manuscript on file at the Black Hills National Forest, Custer SD.

Johnson, A.S., and S.H. Anderson. 2002. Conservation assessment for the Western burrowing owl (*Athene cunicularia hypugaea*) in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service. Custer SD. 24 pp. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012149.pdf [Accessed February 8, 2012].

Johnson, A.S., and S.H. Anderson. 2003. Conservation Assessment for the Northern Saw-whet Owl in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Rocky Mountain Region, Black Hills National Forest. Custer SD. May 2003. 27pp. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012447.pdf [Accessed January, 2011].

Kanta, J. 2009. Personal communication. Regarding bighorn sheep use in the central Black Hills. South Dakota Department of Game, Fish and Parks. Rapid City SD.

Kanta, J. 2011. Personal communication. E-mail regarding management of bighorn sheep in the Pactola Project Area. South Dakota Department of Game, Fish and Parks. Rapid City SD.

Keinath, D.A. 2004. Fringed Myotis (*Myotis thysanodes*): a technical conservation assessment. October 29, 2004. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/fringedmyotis.pdf [Accessed February 2, 2012].

Kennedy, J.F. 1992. Habitat Selection by Female White-tailed Deer in the Northern Black Hills, South Dakota and Wyoming. Master's thesis. South Dakota State University. Brookings SD.

Kennedy. P.L. 2003. Northern goshawk (*Accipiter gentiles atricapillus*): A technical conservation assessment. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/Region 2/projects/scp/assessments/northerngoshawk.pdf [Accessed February 9, 2012].

Kennedy, R. 1997. Road Maintenance Frequency versus Sediment Production. Region 4. U.S. Department of Agriculture, Forest Service, Bridger-Teton National Forest. Jackson WY.

Keyser, T., F. Smith, and L. Lentile. 2006. Monitoring fire effects and vegetation recover on the Jasper Fire, Black Hills National Forest, South Dakota. Final Report, in-service agreement #0203-01-007. Colorado State University. Fort Collins CO.

Kilgore, Bruce M., and George A. Curtis. 1987. Guide to Understory Burning in Ponderosa Pine-Larch-Fir Forests in the Intermountain West. General Technical Report, INT-233. US Department of Agriculture, Forest Service, Intermountain Research Station. Ogden UT.

King, J.G., and L.C. Tennyson. 1984. Alteration of Streamflow Characteristics Following Road Construction in North Central Idaho. Water Resources Research, 20(8): 1159-1163.

King, T.L., J.F. Swuitzer, C.L. Morrison, M.S. Eackles, C.C. Young, B.A. Lubinski and P.M. Cryan. 2006. Comprehensive genetic analysis reveal evolutionary distinction of a mouse (*Zapus hudsonius preblei*) proposed for delisting from the US Endangered Species Act. Molecular Ecology, 15: 4331-4359.

Klenner, W., and A. Arsenault. 2009. Ponderosa pine mortality during a severe bark beetle (Coleoptera: *Curculionidae*, *Scolytinae*) outbreak in southern British Columbia and implications for wildlife habitat management. Forest Ecology and Management, 2585: S5-S14.

Klute, D.S., L.W. Ayers, M.T. Green, W.H. Howe, S.L. Jones, J.A. Shaffer, S.R. Sheffield, and T.S. Zimmerman. 2003. Status assessment and conservation plan for the western burrowing owl in the United States. USDI Fish and Wildlife Service, Biological Technical Publication FWS/BTP-R6001-2003. Washington DC.

Knapp, Eric E., Dylan W. Schwilk, Jeffrey M. Kane, and Jon E. Keeley. 2007. Role of burning season on initial understory vegetation response to prescribed fire in a mixed conifer forest. Canadian Journal of Forest Research, 37:11-22.

Knight, R. and D.N. Cole. 1995. Factors that influence wildlife responses to recreations. In: Wildlife and Recreationist, coexistence through management and research. Edited by R.J. Knight and K.J. Gutswiller. Island Press. 371p.

Knowles, C.J., and P.R. Knowles. 2009. Nesting ecology of the northern goshawk in the Black Hills of South Dakota. Report for the 2009 nesting season. Prepared for the South Dakota Department of Game, Fish and Parks Department. Pierre SD. 40pp.

Kocis, Susan M., Donald B.K. English, Stanley J. Zarnoch, Ross Arnold, Larry Warren, and Catherine Ruka. 2004. Black Hills National Forest. In: National Visitor Use Monitoring Results. US Department of Agriculture, Forest Service, Southern Research Station (Producer). Internet Accessed [May 2005] at: http://www.fs.fed.us/recreation/programs/nvum/reports/year4/R2_F3_blackhills_final.htm

Kornfeld, Marcel, George C. Frison, and Mary Lou Larson. 2010. Prehistoric Hunter-Gatherers of the High Plains and Rockies (3rd edition). Left Coast Press. Walnut Creek CA.

Kotliar, N.B. 2007. Olive-sided Flycatcher (*Contopus cooperi*) a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/olivesidedflycatcher.pdf [Accessed January 2011].

Kricher, J.C. 1995. Black-and-white warbler (*Mniotilta varia*). In: The Birds of North America, No. 540. A. Poole and F. Gill, editors. The Birds of North America, Inc. Philadelphia PA.

Krueger, E.M. 2004. Distribution and habitat associations of the northern flying squirrel in the northern Black Hills of South Dakota. Self-published. Filed in Black Hills National Forest Supervisor's Office (Forest Biologist's files), Custer SD.

Land Status Atlas, corner cards and Utility Atlas for the Pactola Planning Area.

Lang, J.W. 1969. Hibernation and movements of *Storeria occipitomaculata* in northern Minnesota. Journal of Herpetology, 3:196-197.

Larson, G.E., and J.R. Johnson. 1999. Plants of the Black Hills and Bear Lodge Mountains. August 1999. South Dakota State University. Brookings SD.

Lawrence County. 2009. Lawrence County Community Wildfire Protection Plan. Lawrence County SD.

Leaf, C.F. 1975. Watershed management in the Central and Southern Rocky Mountains: A summary of the status of our knowledge by vegetation types. Research Paper, RM-142. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 28pp.

Lee, W.K., and A.M. Everett. 2001. South Dakota Silviculture Best Management Practices Audit Project Final Report: Implementation Monitoring and Evaluation. Black Hills Forest Resource Association and South Dakota Department of Environment and Natural Resources. Rapid City SD. 48pp.

Lentile, Leigh B., Zachary A. Holden, Alistair M.S. Smith, Michael J. Falkowski, Andrew T. Hudak, Penelope Morgan, Sarah A. Lewis, Paul E. Gessler, and Nate C. Benson. 2006. Remote sensing techniques to assess active fire characteristics and post-fire effects. International Journal of Wildland Fire, 15: 319-345.

Lentile, Leigh B., F.W. Smith, and W.D. Sheppard. 2000a. Snag Management in the Black Hills National Forest. Unpublished Research Paper. Colorado State University and Rocky Mountain Research Station, United States Department of Agriculture, Forest Service. Fort Collins CO.

Lentile, Leigh B., F.W. Smith, and W. Shepperd. 2000b. Snag populations of the Black Hills National Forest. Final Report. US Department of Agriculture, Forest Service Black Hills National Forest. Custer SD.

Lentile, Leigh B., F.W. Smith, and W.D. Sheppard. 2006. Influence of topography and forest structure on patterns of mixed severity fire in ponderosa pine forests of the South Dakota Black Hills, USA. International Journal of Wildland Fire, 15: 557-566.

Libohova, Z. 2004. Effects of thinning and a wildfire on sediment production rates, channel morphology, and water quality in the Upper South Platte River watershed. Master of Science Thesis. Spring 2004. Department of Forest, Rangeland, and Watershed Stewardship. Colorado State University. Fort Collins CO.

Litton, R. Burton, Jr. 1984. Visual Vulnerability of the Landscape Control of Visual Quality. Research Paper, WO-39. US Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Research Station. Berkley CA. Available at: http://babel.hathitrust.org/cgi/pt?id=umn.31951d02973094s;page=root;view=image;size=100;seq=3;num=3

Long, J.N., and F.W. Smith. 2000. Restructuring the forest – goshawks and the restoration of southwestern ponderosa pine. Journal of Forestry, 98(8): 25-30.

Lovett, Kristie. 2010. The American dipper (*Cinclus mexicanus*) in the Black Hills of South Dakota. Final report to the South Dakota Department of Game, Fish and Parks. 56p.

Luce, B., A. Cerovski, B. Oakleaf, J. Priday, and L. Van Fleet. 1999. Atlas of Birds, Mammals, Reptiles, and Amphibians in Wyoming. Wyoming Game and Fish Department, Wildlife Division, Biological Services Section. Lander WY. November 1999.

Luce, C.H. and T.A. Black. 1999. Sediment Production from Forest Roads in Western Oregon. Water Resources Research, 35(8): 2561-2570.

Mahlum, S.K., L.A. Eby, M.K. Young, C.G. Clancy, and M. Jakober. 2011. Effects of wildfire on stream temperatures in the Bitterroot River Basin, Montana. International Journal of Wildland Fire, 20: 240–247.

Marc, Jaques. n.d. Predicting the Visual Impacts of Retention Cutting. British Columbia Ministry of Forests, Abstract of REC035, 2003. Internet Accessed [June 2006] at: http://www.for.gov.bc.ca/hfp/fordev/visual_resource_mgnt.htm#publications
Marc, Jacques. 1996. Clear-cutting and Visual Quality – A Public Perception Study. British Columbia Ministry of Forests, Forest Practices Branch, Published 1996. Internet Accessed [June 2006] at: http://www.for.gov.bc.ca/hfp/fordev/visual_resource_mgnt.htm#publications

Marc, Jaques. 2004. Public Opinion - What Do People Like? British Columbia Ministry of Forests - Forest Practices Branch. Victoria BC. Available at: http://www.for.gov.bc.ca/ftp/DKL/external/!publish/Forest_Development_Info/General_FSPandFDP_info/Exit%20Presentations/Visuals/Marc02.pdf

Marriott, Hollis J. 2000. Survey of Black Hills montane grasslands. Report to the South Dakota Department of Game, Fish and Parks. Pierre SD. 56pp.

Marriott, Hollis J., D. Faber-Langendoen, A. McAdams, D. Stutzman, and B. Burkhart. 1999. Black Hills community inventory: Final report. The Nature Conservancy, Midwest Conservation Science Center, Midwestern Resource Office. Minneapolis MN.

Marriott, Hollis J. and D. Faber-Langendoen. 2000. The Black Hills community inventory; Vol. 2: Plant Community Descriptions. The Nature Conservatory. Midwest Conservation Science Center and Association for Biodiversity Information. Midwestern Resource Office, Minneapolis MN. 326pp.

Marrone, G.M. 2002. Field Guide to the Butterflies of South Dakota. South Dakota Department of Game, Fish and Parks. Pierre SD. 478pp.

Marrone, G.M. 2005. A butterfly survey of the southern Black Hills and adjacent areas with emphasis on species monitored by the South Dakota Natural Heritage Program. Report submitted to South Dakota Department of Game, Fish and Parks. Fort Pierre SD.

Marrone, G.M. 2006. A butterfly survey of the northern Black Hills and adjacent areas with emphasis on species monitored by the South Dakota Natural Heritage Program. Report submitted to South Dakota Department of Game, Fish and Parks. Fort Pierre SD.

Marrone, G.M. 2007. Monitoring Surveys for the Dakota Fritillary (*Speyeria atlantis pahasapa*) in the Black Hills of South Dakota. Report submitted to South Dakota Department of Game, Fish and Parks. Fort Pierre SD.

Martin, J.E, et al. 2004. Geologic Map of South Dakota, General Map 10. South Dakota Department of Environment and Natural Resources, Geological Survey.

McCaffery, K.R., J.E. Ashbrener, W.A. Creed and B.E. Kohn. 1997. The Aspen-Ruffed Grouse Connection. Journal of Forestry, August: 16-20.

McCambridge, W.F., and R.E. Stevens. 1982. Effectiveness of Thinning Ponderosa Pine Stands in reducing Mountain Pine Beetle-Caused Tree Losses in the Black Hills. Preliminary Observations. Research Note, RM-414. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

McCambridge, W.F., et al. 1982. Ponderosa Pine Mortality Resulting from a Mountain Pine Beetle Outbreak. Research Paper, RM-235. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

McDonald, D., N.M. Korfanta, and S.J. Lantz. 2004. The Burrowing Owl (*Athene cunicularia*): a technical conservation assessment. September 14, 2004. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/burrowingowl.pdf [Accessed February 2, 2012].

McDonald, Phillip M., and R. Burton Litton, Jr. 1998. Combining Silviculture and Landscape Architecture to Enhance the Roadside View. Research Paper, PSW-RP-235. US Department of Agriculture, Forest Service, Pacific Pactola West Research Station. Albany CA.

McDowell, B. 2004. E-mail message dated April 1, 2004 from Bob McDowell, Wyoming Game and Fish Department regarding finescale dace information on the Black Hills of Wyoming.

McIntosh, A.C. 1931. A botanical survey of the Black Hills of South Dakota. Black Hills Engineer, 12: 159-276.

Meehan, W.R., editor. 1994. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. AFS Special Publication 19. Bethesda MD.

Megahan, W.F. 1986. Recent studies on erosion and its control on forest lands in the United States. In: Richard, F., editor. Range basin sediment delivery: Proceedings, 1986, August. Albuquerque NM. IAHS Publication 159, Wallingford, Oxon, United Kingdom: 178-189.

Megahan, W.F. and J. Hornbeck. 2000. Lessons learned in watershed management: a retrospective view. US Department of Agriculture, Forest Service, Proceedings RMRS-P-13.2000.

Mehl, S.M. 1992. Growth descriptions for the major cover types in the Rocky Mountain region. General Technical Report, RM-213. In: Old-growth forests in the Southwest & Rocky Mountain Regions, Proceedings of a Workshop. US Department of Agriculture, Forest Service. 106pp.

Merwin, D.S. 2000. Comparing levels and factors of lambing mortality between two herds of Rocky Mountain bighorn sheep in the Black Hills, South Dakota. Masters Thesis. University of Washington. Seattle WA. 125pp.

Millspaugh, J.J., G.C. Brundidge, R.A. Gitzen, and K.J. Raedeke. 2000. Elk and Hunter space-use sharing in South Dakota. The Journal of Wildlife Management, 64(4): 994-1003.

Mitsch, W.J., and J.G. Gosselink. 2007. Wetlands. 4th edition. John Wiley and Sons, Inc. Hoboken NJ. 582pp.

Mohren, Sean R. 2002. Habitat Evaluation and Density Estimates for the Black-backed Woodpecker (*Picoides arcticus*) and Northern Three-toed Woodpecker (*Picoides tridactylus*) in the Black Hills National Forest. Masters Thesis. University of Wyoming. Laramie WY.

Mohren, S., and S. Anderson. 2000. Black-backed woodpeckers (*Picoides articus*) and three-toed woodpeckers (*Picoides tridactylus*) in the Black Hills National Forest of Wyoming and South Dakota: Annual report for 2000 summer field season. Unpublished Report prepared for the Black Hills National Forest. Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming. Laramie WY.

Molinar, F., D. Galt, and J. Holechek. 2001. Managing For Mulch. Rangelands, 23(4): 3-7.

Moore, L., S. Friedley, and D.L. Hazlett. 2006. *Carex alopecoidea* Tuckerman (foxtail sedge): a technical conservation assessment. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at http://www.fs.fed.us/r2/projects/scp/assessments/carexalopecoidea.pdf.

NatureServe. 2011. NatureServe Explorer: An online encyclopedia of life. Version 7.1. NatureServe. Arlington VA. Available at: http://www.natureserve.org [Accessed: November 2011].

NWCG. 1998. Fireline Handbook. National Wildfire Coordinating Group Handbook 3, PMS 410-1.

Neary, Daniel G., Carole C. Klopatek, Leonard F. DeBano, and Peter F. Ffolliott. 1999. Fire effects on below ground sustainability: a review and synthesis. Forest Ecology and Management, 122: 51-71.

Neary, Daniel G., Kevin C. Ryan, Leonard F. DeBano, editors. 2005. Wildland fire in ecosystems: effects of fire on soils and water. General Technical Report, RMRS-GTR-42-vol4. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Ogden UT. 250pp.

Negron, J.F., K. Allen, B. Cook, and J.R. Withrow Jr. 2008. Susceptibility of ponderosa pine, *Pinus ponderosa* (Dougl. Ex Laws.), to mountain pine beetle, *Dendroctonus ponderosae* Hopkins, attack in uneven-aged stands in the Black Hills of South Dakota and Wyoming, USA. Forest Ecology and Management, 254: 327-334.

Newport, Carl A. 1956. A History of Black Hills Forestry. South Dakota Department of Game, Fish and Parks. Pierre SD. 112pp.

Nicholoff, S.H., Compiler. 2003. Wyoming Bird Conservation Plan, Version 2.0. Wyoming Partners In Flight. Wyoming Game and Fish Department. Lander WY. Available at: http://www.blm.gov/wildlife/plan/WY/menu.htm (Accessed February 4, 2012).

Olson, R., and W.A. Hubert. 1994. Beaver: Water Resources and Riparian Habitat Manager. University of Wyoming. Laramie WY.

Omi, P.N., Martinson, E.J., Chong, G.W. 2007. Tested by Fire: What Happens When Wildfires Meet Fuel Treatments. Joint Fire Science Program. Fire Science Brief. Issue 1, October, 2007. Available at: www.firescience.gov

Opler, P.A., K. Lotts, and T. Naberhaus, Coordinators. 2010. Butterflies and Moths of North America. Bozeman MT: Big Sky Institute. Available at: http://www.butterfliesandmoths.org [Accessed January 2011].

Oregon State University and Sea Grant Extension. 2003. Watershed Stewardship Education Program Training Guide. Watershed Definition. Available at: http://www.co.yamhill.or.us/ybc/defnWS.htm

Orr, H.K. 1968. Soil-moisture trends after thinning and clearcutting in a second-growth ponderosa pine stand in the Black Hills. Research Note, RM-99. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 8pp.

Orr, H.K. 1972. Throughfall and stemflow relationships in second-growth ponderosa pine in the Black Hills. Research Note RM-210. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 7pp.

Orr, H.K. 1975. Watershed management in the Black Hills: The status of our knowledge. Research Paper, RM-141. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 12pp.

Orr, H.K., and T. VanderHeide. 1973. Water yield characteristics of three small watersheds in the Black Hills of South Dakota. Research Paper, RM-100. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 8pp.

Panjabi, A. 2001. Monitoring the Birds of the Black Hills: Year 1 Final Report. Rocky Mountain Bird Observatory. Fort Collins CO. Available at:
http://www.fs.fed.us/r2/blackhills/projects/wildlife/index.shtml
Panjabi, A. 2003. Monitoring the Birds of the Black Hills: Year 2 Final Report. Rocky Mountain Bird Observatory. Brighton CO. Available at:
http://www.fs.fed.us/r2/blackhills/projects/wildlife/index.shtml

Panjabi, A. 2004. Monitoring the Birds of the Black Hills: Year 3 Annual Report. Rocky Mountain Bird Observatory. Brighton CO. Available at:
http://www.fs.fed.us/r2/blackhills/projects/wildlife/index.shtml

Panjabi, A. 2005. Monitoring the Birds of the Black Hills: Year 4 Annual Report. Rocky Mountain Bird Observatory. Brighton CO. Available at:
http://www.fs.fed.us/r2/blackhills/projects/wildlife/index.shtml

Parrish, J.B., D.J. Herman, D.J. Reyher, and Black Hills National Forest. 1996. A Century of Change in the Black Hills Forest and Riparian Ecosystems. B 722. US Department of Agriculture, Forest Service Agricultural Experiment Station, South Dakota State University. Brookings SD. 13pp.

