Chapter 3. Affected Environment and Environmental Consequences

Introduction

This section presents the biological, physical and socioeconomic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for comparing the alternatives as described in Chapter 2.

This chapter is arranged by resource area, starting with an overall introduction to vegetation to provide the reader a better understanding of the overall vegetative condition. Following each resource description is a discussion of the potential effects (environmental consequences) to the resources associated with the implementation of each alternative. Potential effects, including direct, indirect, and cumulative effects are disclosed. Effects are quantified, where possible, and qualitative discussions are also included.

This analysis uses best available science, but recognizes that opposing science exists. A literature review of opposing science sent to the project by the public in scoping responses, and the Forest Service accompanying response, is available in the project record at the Lincoln Ranger District.

This DEIS incorporates by reference the resource specialist reports in the project record (40 CFR 1502.21). Specialist reports contain detailed data, executive summaries, regulatory framework, assumptions and methodologies, analyses, conclusions, maps, references, and technical documentation that the resource specialists relied upon to reach conclusions in the DEIS.

This DEIS incorporates the Forest Plan by reference and tiers to the FEIS completed for the Forest Plan, and amendments. The discussions of resources and potential effects take advantage of existing information included in the Forest Plan and other sources as indicated. Where applicable, such information is briefly summarized and referenced to minimize duplication. The planning record includes all project-specific information such as resource reports, ecosystem analyses, and other results of field investigations. The record also contains information resulting from public involvement efforts. The planning record is available for review by contacting the Helena National Forest office.

Analyzing Environmental Consequences

Environmental consequences are the effects of implementing an alternative on the biological, physical, economic, and social environment. The Council of Environmental Quality regulations implementing the National Environmental Policy Act include a number of specific categories to use for the analysis of environmental consequences. Several form the basis of much of the analysis that follows. They are explained briefly here.

Direct, Indirect, and Cumulative Effects

Direct environmental effects are those occurring at the same time and place as the initial cause or action. Indirect effects are those that occur later in time or are spatially removed from the activity, but would occur in the foreseeable future. The project is expected to be active over approximately the next 7 to 10 years, or from the time the decision is made to full implementation. Cumulative effects result when the incremental effects of actions are added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time. Past activities contributed to the existing condition and are considered in the affected environment. Present and

reasonably foreseeable future actions are assessed along with the effects of the proposed action to determine whether significant cumulative effects may occur. This analysis is consistent with the Council on Environmental Quality memo from James L. Connaughton titled “Guidance on the Consideration of Past Actions in Cumulative Effects Analysis” dated June 24, 2005, incorporated by reference.

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis considers the current environmental conditions as a reflection of the aggregate impact of all prior human actions and natural events that affected the environment and might contribute to cumulative effects.

The 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 not 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 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, we cannot focus on the impacts of past human actions and ignore 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 those effects. Third, public scoping for this project did not identify any public interest or need for detailed information on individual past actions. Finally, the Council on Environmental Quality issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which 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).

The Helena National Forest Schedule of Proposed Actions (SOPA) was reviewed and forest and district personnel consulted to identify current and reasonably foreseeable projects on the Lincoln Ranger District. Contacts were made with adjacent Forests for proposed activities to be considered for affected resources cumulative effects analysis.

Assessment areas vary by resource, and so do the other actions included in each cumulative effects analysis. Cumulative effects may include estimated effects from present logging (timber harvest, fuels treatments, road and landing construction and maintenance) and wildfire activities (e.g. suppression activities and the affected burn areas). Other actions may include but are not limited to grazing and fuels reduction and/or forest health projects in the vicinity.

Ongoing activities include annual road maintenance, recreation trail use for hiking and snowmobiling, dispersed camping, hunting, and appropriate responses for fire suppression. The past, present and reasonably foreseeable actions considered for this project analysis are displayed in appendix C on figure C-1 (map) with impacts noted in tables C-4, C-5, and C-6.

Vegetation

Introduction

In this section we describe the current vegetative condition and the factors shaping the current condition of the project area, as well as the desired condition and how the current vegetative condition relates to the desired condition. This section discusses how three alternative management scenarios would or would not move the vegetation from the current condition to or toward the desired condition. We discuss changes in stand density, stand structure, species composition and how those changes address the purpose and need for the project.

Methodology

In this section we identify information sources and assumptions used and briefly outline the analysis process.

Information Sources

A variety of information sources were used for qualitative and quantitative analysis. These information sources are listed below, and are explained in greater detail in volume 2, appendix B. Information sources used in this analysis includes:

- Individual treatment unit diagnosis from field reviews completed by Helena National Forest personnel and last updated in fall 2009. These can be found in project records.
- 30-meter Digital Elevation Model (DEM) Geographic Information Systems (GIS) raster layers from which we attained elevation, percent slope and aspect
- National Agricultural Imagery Program (USDA Farm Service Agency 2011) aerial photo digital imagery
- Forest Inventory and Analysis (FIA) grid-intensification sample plot data
- Formal stand exam data collected in 1989, 1991, and 2010 and housed in the Field Sampled Vegetation database
- Past management activity contained in the Forest Service Activity Tracking System (FACTS) database
- Site visits during the summer of 2010
- GIS spatial data acquired from the Helena National Forest including:
    - VMAP spatial data including classification for tree dominance type, tree canopy cover class, and tree diameter
    - Helena National Forest Plan (USDA Forest Service 1986) Management Area boundaries
    - 2001-2010 aerial insect and disease detection (ADS) survey data
    - Property ownership boundaries
    - Project area boundary
    - Historic wildfires
    - Past management activities

- Fire Regime Condition Class (FRCC) analysis data including classification for biophysical settings and vegetation-fuel classes

- Other literature representing the best available science referenced in this report.

Assumptions

A number of assumptions are made in any analysis. These assumptions range from very small to large in scope. In this analysis we do not include as assumptions that natural processes which are certain to happen will continue to happen. For example, succession is a natural process constantly occurring due to differences in plants abilities to colonize, survive, grow, and propagate as conditions change. The process of succession will always happen, however we do include as assumptions factors such as changes in climate conditions and the occurrence or non-occurrence of disturbances which can modify the direction of succession. Read more about assumptions in volume 2, appendix B.