Parson, A., P.R. Robichaud, S.A. Lewis, C. Napper, and J.T. Clark. 2010. Field guide for mapping post-fire soil burn severity. General Technical Report, RMRS-GTR-243. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins CO. 49pp.

Pearson, G.A. 1951. A comparison of the climate in four ponderosa pine regions. Journal of Forestry, 49: 256-258.

Pechota, Todd. 2012. Fires and Fuels Report for the Pine Beetle Response Project. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

Pennington County. 2006. Pennington County Community Wildfire Protection Plan. 2006. Pennington County SD.

Permit 2230 Files. Located at the Mystic Ranger District Office.

Peterson, C.R. 1974. A preliminary report on the amphibians and reptiles of the Black Hills of South Dakota and Wyoming. MS Thesis. University of Illinois.

Peterson, R.A. 1995. The South Dakota breeding bird atlas. South Dakota Ornithologists' Union. Northern Prairie Wildlife Research Center home page. Jamestown ND. Available at: http://www.npwrc.usgs.gov/resource/distr/birds/sdatlas/sdatlas.htm

Pettingill, P.S., and N.R. Whitney. 1965. Birds of the Black Hills. Special publication number 1, Cornell Laboratory of Ornithology, Cornell University. Ithaca NY. 140pp.

Piatt, J.R., and Paul D. Krause. 1974. Road and Site Characteristics that Influence Road Salt Distribution and Damage to Roadside Aspen Trees. Water, Air, and Soil Pollution, 3: 301-304.

Rabe, M., T. Morrell, H. Green, J. Devos Jr., and C. Miller. 1998. Characteristics of ponderosa-pine snag roosts used by reproductive bats in northern Arizona. Journal of Wildlife Management, 62(2): 612-621.

Rahn, P.H., and J.P. Gries. 1973. Large Springs in the Black Hills, South Dakota and Wyoming. Report of Investigations, No. 107. South Dakota Geological Survey. Vermillion SD.

Reeves, Derrick, Deborah Page-Dumroese, and Mark Coleman. 2011. Detrimental soil disturbance associated with timber harvest systems on National Forests in the Northern Region. Research paper, RMRS-RP-89. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins CO. 12pp.

Reid, L., and T. Lisle. 2008. Cumulative Effects and Climate Change. (May 20, 2008). US Department of Agriculture, Forest Service, Climate Change Resource Center. Available at: http://www.fs.fed.us/ccrc/topics/cumulative-effects.shtml [Accessed February 9, 2012].

Reid, L.M. 1993. Research and Cumulative Watershed Effects. General Technical Report, PSW-GTR-141. US Department of Agriculture, Forest Service. Berkeley CA. 118p.

Reinhardt, E.D., R.E. Keane, D.E. Calkin, and J.D. Cohen. 2008. Objectives and considerations for wildland fuel treatment in forested ecosystems of the interior western United States. Forest Ecology and Management, 256: 1997-2006.

Reyher, Deanna. 2012. Soils Report for the Pine Beetle Response Project. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer, SD.

Reynolds, R.T. 1983. Management of western coniferous forests for nesting accipiter hawks. General Technical Report, Report RM-102. US Department of Agriculture, Forest Service.

Reynolds, R.T., R.T. Graham, and D.A. Boyce. 2006. An ecosystem-based conservation strategy for the northern goshawk. Studies in Avian Biology, 31: 299-311.

Reynolds R.T., R.T. Graham, M.H. Reiser, M. Hildegard, R.L. Bassett, P.L. Kennedy, D.A. Boyce Jr., G. Goodwin, R. Smith, and E.L. Fisher. 1992. Management recommendations for the northern goshawk in the southwestern United States. General Technical Report, RM-217. US Department of

Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station and Southwestern Region Forest Service. Fort Collins CO. 90pp.

Reynolds, R.T., and S.M. Joy. 2006. Demography of goshawks in northern Arizona, 1991-1996. Studies in Avian Biology, 31: 63-74.

Ribe, Robert G. 1989. The Aesthetic of Forestry: What Has Empirical Preference Research Taught Us? Environmental Management, 13(1). Internet Accessed [October, 2006] at : http://www.springerlink.com/content/v4x5132735646770/fulltext.pdf

Ribe, Robert G. 2004. Aesthetic perceptions of green-tree retention harvests in vista views: The interaction of cut level, retention pattern and harvest shape. Landscape and Urban Planning, 73(4): 277-293. Available at: http://www.sciencedirect.com/science/article/pii/S0169204604000970

Richardson, A. 1971. The Rocky Mountain goat in the Black Hills. South Dakota Department of Game, Fish and Parks. Bulletin Number 2. 25pp.

Richie, C. 2008. Management and challenges of the mountain pine beetle infestation in British Columbia. Alces, 44: 127-135.

Rideout, C.B., and R.S. Hoffmann. 1975. *Oreamnos americanus*. Mammalian Species. American Society of Mammalogists, 63: 1-6.

Robichaud, P.R., and Waldrop, T.A. 1994. A Comparison of Surface Runoff and Sediment Yields from Low-and High-Intensity Prescribed Burns. Water Resources Bulletin, 30(I): 27-34.

Rocky Mountain Bird Observatory (RMBO). 2001-2010. Monitoring the Birds of the Black Hills: Annual Reports (Year 1-8) to the Black Hills National Forest. Custer, SD. Available at: http://www.fs.fed.us/r2/blackhills/projects/wildlife/index.shtml [Accessed January 2011].

Rom, Lance, Tim Church, and Michele Church. 1996. Black Hills National Forest Cultural Resources Overview. Manuscript of file at the Black Hills National Forest, Custer SD.

Rowland, M.M., M.J. Wisdom, B.K. Johnson and M.A. Penninger. 2004. Effects of Roads on Elk: Implications for Management in Forested Ecosystems. In: Transactions of the sixty-ninth North American Wildlife and Natural Resources Conference: resource stewardship in the 21st century: a voyage of rediscovery: March 16-20, 2004, Spokane, Washington. Pages 491-508. Wildlife Management Institute. Washington DC.

Royer, R.A., and G.M. Marrone. 1992. Conservation Status of the Tawny Crescent (*Phycoides batesii*) in North and South Dakota. US Department of Interior, Fish and Wildlife Service. Denver CO.

Ruggiero, L., K. McKelvey, J. Squires, and W. Block. 2008. Wildlife and Climate Change. (May 20, 2008). US Department of Agriculture, Forest Service, Climate Change Resource Center. Available at: http://www.fs.fed.us/ccrc/topics/wildlife.shtml

Rumble, Mark, and Anderson. 1996. Feeding ecology of Merriam's turkeys (*Meleagris gallepavo merriami*) in the Black Hills, South Dakota. American Midland Naturalist, 136(1): 157-171.

Rumble, Mark A., L. Benkobi, and R.S. Gamo. 2005. Elk responses to humans in a densely roaded area. Intermountain Journal of Sciences, 11(1): 10-24.

Running, S.W. 2006. Is Global Warming Causing More, Larger Wildfires? Science, 313: 927-928.

Ryan, J., S. Miyamoto, and J.L. Stroehlein. 1975. Salt and Specific Ion Effects on Germination of Four Grasses. Journal of Range Management, 28(1): 61-64.

Ryan, Robert L. 2005. Social Science to Improve Fuels Management: A synthesis of Research On Aesthetics and Fuels Management. General Technical Report, NC-261. US Department of Agriculture, Forest Service, North Central Research Station. Saint Paul MN.

Saab, V., W. Block, R. Russell, J. Lehmkuhl, L. Bate and R. White. 2007. Birds and burns of the interior west: descriptions, habitats, and management in western forests. General Technical Report, PNW-GTR-712. US Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland OR. 23pp.

SAIC. 2003. Memorandum. A Framework for Revising Deer and Elk Strategic Management Direction on the Black Hills National Forest. Science Application International Corporation (SAIC). SAIC project number 01-0209-04-4456-106. 26pp.

SAIC. 2005. Selection of management indicator species on the Black Hills National Forest Phase II Plan Amendment. Science Application International Corporation (SAIC).
Sando, S.K. 1998. Techniques for Estimating Peak-Flow magnitude and Frequency Relations for South Dakota Streams. USGS Water-Resources Investigations Report 98-4055. 52p.

Sandrini, J. 2007. 2006 Job Completion Report, Black Hills White-tailed Deer. Casper Region; Herd Unit 706, Wyoming Game and Fish Department. Newcastle WY.

Sauer, J.R., J.E. Hines, and J. Fallon. 2008. The North American Breeding Bird Survey, Results and Analysis 1966 - 2007. Version 5.15.2008. USGS Patuxent Wildlife Research Center, Laurel, MD Available: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html [Accessed January 2011].

Sauer, J.R., J.E. Hines, J.E. Fallon, K.L. Pardieck, D.J. Ziolkowski Jr., and W.A. Link. 2011. The North American Breeding Bird Survey, Results and Analysis 1966 - 2009. Version 3.23.2011 USGS Patuxent Wildlife Research Center. Laurel MD.

Sawyer, H., R.M Nielson, F. Lindzey and L.L. McDonald. 2006. Winter habitat selection of mule deer before and during development of a natural gas field. Journal of Wildlife Management, 70(2): 396-403.

Schaupp, Willis C. 2011. Personal communication. Communication regarding mountain pine beetle effects to pine and spruce communities. US Department of Agriculture, Forest Service. Forest Health Protection, Rocky Mountain Research Station. Rapid City SD.

Schmid, J.M. and S.A. Mata. 1992. Stand density and mountain pine beetle-caused tree mortality in ponderosa pine stands. Research Note, RM-515. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Schmid, J.M., and S.A. Mata. 2005. Mountain pine beetle-caused tree mortality in partially cut plots surrounded by unmanaged stands. Research Paper, RMRS-RP-54. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 11pp.

Schmid, J.M., S.A. Mata, R.R. Kessler, and J.B. Popp. 2007. The Influence of Partial Cutting on Mountain Pine Beetle-caused Tree Mortality in Black Hills Ponderosa Pine Stands. Research Paper, RMRS-RP-68. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 19pp.

Schmid, J.M., S.A. Mata and R.A.Obedzinski. 1994. Hazard Rating Ponderosa Pine Stands for Mountain Pine Beetles in the Black Hills. Research Note, RM-529. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO.

Schmid, J.M., S.A. Mata, and W.C. Schaupp, Jr. 2009. Mountain pine beetle-killed trees as snags in Black Hills ponderosa pine stands. Research Note, RMRS-RN-40. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO. 5pp.

Schmid, J.M., S.A. Mata, R.K. Watkins, and M.R. Kaufmann. 1991. Water potential in ponderosa pine stands of different growing-stock levels. Canadian Journal of Forestry Research, 21: 750-755.

Schmidt, C.A. 2003a. Conservation Assessment for the Long-eared Myotis in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Rocky Mountain Region, Black Hills National Forest. Custer SD. 22 pp. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012270.pdf

Schmidt, C.A. 2003b. Conservation Assessment for the Long-legged Myotis in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Rocky Mountain Region, Black Hills National Forest. Custer SD. 20 pp. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012271.pdf

Schmidt, C.A. 2003c. Conservation Assessment for the Northern Myotis in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Rocky Mountain Region, Black Hills National Forest. Custer SD. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012446.pdf

Schmidt, C.A. 2003d. Conservation Assessment for the Small-footed Myotis in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Rocky

Mountain Region, Black Hills National Forest. Custer SD. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012519.pdf

Schmidt, C.A. 2003e. Conservation Assessment for the Townsend's big-eared bat in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Rocky Mountain Region, Black Hills National Forest. Custer SD. 23pp. Available: http://fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012119.pdf. [January 2011].

Schmidt, C.A., and S.H. Anderson. 2003. Conservation assessment for the fringed bat in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Rocky Mountain Region, Black Hills National Forest. Custer SD. Available: http://fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012246.pdf. [January 2011].

Schmidt, K.M., J.P. Menakis, C.C. Hardy, W.J. Hann, and D.L. Bunnell. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. General Technical Report, RMRS-GTR-87. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins CO.

Schultz, B. 2011. Personal communication. Senior Scientist, Air Quality Staff. South Dakota Department of Environment and Natural Resource. Pierre SD. Email Communication.
Schultz, Luke D. 2011. Environmental factors associated with long-term trends of mountain sucker populations in the Black Hills, and an assessment of their thermal tolerance. Available at: http://pubstorage.sdstate.edu/wfs/thesis/Schultz%20Luke%20D%202011%20MS.pdf

Schultz, Luke D., and K.N. Bertrand. 2012. Long Term Trends and Outlook for Mountain Sucker in the Black Hills of South Dakota. American Midland Naturalist, 167: 96-110. Available at: http://www.bioone.org/doi/full/10.1674/0003-0031-167.1.96

Sedgwick, J.A. 2006. Long-billed curlew (*Numenius americanus*): A technical conservation assessment. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/longbilledcurlew.pdf [Accessed February 9, 2012].

Selby, G. 2005. Ottoe Skipper (*Hesperia ottoe* W.H. Edwards): a technical conservation assessment. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/ottoeskipper.pdf [Accessed January 2011].

Selby, G. 2007. Regal Fritillary (*Speyeria idalia* Drury): a technical conservation assessment. February 9, 2007. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/regalfritillary.pdf [Accessed February 2, 2012].

Sestrich, C.M., T.E. McMahon, and M.K. Young. 2011. Influence of Fire on Native and Nonnative Salmonid Populations and Habitat in a Western Montana Basin. Transactions of the American Fisheries Society, 140: 136-146.

Sharps, J.C., and D. O'Brien. 1985. Peregrine falcon reintroduction in the Black Hills, South Dakota, 1977–1980. Game Report. Completion Report No. 85-10. South Dakota Department of Game, Fish and Parks, Wildlife Division. Pierre SD.

Shearer, J. 2006. Personal communication. E-mail message dated May 25, 2006 from Jeff Shearer, Coldwater Fisheries Biologist, South Dakota Department of Game, Fish and Parks, Rapid City, SD to Steve Hirtzel, Fisheries Biologist, Black Hills National Forest, Custer, SD regarding the spawning period for mountain suckers in the Black Hills.

Sheley, R.L., and J.K. Petroff. 1999. Biology and Management of Noxious Rangeland Weeds. Oregon State University Press. Corvallis OR.

Shepperd, Wayne D., and Michael A. Battaglia. 2002. Natural Disturbances: Insects: Mountain Pine Beetle. General Technical Report, RMRS-GTR-97. In: Ecology, Silviculture, and Management of Black Hills Ponderosa Pine. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins CO. 122pp.

Shepperd, Wayne D., Fredrick W. Smith, and Leigh Lentile. 2000. Snag Management in the Black Hills National Forest: Final Report. Unpublished Paper. Department of Forest Sciences, Colorado State University, and US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins CO. For the Black Hills National Forest, Custer SD.

Shepperd, W.D., C.E. Troendle, and C.B. Edminster. 1992. Linking water and growth and yield models to evaluate management alternatives in subalpine ecosystems. In: Murphy, D., comp. Getting to the future through silviculture—Workshop proceedings; 1991 May 6–9; Cedar City, UT. General Technical Report, INT-291, 42-48 pp. US Department of Agriculture, Forest Service, Intermountain Research Station. Ogden UT.

Shinneman, D.J., and W.L. Baker. 1997. Non-equilibrium dynamics between catastrophic disturbances and old-growth forest in ponderosa pine landscapes of the Black Hills. Conservation Biology, 11(6): 1276-1288.

Sieg, Carolyn Hull, and Keith E. Severson. 1996. Managing habitats for white-tailed deer in the Black Hills and Bear Lodge Mountains of South Dakota and Wyoming. General Technical Report, RM-GTR-274. 24pp. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO.

Skinner, C., and M. Ritchie. 2008. The Cone Fire: A Chance Reckoning for Fuel Treatments. Joint Fire Science Program. Fire Science Brief, Issue 4, January 2008.

Skorkowsky, R.C. 2009. Response of northern goshawk under a no-action alternative to tree mortality resulting from a mountain pine beetle epidemic. White-paper completed for US Department of Agriculture, Forest Service, Rocky Mountain Region, in response to large scale insect epidemic conditions in lodgepole pine forest. Lakewood CO. 13pp.

Slater, G.L. 2004. Grasshopper Sparrow (*Ammodramus savannarum*): A Technical Conservation Assessment. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/project/scp/assessments/grasshoppersparrow.pdf [Accessed February 9, 2012].
Slater, G.L., and C. Rock. 2005. Northern harrier (*Circus cyaneus*): A technical conservation assessment. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/northernharrier.pdf [Accessed February 9, 2012].

Smith, B.E. 2003. Conservation assessment for the northern leopard frog in the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. 78p. Available at: http://fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012268.pdf. [Accessed January 2011]

Smith, B.E., and N.T. Stephens. 2003. Conservation assessment for the redbelly snake in the Black Hills National Forest, South Dakota and Wyoming. 18p. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at: http://fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012483.pdf [Accessed January 2011].

Smith, B.E. and D.A. Keinath. 2007. Northern leopard frog (*Rana pipiens*): a technical conservation assessment. US Department of Agriculture, Forest Service, Rocky Mountain Region. Available at: http://www.fs.fed.us/r2/projects/scp/assessments/northernleopardfrog.pdf [Accessed February 9, 2012].

Smith, David M., et al. 1997. The Practice of Silviculture. John Wiley & Sons, Inc. New York City NY. 577pp.

Smith, F.M. 1983. Appraisal of water yield as affected by basal area reduction of ponderosa pine: Sturgis Watersheds, Black Hills, South Dakota. Cooperative agreement 16-949-CA. 36pp. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins CO.

SD Codified Laws: 31-18-1 Section Line R-O-W; 31-18-2 Section Line R-O-W; 31-22-1 Access from Isolated Tracts; 31-22-2 Inability to Agree with Servient Landowner; 40-28-5 Trespass Liability not Applicable to Unfence Lands within the National Forest; 43-23-3 Fence Agreed to by Owners of Adjoining Land; 43-23-4 Legal Partition Fence.

SDDA. 2010. Noxious and Invasive Plant List. South Dakota Department of Agriculture. http://sdda.sd.gov/Ag_Services/Plant-Protection/Weed%20and%20Pest/State-Noxious-Weeds.aspx

SDDENR. 1998. The 1998 South Dakota 303(d) Waterbody List. 109pp. South Dakota Department of Environment and Natural Resources. Available at: http://www.state.sd.us/denr

SDDENR. 1999. Article 74:51. The Administrative Rules of South Dakota (ARSD 74:51:01:02 and :03). South Dakota's Surface Water Quality Standards. South Dakota Department of Environment and Natural Resources.