Assumptions made in this analysis are listed below:

- Current Forest Plan and other pertinent management direction would continue indefinitely into the future
- In the long-term time frame of the analysis, no additional major disturbances, such as wildfire or bark beetle epidemics would occur, the analysis is of future risk and probable effects if the disturbance occurs and is not a future projection of the occurrence
- Climate change has occurred to some degree and will continue to occur in the future; ramifications of a changing climate are likely to be (Karl et al. 2009):
  - More of the winter precipitation will fall as rain
  - Snow levels will raise in elevation
  - Snow melt will occur earlier in the spring
  - The late-spring to summer dry season (fire season) will increase in length
  - Summer dry seasons will be drier and warmer
  - Prolonged drought periods will increase, but their occurrence will probably be variable
  - Storms will become more intense with a larger portion of annual precipitation falling in the heaviest storms
  - Night-time minimum temperatures will increase
  - Growing season and number of frost-free days will increase
  - Wildfires are likely to become more frequent and the area burned averaged annually likely greater
  - Weather conditions conducive to bark beetle mortality are likely to become more frequent
  - Climate changes will most likely bring about some change in site characteristics leading to climax plant community changes and so Biophysical Setting changes, but the direction and magnitude of the changes are unknown and would be very small within the time frame of this analysis
  - FIA grid intensification plot data can provide reliable estimates of average vegetation attributes at a landscape-level
- ADS data can provide a reasonable estimate of the magnitude and spatial location of tree damage and mortality on the landscape

- Intensive (formal) stand exam data provide the most accurate estimates of individual stand attributes
- Individual informal stand exams and diagnosis can provide reliable descriptions of stand conditions
- Formal and informal field exams from 2009 and 2010 represent the current condition and formal exam data taken before that time should be adjusted for bark beetle mortality
- The FACTS database contains the most current and accurate past management activity data
- The accomplishment time peiod is estimated to be 2015-2020
- No unforeseen occurrences such as fire, blowdown, or insect mortality would occur from 2010 until the time of implementation
- Forest Vegetation Simulator (FVS) modeling can provide a reasonable estimate of the magnitude and direction of proposed treatment effects on individual stands or on forest types
- Remote-sensed data such as VMap can provide reliable landscape-level estimates of forest conditions and can be informative at the stand-level if used with caution
- The Stonewall Vegetation Project area, at about 24,000 acres is sufficiently large to analyze and discuss landscape-level effects
- Landscape-level desired conditions contained in the Stone Dry Vegetation Report (Milburn et al. 2006, Milburn et al. 2006) can also be directly applied to the Stonewall Vegetation Project area.

Analysis Process

In the following analysis we summarize the current condition and reference condition from the Stone Dry analysis as the current and desired condition in terms of Biophysical Setting (BpS) and vegetation-fuel class (VFC) for the landscape. We also display current conditions for several stands as examples of stand structures, species compositions, and stocking levels with discussion of how they do not represent the desired condition.

We analyzed alternative effects by comparing landscape-level changes in vegetation-fuel classes for each BpS due to treatment unit changes in vegetation-fuel class. We compare the effects of treatments qualitatively and we also model the effects of treatments on stand structure, species compositions, and stocking levels for representative stands using available formal stand exam data and the Forest Vegetation Simulator program. We also used the Forest Vegetation Simulator Fire and Fuels Extension with stand exam data and FIA grid-intensification plot data to model changes in crown bulk density, canopy base height, and percent canopy cover for use in modeling fire and fuel effects (Buhl 2015). See the Fire and Fuels section for a discussion of fire and fuels effects.

Overview of Issues Addressed

The purpose and need for the project includes:

- Improve the mix of vegetation composition and structure across the landscape that is diverse, resilient, and sustainable to wildfire and insects
- Modify fire behavior to enhance community protection while creating conditions that allow the reestablishment of fire as a natural process on the landscape
- Enhance and restore aspen, western larch, and ponderosa pine species and habitats
- Utilize economic value of trees with economic removal
- Integrate restoration with socioeconomic considerations

On August 26, 2011 Region 1 Regional Forester Leslie A. C. Weldon designated whitebark pine as a sensitive species in the Region. Direction following the designation includes considering the species in new analysis.

Indicators

Indicators used in this analysis to discuss how the alternatives would address the purpose and need for the project as well as issues relating to wildlife identified from public comments are:

- Within-stand changes in tree species compositions as a result of proposed treatments and the proportion of the analysis area on which quaking aspen, western larch, and ponderosa pine would increase in presence
- Landscape-level changes in species compositions as measured by the acres treated in each alternative with an emphasis on benefits to aspen, western larch, ponderosa pine, and whitebark pine
- Within-stand changes in stand structures and species compositions in terms of tree diameter distributions for proposed treatment type groups
- Landscape-level changes in stand structures in terms of Biophysical Setting (BpS) and vegetation-fuel classes as measured by the acres and proportion of change within each BpS/vegetation fuel class combination
- Forest health in terms of reduced susceptibility (increased resistance) of individual stands and the landscape to diseases and insects found within the project area of concern

Affected Environment

Stonewall Desired Condition

In 2006, the Lincoln Ranger District completed a vegetation report (Stone Dry Vegetation Report, Milburn et al. 2006) as part of an ecosystem analysis at the watershed scale (EWAS) for the Stone-Dry area that includes the Stonewall project area. In the analysis, they used the Fire Regime Condition Class (FRCC) system to describe reference vegetative, fuel and fire conditions and to compare them to current conditions based on site visits (Milburn et al. 2009, FRCC 2005). The FRCC analysis for the area was updated in 2010 (Olson 2010) including updates to the biophysical settings and vegetation-fuel classifications. See the discussion in chapter 1for more information about biophysical settings, vegetation fuel classes, habitat types, insects and diseases, and tree canopies.

Existing Condition

The existing condition of the 24,000 acre project area has been shaped by management activities including: (1) many years of fire suppression, (2) 3,473 acres of harvest/regeneration treatments that created an early-seral stage following the treatment and of which a few are still providing most of the early-seral in the project area, and (3) 1,660 acres of other tree-cutting from 1950 to present. In natural fire events, 87 acres were burned in the Snow/Talon Fire (2003), and 261 acres were burned in the Keep Cool Fire (2006). In addition, natural processes such as succession, and natural events such as droughts are always occurring.

Table 10 that follows displays the existing condition information for proposed treatment units.