SDDENR. 2002. South Dakota Total Maximum Daily Load Waterbody List 2002. 67pp. South Dakota Department of Environment and Natural Resources. Available at: http://denr.sd.gov/des/sw/IntegratedReports.aspx

SDDENR. 2004. The 2004 South Dakota Integrated Report for Surface Water Quality Assessment. 230pp. South Dakota Department of Environment and Natural Resources. Available at: http://denr.sd.gov/des/sw/IntegratedReports.aspx

SDDENR. 2006. The 2006 South Dakota Integrated Report for Surface Water Quality Assessment. 211pp. South Dakota Department of Environment and Natural Resources. Available at: http://denr.sd.gov/des/sw/IntegratedReports.aspx

SDDENR. 2008. The 2008 South Dakota Integrated Report for Surface Water Quality Assessment. 262pp. South Dakota Department of Environment and Natural Resources. Available at: http://denr.sd.gov/des/sw/IntegratedReports.aspx

SDDENR. 2010. The 2010 South Dakota Integrated Report for Surface Water Quality Assessment. 272pp. South Dakota Department of Environment and Natural Resources, Steven M Pirner, Secretary. Pierre SD. Available at: http://denr.sd.gov/des/sw/IntegratedReports.aspx. Available at: http://denr.sd.gov/documents/10irfinal.pdf

SDDENR. 2011a. Groundwater Quality Program, Online Spill Reporting Database. South Dakota Department of Environment and Natural Resources. Available at http://denr.sd.gov/des/gw/Spills/SpillData.aspx [Accessed February 2011].

SDDENR. 2011b. Water Rights Program. South Dakota Well Completion Reports Database. Accessed February 2011. South Dakota Department of Environment and Natural Resources. Available at http://denr.sd.gov/des/wr/dblogsearch.aspx

SDDOT. 2006. 2005 South Dakota Traffic Flow Map. South Dakota Department of Transportation. Pierre SD. 2006. Available at: http://www.sddot.com/pe/data/Docs/trafficmaps/Traffic2005.pdf [accessed November 17, 2006].

SD Division of Forestry (unknown date). Best Management Practices for Water Quality Protection on Timber Harvest and Their Silvicultural Activities in South Dakota. South Dakota Division of Forestry. Pierre SD.

SDGFP. 2004a. South Dakota Bat Management Plan. South Dakota Bat Working Group. Wildlife Division Report 2004-08. July 13, 2004. 97pp. South Dakota Department of Game, Fish and Parks. Available at: http://gfp.sd.gov/wildlife/management/plans/bat-management-plan.aspx [Accessed February 9, 2012].

SDGFP. 2004b. South Dakota Statewide Fisheries Surveys. Pactola Reservoir. South Dakota Department of Game, Fish and Parks.

SDGFP. 2005a. South Dakota All Bird Conservation Plan. Wildlife Division Report 2005-09. 131pp. South Dakota Department of Game, Fish and Parks. Pierre SD. Available at: http://www.sdgfp.info/Wildlife/Diversity/Birdplan.pdf [Accessed January 27, 2011].

SDGFP. 2005b. Stream Fisheries Database. April 14, 2005. South Dakota Department of Game, Fish and Parks.

SDGFP. 2006a. Statewide Fisheries Surveys, 2004. Surveys of Public Waters – Part 1 Lakes Region 1. Progress Report Number 06-09. South Dakota Department of Game, Fish and Parks. Available at: http://e.library.sd.gov/SodakLIVE-Docs/content/gfp/GFPdoc104.pdf

SDGFP. 2006b. Statewide Fisheries Surveys, 2005. Surveys of Public Waters – Part 1 Lakes Region 1. Progress Report No. 06-10. South Dakota Department of Game, Fish and Parks.

SDGFP. 2006c. Statewide Fisheries Surveys, 2006. Surveys of Public Waters – Part 1 Lakes Region 1. Report 07-11. South Dakota Department of Game, Fish and Parks.

SDGFP. 2007. Statewide Fisheries Surveys, 2007. Surveys of Public Waters – Part 1 Lakes Region 1. South Dakota Department of Game, Fish and Parks.

SDGFP. 2009. South Dakota 2009 fish stocking schedule. South Dakota Department of Game, Fish and Parks. Available at: http://gfp.sd.gov/fishing-boating/tacklebox/lake-surveys/fish-stocking.aspx [Accessed August 13, 2010].

SDGFP. 2010a. Hunting and Trapping Handbook. South Dakota Department of Game, Fish and Parks. Pierre SD. 61pp.

SDGFP. 2010b. Stream Fisheries Database. March 31, 2010. South Dakota Department of Game, Fish and Parks.

SDGFP. 2011a. Natural Heritage Database: List of State Species of Concern. South Dakota Department of Game, Fish and Parks. Pierre SD. Available at: http://www.sdgfp.info/Wildlife/Diversity [Accessed January 5, 2011].

SDGFP. 2012. Eagle awareness: Midwinter survey results. South Dakota Department of Game, Fish and Parks. Available at: http://gfp.sd.gov/outdoor-learning/bald-eagle-awareness-days/midwinter.aspx [Accessed February 9, 2012].

SDNHP. 2009. Rare, Threatened, and Endangered Plant Species Tracked by the South Dakota Natural Heritage Program. South Dakota Natural Heritage Program, South Dakota Department of Game, Fish and Parks. Available at: http://www.sdgfp.info/Wildlife/Diversity/RarePlant.htm [Accessed January 12, 2011].

SD Pennington County. 2007. Noxious and Invasive Plant List. Pennington County, South Dakota. Available at: http://www.co.pennington.sd.us/weedpest/localwds.htm

SDSU et al. 2003. Forestry Best Management Practices for South Dakota. 26pp. South Dakota State University, South Dakota Cooperative Extension Service, US Environmental Protection Agency, South Dakota Department of Environment and Natural Resources and South Dakota Department of Agriculture.

SDSU et al. 2004. Forestry Best Management Practices for South Dakota. South Dakota State University, South Dakota Cooperative Extension Service, US Environmental Protection Agency, South Dakota Department of Environment and Natural Resources and South Dakota Department of Agriculture. 2004. Forestry Best Management Practices for South Dakota.

Spiering, D.J., and R.L Knight. 2005. Snag density and use by cavity-nesting birds in managed stands of the Black Hills National Forest. Forest Ecology and Management, 214: 40-52.

Squires, J.R., and L.F. Ruggiero. 1996. Nest-site preference of northern goshawks in South-central Wyoming. Journal of Wildlife Management, 60(1): 170–177.

Stankowich, T. 2008. Ungulate flight responses to human disturbance: a review and meta-analysis. Biological Conservation, 141: 2159-2173.

Stefanich, M.R. 1995. Movements and habitat use of white-tailed deer in the northwestern Black Hills of Wyoming and South Dakota. Master's thesis. University of Wyoming. Laramie WY.

Stefanich, M.R. 2001a. Conservation Assessment for the Tawny Crescent in the Black Hills National Forest of South Dakota and Wyoming. US Department of Agriculture, Forest Service, Rocky Mountain Region. Custer SD. 45pp.

Stefanich, M.R. 2001b. Draft conservation assessment for the tawny crescent in the Black Hills National Forest of South Dakota and Wyoming. US Department of Agriculture, Forest Service, Black Hills National Forest. March 2001.

Stephens, R.M. and S.H. Anderson. 2002. Conservation Assessment for the Cooper's Hawk and Sharp-Shinned Hawk in the Black Hills National Forest, South Dakota and Wyoming. 50pp. Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming. Laramie, WY. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012178.pdf [Accessed January 2011].

Stephens, R.M., and S.H. Anderson. 2003. Conservation assessment for the broad-winged hawk of the Black Hills National Forest, South Dakota and Wyoming. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. 25pp. Available at: http://fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_012127.pdf [Accessed January 2011].

Stewart, R.K., and C.A. Thilenius. 1964. Stream and lake inventory and classification in the Black Hills of South Dakota. Dingell-Johnson Project F-1-R-13, Job Numbers 14 and 15. South Dakota Department of Game, Fish and Parks. Pierre SD.

Strobel, M.L., G.J. Jarrell, J.F. Sawyer, J.R. Schleicher, and M.D. Fahrenbach. 1999. Distribution of Hydrogeologic Units in the Black Hills Area, South Dakota. US Geologic Survey Hydrologic Investigations Atlas HA-743.

Stubblefield, C.H., K.T. Vierling, and M.A. Rumble. 2006. Landscape-scale attributes of elk centers of activity in the central Black Hills of South Dakota. Journal of Wildlife Management, 70(4): 1060-1069.

Sturdevant, Jay T. 2009. Experimental Study of Local Fire Conditions and Effect on Surface or Near-Surface Archeological Resources at National Park Service Units — Midwest Region; Joint Fire Science Program Final Report, Project Number 06-2-1-05.

Sundstrom, Linea. 1989. Culture history of the Black Hills with reference to adjacent areas of the Northern Great Plains. Reprints in Anthropology 40. J & L Reprint Company. Lincoln NE.

Suttle, K.B., M.E. Power, J.M. Levine, and C. McNeely. 2004. How fine sediment in riverbeds impairs growth and survival of juvenile salmonids. Ecological Applications, 14(4): 969-974.

Swengel, Ann B. 1996. Effects of fire and hay management on abundance of prairie butterflies. Biological Conservation, 83:77-89.

Taglioli, B. 2012. Engineering Report for the Mountain Pine Beetle Response Project. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

Tallman, Dan A., David L. Swanson, and Jeff S. Palmer. 2002. Birds of South Dakota. 3rd Edition. Northern State University Press. Aberdeen SD. 441pp.

Thomas, S. 2007. Mystic Ranger District: Best Management Practices/Watershed Conservation Practices Summary Report 2002-2006. US Department of Agriculture, Forest Service, Black Hills National Forest, Mystic Ranger District. Rapid City SD.

Thomas, S. 2008. Best Management Practices/Watershed Conservation Practices Summary Report 2002-2007. US Department of Agriculture, Forest Service, Black Hills National Forest, Hell Canyon Ranger District. Custer SD.

Thomas, S. 2010a. Best Management Practices. Beagle Timber Sale, Unit 4 Roads Summary. US Department of Agriculture, Forest Service, Black Hills National Forest, Mystic Ranger District. Rapid City SD.

Thomas, S. 2010b. Forest plan standards monitoring report field season 2010. US Department of Agriculture, Forest Service, Black Hills National Forest, Mystic Ranger District. Rapid City SD.

Tigner, Joel, and W.C. Aney. 1994. Report of Black Hills bat survey, October 1993-October 1994. Yearly Report, Nemo/Spearfish Ranger District, Black Hills National Forest, Nov. 25, 1994.

Tigner, Joel, and E. Dowd Stukel. 2003. Bats of the Black Hills: A Description of Status and Conservation Needs. South Dakota Dept. of Game, Fish and Parks. Wildlife Division Report 2003-05. 94pp. South Dakota Department of Game, Fish and Parks. Pierre SD. 94pp. Available at: http://www.sdgfp.info/Wildlife/Diversity/battechreport.pdf [Accessed January 2011].

Tobalske, B.W. 1997. Lewis' woodpecker (*Melanerpes lewis*). In the birds of North America, No. 284 (A. Poole and F. Gills, editors). The Academy of Natural Sciences. Philadelphia PA. The American Ornithologists' Union. Washington DC.

Tratebas, Alice M., Niccole Villa Cerveny, and Ronald I. Dorn. 2004. The Effects of Fire on Rock Art: Microscopic Evidence Reveals the Importance of Weathering Rinds. Physical Geography, 25(4): 313–333.

Troendle, C.A., and King, R.M. 1987. The effect of partial and clearcutting on streamflow at Deadhorse Creek, Colorado. Journal of Hydrology, 90: 145-157.

Turner, A.K., and R.L. Schuster, editors. 1996. Landslides: Investigation and Mitigation. Special Report 247, National Research Council, Transportation Research Board. National Academy Press. Washington DC. 675pp.

Turner, R.W. 1974. Mammals of the Black Hills of South Dakota and Wyoming. University of Kansas. Museum of Natural History. Miscellaneous Publication 60: 1-178.

Twiss, John C. 2003. Letter from Twiss, Forest Supervisor, Black Hills National Forest to D. Gober, Field Supervisor, United States Fish and Wildlife Service, South Dakota Field Office. August 6, 2003.

US Army Corps of Engineers. 1987. Corps of Engineers Wetlands Delineation Manual. Wetlands Research Program Technical Report, Y-87-1. Environmental Laboratory, Waterways Experiment Station. Vicksburg MS.

US Army Corps of Engineers and Environmental Protection Agency (EPA). 2008. Compensatory Mitigation for Losses of Aquatic Resources – Final Rule. Federal Register April 10, 2008. Part II. Department of Defense, Department of the Army, Corps of Engineers at 33 CFR Parts 325 and 332; Environmental Protection Agency at 40 CFR Part 230. 113pp.

US Census Bureau. 2000. Available at http://www.census.gov

US Census Bureau. 2010. Available at http://www.census.gov

USDA Animal and Plant Health Inspection Service (APHIS). 2010. Federal Noxious Weed List Available at: http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/index.shtml

USDA Forest Service. n.d. Agricultural Manual 7700 Transportation System, Chapter 10 Atlas, Records, and Analysis, Chapter 20 Development, and Chapter 30 Operation and Maintenance. US Department of Agriculture, Forest Service.

USDA Forest Service. n.d. Best Management Practices for the Control of Nonpoint Pollution from Silvicultural and Related Road Activities. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. n.d. Forest Service Handbook. 2409.15 – Timber Sale Administration Handbook, Chapter 50, Specified Transportation Facilities, Black Hills Supplement No. 2409.15-92-1. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. n.d. Forest Service Handbook, 2209.13. US Department of Agriculture, Forest Service. Washington DC.

USDA Forest Service. n.d. Forest Service Manual 2230. US Department of Agriculture, Forest Service. Washington DC.

USDA Forest Service. 1973. Agricultural Handbook 434. National Forest Landscape Management, Volume 1. US Department of Agriculture, Forest Service. US Government Printing Office. Washington DC.

USDA Forest Service. 1977. Agricultural Handbook 483, National Forest Landscape Management, Volume 2 - Chapter 4, Roads. US Department of Agriculture, Forest Service. US Government Printing Office. Washington DC.

USDA Forest Service. 1979. Environmental analysis report, peregrine falcon reintroduction. US Department of Agriculture, Rocky Mountain Region, Black Hills National Forest, Harney Ranger District. May 31, 1979. 29pp.

USDA Forest Service. 1980. Agricultural Handbook 559. National Forest Landscape Management, Volume 2 - Chapter 5, Timber. US Government Printing Office. Washington DC.

USDA Forest Service. 1982. Photo Series for Quantifying Forest Residues in the Black Hills: Ponderosa Pine Type and Spruce Type. US Department of Agriculture, Forest Service, Rocky Mountain Region. 80pp.

USDA Forest Service. 1985. Agricultural Handbook 608. National Forest Landscape Management, Volume 2 - Chapter 6, Fire. US Department of Agriculture, Forest Service. US Government Printing Office. Washington DC.

USDA Forest Service. 1990. Photo Series For Quantifying Forest Residues in the: Black Hills – Ponderosa Pine Type and Spruce Type. A-89-1-90. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins CO.

USDA Forest Service. 1991. Mineral Program Handbook. US Department of Agriculture, Forest Service. Washington DC.

USDA Forest Service. 1992. Forest Service Handbook, Region 2 Supplement, 2509.18 – Soil Management Handbook. US Department of Agriculture, Forest Service, Rocky Mountain Region. Fort Collins CO.

USDA Forest Service. 1995a. Agricultural Handbook 701. Landscape Aesthetics; A Handbook for Scenery Management, and (2000) Landscape Aesthetics Handbook Revision. US Department of Agriculture, Forest Service. US Government Printing Office. Washington DC.
Available at: http://www.esf.edu/es/via

USDA Forest Service. 1995b. Burned-Area Emergency Rehabilitation Handbook, FSH 2509.13. US Department of Agriculture, Forest Service. Washington DC.

USDA Forest Service. 1996a. Black Hills National Forest Cultural Resources Overview, Volumes 1 (Synthetic Summary) and 2 (Management Summary). Edited by Lance Rom, Tim Church, and Michele Church. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Manuscript on file at Supervisors Office, Black Hills National Forest.

USDA Forest Service. 1996b. Final environmental impact statement for the revised land and resource management plan for the Black Hills National Forest. December, 1996. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at: http://www.fs.fed.us/r2/blackhills/projects/planning/index.shtml

USDA Forest Service. 1996c. Memo 2500/2600 (July 29, 1996) NEPA Guidance for Watershed from Jim Maxwell, Water Program Team Leader to Region 2 Director of Planning and Budget and Region 2 Watershed Staff. US Department of Agriculture, Forest Service, Rocky Mountain Region.

USDA Forest Service. 1996d. Rangeland Analysis and Management Training Guide. August 2006. US Department of Agriculture, Forest Service, Rocky Mountain Region. Denver CO.

USDA Forest Service. 1997a. Livestock Grazing Environmental Assessment for Pactola/Harney Ranger District. September, 1997. US Department of Agriculture, Forest Service, Black Hills National Forest. Rapid City SD.

USDA Forest Service. 1997b. Revised Black Hills National Forest Land and Resource Management Plan. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 1999a. Evaluation of Mountain Pine Beetle Activity in the Black Hills National Forest. Biological Evaluation, R2-00-03. 19pp.

UDSA Forest Service. 1999b. Roads Analysis: Informing Decisions about Managing the National Forest Transportation System. Miscellaneous Report, FS-643. US Department of Agriculture, Forest Service. Washington DC. 222pp.

USDA Forest Service. 2000a. Expert interview summary for the Black Hills National Forest Land and Resource Management Plan Amendment. US Department of Agriculture, Forest Service, Black

Hills National Forest. Custer SD. 151pp. Available at:
http://fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_011876.pdf

USDA Forest Service. 2000b. Quick Silver, a project analysis tool to determine the economic performance of long-term investments. Mike Vasievich, US Department of Agriculture, Forest Service, Rocky Mountain Region. Golden CO. February 15, 2000.

USDA Forest Service. 2001a. Agricultural Manual 7700 Transportation System, Chapter 10 Atlas, Records, and Analysis, Chapter 20 Development, and Chapter 30 Operation and Maintenance. US Department of Agriculture, Forest Service. Washington DC.

USDA Forest Service. 2001b. R2 Roads Analysis Supplement to FS-643. US Department of Agriculture, Forest Service, Rocky Mountain Region. Denver CO.

USDA Forest Service. 2001c. USDA Forest Service Guide to Noxious Weed Prevention Practices. US Department of Agriculture, Forest Service. Washington DC.
USDA Forest Service. 2002. Memo 2070/2520-7/2620 (March 19, 2002) Wetland Protection - Fens from Bruce F. Short (FOR) Marisue Hilliard, Director Renewable Resources to Region 2 forest supervisors.

USDA Forest Service. 2003a. Black Hill National Forest, Forest Plan Best Management Practices Evaluation. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 2003b. Forest Plan Best Management Practices Evaluation. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 2003c. Noxious Weed Management Plan. Custer, SD. February 2003. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 2004a. Black Hills National Forest 2003 Monitoring and Evaluation Report. US Department of Agriculture, Forest Service, Black Hills National Forest. Available at:
http://www.fs.fed.us/r2/blackhills/projects/planning/index.shtml

USDA Forest Service. 2004b. Forest Service Manual 2520 – Watershed Protection and Management. US Department of Agriculture, Forest Service, Washington Office. Washington DC. 44pp.