Table 10. Existing condition data for proposed treatment units

Description Group	Unit	Slope	Aspect	Elevation	Forest Type	Species Comp	Acres	Est. TPA O/S	Est. TPA U/S	Est. Ba	Average d.b.h.	Age	Mortality Rating
1	6	35-60	E	47-52	DF	50DF/45LP/5PP	14	200-450	300-400	80-180	12"	100-175	High
1	7	35-60	E	47-52	DF	50DF/45LP/5PP	17	200-450	300-400	80-180	12"	100-175	High
1	8	35-60	E	47-52	LP	60LP/40DF/tracePP	62	200-450	300-400	80-180	12"	100-175	Severe
1	15	40-55	SW	48	DF	75DF/20PP/5LP/trace AS/ES	15	250	400	80-180	16"	100-120	Low-High
1	23	40-55	E	48-52	LP	60LP/40DF	29	275	0-100	80-180	12"	140	Severe
1	24	30-40	NE	52-54	LP	50LP/40DF/trace WL/PP	5	300-400	Trace	120-180	12"	140	Severe
1	26	40-60	E, SE	50-56	DF	65DF/35LP/5PP/ES/ AF	65	300	Trace	120-200	14"	130	Severe
1	28	35	NW	53-55	LP	60LP/40DF	22	300	200-600	60-180	12"	120-150	Severe
1	30	15-45	E	52-57	DF	50DF/50LP	14	300	200-600	80-180	14"	85-150	High
1	31	15-45	E	52-57	DF	75DF/25LP/tracePP/ AS	16	300	200-600	80-180	14"	85-150	High
1	32	15-45	E	52-57	DF	75DF/25LP/tracePP/ AS	45	300	200-600	80-180	14"	85-150	High
1	33	45-55	NE	54-60	DF	60DF/40LP	17	400	200-600	140-200	14"	120	High
1	44	50	SW	48-56	DF	50DF/30PP/20LP	97	250-300	200	120-200	16"	120	High
1	45	50	SW	48-56	Mix	45LP/35DF/20PP	38	250-300	200	140-220	16"	120	Severe
1	46	0-30	SW	50	Mix	40DF/40LP/15PP/5A F/AS/ES	251	300	300-1000	80-200	16"	180-200	Severe
1	47	0-20	S	50	Mix	40DF/40LP/15PP/5A F/AS/ES	220	300	300-1000	80-200	16"	180-200	Severe
1	54	45-55	NE	54-60	DF	60DF/40LP	20	400	200-600	140-200	14"	120	High
1	55	35-55	NE, SE	60-64	DF	50DF/40LP/10AF	29	350	200	120	14"	130	High
2	3	0-20	E, SE	46	LP	60LP/15DF/25AS/trac eES	37	Trace	500	80-120	6"	45	Low
2	14	0-25	SW	48	Mix	30PP/30DF/15LP/10	11	400	200	40-100	9"	30	Low

Description Group	Unit	Slope	Aspect	Elevation	Forest Type	Species Comp	Acres	Est. TPA O/S	Est. TPA U/S	Est. Ba	Average d.b.h.	Age	Mortality Rating
						AS/5ES							
2	16	30-50	SW	48	DF	90DF/10LP	3	Trace	1000	0	2"	20-30	Low
2	18	0-25	SW	46-48	LP	95LP/5DF/tracePP/WL/AS	21	Trace	800-1000	0	2"	29	Low
2	21	0-25	SW	46-48	LP	95LP/5DF/tracePP/WL/AS	6	Trace	800-1000	0	2"	29	Low
2	48	20-35	SW	51-58	Mix	40PP/35LP/15DF	141	400-500	100	120-140	8"	41	Low
2	49	20-35	SW	50-52	Mix	40DF/30PP/15LP/5AS	49	400-500	100	120-140	8"	41	Low
2	50	35-45	SW	51-54	DF	50DF/40DF/5LP/5PP/AS	49	400-500	100	120-140	8"	41	Low
2	51	20-35	SW	48-50	Mix	40DF/30PP/15LP/5AS	193	400-500	100	120-140	8"	41	Low
2	59	<35%	E	60-62	LP	WL/AF/LP	16	Trace	600	N/A	4-6"	41	Low
2	60	<35%	N	46-50	LP	LP/DF/WL	25	Trace	400-500	N/A	1-2"	19	Low
2	61	<35%	NE	50-54	LP	LP/WL/DF	34	Trace	600-800	N/A	2-3"	29	Low
2	62	<35%	NW	52-57	DF	DF/LP/AS	37	Trace	600-800	N/A	2-4"	12-20	Low
2	63	<35%	E	57-62	LP	LP/AF/DF	17	Trace	600-800	N/A	8"	41	Low
2	64	<35%	N, NE	53-60	LP	LP/AF/WL	30	Trace	600	N/A	1-2"	19	Low
2	65	<35%	NE	56-60	LP	LP/AF/DF	25	Trace	600-800	N/A	2-4"	44	Low
2	66	<35%	NE	52-56	AF	AF/WL/LP	26	Trace	800	N/A	1-2"	19	Low
2	67	<35%	NE	49-52	LP	LP/DF/WL	20	Trace	400-500	N/A	1-2"	19	Low
2	68	<35%	NE	57-59	LP	LP/DF/WL	15	Trace	400-500	N/A	1-2"	19	Low
2	69	<35%	E	50-55	LP	LP/DF/WL	31	Trace	400-500	N/A	1-2"	19	Low
2	70	<35%	E	48-51	LP	LP/DF/WL	39	Trace	400-500	N/A	1-2"	22	Low
2	71	<35%	SE	50-52	LP	LP/DF/WL	40	Trace	400-500	N/A	1-2"	22	Low
2	72	<35%	SE	48	LP	LP/ES/AF	85	Trace	800	N/A	2-9"	49	Low
2	73	<35%	SE	46-50	PP	PP/DF/LP	33	Trace	600	N/A	4-8"	44	Moderate
2	75	<35%	Flat	49	DF	DF/LP/PP	148	Trace	600	N/A	2-4"	27	Low

Description Group	Unit	Slope	Aspect	Elevation	Forest Type	Species Comp	Acres	Est. TPA O/S	Est. TPA U/S	Est. Ba	Average d.b.h.	Age	Mortality Rating
3	1	0-35	E, NE	44-48	LP	80LP/20DF/trace PP/AS	96	300-400	200-1000	100-240	12-14"	75-95	Severe
3	9	0-30	NE,E	50-52	LP	85LP/15DF/traceAF	18	300-400	200-300	140	12"	100	Severe
3	11	0-10	NE	45	Mix	30LP/20AS/20PP/20 DF/10ES	23	250	200-700	120-200	16"	85/30	Severe
3	12	0-10	NE	46	LP	50LP/20AS/10DF/15 ES/5PP	80	300	200-600	120-140	14"	85/30	Severe
3	13	20-40	E	47	LP	85LP/15DF/traceAS/ ES/AF	41	350	300-700	100-220	14"	100	Severe
3	20	5-35	SW	46-48	LP	80LP/20PP/traceDF/ AS	32	250-400	200-600	120-200	16"	100	Severe
3	22	40-55	N	48-50	LP	65LP/30DF/5PP/trace WL/AS	30	350	200	180	14"	140	Severe
3	25	40-55	E	52-55	LP	75LP/25DF/traceAF	29	200-400	300	180	14"	120	Severe
3	29	10-35	E	50-55	LP	70LP/30DF	25	200	400-1000	80-180	11"	100	High
3	34	35-50	SE	54-60	LP	55LP/40DF/5AF	12	300	100-400	80-180	14"	130	Severe
3	39	5-25	E to SW	48-53	LP	80LP/15DF/5AF/ES/P P	42	400	100-1000	100-260	12"	110	Severe
3	40	5-25	E to SW	48-53	LP	80LP/15DF/5AF/ES/P P	11	400	100-1000	100-260	12"	110	Severe
3	41	5-25	E to SW	48-53	LP	80LP/15DF/5AF/ES/P P	12	400	100-1000	100-260	12"	110	Severe
3	42	5-25	E to SW	48-53	LP	80LP/15DF/5AF/ES/P P	65	400	100-1000	100-260	12"	110	Severe
3	43	5-25	E to SW	48-53	LP	80LP/15DF/5AF/ES/P P	104	400	100-1000	100-260	12"	110	Severe
3	53	35-50	SE	54-60	LP	55LP/40DF/5AF	17	300	100-400	80-180	14"	130	Severe
3	57	5-20	SW	50-53	Mix	30PP/30DF/30LP/10 AS	93	300	200	80-160	8"	47	Severe
3	58	15-35	SW	53-55	Mix	30PP/30DF/30LP/10 AS	15	300	200	80-160	8"	47	Severe

Description Group	Unit	Slope	Aspect	Elevation	Forest Type	Species Comp	Acres	Est. TPA O/S	Est. TPA U/S	Est. Ba	Average d.b.h.	Age	Mortality Rating
4	10	5-15	NE	46-48	LP	90LP/5DF/5PP	18	300	250-700	120-140	14"	100	Severe
4	17	5-25	SW	48	LP	70LP/15DF/15PP/traceES/WL	38	200-300	300	120-220	16"	100	Severe
4	19	5-35	SW	46-48	LP	80LP/20PP/traceDF/AS	15	250-400	200-600	120-200	16"	100	Severe
4	27	35-50	NE, SE	52-55	LP	60LP/40DF/tracePP/WL	31	400	50-75	100-160	14"	120-140	Severe
4	35	45-55	NE	55-57	LP	85LP/10DF/5AF/ES	24	450	300-900	100-200	12"	120-140	Severe
4	36	35-65	NE, SE	56-59	LP	90LP/10DF/traceES/AF	20	300-400	200	100-200	14"	130	Severe
4	37	20-55	E	58-64	LP	80LP/20DF/traceAF	8	300-400	300-500	140-180	13"	130	Severe
4	38	20-55	E	58-64	LP	80LP/20DF/traceAF	7	300-400	300-500	140-180	13"	130	Severe
4	52	20-55	E	58-64	LP	80LP/20DF/traceAF	22	300-400	300-500	140-180	13"	130	Severe
4	56	35-55	NE, SE	60-64	LP	80LP/15DF/5AF	17	350	200	120	14"	130	Severe
4	74	<35%	SE	50-53	LP	75LP/25DF/traceAF	23	200-400	300	100-120	9-11"	120	Severe
5	4	0-30	E, SE	45-48	Mix	40LP/25ES/25DF/10AS/tracePP	7	250	400	200	10"	90	High
5	5	0-30	E, SE	45-48	Mix	40LP/25ES/25DF/10AS/tracePP	18	250	400	200	10"	90	High
6	2	25-55	E, SE	46-53	DF	60DF/30PP/10LP	146	100-400	100	40-180	14"	100-250	High
6	76	Variable	Variable		DF	70DF/20LP/5AF/5WB	123	Variable	Variable	Variable	Variable	Variable	High
6	78	Variable	Variable		DF	70DF/10PP/10LP	38	Variable	Variable	Variable	Variable	Variable	High
6	85	Variable	Variable		DF	80DF/5PP/5LP/traceAF	143	Variable	Variable	Variable	Variable	125	Low
7	80	Variable	Variable		DF	80DF/10PP/5LP/traceAS	326	Variable	Variable	Variable	Variable	Variable	Low
7	86	Variable	Variable		DF	90DF/10PP/traceAS	47	Variable	Variable	Variable	Variable	Variable	Moderate

Description Group	Unit	Slope	Aspect	Elevation	Forest Type	Species Comp	Acres	Est. TPA O/S	Est. TPA U/S	Est. Ba	Average d.b.h.	Age	Mortality Rating
7	87	Variable	Variable		LP	60LP/35DF/5AS	36	Variable	Variable	Variable	Variable	Variable	Moderate
8	77	Variable	Variable		LP	50LP/5AF/30DF/10PP	736	Variable	Variable	Variable	Variable	Variable	Low-High
8	79	Variable	Variable		LP	50LP/40DF/10PP/AS/WB/AF	337	Variable	Variable	Variable	Variable	Variable	Low-High
8	81	Variable	Variable		DF	70DF/15PP/15LP	629	Variable	Variable	Variable	Variable	Variable	Low-High
8	82	Variable	Variable		LP	70LP/15AF/15WB	776	Variable	Variable	Variable	Variable	Variable	Low-High
8	83	Variable	Variable		LP	70LP/15AF/15WB	457	Variable	Variable	Variable	Variable	Variable	Low-High
8	84	Variable	Variable		DF	50DF/50LP/5PP/trace AF	831	Variable	Variable	Variable	Variable	Variable	Low-Severe
8	88	Variable	Variable		LP	50LP/20DF/20AF/10WB	892	Variable	Variable	Variable	Variable	Variable	Low-Severe

Asp – Aspect code: NE-northeast, E-east, SE-southeast, S-south, SW-southwest, W-west, NW-northwest

Elev – Elevation in 100's of feet

Forest Type Code: DF-Douglas-fir, LP-lodgepole pine, Mix-mixed species, PP-ponderosa pine, AF-subalpine fir

Species Comp – Tree species and percent composition:

- AF-subalpine fir
- AS-aspen
- DF-Douglas-fir
- ES-Engelmann spruce
- LP-lodgepole pine
- Mix-mixed species
- PP-ponderosa pine
- WB-whitebark pine
- WL-western larch

Est TPA O/S – Estimated trees per acre (TPA) overstory: Est TPA U/S – Estimated trees per acre understory

Est BA – Estimated basal area in ft^2/acre

Ave d.b.h. – Estimated average diameter at breast height (d.b.h.) in inches

Age – Estimated stand age: Mortality rating: Severe – estimated more than one-half of basal area dead, High – estimated from one-quarter to one-half of basal area dead, Low – estimated up to one-quarter of basal area dead

Habitat Types

The project area is heavily dominated by subalpine habitat types which cover about 69 percent of the area, Figure 17 and Table 11. Second in presence are Douglas-fir habitat types which cover about 18 percent of the area. Whitebark pine-subalpine fir and spruce habitat types each cover only about 0.3 percent of the area. The rest of the area is covered by rock, grass, meadows, water or private land.