USDA Forest Service. 2004c. Western Forests, Fire Risk, and Climate Change. Science Update, Issue 6. January 2004. US Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland OR. Available at: http://www.fs.fed.us/pnw.

USDA-Forest Service. 2005a. Analysis of Alternative Treatment Methods to Maintain Limited Fire Potential Following the Prairie Project, Black Hills National Forest. March, 2005. US Department of Agriculture, Forest Service, Black Hills National Forest, Mystic Ranger District. Rapid City SD.

USDA Forest Service. 2005b. Biological Evaluation for the Phase II Amendment to the Forest Plan. Black Hills National Forest. US Department of Agriculture, Forest Service, Black Hills National

Forest. Available online:
http://www.fs.fed.us/r2/blackhills/projects/planning/amendments/phase_II/feis/10_append_c_2005_1019_p1-106.pdf

USDA Forest Service. 2005c. Black Hills National Forest Developed Recreation Strategy. July 2005. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 2005d. Black Hills National Forest Phase II Amendment and Final Environmental Impact Statement for the 1997 Land and Resource Management Plan. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 2005e. Deerfield Project Area Final Environmental Impact Statement. US Department of Agriculture, Forest Service, Black Hills National Forest, Mystic Ranger District. Rapid City SD. Available at:
http://www.fs.fed.us/r2/blackhills/projects/nepa/public_docs/deerfield/index.shtml.

USDA Forest Service. 2005f. Final Environmental Impact Statement and Biological Evaluation for the Phase II Amendment to the 1997 Revised Land and Resource Management Plan for the Black Hills National Forest. October 2005. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at:
http://www.fs.fed.us/r2/blackhills/projects/planning/index.shtml

USDA Forest Service. 2005g. Final Environmental Impact Statement for the Phase II Amendment to the 1997 Revised Land and Resource Management Plan for the Black Hills National Forest. October 2005. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Manuscript on file at Supervisors Office, Black Hills National Forest. Also available at:
http://www.fs.fed.us/r2/blackhills/projects/planning/index.shtml

USDA Forest Service. 2005h. Memorandum of Understanding between United States Department of Agriculture, Forest Service, Rocky Mountain Region and Intermountain Region and Wyoming Department of Environmental Quality. FS Agreement #05-MU-11020000-021.

USDA Forest Service. 2005i. Record of Decision for the Phase II Amendment to the 1997 Revised Land and Resource Management Plan for the Black Hills National Forest. October, 2005. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at:
http://www.fs.fed.us/r2/blackhills/projects/planning/index.shtml

USDA Forest Service. 2006a. Black Hills National Forest Fire Management Plan. July, 2006. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 2006b. Black Hills National Forest FY2005 Monitoring and Evaluation Report. US Department of Agriculture, Forest Service, Black Hills National Forest. September 2006. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm9_011879.pdf

USDA Forest Service. 2006c. Forest Service Handbook, Region 2 Supplement, 2509.25 – Watershed Conservation Practices Handbook. US Department of Agriculture, Forest Service, Rocky Mountain Region. Fort Collins CO. 58pp.

USDA Forest Service. 2006d. Forest Service Handbook 2509.25 – Watershed Conservation Practices Handbook. Amendment No.: 2509.25-2006-2. Effective date May 5, 2006. US Department of Agriculture, Forest Service, Rocky Mountain Region (Region 2). Denver CO.

USDA Forest Service. 2006e. Forest Service Manual 2880 - Geologic Resources, Hazards, and Services. US Department of Agriculture, Forest Service, Washington Office. Washington DC.
USDA Forest Service. 2006. Land and Resource Management Plan, as amended by Phase II. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 2006f. Monitoring Implementation Guide for Sensitive Plant Species and Plant Species of Local Concern for the Black Hills National Forest Land and Resource Management Plan (Addendum to the October 2005 Guide). US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at:
http://www.fs.fed.us/r2/blackhills/projects/planning/plant_monitoring_guide_2006.pdf

USDA Forest Service. 2006g. 1997 Revised Land and Resource Management Plan for the Black Hills National Forest, As Amended by the Phase II Amendment. March 2006. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Manuscript on file, Supervisors Office, Black Hills National Forest, Custer SD. Available at:
http://www.fs.fed.us/r2/blackhills/projects/planning/index.shtml

USDA, Forest Service. 2006h. Writing a Cumulative Effects Analysis for Rangeland/Allotment Planning Documents. Version 2.0. April 2006. US Department of Agriculture, Forest Service, Rocky Mountain Region (Chuck Quimby). 27pp.

USDA Forest Service. 2007a. Black Hills National Forest FY2006 monitoring and evaluation report. May 2007. US Department of Agriculture, Forest Service, Black Hills National Forest. Available at:
http://www.fs.fed.us/r2/blackhills/projects/planning/fy2006_report.pdf

USDA Forest Service. 2007b. Groundwater Technical Guide. US Department of Agriculture, Forest Service, Washington Office. Washington DC. 295pp.

USDA Forest Service. 2007c. RCSC-08-01, Mountain Pine Beetle Conditions in the Upper Spring Creek Area, Black Hills National Forest. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. 9pp.

USDA Forest Service. 2008a. Black Hills National Forest FY2007 Monitoring and Evaluation Report. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at: http://www.fs.fed.us/r2/blackhills/projects/planning/fy2007_report.pdf. [Accessed January 2011].

USDA Forest Service. 2008b. Black Hills National Forest FY2008 Monitoring and Evaluation Report. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at: http://www.fs.fed.us/r2/blackhills/projects/planning/fy2006_report.pdf

USDA Forest Service. 2008c. Black Hills National Forest Recreation Facility Analysis. July, 2008. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5114284.pdf

USDA Forest Service. 2008d. Climate Change Resource Center. Web based information and tools for managers. US Department of Agriculture, Forest Service. Available at: http://www.fs.fed.us/ccrc [Accessed March 2011].

USDA Forest Service. 2008e. Forest Service Manual 2360, Heritage Program Management. Amendment No. 2300-2008-1. Effective July 25, 2008. US Department of Agriculture, Forest Service, Washington Office. Washington DC.

USDA Forest Service. 2008f. Forest Service Manual 2880, Geologic Resources, Hazards, and Services. US Department of Agriculture, Forest Service, Washington Office. Washington DC. 18pp.

USDA Forest Service. 2008g. Forest Service Strategic Framework for responding to climate change. US Department of Agriculture, Forest Service, Washington Office. Washington DC. 21pp. Available at:
http://www.fs.fed.us/climatechange/documents/strategic-framework-climate-change-1-0.pdf

USDA Forest Service. 2009a. Black Hills National Forest FY 2008 Monitoring and Evaluation Report. September, 2009. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at: http://www.fs.fed.us/r2/blackhills/projects/planning/index.shtml

USDA Forest Service. 2009b. Black Hills National Forest Plants Database. Unpublished database information updated in November 2009. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 2009c. Memorandum of Understanding between USDA Forest Service, Rocky Mountain Region and Northern Region, and South Dakota Department of Environment and Natural Resources. Forest Service Agreement #09-MU-11020000-014. 8pp.

USDA Forest Service. 2009d. Monitoring implementation guide for the Black Hills National Forest Land and Resource Management Plan. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at:
http://www.fs.fed.us/r2/blackhills/projects/planning/MonGuide.pdf [Accessed January 2011].

USDA Forest Service. 2009e. National Visitor Use Monitoring Results – USDA Forest Service – National Summary Report – FY 2005 thru FY 2009. United States Department of Agriculture - Forest Service, Southern Research Station (Producer). Updated April 25, 2010. Available at:
http://www.fs.fed.us/recreation/programs/nvum/nvum_national_summary_fy2009.pdf

USDA Forest Service. 2009f. National Visitor Use Monitoring Results – USDA Forest Service, Region 2 - Black Hills National Forest – February 2009. United States Department of Agriculture, Forest Service, Southern Research Station (Producer). Updated June 11, 2010. Available at: http://www.fs.fed.us/recreation/programs/nvum/2009/BlackHills_FY2009.pdf

USDA Forest Service. 2009g. Slate Castle Project Area Final Environmental Impact Statement. US Department of Agriculture, Forest Service, Black Hills National Forest, Mystic Ranger District. Rapid City SD.

USDA Forest Service. 2009h. Telegraph Project Area Draft Environmental Impact Statement. US Department of Agriculture, Forest Service, Black Hills National Forest. Northern Hills Ranger District. Spearfish SD. Available at: http://www.fs.fed.us/r2/blackhills/projects/nepa/public_docs/Telegraph/index.shtml

USDA Forest Service. 2010a. Allotment 2210 Files. US Department of Agriculture, Forest Service, Black Hills National Forest, Mystic Ranger District Office. Rapid City SD.

USDA Forest Service. 2010b. Black Hills National Forest FY 2009 Monitoring and Evaluation Report. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. September 2010. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5262950.pdf

USDA Forest Service. 2010c. Draft inventory and monitoring protocols for groundwater dependent ecosystems: level 2 sampling protocol for springs and groundwater dependent wetlands. US Department of Agriculture, Forest Service, Intermountain Region. Ogden UT. 90pp.

USDA Forest Service. 2010d. Final Environmental Impact Statement and Record of Decision, Black Hills National Forest Travel Management Plan. March 2010. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at: http://www.fs.fed.us/r2/blackhills/projects/planning/index.shtml

USDA Forest Service. 2010e. Forest Health Evaluation R2-10-02, Evaluation of Mountain Pine Beetle Activity in the Pactola Area, Black Hills National Forest. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. 9pp.

USDA Forest Service. 2010f. Forest Service Manual 2500 – Watershed and Air Management, Chapter 2550 – Soil Management. Amendment No.: 2500-2010-1. Effective Date: November 23, 2010. US Department of Agriculture, Forest Service, Washington Office. Washington DC.

USDA Forest Service. 2010g. Mystic Range Final Environmental Impact Statement and Record of Decision. October 12, 2010. US Department of Agriculture, Forest Service, Black Hills National Forest, Mystic Ranger District. Rapid City SD. Available at http://go.usa.gov/g4a.

USDA Forest Service. 2010h. RCSC-2-11, Consequences of the No Action Alternative in the Pactola Area. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. 3pp.

USDA Forest Service. 2010i. Record of Decision, Black Hills National Forest Travel Management Plan. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.
USDA Forest Service. 2010j. Travel Management Plan. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available online at: http://www.fs.usda.gov/wps/portal/fsinternet/!ut/p/c4/04_SB8K8xLLM9MSSzPy8xBz9CP0os3gDfxMDT8MwRydLA1cj72BTMwMTAwjQL8h2VAQArb-_RA!!/?ss=110203&navtype=BROWSEBYSUBJECT&navid=130110000000000&pnavid=130000000000000&accessDB=true&position=Project*&groupid=22263&ttype=projectdetail&pname=Black Hills National Forest- Projects

USDA Forest Service. 2011a. Black Hills National Forest FY2009 monitoring and evaluation report. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at: http://www.fs.fed.us/r2/blackhills/projects/planning/fy08_monitoring_evaluatio_report29sept2009.pdf [Accessed December 8, 2009].

USDA Forest Service. 2011b. Black Hills National Forest Plants Database. Unpublished database information updated in November 2010.

USDA Forest Service. 2011c. Environmental Impact Statement and Record of Decision, Norbeck Wildlife Preserve Project Plan. March, 2010. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD. Available at: http://www.fs.fed.us/r2/blackhills/projects/planning/index.shtml

USDA Forest Service. 2011d. Forest Plan Monitoring Report. Summary Report 2002-2010. December 2011. US Department of Agriculture, Forest Service, Black Hills National Forest, Mystic Ranger District. Rapid City SD.

USDA Forest Service. 2011e. Forest Service Manual 2600, Chapter 2670 – Threatened, Endangered, and Sensitive Plants and Animals. Region 2 Supplement Number R2_2600-2011-1. US Department of Agriculture, Forest Service, Rocky Mountain Region.

USDA Forest Service. 2011f. Notice of Intent: Black Hills National Forest, Custer, SD. Mountain Pine Beetle Response Project. Federal Register, 76(152): 48120–48121.

USDA Forest Service. 2011g. Review of the Forest Service Response: The Bark Beetle Outbreak in Northern Colorado and Southern Wyoming. A Report by the USDA Forest Service RMR and RMRS at the request of Senator Mark Udall.

USDA Forest Service. 2011h. Sensitive Species Evaluation and Rational for listing the Hoary Bat. March 21, 2011. US Department of Agriculture, Forest Service, Rocky Mountain Region. Denver CO. Available at: http://prdp2fs.ess.usda.gov/detail/r2/landmanagement/?cid=stelprdb5193327 [Accessed February 13, 2012].

USDA Forest Service. 2011i. Species Conservation Program: Region 2 Regional Forester's Sensitive Species. US Department of Agriculture, Forest Service, Rocky Mountain Region. Denver CO.

Available at: http://www.fs.fed.us/r2/projects/scp/sensitivespecies/index.shtml [Accessed January 2011].

USDA Forest Service. 2011j. Vestal Environmental Impact Statement. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 2011k. Watershed Assessment Classification Tracking Tool (WCATT). Accessed September 2011 at: http://apps.fs.fed.us/fsmapserviceviewer/index.html?title=NRM%20-%20WCATT%20Watershed%20Condition,%20Assessment%20Year%202010&subtitle=Nightly%20Snapshot,%20PRELIMINARY%20DRAFT%20ASSESSMENT%20(Do%20not%20cite%20or%20distribute)&extent=-15135754.592913182%2

USDA Forest Service. 2011l. Watershed Condition Framework. FS-978. July 2011. US Department of Agriculture, Forest Service, Washington Office. Washington DC.

USDA Forest Service. 2011m. Western Bark Beetle Strategy – Human Safety, Recovery and Resiliency. US Department of Agriculture, Forest Service. 7/11/2011.

USDA Forest Service. 2012a. Aerial Detection Survey Results for the Black Hills, 2011. Technical Report . US Department of Agriculture, Forest Service, Forest Health Management, Rapid City Service Center. Rapid City SD.

USDA Forest Service. 2012b. Calumet Environmental Impact Statement. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Forest Service. 2012c. Increasing the Pace of Restoration and Job Creation on Our National Forests. February 2012. Available at: http://www.fs.fed.us/publications/restoration/restoration.pdf [Accessed February 22, 2012].

USDA Forest Service. 2012d. Letter to Forest Supervisor, Bighorn National Forest, Forest Supervisor, Black Hills National Forest, Forest Supervisor, Medicine Bow and Routt National Forests and Thunder Basin National Grassland, Forest Supervisor, Shoshone National Forest. 2530/7730. February 15, 2012. Authorization from Wyoming Department of Environment Quality for Temporary Turbidity Increase from small projects on NFS lands in Wyoming. Rocky Mountain Regional Office. Golden, CO.

USDA Forest Service. 2012e. Unpublished Black Hills National Forest letter to the Forest Leadership Team regarding the Mountain Pine Beetle Response Project Alternatives. February 15, 2012. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

USDA Natural Resources Conservation Service. 2007. Web Soil Survey. Available at: http://websoilsurvey.nrcs.usda.gov/app

USDA Natural Resources Conservation Service. 2009. Soil Data Mart, Geospatial data for Soil Survey Area SD604 – Custer and Pennington Counties, Black Hills Parts, South Dakota. Available at: http://soildatamart.nrcs.usda.gov [Accessed August 30, 2010].

USDA Natural Resources Conservation Service. 2012a. Soil Data Mart. US Department of Agriculture, Natural Resources Conservation Service, Soil Survey Staff. Available at: http://soildatamart.nrcs.usda.gov [Accessed multiple times in February and March, 2012].

USDA Natural Resources Conservation Service. 2012b. Web Soil Survey. US Department of Agriculture, Natural Resources Conservation Service, Soil Survey Staff. Available online at http://websoilsurvey.nrcs.usda.gov [Accessed multiple times: January to March, 2012].

USDA Soil Conservation Service. 1990. Soil Survey of Custer and Pennington Counties, Black Hills Parts, South Dakota. Prepared in cooperation with USDA Forest Service and South Dakota Agricultural Experiment Station.

USDI Bureau of Land Management. 1998. Riparian Area Management: Process for Assessing Proper Function Condition. Technical Reference, TR-1737-9. US Department of the Interior, Bureau of Land Management. Denver CO. 58pp.

USDI Bureau of Land Management. 2000. Microfiche unpatented mining claims.

USDI Bureau of Reclamation. 2011. Monthly Values for Pactola Reservoir, Rapid Creek near Rapid City, SD - Monthly Total Discharge (acre-feet) for Period of Record 1956-2011. Available at: http://www.usbr.gov/gp-bin/res070.pl [Accessed February 2011].

USDI Fish and Wildlife Service. 1984. American peregrine falcon Rocky Mountain/southwest population recovery plan. Denver CO.

USDI Fish and Wildlife Service. 1995a. Memo (January 14, 1999) Regional Policy on the Protection of Fens, as amended from Dennis Buechler, Senior Staff Specialist for Federal Activities to multiple individuals and agencies as listed in included distribution list. 7pp.

USDI Fish and Wildlife Service. 1995b. National Wetlands Inventory. Available at: http://www.fws.gov/nwi/index.html.

USDI Fish and Wildlife Service. 1999. Peatland Mitigation Policy Considerations. US Fish and Wildlife Service, Region 6, Ecological Services. Colorado Field Office. Lakewood CO. 43pp.

USDI Fish and Wildlife Service. 2007a. Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48, States From the List of Endangered and Threatened Wildlife. Federal Register, 72(130). Monday, July 9, 2007. Available at: http://www.fws.gov/southdakotafieldoffice/baldeaglefinaldelisting.pdf [Accessed December 2010].

USDI Fish and Wildlife Service. 2007b. Endangered and Threatened Wildlife and Plants; Review of Native Species That Are Candidates for Listing as Endangered or Threatened; Annual Notice of

Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions. Federal Register, 72(234): 69034.

USDI Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington VA. Available at: http://library.fws.gov/Bird_Publications/BCC2008.pdf [Accessed January 2011].

USDI Fish and Wildlife Service. 2009a. 12-month finding on a petition to list the black-tailed prairie dog (*Cynomys ludovicianus*) as threatened and endangered. Federal Register, 74(231). December 2, 2009, p. 63343-63366. Available at: http://www.fws.gov/mountain-prairie/species/mammals/btprairiedog/74FR63343.pdf

USDI Fish and Wildlife Service. 2009b. 90-day finding on a Petition to List the American Dipper in the Black Hills of South Dakota as Threatened or Endangered. Federal Register, 74(206): 55177-55180.

USDI Fish and Wildlife Service. 2009c. 90-day finding on a petition to list the northern leopard frog (*Lithobates pipiens*) in the western United States as threatened. Federal Register, 74(125): 31389-31401. July 1, 2009. [Accessed January 21. 2010].

USDI Fish and Wildlife Service. 2009d. Candidate Notice of Review. Federal Register, 74(215): 69034. November 9, 2009. Available at: http://www.fws.gov/endangered/pdfs/CNOR/CNOR%2011-9-09.pdf [December 10, 2010].

USDI Fish and Wildlife Service. 2009e. Endangered Species by County List. US Department of the Interior, Fish and Wildlife Service, Mountain-Prairie Region, South Dakota Ecological Services Field Office. Pierre SD. Updated November 2, 2009. Available: http://www.fws.gov/southdakotafieldoffice/endsppbycounty.htm [Accessed January 2011].