For the habitat type coverage in the project area, species such as ponderosa pine, lodgepole pine, quaking aspen, western larch, and whitebark pine are always or almost always a seral species, and as such would decline in presence and eventually die out of the stands without disturbance (Pfister et al.1977, Fischer and Bradley 1987). Douglas-fir would be seral to subalpine fir on about 69 percent of the area. More discussion of habitat types is in chapter 1.

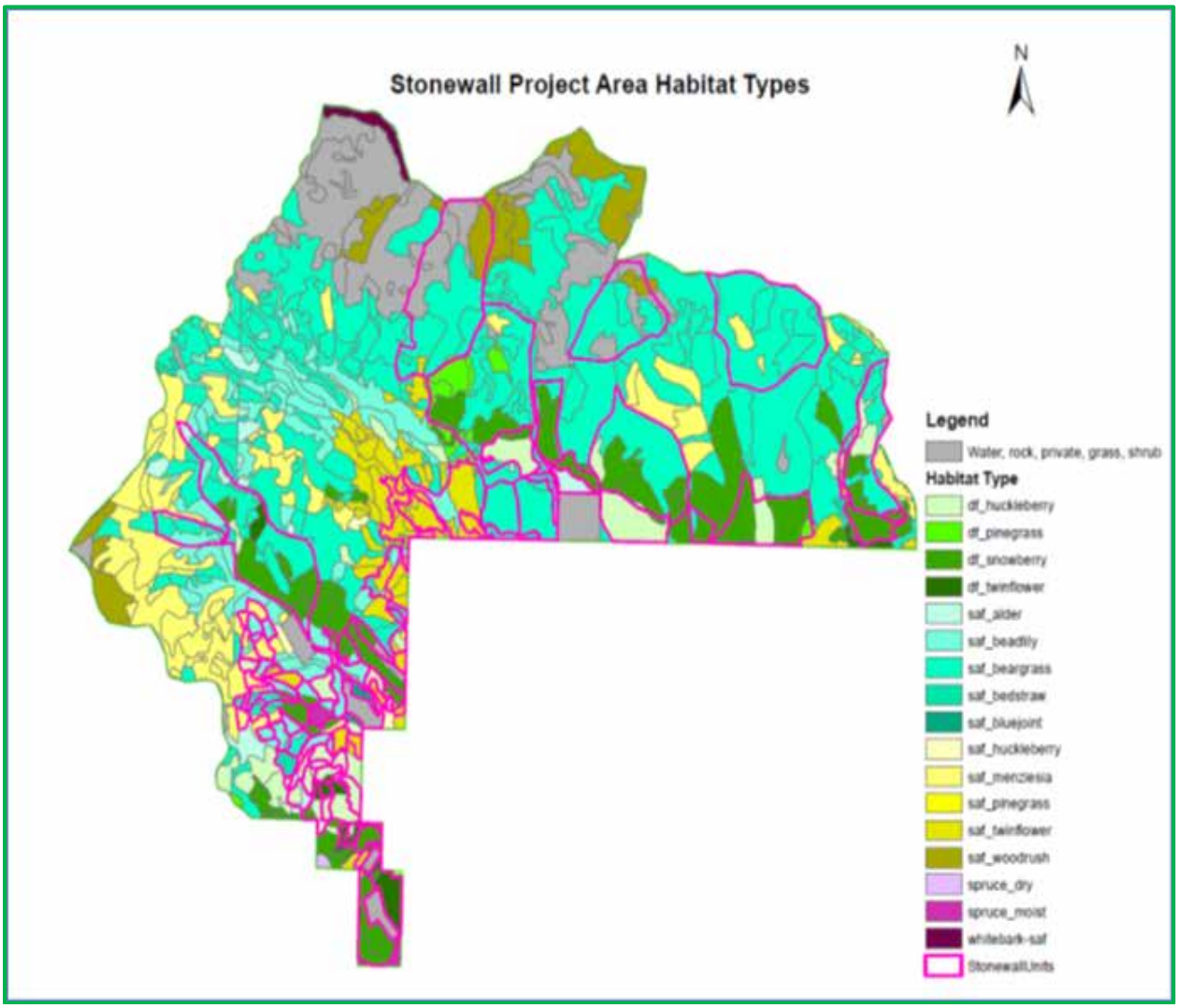

Figure 17. Stonewall project area habitat types and units

Table 11. Habitat types for each prescription group and treatment unit

Prescription Group	Unit Number	Habitat Type	Acres
1	6	Douglas-fir/huckleberry	3
1	6	Douglas-fir/twinflower	11
1	7	Douglas-fir/huckleberry	7
1	7	Douglas-fir/twinflower	10
1	8	Douglas-fir/huckleberry	46
1	8	Douglas-fir/twinflower	15
1	15	Douglas-fir/snowberry	10
1	15	subalpine fir/queencup beadlily	3
1	23	subalpine fir/queencup beadlily	8
1	23	subalpine fir/beargrass	21
1	24	Douglas-fir/huckleberry	5
1	26	Douglas-fir/snowberry	39
1	26	subalpine fir/beargrass	14
1	26	subalpine fir/menziesia	12
1	28	Douglas-fir/huckleberry	21
1	30	Douglas-fir/twinflower	13
1	31	Douglas-fir/huckleberry	15
1	32	Douglas-fir/huckleberry	22
1	32	Douglas-fir/snowberry	10
1	32	Douglas-fir/twinflower	10
1	32	subalpine fir/Sitka alder	3
1	33	subalpine fir/queencup beadlily	13
1	33	subalpine fir/huckleberry	2
1	44	unknown	17
1	44	Douglas-fir/snowberry	80
1	45	unknown	12
1	45	Douglas-fir/snowberry	22
1	45	subalpine fir/beargrass	3
1	46	Douglas-fir/pinegrass	3
1	46	subalpine fir/queencup beadlily	54
1	46	subalpine fir/beargrass	25
1	46	subalpine fir/twinflower	169
1	47	Douglas-fir/huckleberry	2
1	47	Douglas-fir/snowberry	2
1	47	subalpine fir/beargrass	215
1	54	subalpine fir/queencup beadlily	18
1	54	subalpine fir/menziesia	2
1	55	subalpine fir/queencup beadlily	9
1	55	subalpine fir/menziesia	18
2	3	Douglas-fir/snowberry	33
2	3	Douglas-fir/twinflower	3

Prescription Group	Unit Number	Habitat Type	Acres
2	14	trees-rock	9
2	16	Douglas-fir/snowberry	2
2	18	Douglas-fir/huckleberry	20
2	21	Douglas-fir/huckleberry	6
2	48	Douglas-fir/huckleberry	103
2	48	Douglas-fir/snowberry	22
2	48	subalpine fir/beargrass	17
2	49	Douglas-fir/snowberry	6
2	49	subalpine fir/Sitka alder	43
2	50	Douglas-fir/snowberry	46
2	51	Douglas-fir/huckleberry	181
2	51	Douglas-fir/snowberry	9
2	51	subalpine fir/beargrass	3
2	59	subalpine fir/menziesia	16
2	60	subalpine fir/twinflower	25
2	61	Douglas-fir/huckleberry	33
2	62	Douglas-fir/huckleberry	20
2	62	subalpine fir/Sitka alder	17
2	63	subalpine fir/menziesia	17
2	64	subalpine fir/menziesia	30
2	65	subalpine fir/queencup beadlily	3
2	65	subalpine fir/menziesia	22
2	66	subalpine fir/queencup beadlily	2
2	66	subalpine fir/twinflower	25
2	67	subalpine fir/queencup beadlily	20
2	68	subalpine fir/queencup beadlily	13
2	68	subalpine fir/menziesia	2
2	69	subalpine fir/bedstraw	31
2	70	Douglas-fir/huckleberry	39
2	71	subalpine fir/queencup beadlily	9
2	71	spruce-moist	30
2	72	subalpine fir/twinflower	85
2	73	Douglas-fir/huckleberry	33
2	75	subalpine fir/beargrass	145
2	75	subalpine fir/twinflower	2
3	1	Douglas-fir/snowberry	5
3	1	Douglas-fir/twinflower	88
3	1	pvt	2
3	9	Douglas-fir/huckleberry	18
3	11	Douglas-fir/huckleberry	12
3	11	subalpine fir/bluejoint	9
3	12	unknown	79

Prescription Group	Unit Number	Habitat Type	Acres
3	13	unknown	2
3	13	Douglas-fir/huckleberry	3
3	13	subalpine fir/queencup beadlily	32
3	13	trees-rock	2
3	20	Douglas-fir/snowberry	20
3	20	subalpine fir/twinflower	12
3	22	subalpine fir/queencup beadlily	27
3	22	subalpine fir/menziesia	2
3	25	subalpine fir/queencup beadlily	23
3	25	subalpine fir/beargrass	4
3	25	subalpine fir/menziesia	2
3	29	Douglas-fir/huckleberry	20
3	29	Douglas-fir/twinflower	5
3	34	Douglas-fir/huckleberry	3
3	34	subalpine fir/queencup beadlily	2
3	34	subalpine fir/twinflower	7
3	39	Douglas-fir/huckleberry	12
3	39	subalpine fir/beargrass	4
3	39	subalpine fir/pinegrass	4
3	39	subalpine fir/twinflower	21
3	40	subalpine fir/beargrass	9
3	41	subalpine fir/beargrass	10
3	41	subalpine fir/twinflower	2
3	42	Douglas-fir/pinegrass	3
3	42	subalpine fir/queencup beadlily	19
3	42	subalpine fir/beargrass	10
3	42	subalpine fir/twinflower	32
3	43	Douglas-fir/pinegrass	6
3	43	subalpine fir/queencup beadlily	7
3	43	subalpine fir/twinflower	92
3	53	subalpine fir/queencup beadlily	13
3	53	subalpine fir/menziesia	4
3	57	Douglas-fir/snowberry	93
3	58	Douglas-fir/snowberry	15
4	10	subalpine fir/twinflower	18
4	17	subalpine fir/queencup beadlily	28
4	17	trees-rock	8
4	19	subalpine fir/twinflower	15
4	27	Douglas-fir/snowberry	12
4	27	subalpine fir/queencup beadlily	18
4	35	Douglas-fir/snowberry	5
4	35	subalpine fir/queencup beadlily	18

Prescription Group	Unit Number	Habitat Type	Acres
4	36	subalpine fir/beargrass	15
4	36	subalpine fir/menziesia	5
4	37	subalpine fir/beargrass	6
4	37	subalpine fir/menziesia	2
4	38	subalpine fir/beargrass	7
4	52	subalpine fir/queencup beadlily	3
4	52	subalpine fir/beargrass	12
4	52	subalpine fir/menziesia	7
4	56	Douglas-fir/huckleberry	14
4	56	subalpine fir/queencup beadlily	2
4	74	Douglas-fir/huckleberry	15
4	74	subalpine fir/Sitka alder	6
5	4	Douglas-fir/twinflower	7
5	5	Douglas-fir/twinflower	9
5	5	subalpine fir/twinflower	9
6	2	Douglas-fir/snowberry	134
6	2	Douglas-fir/twinflower	3
6	2	subalpine fir/twinflower	2
6	2	spruce-moist	5
6	76	subalpine fir/queencup beadlily	48
6	76	subalpine fir/beargrass	68
6	76	subalpine fir/menziesia	7
6	78	Douglas-fir/snowberry	30
6	78	subalpine fir/queencup beadlily	8
6	85	Douglas-fir/snowberry	106
6	85	subalpine fir/beargrass	37
7	80	Douglas-fir/huckleberry	66
7	80	Douglas-fir/pinegrass	14
7	80	Douglas-fir/snowberry	243
7	80	subalpine fir/beargrass	3
7	86	Douglas-fir/snowberry	35
7	86	subalpine fir/beargrass	13
7	87	Douglas-fir/huckleberry	7
7	87	Douglas-fir/snowberry	8
7	87	subalpine fir/beargrass	11
7	87	subalpine fir/menziesia	5
7	87	subalpine fir/twinflower	6
8	77	Douglas-fir/huckleberry	17
8	77	Douglas-fir/snowberry	256
8	77	Douglas-fir/twinflower	32
8	77	pvt	5
8	77	subalpine fir/Sitka alder	25

Prescription Group	Unit Number	Habitat Type	Acres
8	77	subalpine fir/queencup beadlily	24
8	77	subalpine fir/beargrass	349
8	79	Douglas-fir/huckleberry	72
8	79	Douglas-fir/snowberry	76
8	79	grass-trees	8
8	79	subalpine fir/beargrass	180
8	81	Douglas-fir/huckleberry	43
8	81	Douglas-fir/snowberry	238
8	81	subalpine fir/beargrass	349
8	82	subalpine fir/beargrass	724
8	82	subalpine fir/menziesia	48
8	82	subalpine fir/twinflower	3
8	83	rock	57
8	83	subalpine fir/beargrass	295
8	83	subalpine fir/woodrush	31
8	83	trees-rock	74
8	84	Douglas-fir/huckleberry	2
8	84	Douglas-fir/pinegrass	168
8	84	Douglas-fir/snowberry	159
8	84	grass-trees	14
8	84	subalpine fir/beargrass	466
8	84	subalpine fir/menziesia	21
8	88	Douglas-fir/pinegrass	6
8	88	rock	51
8	88	subalpine fir/beargrass	471
8	88	subalpine fir/twinflower	11
8	88	subalpine fir/woodrush	101
8	88	trees-rock	225

Biophysical Settings

Biophysical Settings are land delineations based on the physical setting, (e.g., elevation and aspect) and the potential vegetation community that can occupy the setting. A national team has established in the FRCC system a set of descriptions for BpS found within regions of the United States (FRCC 2005). HNF ecologists, fuel specialists, and silviculturists reviewed the BpS descriptions applicable to the Stone Dry area and determined that the descriptions could be used for the Stone Dry area without modification (Milburn et al. 2009). For the Stone Dry analysis, HNF personnel spatially assigned BpS based upon habitat type (Milburn et al. 2009). Table 12 identifies acres of biophysical settings by unit.