USDI Fish and Wildlife Service. 2010a. A national plan for assisting states, federal agencies, and tribes in Managing White-Nose Syndrome in Bats. DRAFT, 21 October 2010. Available: http://www.fws.gov/WhiteNoseSyndrome/pdf/WNSNational%20Plan_DRAFT_10.21.2010.pdf [January 2011].

USDI Fish and Wildlife Service. 2010b. Endangered Species by County List. Last updated November 2, 2009. South Dakota Ecological Services Field Office. Pierre SD. Available at: http://southdakotafieldoffice.fws.gov/endsppbycounty.htm [Accessed January 2010].

USDI Fish and Wildlife Service. 2011a. Endangered Species by County List. US Department of the Interior, Fish and Wildlife Service, Mountain-Prairie Region, South Dakota Ecological Services Field Office. Pierre SD. Updated October 27, 2011. Available online at: http://www.fws.gov/southdakotafieldoffice/SpeciesByCounty.pdf [Accessed January 2012].

USDI Fish and Wildlife Service. 2011b. Plants of the Mountain Prairie Region. Available at: http://www.fws.gov/mountain%2Dprairie/species/plants [Accessed January 2011].

USDI Fish and Wildlife Service. 2011c. Threatened and Endangered species on the Black Hills National Forest. US Department of the Interior, Fish and Wildlife Service, Wyoming Field Office.

USDI Fish and Wildlife Service. 2011d. Threatened and Endangered Species System (TESS) for South Dakota: Candidate Species. Available at: http://ecos.fws.gov/tess_public//pub/stateListing.jsp?state=SD&status=candidate [Accessed January 2011].

USDI Fish and Wildlife Service. 2011e. Threatened and Endangered Species System (TESS) for South Dakota: Listing and Occurrence. Available at: http://ecos.fws.gov/tess_public//pub/stateListingAndOccurrence.jsp?state=SD [Accessed January 11, 2011].

USDI Fish and Wildlife Service. 2011f. Threatened and Endangered Species System (TESS) for South Dakota: Proposed Species. Available at: http://ecos.fws.gov/tess_public//pub/stateListing.jsp?state=SD&status=proposed [Accessed January 2011].

USDI Fish & Wildlife Service. 2012a. USFWS Threatened and Endangered Species System (TESS) Candidate Species for Region 6. Available at: http://ecos.fws.gov/tess_public/pub/SpeciesReport.do?lead=6&listingType=C [Accessed February 2012].

USDI Fish & Wildlife Service. 2012b. USFWS Threatened & Endangered Species System (TESS) for South Dakota: Candidate Species. Available at: http://ecos.fws.gov/tess_public//pub/stateListing.jsp?state=SD&status=candidate [Accessed February 3, 2012].

USDI Fish & Wildlife Service. 2012c. USFWS Threatened and Endangered Species System (TESS) for South Dakota: Listing and Occurrence. Available at: http://ecos.fws.gov/tess_public//pub/stateListingAndOccurrence.jsp?state=SD [Accessed February 3, 2012].

USDI Fish & Wildlife Service. 2012d. USFWS Threatened & Endangered Species System (TESS) for South Dakota: Proposed Species. Available at: http://ecos.fws.gov/tess_public//pub/stateListing.jsp?state=SD&status=proposed [Accessed February 3, 2012].

USDI Fish & Wildlife Service. 2012e. USFWS Threatened & Endangered Species System (TESS) for Wyoming: Candidate Species. Available at: http://ecos.fws.gov/tess_public//pub/stateListing.jsp?state=WY&status=candidate [Accessed February 3, 2012].

USDI Fish & Wildlife Service. 2012f. USFWS Threatened and Endangered Species System (TESS) for Wyoming: Listing and Occurrence. Available at:

http://ecos.fws.gov/tess_public//pub/stateListingAndOccurrence.jsp?state=WY [Accessed February 3, 2012].

USDI Fish & Wildlife Service. 2012g. USFWS Threatened & Endangered Species System (TESS) for Wyoming: Proposed Species. Available at: http://ecos.fws.gov/tess_public//pub/stateListing.jsp?state=WY&status=proposed [Accessed February 3, 2012].

USDI Geological Survey (USGS). 1995. Science in Your Watershed: General Introduction and Hydrologic Definitions. HTML version of Manual of Hydrology: Part 1. General Surface-Water Techniques by W.B. Langein and K.T. Iseri, Water Supply Paper 1541-A, "Methods and practices of the Geological Survey". Available at: http://water.usgs.gov/wsc/glossary.html#INTRODUCTION

USDI Geological Survey (USGS). 2008. National Hydrography Dataset, Watershed Boundary Dataset. Available at: http://nhd.usgs.gov/data.html. [Accessed April 21, 2010].

USDI Geological Survey, USGS National Water Information System (NWIS). 2009. [Online] http://waterdata.usgs.gov/sd/nwis.

USDI Geologic Survey. 2010. National hydrography dataset. http://nhd.usgs.gov/index.html

USDI Geological Survey (USGS). 2011. National Water Information System (NWIS). Streamflow statistics for selected stations on Rapid Creek. [Online] Available at: http://waterdata.usgs.gov/sd/nwis.

USDI Interagency Burned Area Emergency Response Team. 2001. Elk Mountain Complex Burned Area Emergency Stabilization and Rehabilitation Plan: Roger's Shack and Elk Mountain II Fires. Custer, SD

USDI Interagency Burned Area Emergency Response Team. 2002. Grizzly Gulch Fire Burned Area Emergency Stabilization and Rehabilitation Plan. Spearfish SD

USDI National Park Service. 1994. National Register Bulletin No. 38: Guidelines for evaluating and documenting Traditional Cultural Properties. National Park Service, Interagency Resources Division. US Government Printing Office, Washington DC.

Uresk, Daniel W., and Kieth Severson. 1988. Influence of Ponderosa Pine Overstory on Forage Quality in the Black Hills, South Dakota. US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. Great Basin Naturalist, 48(1): 5pp.

Uresk, Daniel W., and Kieth Severson. 1989. Understory-overstory relationship in ponderosa pine forests, Black Hills, South Dakota. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station 6p. Journal of Range Management, 42(3).

Uresk, Daniel W., and Kieth Severson. 1998. Response of Understory Species to Changes in Ponderosa Pine Stocking Levels in the Black Hills. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station 16p. Great Basin Naturalist, 58(4): 312-327.

Vallentine, J.F. 1989. Range Developments and Improvements, Third Edition. Academic Press. 524pp.

Vandendriesche, Don. 2004. Black Hills National Forest Phase II Amendment - Description of the Analysis Process regarding the Construction of Vegetative Yield Profiles. US Department of Agriculture, Forest Service, Black Hills National Forest. Custer SD.

Van Dyck, Michael G. 2005. User's guide to the post processors for the Forest Vegetation Simulator. US Department of Agriculture, Forest Service, Forest Management Center. Fort Collins CO.

Vickery, P.D. 1996. Grasshopper Sparrow (*Ammodramus savannarum*), The Birds of North America Online (A. Poole, editor). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America. Available at: http://bna.birds.cornell.edu/bna/species/239doi:10.2173/bna.239 [Accessed January 2011].

Vierling, K.T., L.B. Lentile, and N. Nielsen-Pincus. 2007. Pre-burn characteristics and woodpecker use of burned coniferous forests. Journal of Wildland Management, 72(2): 422-427.

Vollmer. Chelsea. 2012. Botany Report for the Pine Beetle Response Project. Black Hills National Forest. Custer, SD.

Waters, T.F. 1995. Sediment in Streams: Sources, Biological Effects, and Control. AFS Monograph 7. Bethesda, MD.

Weaver, K.F., T. Anderson, and R. Guralnick. 2006. Combining phylogenetic and ecological niche modeling approaches to determine distribution and historical biogeography of Black Hills mountain snails (Oreohelicidae). Diversity and Distributions, 12: 756-766.

Wells-Gosling, N., and L.R. Heaney. 1984. Glaucomys sabrinus. Mammalian Species No. 229, The American Society of Mammalogists.

Westerling, A.L., Hidalgo, H.G., Cayan, D.R., and Swetnam, T.W. 2006. Warming and Earlier Spring Increases Western U.S. Forest Wildfire Activity. Science Express, July 6. Available at: www.sciencexpress.org

White, C. and G. Giroir. 2009. Monitoring the Birds of the Black Hills, 2008 Field Season Report. Tech. Rep. M-MBBH-USFS08, SDDGF08. Rocky Mountain Bird Observatory, Brighton, CO, 57 pp. http://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5114243.pdf

White, C.M., J.A. Blakesley, D.C. Pavlacky, and D.J. Hanni. 2010. Monitoring the Birds of Black Hills National Forest: 2009 Field Season Report. Tech. Rep. SC-RMRUSFS09-01. Rocky Mountain

Bird Observatory, Brighton, CO, 54 pp. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5177208.pdf

White, C.M., N.J. Clum, T.J. Cade and W.G. Hunt. 2002. Peregrine Falcon (Falco peregrinus), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology: Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/660 [Accessed March 14, 2011].

Wiggins, D. 2004. American Three-toed Woodpecker (*Picoides dorsalis*): a technical conservation assessment [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/americanthreetoedwoodpecker.pdf [Accessed January 2011].

Wiggins, D. 2005a. Brown Creeper (*Certhia americana*): A Technical Conservation Assessment. January 27, 2005. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/browncreeper.pdf [Accessed February 9, 2012].

Wiggins, D. 2005b. Loggerhead shrike (*Lanius ludovicianus*): A Technical Conservation Assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/loggerheadshrike.pdf [Accessed: February 13, 2012].

Wiggins, D. 2005c. Yellow-billed cuckoo (Coccyzus americanus): A Technical Conservation Assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/yellowbilledcuckoo.pdf [February 13, 2012].

Wiggins, D. 2006. Ruffed Grouse (Bonasa umbellus): A Technical Conservation Assessment. December 6, 2006. [Online]. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/ruffedgrouse.pdf [February 13, 2012].

Williamson, J.E., G.J. Jarrell, R.M. Clawges, J.M. Galloway, and J.M. Carter. 2000. Digital data sets for map products produced as part of the Black Hills Hydrology Study, Western South Dakota: U.S. Geological Survey Open-File Report 00-471. Online only. Available at: http://pubs.usgs.gov/of/2000/ofr00-471/ofr00471.html.

Wisdom, M.J., A.A. Ager, H.K. Preisler, N.J. Cimon and B.K. Johnson. 2004. Effects of off-road Recreation on Mule Deer and Elk. In: Transactions of the 69th North American Wildlife and Natural Resources Conference: 531-550.

Wyoming Department of Environmental Quality. 2006. Wyoming forestry best management practices: forestry BMPs water quality protection guidelines. Wyoming State Forestry Division and Wyoming Department of Environmental Quality. Cheyenne WY.

Wyoming Department of Environmental Quality. 2010. Wyoming Water Quality Assessment and Impaired Waters List (2010 Integrated 305(b) and 303(d) Report). Water Quality Division, Watershed Section. Cheyenne WY. Document #10-0230. Available at: http://deq.state.wy.us/wqd/watershed/Downloads/305b/2010/WY2010IR.pdf

Wyoming Range Service Team. 2001. Wyoming Rangeland Monitoring Guide: A Cooperative and Voluntary Approach to Monitoring Rangelands. Wyoming Department of Agriculture. June, 2001.

Wyoming State Forestry Division. 2007. Wyoming forestry best management practices: forestry stewardship guidelines for water quality 2007 field audit report. Office of State Lands and Investments, Wyoming State Forestry Division. Cheyenne WY. 24p.

Wyoming Timber Industry Association. 2001. Wyoming Silviculture Best Management Practices Field Audit: Implementation, Monitoring, and Evaluation. Wyoming Timber Industry Association. Saratoga WY.

CHAPTER 5 GLOSSARY

Access The opportunity to approach, enter and make use of public or private lands.

Activity Fuels Fuels resulting from or altered by forestry practices, such as timber harvest or thinning, as opposed to naturally created fuels.

Adaptive Management Implementing policy decisions as science-driven management experiments that test assumptions and predictions in management plans.

Age Class Groups of trees or shrubs approximately the same age.

Air Quality Classes Classification established under the "Prevention of Significant Deterioration" portion of the Clean Air Act, which limits the amount of air pollution considered significant within an area. Class I applies to areas where almost any change in air quality would be significant; Class II applies to areas where the deterioration normally accompanying moderate, well-controlled growth would be permitted; Class III applies to areas where industrial deterioration would generally be allowed.

Appropriate Suppression Response (Fire Management) The planned strategy for suppression action (in terms of type, amount, and timing) on a wildfire that most efficiently meets the Forest Plan fire-management direction under current and expected burning conditions. The planned response can range from prompt control to one of containment or confinement.

Confine: To limit the spread of wildfire within a predetermined area principally by use of natural or pre-constructed barriers or environmental conditions. Suppression action may be minimal and limited to surveillance under appropriate conditions.

Control: To complete the control line around a fire, any spot fire there-from, and any interior unburned areas to be saved; to burn any unburned fuel or areas adjacent to the fire side of the control line and to cool all hot spots that are immediate threats to the control line until the control line can reasonably be expected to hold under foreseeable conditions.

Contain: To surround a fire and any spot fires there-from with a control line, as needed, which can reasonably be expected to check the fire's spread under prevailing conditions.

Aquatic Ecosystem The stream channel, lake or estuary bed, water, biotic communities, and the habitat features that occur within an ecosystem (biological and physical components and their interactions) in which water is the principal medium. Examples include wetlands, streams, reservoirs, and areas with plants or animals characteristic of either permanent or seasonal inundated soils.

Area of Potential Effects The geographic area or areas within which an undertaking may cause changes in the character or use of historic properties, if any such properties exist.

Artificial Regeneration The renewal of a tree crop by seeding or planting.

At-Risk Community An area (A) that is comprised of —(i) an interface community as defined in the notice entitled “Wildland Urban Interface Communities Within the Vicinity of Federal Lands That Are At High Risk From Wildfire” issued by the Secretary of Agriculture and the Secretary of the Interior in accordance with Title IV of the Department of the Interior and Related Agencies Appropriations Act, 2001 (114 Stat. 1009) (updated 66 Fed. Reg. 43384, August 17, 2001); or (ii) a group of homes and other structures with basic infrastructure and services (such as utilities and collectively maintained transportation routes) within or adjacent to Federal land; (B) in which conditions are conducive to a large-scale wildland fire disturbance

event; and (C) for which a significant threat to human life or property exists as a result of a wildland fire disturbance event."

Basal Area (Timber Resource) The cross-sectional area of a stand of trees measured at breast height. The area is expressed in square feet per acre.

Best Management Practices (BMPs) Land management methods, measures, or practices intended to minimize or reduce water pollution. Usually BMPs are applied as a system of practices rather than a single practice. BMPs are selected on the basis of site-specific conditions that reflect natural background conditions and political, social, economic, and technical feasibility.

Big Game Certain wildlife that may be hunted for sport under state laws and regulations. In the Black Hills, these animals include deer, elk, turkey, mountain goats, and bighorn sheep.

Biological Control Methods Use of natural organisms such as insects, diseases, parasites, and predators to reduce pest populations of insects, diseases, or weeds. Methods may include importation and release; conservation of native natural-enemy species; and augmentation (supplementation through rearing and release or genetic improvement) of biological control agents.

Biological Diversity The full variety of life in an area including the ecosystems, plant, and animal communities; species and genes; and the processes through which individual organisms interact with one another and with their environments.

Biological Evaluations As defined by FSM 2670.5, a biological evaluation is a documented Forest Service review of Forest Service programs or activities in sufficient detail to determine how an action or proposed action may affect any threatened, endangered, proposed, or sensitive species. FSM 2672.4 identifies biological evaluation objectives and standards.

BMPs (See "Best Management Practices.")

Board Foot A unit of timber measurement equaling the amount of wood contained in a board one-inch thick, 12-inches long, and 12-inches wide.

Broadcast Burning A fire ignited under specific conditions (prescriptions) and within established boundaries to achieve some land-management objective.

BTU British thermal unit. The quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit at or near its maximum density.

Burning Index A relative number related to the contribution that fire behavior makes to the amount of effort needed to contain a fire in a specified fuel type. Doubling the burning index indicates that twice the effort will be required to contain a fire in a specified fuel type, providing all other parameters are held constant.

Canopy, Canopy Closure (Canopy Cover), Canopy Layer (Silviculture)

> **Canopy**: The cover by vegetation and/or branches. Often but not always restricted to the tree layer or greater than six feet tall.
>
> **Canopy Closure/Cover**: The percentage of the ground and/or sky covered by vegetation and/or branches. These are perceived from a human point of view perpendicular to flat ground.
>
> **Canopy Layer**: Cover by vegetation and branches in different height intervals. These intervals are often defined in terms of vegetation, such as herbaceous or grass/forbs less than two feet tall, shrubs less than six feet tall, and overstory greater than six feet tall.

Cavity Nesting Species Wildlife species that depend on cavities in trees for their shelter and/or nesting. These species include primary cavity nesters, such as woodpeckers, which excavate

cavities in soft or decayed wood for nesting, and secondary cavity nesters that typically nest in natural cavities or those excavated by another species.

CFR Code of Federal Regulations.

Closed Road An intermittent service road in Maintenance Level 1 that is closed to all vehicular traffic for more than one year. The closure may be ordered under 36 CFR 261.

CMAI (See "Culmination Mean Annual Increment.")

Commercial Thinning (See "Thinning.")

Commercial Timber Sales The selling of timber from National Forest System (NFS) lands for the manufacture of commercial products such as lumber, plywood, etc.

Community (Social) The people who reside in one locality and are subject to the same laws or who have common interests, etc.

Community Life-styles The ways in which residents conduct their everyday routines and how the "way they live" is associated with the National Forest.

Condition Class 2 This term means the condition class description developed by the USDA-Forest Service Rocky Mountain Research Station (RMRS) in the Development of Coarse-Scale Spatial Data for Wildland Fire and Fuel Management (RMRS-GTR-87, http://www.fs.fed.us/rm/pubs/rmrs_gtr87.html), dated April 2000 (including any subsequent revisions), under which

- Fire regimes on the land have been moderately altered from historical ranges;
- A moderate risk exists of losing key ecosystem components from fire;
- Fire frequencies have increased or decreased from historical frequencies by one or more return intervals, resulting in moderate changes to

—The size, frequency, intensity, or severity of fires;

OR

—Landscape patterns

AND

—Vegetation attributes have been moderately altered from their historical ranges.

Condition Class 3 This term means the condition class description developed by the Rocky Mountain Research Station (RMRS) in RMRS-GTR-87 (see above) under which

- Fire regimes on land have been significantly altered from historical ranges;
- A high risk exists of losing key ecosystem components from fire;
- Fire frequencies have departed from historical frequencies by multiple return intervals, resulting in dramatic changes to

—The size, frequency, intensity, or severity of fires;

OR

—Landscape patterns

AND

—Values of vegetation attributes have been significantly altered from their historical ranges.

Confine (Fire Management) (See "Appropriate Suppression Response.")

Conifer A group of cone-bearing trees, mostly evergreen, such as the pine, spruce and juniper.

Conservation The management of a renewable natural resource with the objective of sustaining its productivity in perpetuity while providing for human use compatible with sustainability of the resource; for a forest this may include managed periodic cutting and removal of trees followed by regeneration.