Table 12. Unit biophysical setting acreages

Unit	Biophysical Setting	Acres
1	Barren	3
1	Ponderosa Pine-Douglas-fir	134
10	Ponderosa Pine-Douglas-fir	44

Unit	Biophysical Setting	Acres
11	Ponderosa Pine-Douglas-fir	50
12	Ponderosa Pine-Douglas-fir	130
13	Ponderosa Pine-Douglas-fir	95
14	Ponderosa Pine-Douglas-fir	47
15	Ponderosa Pine-Douglas-fir	51
16	Ponderosa Pine-Douglas-fir	12
17	Ponderosa Pine-Douglas-fir	95
18	Ponderosa Pine-Douglas-fir	62
19	Ponderosa Pine-Douglas-fir	50
2	Barren	5
2	Mountain Grassland with Shrubs	2
2	Mountain Shrubland	0
2	Ponderosa Pine-Douglas-fir	178
20	Ponderosa Pine-Douglas-fir	72
21	Ponderosa Pine-Douglas-fir	23
22	Ponderosa Pine-Douglas-fir	84
23	Mountain Grassland with Shrubs	3
23	Mountain Shrubland	5
23	Ponderosa Pine-Douglas-fir	50
24	Mountain Grassland with Shrubs	7
24	Ponderosa Pine-Douglas-fir	14
25	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	21
25	Mountain Grassland with Shrubs	3
25	Ponderosa Pine-Douglas-fir	53
26	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	33
26	Mountain Grassland with Shrubs	2
26	Ponderosa Pine-Douglas-fir	96
27	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	3
27	Ponderosa Pine-Douglas-fir	77
28	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	13
28	Ponderosa Pine-Douglas-fir	50
29	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	3
29	Ponderosa Pine-Douglas-fir	60
3	Ponderosa Pine-Douglas-fir	68
30	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	2
30	Ponderosa Pine-Douglas-fir	40
31	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	5
31	Ponderosa Pine-Douglas-fir	46
32	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	39
32	Mountain Shrubland	0

Unit	Biophysical Setting	Acres
32	Ponderosa Pine-Douglas-fir	58
33	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	23
33	Mountain Grassland with Shrubs	2
33	Ponderosa Pine-Douglas-fir	25
34	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	31
34	Ponderosa Pine-Douglas-fir	4
35	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	53
35	Ponderosa Pine-Douglas-fir	6
36	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	42
36	Ponderosa Pine-Douglas-fir	5
37	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	28
38	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	9
38	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	21
39	Ponderosa Pine-Douglas-fir	67
4	Ponderosa Pine-Douglas-fir	30
40	Ponderosa Pine-Douglas-fir	29
41	Ponderosa Pine-Douglas-fir	34
42	Ponderosa Pine-Douglas-fir	126
43	Ponderosa Pine-Douglas-fir	204
44	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	3
44	Ponderosa Pine-Douglas-fir	185
45	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	25
45	Ponderosa Pine-Douglas-fir	74
46	Ponderosa Pine-Douglas-fir	365
47	Ponderosa Pine-Douglas-fir	284
48	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	14
48	Mountain Shrubland	1
48	Ponderosa Pine-Douglas-fir	223
49	Ponderosa Pine-Douglas-fir	79
5	Ponderosa Pine-Douglas-fir	37
50	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	15
50	Mountain Shrubland	1
50	Ponderosa Pine-Douglas-fir	89
51	Barren	4
51	Ponderosa Pine-Douglas-fir	242
52	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	68
52	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	2
53	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	40
53	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	2
54	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	53

Unit	Biophysical Setting	Acres
54	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	2
55	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	21
55	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	46
56	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	10
56	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	38
57	Ponderosa Pine-Douglas-fir	173
58	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	21
58	Ponderosa Pine-Douglas-fir	29
59	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	19
59	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	37
6	Ponderosa Pine-Douglas-fir	57
60	Ponderosa Pine-Douglas-fir	58
61	Ponderosa Pine-Douglas-fir	65
62	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	50
62	Ponderosa Pine-Douglas-fir	27
63	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	43
63	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	24
64	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	49
64	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	2
64	Ponderosa Pine-Douglas-fir	30
65	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	50
65	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	4
65	Ponderosa Pine-Douglas-fir	3
66	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	33
66	Ponderosa Pine-Douglas-fir	41
67	Mountain Grassland with Shrubs	14
67	Mountain Shrubland	2
67	Ponderosa Pine-Douglas-fir	41
68	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	29
68	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	15
68	Ponderosa Pine-Douglas-fir	5
69	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	16
69	Mountain Grassland with Shrubs	20
69	Mountain Shrubland	5
69	Ponderosa Pine-Douglas-fir	39
7	Ponderosa Pine-Douglas-fir	39
70	Ponderosa Pine-Douglas-fir	70
71	Ponderosa Pine-Douglas-fir	90
72	Ponderosa Pine-Douglas-fir	158
73	Barren	3

Unit	Biophysical Setting	Acres
73	Ponderosa Pine-Douglas-fir	63
74	Mountain Grassland with Shrubs	7
74	Ponderosa Pine-Douglas-fir	72
75	Ponderosa Pine-Douglas-fir	195
76	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	88
76	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	74
76	Ponderosa Pine-Douglas-fir	29
77	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	335
77	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	369
77	Ponderosa Pine-Douglas-fir	224
78	Ponderosa Pine-Douglas-fir	90
79	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	208
79	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	111
79	Mountain Grassland with Shrubs	1
79	Ponderosa Pine-Douglas-fir	96
8	Barren	3
8	Ponderosa Pine-Douglas-fir	136
80	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	106
80	Ponderosa Pine-Douglas-fir	317
81	Barren	4
81	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	264
81	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	333
81	Ponderosa Pine-Douglas-fir	202
81	Interior West Lower Subalpine Forest	3
82	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	150
82	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	503
82	Mountain Grassland with Shrubs	23
82	Ponderosa Pine-Douglas-fir	5
82	Interior West Lower Subalpine Forest	237
83	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	109
83	Mountain Grassland with Shrubs	37
83	Mountain Shrubland	4
83	Interior West Lower Subalpine Forest	359
83	Interior West Upper Subalpine Forest	64
84	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	410
84	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	296
84	Mountain Grassland with Shrubs	8
84	Mountain Shrubland	3
84	Ponderosa Pine-Douglas-fir	245
84	Interior West Lower Subalpine Forest	21