Construction (Roads) The displacement of vegetation, soil, and rock and the installation of human-made structures involved in the process of building a complete, permanent road facility. The activities occur at a location, or corridor, that is not currently occupied by a road.

Contain (Fire Management) (See "Appropriate Suppression Response.")

Continuous Fuel Concentrations (Fire Management) An uninterrupted distribution of fuel particles (surface or aerial) in a fuel bed, which allows a fire to sustain combustion and actively continue to spread.

Control (Fire Management) (See "Appropriate Suppression Response.")

Cord A unit of gross volume measurement for stacked roundwood based on external dimensions; generally implies a stack of 4 feet by 4 feet vertical cross sections 8 feet long (128 stacked cubic feet).

Cost Effective Achieving specified outputs or objectives under given conditions for the least cost.

Cost Efficient A comparative measure of economic efficiency determined by maximizing the present net worth or value of an alternative, subject to meeting the objectives of the alternative.

Council on Environmental Quality (CEQ) An advisory council to the President established by the National Environmental Policy Act NEPA) of 1969.

Cover Type The vegetative species that dominates a site. Cover types are named for one plant species or non-vegetated condition presently (not potentially) dominant, using canopy or foliage cover as the measure of dominance. In several cases, sites with different species dominant have been lumped together into one cover type; co-dominance is not necessarily implied.

Critical Ecosystems Specific areas, including riparian areas, wetlands, winter range, and habitat for threatened and endangered species.

Crown (Vegetation) The upper part of a tree or other woody plant carrying the main branch system and foliage and surmounting at the crown base a more or less clean stem.

Crown Closure (See "Canopy Cover.")

Crown Density The thickness both spatially in depth and in closeness of growth (compaction) of an individual crown, such as its opacity as measured by its shade density.

Crown Height For a standing tree, crown height is the vertical distance from ground level to the base of the crown, measured either to the lowest live branch-whorl or to the lowest live branch, excluding shoots arising spontaneously from buds on the stem of a woody plant or to a point halfway between.

Cubic Foot A unit of measure usually referring to wood volume (1 foot wide by 1 foot long by 1 foot thick).

Culmination Mean Annual Increment (CMAI) The point at which a tree or stand achieves its greatest average growth, based on expected growth, according to the management systems and utilization standards assumed in the Forest Plan.

Cultural Element Attributes in a human-altered landscape; scenically positive cultural elements, most of which have historical backgrounds or nostalgic connotations. Examples include split-rail fences, stone walls, barns, orchards, hedgerows, and cabins.

Cultural Landscapes Human-altered landscapes, especially those with slowly evolving landscapes, scenic vegetation patterns, or scenic structures. Addition of these elements creates a visually pleasing complement to the natural character of a landscape.

Cultural Properties (See "Historic Property.")

Cultural Resources (See "Heritage Resources.")

Cumulative Effects Collective results of past, present, and reasonably foreseeable future actions, regardless of which agency or person undertakes the actions.

Cutover Area Timber stands that have been cut.

DBH (See "Diameter at Breast Height.")

Dead Fuels (Fire Management) Fuels with no living tissue within which moisture content is governed almost entirely by solar radiation.

Dead Woody Material (See "Down Woody Material.")

Decision Documents Documents that provide the criteria and information used in the formulation and evaluation of alternatives and the preferred alternative.

Desired Future Condition, Desired Ecological Condition

> A portrayal of the land or resource conditions that are expected to result if goals and objectives are fully achieved.
>
> A description of the landscape as it could reasonably be expected to appear at the end of the planning period if the Plan's goals, objectives, standards, and guidelines for that landscape are fully achieved.

Desired Landscape Character Appearance of the landscape to be retained or created over time, recognizing that a landscape is a dynamic and constantly changing community of plants and animals. It is a combination of landscape design attributes and opportunities as well as biological opportunities and constraints.

Diameter at Breast Height (DBH) The diameter of a standing tree at a point 4 feet, 6 inches from ground level.

Direct Effects Results of an action occurring when and where that action takes place.

Diversity Diversity refers to the distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan (LRMP). This term is derived from the National Forest Management Act (NFMA). This term is not synonymous with "biological diversity."

Down and Dead Woody Material, Down Logs, Down Woody Material (Vegetation) Woody material from any source that is dead and lying on the forest floor.

Draft Environmental Impact Statement (DEIS) The statement of environmental effects required for major federal actions under Section 102 of the National Environmental Policy Act (NEPA) and released to the public and other agencies for comment and review.

Easement A right held by one person to make use of the land of another for a limited purpose, such as a special-use authorization for a right-of-way that conveys a conditioned interest in National Forest System (NFS) land and is compensable according to its terms.

Ecosystem A community of living plants and animals interacting with each other and with their physical environment. A geographic area where it is meaningful to address the interrelationships with human social systems, sources of energy, and the ecological processes that shape change

over time. The complex of a community of organisms and its environment functioning as an ecological unit in nature.

Ecosystem Management A concept of natural resources management where-in National Forest activities are considered within the context of economic, ecological, and social interactions within a defined area or region over both short-and long-term.

Egress Path by which a person goes out; exit. The means or act of going out. Often used with the word "access."

EIS (See "Environmental Impact Statement.")

Eligible (Heritage Resources) Indicates a specific heritage resource qualifies for or is already listed in the National Register of Historic Places.

Endangered Species Any species of animal or plant in danger of extinction throughout all or a significant portion of its range and so designated by the Secretary of Interior in accordance with the 1973 Endangered Species Act.

Environmental Impact Statement (EIS) A document prepared by a federal agency in which anticipated environmental effects of a planned course of action or development are evaluated. A federal statute requires that such statements be prepared. It is prepared first in draft or review form and then in a final form. An impact statement includes the following points: the environmental impact of the proposed action; any adverse impacts that cannot be avoided by the action; the alternative courses of actions; the relationships between local short-term use of the human environment and the maintenance and enhancement of long-term productivity; and a description of the irreversible and irretrievable commitment of resources that would occur if the action were accomplished.

Ephemeral Streams A stream or portion of a stream that flows briefly in direct response to precipitation in the immediate vicinity and whose channel is at all times above the water table. Ephemeral areas drain water to intermittent or perennial stream channels. Any sediment created by soil erosion during logging or road-building activities can be carried by way of the ephemeral, intermittent, and perennial stream channels to the watershed outlet. Ephemeral areas generally occur above the upper reaches of intermittent or perennial streams. Since they can direct water into intermittent or perennial stream channels, care should be taken to minimize disturbing soil in these areas.

Erosion The wearing away of the land surface by running water, wind, ice, gravity, or other geological activities.

Erosion Hazard Rating The probability of soil loss resulting from complete removal of vegetation and litter. It is an interpretation based on potential soil loss.

Escape Route (Fire Management) A path of travel to get away from danger, such as the threat of wildfire.

Even-aged Management The application of a combination of actions that results in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and therefore, tree sizes) throughout the forest area. The difference in age between trees forming the main canopy level on a stand usually does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration in a particular stand is obtained during a short period at or near the time of harvest. Clear-cut, shelterwood, or seed-tree cutting methods may produce even-aged stands.

Existing Road System All existing roads owned or administered by various agencies that are wholly or partly within or adjacent to and serving the National Forests and other Forest Service-administered areas or intermingled private lands. These roads may or may not be included on the current Forest

Transportation Inventory but are evident on the ground as meeting the definition of a road.

Fire Incidence The average number of fires in a specified area during a specified time period.

Fire Occurrence Number of fires per unit time in a specified area (synonym for fire frequency).

Fire Protection Assessment (FPA) (Fire Management) A computer software based analysis to assist managers in determining where specific types and intensities of fire-management activities should occur. The analysis uses three map overlays depicting fuel flammability (Hazard); potential value change from fire (Value); and the potential that an ignition will occur (Risk) as a means of identifying and prioritizing appropriate fire- management activities for a given land unit.

> **Risk**: A term within the Fire Protection Assessment identifying the potential for an ignition to occur in a given land unit based on historical data associated with frequency of natural ignitions and the probability of human ignitions based on an assessment of human activities.
>
> **Hazard**: A term within the Fire Protection Assessment that represents a function of potential fire line intensity based on fuels, topography, and weather influences.
>
> **Value**: In the context of the Fire Protection Assessment, value refers to the potential for negative value change from wildfire. Value considerations would include the value of developments and natural resources, including aesthetics, all of which are subject to change from wildfire.

Fire Risk The chance of a fire starting, as affected by the nature and incidence of causative agents, including lightning, people, and industry. Three risk scales are used: high, moderate, and low. High-risk areas include locations where lightning, people, or industry have commonly caused fire in the past; moderate-risk areas include locations where lightning, people, or industry have periodically caused fire in the past; and low-risk areas include locations where lightning, people, or industry have infrequently caused fire in the past.

Fire Suppression All the work and activities connected with fire-extinguishing operations beginning with discovery and continuing until the fire is completely extinguished.

Fire Suppression Objective To suppress wildfires at minimum costs consistent with land and resource management objectives and fire-management direction as determined by National Fire Management Analysis System (NFMAS). This includes all work and activities associated with fire-extinguishing operations beginning with discovery and continuing until the fire is completely extinguished. An example might be that a fire suppression objective is set at 5 acres, based on a cost-effectiveness analysis.

Fireline Intensity The rate of heat energy released per unit time per unit length of a fire front. Numerically, it is the product of the heat combustion, quality of fuel consumed per unit area in the fire front, and the rate of spread of a fire as measured in BTUs per second per foot of the fire front.

Firewood (See "Fuelwood.")

Fiscal Year (FY) Within the Forest Service, the fiscal year includes October 1 to September 30. The fiscal year is referred to by the calendar year beginning January 1. For example, October 1, 1991, to September 30, 1992, is referred to as Fiscal Year 1992.

Forage Vegetation used for food by wildlife, particularly ungulate wildlife and domestic livestock.

Forbs Any herbaceous plant other than those in the grass, sedge, and rush families. For example, any non-grass-like plant that has little or no woody material.

Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) An Act of Congress requiring the preparation of a program for the management of the National Forest's

renewable resources, and of land and resource management plans for units of the National Forest System (NFS). It also requires a continuing inventory of all National Forest System (NFS) lands and renewable resources.

Forest Interior Habitat That portion of the stand not affected by edge is termed interior habitat. The value of forest stands in providing interior habitat depends on the effects of edge on the microclimate of the stand. In the Black Hills, forest interior is defined as that portion of a forest stand more than 300 feet from an opening.

Forest Supervisor Official responsible for administering the Black Hills National Forest. The Forest Supervisor reports to the Regional Forester.

Forest System Roads Roads that are part of the Forest Development Transportation System that includes all existing and planned roads as well as other special and terminal facilities designated as part of the Forest Development Transportation System.

Forested Area Land at least 10 percent of which is occupied by trees of any size or formerly having had such tree cover and not currently developed for non-forest use. Lands developed for non-forest use include areas for crops; improved pastures; residential or administrative areas; improved roads of any width; and adjoining road clearing and powerline clearing of any width.

FSH Forest Service Handbook.

FSM Forest Service Manual.

Fuel Breaks Generally wide strips of land 60 to 1,000 feet in width on which native vegetation has been modified so that fires burning into them can be more readily controlled. Some fuel breaks contain fire lines such as roads or hand lines that can be widened.

Fuel Continuity Degree or extent of continuous or uninterrupted distribution of fuel particles (surface or aerial) in a fuel bed that affects a fire's ability to sustain combustion and spread.

Fuel Loading The volume of the available or burnable fuels in a specified area, usually expressed in tons per acre.

Fuel Reduction Treatments Prescribed burn, non-commercial thin, mechanical fuel treatment, and product other than log (POL) sales.

Fuel Treatment Any manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control, including lopping, chipping, crushing, piling, and burning (synonym for fuel modification).

Fuels The organic materials that will support the start and spread of a fire: duff, litter, grass, weeds, forbs, brush, trees, and dead woody materials.

Fuelwood Round, split, or sawed wood cut into short lengths for burning as fuel.

Goal Broad, general statement that encompasses the desired future conditions that the U.S. Forest Service seeks to attain.

Grass/Forb, Grass/Forb Stage (Structural Stage 1) (See Structural Stages - Structural Stage 1)

Green Slash Wood residue left on the ground after logging that still contains moist phloem tissue and wood and may be susceptible to attack by bark beetles, generally within 1 year after cutting.

Guideline Preferred or advisable courses of action; deviations from guidelines are permissible, but the responsible official must document the reasons for the deviation.

Habitat The place where an organism (plant or animal) lives.

Hard Snags (Vegetation) A dead or partially dead tree composed primarily of sound wood,

particularly sound sapwood.

Hardwood Pertains to broadleaf trees or shrubs.

Hazard (Fire Management) (See "Fire Protection Assessment.")

Hazard Reduction (See "Fuel Treatment.")

Heavy Fuels Fuels of large diameter, usually 3 inches or more, like snags, logs, large branchwood, and peat that ignite and burn more slowly than fine fuels (synonym for coarse fuels).

Herbaceous Fuels Grasses, forbs, and other plants that contain little woody tissue.

Herbicide A chemical substance used for killing or suppressing plants.

Heritage Resources The physical remains (including but not limited to artifacts, structures, landscape modifications, rock art, trails, or roads) and conceptual content or context (as a setting for legendary, historic, or prehistoric events, such as a sacred area for native peoples) of an area.

High Risk (Fuels) (See "Fire Risk.")

Historic Property Any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the National Register. This term includes artifacts, records, and remains related to and located within such properties.

Human-caused Risk (Fire Management) A number related to the potential of fire starts originating from human activities to which a protection unit will be exposed during the rating period.

IDT (See "Interdisciplinary Team.")

Ignition (Fire Management) The initiation of combustion.

Implementation Those activities necessary to initiate the actions in the approved land and resource management plan (LRMP).

Indirect Effects Results of an action occurring at a location other than where the action takes place and/or later in time but in the reasonably foreseeable future.

Infrastructure The facilities, utilities, and transportation systems needed to meet public and administrative needs.

Ingress The act or right to enter; access; entrance.

Inholdings Lands within the proclaimed boundaries of a National Forest that are owned by some other agency, organization, or individual.

Insect and Disease Epidemics High population levels of insect-or-disease pests that cause substantial injury to plant or animal hosts.

Insect and Disease Suppression Management practices applied to reduce insect-and-disease pest populations or damage. Insect- and-disease suppression includes actions taken to limit the spread of pests or to reduce susceptibility of hosts in imminent danger of being attacked.

Intensity (Fire Management) How hot a fire is. Specifically, a measure (in BTUs per foot per second) of the energy released per unit of time in an area of actively burning fire. The amount of heat released per foot of fire front per second.

Interdisciplinary Team (IDT) A group of individuals with different specialized training assembled to solve a problem or perform a task. The team is assembled out of recognition that no one discipline is sufficiently broad to adequately solve the problem. Through interaction, participants bring different points of view and a broader range of expertise to bear on the problem.

Intermediate Cut (Timber Management) Any removal of trees from a stand between the time of their regeneration and the final harvest.

Intermittent Stream A stream that flows only at certain times of the year, as when it receives water from springs or from a surface source, such as melting snow. A stream that does not flow continuously, as when water losses from evaporation or seepage exceed the available streamflow.

Ips (Pine Engraver Beetle) A genus of bark beetle that feeds beneath the bark of pines, typically killing branches, tops, or entire trees. These beetles often breed in logging slash or attack stressed and injured pines.

Irretrievable, Irretrievable Commitments Applies to losses of production or use of renewable natural resources for a period of time. For example, road construction leads to an irretrievable loss of the productivity of the land under which the road is located. If the road is later obliterated, the land may eventually become productive again. The production lost is irretrievable, but the action is not irreversible.

Irreversible, Irreversible Commitments Decisions causing changes that cannot be reversed. For example, if an area is mined, that area cannot, at a later date, be allocated to some other resource activity, such as Wilderness. Once mined, the ability of that area to meet Wilderness criteria, for instance, has been irreversibly lost. Irreversible commitments often apply to non-renewable resources, such as minerals and heritage resources.

Land Unit (Watershed) A mapped land type polygon; or a mapped soil unit.

Landline (Land Survey) For Forest Plan purposes, National Forest property boundaries.

Landscape (Silviculture) The primary unit of analysis for silviculture. A landscape for purposes of silviculture is a sixth-level watershed.

Landscape Character Particular attributes, qualities, and traits of a landscape that give it an image and make it identifiable or unique. Valued landscape character creates a "sense of place" and describes the image of an area. The landscape character provides a reference for defining the inherent scenic attractiveness classes.

Landscape Scale A heterogeneous land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout. Landscapes vary in size from many thousands of acres to only a few acres.

Late Succession Ecosystems distinguished by old trees and related structural features. This term encompasses the later stages of stand development that typically differ from earlier stages in structure, composition, function, and other attributes.

There are two types of late-successional ponderosa pine defined for the Black Hills. The first type, open-canopy late-successional ponderosa pine, occurs where periodic, low-intensity fires have been part of the ecosystem. These late-successional stands would consist of clumps or groups of trees with grasses in the openings between the clumps. They would contain large old trees with open branches, irregular, and flattened crowns. The clumps or groups of trees would contain little down dead material and few small trees.

The second type, closed-canopy late-successional ponderosa pine occurs where periodic, low-intensity high-frequency fires have not been a significant part of the ecosystem. These stands would contain large old trees with open branches and irregular crowns. The stands would have multiple canopy layers made up of various-aged trees. They would be well stocked with trees and contain standing dead and down trees.

Local Roads (See "Road Functional Classification.")

Logging Debris Unmerchantable tree parts like crowns, rotted logs, and uprooted stumps that remain after harvest.

Logging Slash The wood residue left on the ground after harvesting. It includes unused logs, uprooted stumps, broken or uprooted stems, tops, branches, and leaves.

Lopped, Lopping (Timber Management) Cutting off one or more branches of a tree, whether standing, dead, or fallen.

Lopping and Scattering Lopping logging debris and spreading it more or less evenly on the ground.

Low Risk (Fuels) (See "Fire Risk.")

Maintenance Levels (See "Road Maintenance Level.")

Management Indicators (Wildlife) Plant or animal species or habitat components selected in a planning process that are used to monitor the effects of planned management activities on populations of wildlife and fish, including those that are socially or economically important.

Management Objectives Clearly stated objectives describing the intended post-management status of an area. Typically, objectives are disclosed in the NEPA documentation.

MBF Thousand board feet.

MCF Thousand cubic feet.

Meadow An area of perennial, herbaceous vegetation, usually grass or grass-like. A natural opening in a forest, generally at higher elevations, that produces exceptional levels of herbaceous plants, which is usually a consequence of high soil/water content or a perched water table. Generally, a prairie grassland will occupy a convex surface while a meadow will occupy a concave surface.

Midstory (Vegetation) Vegetative layer 10 to 40 feet tall between the overstory trees and ground layer. May consist of trees and/or shrubs.

Mitigation Includes avoiding the impact altogether by not taking certain action or parts of an action; minimizing impacts by limiting the degree or magnitude of the action and its implementation; rectifying the impacts by repairing, rehabilitating or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or compensating for the impact by replacing or providing substitute resources or environments.

MMBF Million board feet.

MMCF Million cubic feet.

Moderate Risk (Fuels) (See "Fire Risk.")

Moisture Regime (Soils) The presence or absence of groundwater or water held at a tension of less than 15 bars in the soil or in specified horizons by periods of the year.

Monitoring The sample collection and analysis of information regarding Forest Plan management practices to determine how well objectives have been met as well as the effects of those management practices on the land and environment.

Multi-storied Stands (Vegetation) Plant communities having two or more recognizable canopy layers or height levels.

Multiple Use According to the Multiple-use Sustained-yield Act of 1960, multiple use is the management of all the various renewable surface resources of the National Forest System (NFS) so that they are utilized in the combination that will best meet the needs of the American people; such management makes the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions. Some lands will be used for less than all of the

resources. Harmonious and coordinated management of the various resources is employed, each with the other, without impairment of the productivity of the land. Consideration is given to the relative values of the various resources and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.

National Environmental Policy Act of 1969 (NEPA) An act declaring a national policy to encourage productive harmony between people and their environment; to promote efforts that will prevent or eliminate damage to the environment and the biosphere and simulate the health and welfare of people; to enrich the understanding of the ecological systems and natural resources important to the nation; and to establish a Council on Environmental Quality.

National Fire Management Analysis System (NFMAS) A broad umbrella process to help fire managers identify the most efficient fire program meeting the direction in the Forest Plan. This includes information for the planning record on program composition, annual programmed costs, emergency firefighting costs, expected resource impacts, and net value change.

National Forest Management Act (NFMA) A law passed in 1976 amending the Forest and Rangeland Renewable Resources Planning Act that requires the preparation of Regional and Forest Plans and the preparation of regulations to guide that development.

National Forest System (NFS) Land Federal lands designated by Executive Order or statute as National Forests, National Grasslands or Purchase Units, or other lands under the administration of the Forest Service.

National Register of Historic Places (NRHP) A list of heritage resources that have local, state, or national significance. The list is maintained by the Secretary of the Interior.

Natural Fuels Fuels resulting from natural processes and not directly generated or altered by land-management practices (compare activity fuels).

Natural Regeneration The renewal of a tree crop by natural means without seeding or planting done by people. The new crop is grown from self-sown seed or by vegetative means, such as root suckers.

Net Public Benefit The overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not. Net public benefits are measured by both quantitative and qualitative criteria rather than a single measure or index.

Non-motorized Activities Activities that do not incorporate the use of a motor, engine, or other non-living power source. Non-motorized activities exclude such machines as aircraft, hovercraft, motorboats, automobiles, motor bikes, snowmobiles, bulldozers, chainsaws, rock drills, and generators.

Noxious Weeds Those plant species designated as weeds by federal or state laws. Noxious weeds generally possess one or more of the following characteristics: aggressive and difficult to manage; poisonous; toxic; parasitic; a carrier or host for serious insects or diseases; and generally non-native.

Objective Concise statement of desired measurable results intended to promote achievement of specific goals. Attainment of objectives is limited by the application of standards and guidelines.

Obliteration (Transportation) The reclamation and/or restoration of the land occupied by a transportation facility for purposes other than transportation.

Off-Highway Vehicle (OHV) Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, snow, ice, marsh, swampland, or other natural terrain.

Openings (Tree Canopy) The hole created by removing the majority of the tree canopy. This includes the harvesting of the majority of trees in a given area.

Overstory (Biological Diversity) The portion of vegetation in a forest forming the uppermost foliage layer.

Pine Engraver Beetle (See "Ips.")

Piling and Burning (Timber Management) Piling slash resulting from logging and subsequently burning individual piles.

Plant Associations A grouping of plants that has reached dynamic equilibrium with the local environmental conditions and is equivalent to climax. On site, there is no evidence of replacement by other dominant plant species (and there is no evidence of serious disturbance.)

Plant Communities Assemblage of plant species living in an area. It is an organized unit to the extent that it has characteristics in addition to the individuals and populations and functions as a unit.

Pre-commercial Cutting (See "Thinning.")

Preparation Cut (Silviculture) A timber harvest method that removes trees near the end of a rotation so as to open the canopy and enlarge the crowns of seed bearers to improve conditions for seed production and natural regeneration, as typically in a shelterwood method.

Preparedness Level (Fire Management) Planning levels of suppression readiness dependent on fire activity, fuel moisture, drought conditions, fire weather, fire danger, and resources deployed or available. There are five preparedness levels with level five being the most active state of readiness.

Prescribed Burning Controlled application of fire to wildland fuels in either their natural or modified state under specified environmental conditions that allows the fire to be confined to a predetermined area and at the same time produce the fireline intensity and rate of spread required to attain planned resource management objectives (synonym for controlled burning).

Prescribed Fire A fire burning within prescription resulting from planned or unplanned ignition.

Prescription (Fire Management) A written statement defining objectives to be attained, as well as temperature; humidity; wind direction and wind speed; fuel-moisture content; and soil moisture, under which the fire will be allowed to burn, generally expressed as acceptable ranges of the various indices, and the limit of the geographic area to be covered.

Present Net Value (PNV) The difference between the discounted value (benefits) of all outputs to which monetary values or established market prices are assigned and the total discounted costs of managing the planning area.

Pre-suppression (Fire Management) Activities required in advance of fire occurrence to ensure an effective suppression action. It includes recruiting and training fire forces; planning and organizing attack methods; procuring and maintaining fire equipment; and maintaining structural improvements necessary for the fire program.

Products Other than Logs (POL), Products Other Than Sawlogs, Products Other Than Sawtimber Products such as posts, poles, and fiber from trees or parts of trees less than sawlog size. POL usually include trees greater than 5 inches diameter breast height (dbh) (4.5 feet from ground level) and less than 7.9 inches diameter breast height (dbh), with tops of trees greater than 4 inches to less than 6 inches in diameter.

Project One or more site-specific activities designed to accomplish a specific on-the-ground purpose or result. Projects are tiered to the Forest Plan and will have further site-specific analysis.

Public Access Usually refers to a road or trail route over which a public agency has secured a right-of-way for public use.

Ranger District Administrative subdivisions of the Forest supervised by a District Ranger who

reports to the Forest Supervisor.

Raptor Habitat Habitat required by hawks, falcons or owls, especially for nesting.

Rate of Spread (Fire Management) Relative activity of a fire in extending its horizontal dimensions, expressed as rate of increase of the perimeter, rate of increase in area, or rate of advance of its head, depending on the intended use of the information, generally in chains or acres per hour for a specified period in the fire's history.

Reforestation Reestablishment of a tree crop on forested land.

Regeneration (Silviculture) The renewal of vegetation whether by natural or artificial means. Also, the new growth itself.

Resource Value-at-risk (Fire Management) Fire-suppression planning tool providing a relative expression in five classes of fire effects on all resources but not the value of the resources themselves (compare values at risk).

Resource Values The tangible and intangible worth of forest resources.

Responsible Official The Forest Service employee who has the delegated authority to make a specific decision.

Retention (Vegetation Management) To keep the existing extent of a vegetative component. Usually refers to a species, such as aspen, birch, or bur oak.

Revegetation The reestablishment and development of a plant cover. This may take place naturally through the reproductive processes of the existing flora or artificially through the direct action of reforestation or reseeding.

Rights-of-way Land authorized to be used or occupied for the construction, operation, maintenance, and termination of a project or facility passing over, upon, under, or through such land. The privilege that one person or persons particularly described may have of passing over the land of another in some particular line.

Rights-of-way Corridors A linear strip of land identified for the present or future location of transportation or utility rights-of-way within its boundaries.

Riparian Area (See "Riparian Ecosystem.")

Riparian Communities Repeating, classified, defined, and recognizable assemblages of plant-or-animal communities associated with riparian areas.

Riparian Ecosystem The moist transition zone between the aquatic ecosystem and the relatively drier, more upland, terrestrial ecosystem(s). This transition zone can extend both laterally and longitudinally away from aquatic ecosystems, sometimes into headwater swales that have no defined stream channel. The riparian ecosystem is the area whose soil is relatively more moist than the adjacent upland and whose vegetation growth reflects the greater accumulation of available water.

Risk (Fire Management) (See "Fire Protection Assessment.")

Risk Index (Fire Management) A number related to the probability of an ignition of a fire (Compare "Human-caused Risk.")

Roads A general term denoting a way with at least two-wheel tracks for purposes of travel by vehicles greater than 50 inches in width.

Maintenance level (ML) ~ Defined in FSH 7709.58, 10, 12. 3 as the level of service provided by, and maintenance required for, a specific road. Maintenance levels must be consistent with road management objectives, and maintenance criteria. Roads may be maintained at one level and planned to be maintained at a different level at some future date. The operational

maintenance level is the maintenance level currently assigned to a road considering today's needs, road condition, budget constraints, and environmental concerns; in other words, it defines the standard to which the road is currently being maintained. The objective maintenance level is the maintenance level to be assigned at a future date considering future road management objectives, traffic needs, budget constraints, and environmental concerns.

Maintenance level 1 road ~ Defined in FSH 7709.58, 10, 12. 3 as intermittent service roads during the time they are closed to vehicular traffic. The closure period must exceed 1 year. Basic custodial maintenance is performed to keep damage to adjacent resources to an acceptable level and to perpetuate the road to facilitate future management activities. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this level. Appropriate traffic management strategies are "prohibit" and "eliminate." Roads receiving level 1 maintenance may be of any type, class, or construction standard, and may be managed at any other maintenance level during the time they are open for traffic. However, while being maintained at level 1, they are closed to vehicular traffic, but may be open and suitable for nonmotorized uses. These roads have the following attributes: (1) vehicular traffic is eliminated, including administrative traffic; (2) physically blocked or entrance is disguised; (3) not subject to the requirements of the Highway Safety Act; (4) maintenance is done only to minimize resource impacts; and (5) no maintenance other than a condition survey may be required so as long as no potential exists for resource damage.

Maintenance level 2 road ~ Defined in FSH 7709.58, 10, 12.3 as roads open for use by high-clearance vehicles. Passenger car traffic is not a consideration. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation, or other specialized uses. Log haul may occur at this level. Appropriate traffic management strategies are either (1) discourage or prohibit passenger cars or (2) accept or discourage high-clearance vehicles. These roads have the following attributes: (1) low traffic volume and low speed; (2) typically local roads; (3) typically connect collectors and other local roads; (4) dips are the preferred drainage treatment; (5) not subject to the requirements of the Highway Safety Act; (6) surface smoothness is not a consideration; and (7) not suitable for passenger cars.

Maintenance level 3 road ~ Defined in FSH 7709.58, 10, 12.3 as roads open and maintained for travel by prudent drivers in a standard passenger car. User comfort and convenience are low priorities. Roads in this maintenance level are typically low speed, single lane with turnouts, and spot surfacing. Some roads may be fully surfaced with either native or processed material. Appropriate traffic management strategies are either "encourage" or "accept." "Discourage" or "prohibit" strategies may be employed for certain classes of vehicles or users. These roads have the following attributes: (1) subject to the requirements of the Highway Safety Act and Manual of Uniform Traffic Control Devices (MUTCD); (2) roads have low to moderate traffic volume; (3) typically connect arterial and collector roads; (4) a combination of dips and culverts provide drainage; (5) may include some dispersed recreation roads; and (6) potholing or washboarding may occur.

Maintenance level 4 road ~ Defined in FSH 7709.58, 10, 12.3 as roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most roads are double lane and aggregate surfaced. However, some roads may be single lane. Some roads may be paved and/or dust abated. The most appropriate traffic management strategy is "encourage." However, the "prohibit" strategy may apply to specific classes of vehicles or users at certain times. These roads have the following attributes: (1) subject to requirements of the Highway Safety Act and MUTCD; (2) roads have moderate traffic volume and speeds; (3) may connect to county roads;

(4) culverts provide drainage; (5) usually a collector; and (6) may include some developed recreation roads.

Maintenance level 5 road ~ Defined in FSH 7709.58, 10, 12.3 as roads that provide a high degree of user comfort and convenience. These roads are normally double-lane, paved facilities. Some may be aggregate surfaced and dust abated. The appropriate traffic management strategy is "encourage." These roads have the following attributes: (1) subject to the requirements of the Highway Safety Act and MUTCD; (2) highest traffic volume and speeds; (3) typically connect State and county roads; (4) culverts provide drainage; (5) usually arterial and collector; (6) may include some developed recreation roads; and (7) usually paved or chip-sealed.

Roadside Corridors A passageway that frames a road or travelway. The corridor includes the viewing area and facilities, which may be within the immediate roadside area or part of a sweeping distance panorama.

Salvage Harvest Removal of damaged, dead or dying trees resulting from insect and disease epidemics, wildfire, or storms to recover logs before they have no commercial value for production.

Salvage of Dead Material (See "Salvage Harvest.")

Sanitation Cutting, Sanitation Harvest (Silviculture) The removal of trees occupied by insect or disease pests to reduce pest populations and limit their spread.

Sawtimber Trees suitable in size and quality for producing logs that can be processed into lumber. For planning purposes, trees with an 8-inch diameter or more are classified as sawtimber.

Scarify To abrade, scratch, or modify the surface of the ground to expose mineral soil.

Scenery The composition of basic terrain, geologic features, water features, vegetative patterns, and landrise effects that typify a land unit and influence the visual appeal the unit may have for visitors.

Scenic Class Scenic classes measure the relative importance or value of discrete landscape areas having similar characteristics of scenic attractiveness and landscape visibility. Scenic classes are used during forest planning to compare the value of scenery with the value of other resources, such as timber, wildlife, late succession, or minerals. The higher the scenic class, the more important it is to maintain the highest scenic value. Scenic classes are determined and mapped by combining the three classes of scenic attractiveness with the distance zones and concern levels of landscape visibility. A numerical value of 1 to 7 is assigned to Forest lands. Generally, scenic classes 1-2 have high public value; classes 3-5 have moderate value; and classes 6 and 7 have low value.

Scenic Integrity (Existing or Objective) State of naturalness or conversely the state of disturbance created by human activities or alteration. Integrity is stated in degrees of deviation from the existing landscape character in a national forest. It is the measure of the degree to which a landscape is visually perceived to be complete. The highest scenic integrity ratings are given to those landscapes that have little or no deviation from the character valued by constituents for its aesthetic appeal. Scenic integrity is used to describe an existing situation, standard for management, or desired future conditions.

Very High: A scenic integrity level that generally provides for ecological change only.

High: A scenic integrity level meaning human activities are not visually evident. In high scenic integrity areas, activities may only repeat attributes of form, line, color, and texture found in the existing landscape character.

Moderate: A scenic integrity level that refers to landscapes where the valued landscape character "appears slightly altered." Noticeable deviations must remain visually subordinate

to the landscape character being viewed.

Low: A scenic integrity referring to the landscapes where the valued landscape character "appears moderately altered." Deviations begin to dominate the valued landscape character being viewed, but they borrow valued attributes such as size, shape, effect, and pattern of natural opening, vegetative type changes, or architectural styles within or outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed but compatible or complimentary to the character within.

Very Low: A scenic integrity level that refers to landscapes where the valued landscape character "appears heavily altered." Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect, and pattern of natural openings, vegetative type changes, or architectural styles within or outside the landscape being viewed. However, deviations must be shaped and blended with the natural terrain so that elements such as unnatural edges, roads, landings, and structures do not dominate the composition.

Unacceptable Low: A scenic integrity level that refers to landscapes where the valued landscape character being viewed appears extremely altered. Deviations are extremely dominant and borrow little if any line, form, color, texture, pattern, or scale from the landscape character. Landscapes at this level of integrity need rehabilitation. This level should only be used to inventory existing integrity. It must not be used as a management objective.

Sediment Material suspended in water or that has been deposited in streams and lakes.

Sediment Load The solid material transported by a stream and expressed as the dry weight of all sediment that passes a given point in a given period of time.

Sediment Yield Amount of sediment leaving an analysis area and entering a channel.

Seed Cutting (Silviculture) A harvest method that removes all mature trees from a stand except for selected seed-bearing trees retained on the site to provide a seed source for stand regeneration. In a two-step shelterwood cutting method, the first of the shelterwood cuttings.

Seed Tree, Seed-tree Cutting Small number of seed-bearing trees left singly or in small groups after timber harvest to provide seed for regeneration of the site.

Selection Cut (Silviculture) A harvest method that periodically removes mature trees individually or in small groups from an uneven-aged forest. By this method, both regeneration cutting and tending of immature stand components are accomplished at each entry.

Sensitive Species Those plant and animal species identified by the Regional Forester for which population viability is a concern, as evidenced by significant current or predicted downward trends in population numbers or density; or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

Seral (Ecology) A biotic community that is in a developmental, transitory stage in an ecological succession.

Seral Stages (Ecology) The sequence of a plant community's successional stages to potential natural vegetation.

Severely Burned Soil A condition in which most woody debris and the entire forest floor is consumed down to bare mineral soil. Soil may have turned red due to extreme heat. Also, fine roots and organic matter are charred in the upper one-half inch of mineral soil.

Shelterwood, Shelterwood Method (Silviculture) A harvest method in which a portion of the

mature stand is retained as a source of seed and/or protection during the period of regeneration. The mature stand is removed in two or more cuttings commonly termed seed cutting and removal cutting. The seed cutting may or may not be preceded by a preparatory cutting.

SHPO (See "State Historic Preservation Officer.")

Silvicultural System A management process that tends, harvests, and replaces forests, resulting in a forest of distinctive form with a desired condition.

Silvicultural Treatment A management practice that utilizes a method of tree culture, harvest, or replacement (See "Single-tree Selection," "Shelterwood Method," "Group Selection," "Even-aged Management," "Uneven-aged Management," and "Clearcutting.")

Silviculture Generally, the science and art of tree management, based on the study of the life history and general characteristics of forest trees and stands, with particular reference to local factors; more particularly, the theory and practice of controlling the establishment, composition, constitution, and growth of forests for desired conditions.

Site An area considered in terms of its physical and/or biological environment; for example, a riparian zone, a homogenous stand of vegetation, or a campground.

Site Index A measure of the relative productive capacity of an area for growing trees. Measurement is based on height of the dominant trees in a stand at a given age.

Site Preparation (Silviculture) The activity that prepares a site for natural regeneration or the planting of seedlings. The objective is to create a favorable environment for establishing and growing the desired vegetation classes. Treatments could include chemical, mechanical, or fire.

Site Productivity Production capability of specific areas of land.

Skid Trails (Timber Management) Any way, more or less prepared, over which logs are dragged. Any road or trail leading from stump to landing.

Skidding (Timber Management) Moving logs from the stump to a collecting point.

Skyline Logging Taking logs from the stump area to a landing using an overhead system of winch-driven cables to which logs are attached with chokers.

Slash (Timber Management) The residue left on the ground after harvesting, sanitation operations, windstorm, or fire. It includes such material as unutilized logs, uprooted stumps, broken or uprooted stems, tops, branches, and leaves.

Snag (Vegetation) Standing dead tree or standing portion from which at least the leaves and smaller branches have fallen; often called a stub if it is less than 20 feet tall.

Snag-dependent Species (See "Cavity Nesting Species.")

Soft Snags (Vegetation) A snag composed primarily of wood in advanced stages of decay and deterioration, particularly in the sapwood (outer) portions; generally there are no live branches on the snag.

Softwood A conventional term for both the timber and the trees belonging to the evergreen group, as the pine, spruce, fir, etc.

Soil Compaction A physical change in soil properties that results in a decrease in porosity and an increase in soil-bulk density and strength.

Soil Erosion The detachment and movement of soil from the land surface by water or wind. Soil erosion and sediment are not the same (See "Sediment.")

Soil Productivity The inherent capacity of a soil to support the growth of specified plants, plant communities, or a sequence of plant communities. Soil productivity may be expressed in terms of

volume or weight/unit area/year, percent plant cover, or other measures of biomass accumulation.

Soil Surveys The systematic examination, description, classification, and mapping of soils in an area.

Standard Mandatory courses of action; any deviation from standards requires amendment of the LRMP.

Stand (Vegetation) A community, particularly of trees, possessing sufficient uniformity as regards to vegetation type, age class, risk class, vigor, size class, and stocking class that distinguishes it from adjacent communities and thus forms a management or silvicultural unity. Within a stand, a dominant or primary species and age class is identifiable, but there may be inclusions or clusters of different species or ages. R2 RIS stands are typically greater than 10 acres. IRI stands are typically greater than 5 acres.

Stand-replacing Fire A fire that kills all or most living overstory trees in a forest and initiates secondary succession or regrowth.

Stand Risk Rating (Insects) A ranking of relative forest stand conditions that reflects the degree of susceptibility to attack by a particular insect species and the potential level of damage if an outbreak occurs. It does not indicate where or when an infestation will actually occur. For mountain pine beetles in ponderosa pine, a computer model exists to determine low-, medium- and high-risk stands based on measures of stand structure, average basal area, and average tree diameter.

State Historic Preservation Officer (SHPO) A person appointed by a state's governor to administer the State Historic Preservation Program.

Stream Health The condition of a stream relative to robust health for that stream type and landscape, considering indicators such as channel pattern; slope; particle size; pool frequency and depth; bank vegetation; and woody debris that reflect the stability and habitat quality of the stream.

Structural Stages (Vegetation) Any of several developmental stages of tree stands described in terms of tree size and the extent of canopy closure they create. They include

> **Structural Stage 1 (Grass/Forb)**: An early forest successional stage during which grasses and forbs are the dominant vegetation. At the RIS site level, Structural Stage 1 is defined as nonstocked, with an AMD less than 10 percent. Small-scale Structural Stage 1 within RIS sites are at least one acre in size, do not meet the seedling stocking criteria, and contain no saplings, poles, or mature trees.
>
> **Structural Stage 2 (Shrubs/Seedlings):** Developmental stage dominated by tree seedlings (less than one inch dbh) and shrub species.
>
> **Structural Stage 3 (Sapling/Pole):** Developmental stage dominated by young trees 1 to 7 inches dbh, 10 to 50 feet tall, and usually less than 50 years old. This stage is subdivided into three canopy closure classes: A (less than 40 percent); B (40 to 70 percent); and C (greater than 70 percent).
>
> **Structural Stage 4 (Mature):** Consists of trees larger and older than structural stage 3. Also classified by the same canopy closure categories as structural stage 3.
>
> **Structural Stage 5 (Late Succession):** This structural stage is characterized by trees 160 years of age and older.

Subdivisions Areas of previously undeveloped land divided into individual home sites and/or blocks of lots.

Successional Stages (Seral Stages) The relatively transitory communities that replace one another during development toward a potential natural community.

Suitability The appropriateness of applying certain resource management practices to a

particular area of land, as determined by an analysis of the economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices.

Suppress a Fire To extinguish a fire or contain it within specified boundaries.

Suppression (See "Fire Suppression" and "Insect and Disease Suppression.")

Temporary Roads (See "Short-term Transportation Facility.")

Thinning (Silviculture) The practice of removing some of the trees in a stand to meet desired conditions. Two types of thinning may be done:

> **Pre-commercial, Non-commercial**: Removing trees that are too small to make a merchantable product.
>
> **Commercial**: Removing trees that have reached sufficient size to be manufactured into a product and to improve tree spacing and promote more rapid growth.

Threatened Species Any species likely to become endangered within the foreseeable future throughout all or a significant portion of its range and that has been designated in the Federal Register by the Secretary of Interior as such.

Timber A general term applied to tree stands that provide a wood-fiber product.

Timber Stand Improvement (TSI) The elimination or suppression of the less desirable vegetation in favor of the more desirable tree growth, such as thinning, cleaning, weeding, and release cuttings.

Trail A general term denoting a way usually less than 50 inches wide for purposes of travel by foot, stock, or trail vehicle.

Transportation System All roads needed to manage and administer Forest resources. A road network.

Transportation/Utility Corridor A linear strip of land identified for the present location of transportation or utility rights-of-way within its boundaries.

Travel Corridor A strip of land that includes up to a maximum of 1,000 feet for major roads (500 feet either side of the road's centerline) or 500 feet for major trails (250 feet either side of the trail's centerline); travel corridors form a passageway that allows travelers to experience and interact with the quality and character of the landscape.

Travel Management Travel management is the movement of people and products to and through national forests and grasslands. It connects many different varieties of users and multiple uses on National Forest System (NFS) lands.

Treated Area Area on which management such as timber harvesting or prescribed burning occurs.

Tree Improvement (See "Timber Stand Improvement.")

Understory (Vegetation) The lowest layer of vegetation in a forest or shrub community composed of grass, forbs, shrubs, and trees less than 10 feet tall. Vegetation growing under the tree canopy.

Uneven-aged Management (Silviculture) The application of a combination of actions needed to simultaneously maintain tall, continuous cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes to provide a sustained yield of forest products. Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to be retained within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.

Value (Fire Management) (See "Fire Protection Assessment.")

Values at Risk (Fire Management) Any or all natural resources, improvements, or other values that may be jeopardized if a fire occurs (Compare "Resource Values-at-risk.")

Vegetative Buffer Strips Strips of grass or other erosion-resisting vegetation between areas of ground disturbance and areas needing protection from sedimentation.

Vegetative Management, Vegetative Manipulation, Vegetative Treatment Any activities undertaken to modify the existing condition of the vegetation.

Vertical Diversity The diversity in an area that results from the complexity of the above-ground structure of the vegetation; has two or more layers; the more tiers of vegetation or the more diverse the species makeup, or both, the higher the degree of vertical diversity.

Viable Population Group of individuals of a particular species that produces enough offspring for long-term persistence and adaptation of the species or population in a given place. 36 CFR 219.19 defines a viable population for planning purposes as one that has the estimated numbers and distribution of reproductive individuals to insure that a continued viable population is well distributed in the planning area. Planning area is further defined by 36 CFR 219.3 as the "area of the National Forest System covered by a regional guide or forest plan." Direction from the Forest Service Manual (FSM) defines a viable population as one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its existing range (or range required to meet recovery for listed species) within the planning area.

Viewshed Total visible area from a single observer position or the total visible area from multiple observer positions. Viewsheds are accumulated seen areas from highways, trails, campgrounds, towns, cities, or other view locations. Examples are corridors, feature, or basin viewsheds.

Water Influence Zone The land next to streams and lakes where vegetation plays a major role in sustaining the long-term integrity of aquatic ecosystems. Includes the geomorphic floodplain, riparian ecosystem, and inner gorge, and has a minimum horizontal width (from top of each bank) of 100 feet or the mean height of mature dominant late-seral vegetation, whichever is greater.

Watershed The area of land bounded by a divide that drains water, sediment, and dissolved materials to a common outlet at some point along a stream channel or to a lake, reservoir, or other body of water. Also called drainage basin or catchment.

Watershed Level The number assigned to an entire drainage basin contributing to the stream segment of a given level and bearing an identical designation; for example, a first-level watershed contains all the drainage area of a first-level stream (See "Stream Level.")

6th Level Watersheds: A watershed coded with a 12-digit code, typically 10,000 to 30,000 acres in size.

Waters of the United States Waters used for navigation and all other waters such as lakes, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes or natural ponds, and their tributaries.

Wetlands Those areas that are inundated by surface water or groundwater with a frequency sufficient to support and under normal circumstances do or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds.

Wildfire Any wildland fire not designated and managed as a prescribed fire within an approved prescription. All wildfires will be given an appropriate suppression action.

Wildland-Urban Interface In applying Title I of the HFRA, this term means:

• An area within or adjacent to an at-risk-community (ARC) identified in recommendations to the Secretary in a Community Wildfire Protection Plan

OR

• In the case of any area for which a Community Wildfire Protection Plan is not in effect:

—an area extending ½ mile from the boundary of an at-risk community (ARC)

—An area within 1-1/2 miles of the boundary of an at-risk community (ARC), including any land that

Has a sustained steep slope that creates the potential for wildland fire behavior endangering the at-risk community (ARC)

Has a geographic feature that aids in creating an effective firebreak, such as a road or ridgetop

OR

Is in Condition class 3 as documented by the Secretary in the project-specific environmental analysis

AND

An area that is adjacent to an evacuation route for an at-risk community (ARC) that the Secretary determines—in cooperation with the at-risk community (ARC)—requires hazardous-fuel reduction to provide safer evacuation.

CHAPTER 6 LIST OF PREPARERS

Interdisciplinary Team

Craig Bobzien Forest Supervisor – Bachelor of Science in Forest Management Science, Colorado State University, 1978. Experience working in silviculture, watershed, lands uses and minerals management, fire and aviation, timber, range, recreation and wilderness management. Served as District Ranger on the Bitterroot National Forest, Montana and the Okanogan National Forest, Washington State, and Deputy Forest Supervisor on the Idaho Panhandle.

Dennis Jaeger Deputy Forest Supervisor – Bachelor of Science in Civil Engineering, U.S. Military Academy, West Point, NY, 1982. Experience as a civil engineer on the Rio Grande National Forest in Monte Vista, Colorado, District engineer on the Medicine Bow National Forest Douglas Ranger District, Wyoming. Works Program Officer, Angell Job Corps, Yachats, Oregon, Boxelder Job Corps Center Director, Nemo, South Dakota.

Katie Van Alstyne ID Team Leader, Writer/Editor - Bachelor of Arts, Biology, Hollins University, 1990. Eleven years with the National Park Service as an interpreter and law enforcement dispatcher. Twelve years of Forest Service experience at the district, regional and national level in planning/litigation.

Blaine Cook Forest Silviculturist and Timber Planner - Education: B.S. in Forest Business Management, University of Idaho, 1974. Experience: thirty-five years with the Forest Service. Forest management experience on the Shasta-Trinity, Medicine Bow, Tongass, Ochoco, Bighorn and Black Hills National Forests.

Todd Pechota Forest Fire Management Officer – Bachelor of Science in Speech with a Mass Communication Emphasis from Black Hills State University, 1989 and Bachelor of Science in Forestry with a Fire Science Emphasis from Colorado State University, 1993. Fire Program Manager since 1993 has participated as an ID Team member on FP Revisions in Colorado and South Dakota. Served as Ops Section Chief and currently IC for a Regional Type II Incident Management Team.

Les Gonyer Hydrologist – Bachelor of Science, Forestry, minor in Hydrology, University of Minnesota, 1977. Thirty-five years of Forest Service experience at the District and Forest levels in Utah, New Mexico, Oregon, Idaho, Wyoming, California, and South Dakota in watershed, timber, special uses, minerals, fire, engineering, and environmental analysis. BAER (Burned Area Emergency Response) Team Leader.

Brandon Taglioli Supervisory Civil Engineer – Bachelor of Science in Civil Engineering. Licensed Professional Engineer in the States of Colorado and South Dakota. Twelve years of Forest Service experience at the District and Forest level in transportation planning, road design, aquatic organism passage design, contract preparation and administration, and environmental analysis. Certified in roads, concrete, trails, bridges, and administration of timber sales and public works under the National Construction Certification Program.

Melissa Dempsey Hydrologist - M.S. in Geology - Northern Arizona University, B.S. in Geology - Northern Arizona University. Eight years Forest Service experience at the District and Forest level.

Rick Hudson Forest Recreation, Trails, and Land Uses Program Manager, Bachelor of Science in

Forestry/Wildlife, Louisiana State University, Baton Rouge, Louisiana 1974. District Recreation and Timber Staff, Jackson Ranger District, Bridger-Teton National Forest, Jackson, WY 1991-2000. District Fire Management, Range, Wildlife, Recreation Staff, Kiamichi Ranger District, Ouachita National Forest, Arkansas/Oklahoma 1979-1991.

Ed Fischer Forest Environmental Coordinator - B.S. in Forest Management, Michigan State University, 1975. Employed with the US Forest Service since 1978 as a forester and planner at District and Forest levels in Colorado, Alaska, Idaho and South Dakota.

Brent Foster Forest Timber Program Manager - Bachelor of Science in Forestry, Iowa State University, Ames, Iowa 1981. Forest Sales Forester, Ouachita National Forest, District Timber and Minerals Staff, Big Timber Ranger District, Gallatin National Forest, MT District Planning/Silv Forester, Chemult Ranger District, Winema National Forest, Oregon District Forester, Monticello Ranger District, Manti-LaSal National Forest, Utah, District Forestry Technician, Paisley Ranger District, Fremont National Forest, Oregon,

Chelsea Vollmer Botanist- Bachelor's Degree in Biology with options in Botany and Ecology, University of Montana – Missoula. Employed with the Forest Service since 2003 as a botanist at the Ranger District and Forest levels in Colorado, California, and South Dakota. Has worked on the Black Hills since 2006.

Craig Beckner Rangeland Management Specialist – Rangeland Management and Invasives Species Analysis -- B.S. in Range/Forest Management, Colorado State University, 1980. Employed with the Forest Service since 1978 as a range conservationist and rangeland management specialist at the ranger district and Forest levels in Utah, Oregon, Wyoming, and South Dakota.

Deanna Reyher Forest Soil Scientist, Forest Watershed Coordinator - B.S. in Agronomy, University of Nebraska, Lincoln, 1984. Twenty-eight years of experience in soils, botany, ecology, watershed coordination and agronomy; 23 years of which was with the USDA Forest Service in the soils, watershed, ecology and botany programs.

Kerry Burns Wildlife Biologist - B.S. in Wildlife Biology, Colorado State University, 1982. Employed with Forest Service since 1985 as a range technician, forestry technician, and wildlife biologist at the ranger district and forest levels in Colorado, Wyoming, Alaska and South Dakota.

Michael Hilton Heritage Resources Program Manager and Tribal Liaison - Ph.D. in Archaeology, UCLA, 2002. Seventeen years of federal government service: six years for National Park Service in Alaska and 11 years for the U.S. Forest Service in Alaska, California, and South Dakota.

Steve Hirtzel Fisheries Biologist – Bachelor of Science in Wildlife & Fisheries Science, South Dakota State University, Brookings, SD, 1987. Twenty-four years of experience in research, regulatory and natural resource management programs with various state and federal agencies, the past ten years on the Black Hills National Forest.

Steve Keegan Forest Landscape Architect - Bachelor of Science, Landscape Architecture and Environmental Studies, State University of New York (SUNY) - College of Environmental Science and Forestry, 1980; Bachelor of Science, Syracuse University 1980; Associates of Arts, Humanities, SUNY - Onondaga Community College, 1978. Thirty years of Forest Service experience at the Zone and Forest level on the Helena, Clearwater, Malheur and Black Hills National Forests.

CHAPTER 7 INDEX

ARC, 2, 368
At-Risk-Community, 2
BA, 2
Basal Area, 2, 348
CMAI, 2, 349, 350
collaboratively, 39
Community Wildfire Protection Plan, 2, 25, 312, 317, 368
Community Wildfire Protection Plans, 34, 39
Condition Class, 2, 46, 147, 349
Culmination of Mean Annual Increment, 2
CWPP, 2, 25, 34
Deciding Official, vii, 27, 33
design criteria, 13, 40
Design Criteria, xi
EIS, 2, ii, v, vii, 13, 27, 28, 33, 44, 50, 293, 352
environmental impact statement, ii, 13
Environmental Impact Statement, 2, ii, 13, 18, 333, 336, 351, 352
fire hazard, 17, 22, 23, 26, 46, 115, 120, 136, 140, 147, 216, 291
Fire Protection Assessment, 353, 355, 360, 366
fire regime, 46
fire suppression, v, 15, 217, 287, 353
Firewise, 39
Forest Plan, ii, iv, v, vii, 18, 19, 25, 26, 27, 29, 38, 39, 115, 140, 218, 293, 299, 332, 347, 350, 356, 357, 358, 359
FP, 34, 116, 219
FP, 18
fuels reduction, 119
hardwood stands, 46, 147
Healthy Forest Initiative, ii, iv, 24
Healthy Forest Restoration Act, 115
Healthy Forests Restoration Act, 2, ii, iv, vii, 13, 24, 27, 140
HFRA, 2, ii, iv, 13, 24, 25, 33, 34, 41, 367
ID Team, 2, v, 29, 33, 369
insect and disease, ii, iv, 19, 115, 119, 216, 362
Interdisciplinary Team, 2, v, 25, 355, 369
MA, 2, 18, 21, 304
Management Area, 2, 18, 19, 21, 22, 23
Management Areas, xi, 18
management indicator species, 320
MIS, 2
mitigation, v, 29, 40, 42, 293
monitoring, iv, 13, 24, 40, 334, 335, 337
motorized, 31
mountain pine beetle, ii, iv, vi, 15, 24, 26, 27, 34, 35, 37, 115, 120, 125, 141, 143, 286, 289, 316, 319, 321, 323
MPB, 2, iv, v, vi, 16, 17, 22, 26, 27, 47, 119, 136, 216, 217, 219, 290, 291
National Environmental Policy Act, 2, ii, v, 13, 25, 34, 50, 350, 351, 358
National Fire Plan, ii, iv, 24, 140
National Forest System, 2, 15, 24, 349, 351, 354, 357, 358, 366, 367
NEPA, 2, ii, v, 13, 25, 28, 29, 33, 34, 41, 50, 293, 331, 350, 351, 357, 358
NFS, 2, vi, 19, 39, 349, 351, 354, 357, 358, 366
non-motorized, 31
noxious weed, v, 34, 116, 217, 219
prescribed burning, 31
prescribed fire, 22, 23, 136, 311, 367
proposed action, ii, iv, v, vii, 13, 19, 27, 28, 29, 33, 34, 42, 49, 115, 348, 352
Record of Decision, 2
restoration, 24, 217, 313, 358
Restoration, 2, ii, iv, vii, 13, 24, 27, 115, 140
retention, 217
Retention, 313, 360
ROD, 2
scoping, ii, v, vi, vii, 27, 28, 29, 34, 41, 50, 116
slash, 293, 308, 356, 359
snags, 216, 218, 321, 355
Snags, 354, 364
soils, 136, 140, 289, 294, 347, 365
Species of Local Concern, 334
structural stage, 22, 23, 24, 115, 136, 365
structural stages, 22, 23, 24, 136, 216, 217
Transportation System, 331, 354, 366

transportation systems, 355
values at risk, 360
Values at Risk, 367
wildfire, iv, v, 16, 17, 24, 26, 31, 42, 47, 119, 120, 217, 286, 289, 290, 291, 292, 293, 347, 352, 353, 362
wildfire hazard, 16, 17, 286, 289
wildfires, ii, iv, 17, 26, 34, 46, 140, 216, 217, 286, 289, 290, 353, 367
wildland-urban interface, 24, 25, 115, 290
Wildland-Urban Interface, 2, iv, 285, 367
WUI, 2, iv, 24, 25, 26, 34, 140, 286