Unit	Biophysical Setting	Acres
85	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	86
85	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	62
85	Ponderosa Pine-Douglas-fir	84
86	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	3
86	Ponderosa Pine-Douglas-fir	78
87	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	29
87	Ponderosa Pine-Douglas-fir	104
88	Barren	1
88	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	154
88	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	334
88	Mountain Grassland with Shrubs	41
88	Mountain Shrubland	16
88	Ponderosa Pine-Douglas-fir	2
88	Interior West Lower Subalpine Forest	384
88	Interior West Upper Subalpine Forest	86
9	Ponderosa Pine-Douglas-fir	42

Table 13. Treatment group biophysical settings

Prescription Group	Biophysical Setting	Acres	Percent of Group
1	Barren	3	0.1
1	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	216	11.6
1	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	48	2.6
1	Mountain Grassland with Shrubs	14	0.8
1	Mountain Shrubland	5	0.3
1	Ponderosa Pine-Douglas-fir	1571	84.6
2	Barren	7	0.3
2	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	318	14.6
2	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	82	3.7
2	Mountain Grassland with Shrubs	34	1.5
2	Mountain Shrubland	10	0.4
2	Ponderosa Pine-Douglas-fir	1729	79.4
3	Barren	9	0.5
3	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	116	6.8
3	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	2	0.1
3	Mountain Grassland with Shrubs	5	0.3
3	Mountain Shrubland	0	0.0
3	Ponderosa Pine-Douglas-fir	1564	92.2

Prescription Group	Biophysical Setting	Acres	Percent of Group
4	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	186	29.5
4	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	88	14.0
4	Mountain Grassland with Shrubs	7	1.1
4	Ponderosa Pine-Douglas-fir	350	55.4
5	Ponderosa Pine-Douglas-fir	68	100.0
6	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	173	33.8
6	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	136	26.5
6	Ponderosa Pine-Douglas-fir	204	39.7
7	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	138	21.6
7	Ponderosa Pine-Douglas-fir	499	78.4
8	Barren	5	0.1
8	Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	1520	26.9
8	Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	2056	36.4
8	Mountain Grassland with Shrubs	110	1.9
8	Mountain Shrubland	23	0.4
8	Ponderosa Pine-Douglas-fir	773	13.7
8	Interior West Lower Subalpine Forest	1005	17.8
8	Interior West Upper Subalpine Forest	150	2.7

Insects and Diseases

Mountain Pine Beetle

The role of mountain pine beetle in ecosystems where lodgepole pine is seral is to remove the larger, dominant lodgepole pine and increase growing space for understory late-seral species such as subalpine fir and Douglas-fir, hastening succession (Amman 1977). Mountain pine beetle in these ecosystems also plays a role in converting stands from even-aged and single-story to uneven-aged and multi-story (Cole and Amman 1980).

Mountain pine beetle (MPB) infestations are closely related to host tree age, size, and density. Larger diameter trees are attacked by mountain pine beetle at higher rates than smaller diameter trees, and trees less than 5 inches d.b.h. have very low levels of attack (Cole and Amman 1969, Roe and Amman 1970, Cole and Amman 1980, Klein et al. 1978). VMap data shows that before the recent MPB outbreak, about 5,300 acres (22 percent of the project area) was dominated by lodgepole or ponderosa pine in or greater than a 5 to 9.9 inches d.b.h. size class. This could be considered a substantial portion of the landscape susceptible to mountain pine beetle, and does not include the area containing lodgepole or ponderosa pine where they are not dominant. Available stand data from recently examined stands in the project area containing lodgepole pine that has been severely impacted by MPB had average diameters greater than 8 inches d.b.h. (table 10).

Mountain pine beetle risk increases in lodgepole pine stands with an average age greater than 80 years old (Amman et al. 1990). Available stand data indicates that examined stands in the project area containing lodgepole severely impacted by mountain pine beetles had stand ages greater than 80 (table 10).

Mountain pine beetle risk also increases with stand stocking levels (Larsson et al. 1983, Anhold and Jenkins 1987, Negron et al. 2008, Obezinski et al. 1999, Oliver 1995, Olsen et al. 1996, Schmitz et al. 1981) and the proportion of stocking in susceptible species. In terms of basal area stocking Olsen et al. (1996) found greater MPB mortality in ponderosa pine where tree density exceeded 200 TPA and where BAs were between 150 and 250 ft^2, Larson et al. (1983) found an attack threshold in ponderosa pine of about 91 ft^2, Amman and Logan (1998) described a basal area of 80 ft^2/acre in lodgepole pine as a threshold for susceptibility. Available stand data indicates that examined stands in the project area containing lodgepole severely impacted by mountain pine beetles had stand basal areas greater than 80 (table 10).

Available research indicates that mountain pine beetle epidemics continue until the available bark beetle habitat is sufficiently reduced that epidemic levels can no longer be sustained (Cole and Amman 1969, Roe and Amman 1970, Cole and Amman 1980, Klein et al. 1978, Mitchell and Preisler 1991). Available stand data from 2009 and 2010 show that most of the larger, mature lodgepole pines are dead. Given this, we suspect that the recent mountain pine beetle epidemic in the project area has probably peaked is now declining because the supply of host trees has been depleted. Ponderosa and whitebark pine are also present in the project area and extensive mortality has also been recorded on those species.

Douglas-fir Beetle

Characteristics such as poor growth and stand density have been shown to be related to Douglas-fir beetle mortality (Negron 1998). Maintaining tree vigor and reducing moisture stress is important to reducing bark beetle hazard in interior Douglas-fir (Furniss and Carolin 1977, Schmitz and Gibson 1996).

Douglas-fir beetle tends to attack trees that are mature or overmature, large-diameter, and in densely-stocked stands (Schmitz and Gibson 1996, Furniss et al. 1979, Reid and Glubish 2001, Garrison-Johnson et al. 2003).

Higher stand density and high density in Douglas-fir results in higher mortality with basal area of Douglas-fir being the best predictor variable for basal area (BA) killed (McMillin and Allen 2000, Negron et al. 2001). Weatherby and Thier (1993) developed a rating model for Douglas-fir beetle which included stand basal areas of greater than 27.5 m^2/ha (119 ft^2) and proportion of stand basal area in Douglas-fir greater than 50 percent integrated which stand age and average tree size as thresholds for susceptibility. Randall and Tensmeyer (1999) developed a hazard rating system for the Inland Northwest integrating average Douglas-fir d.b.h., average stand age, stand BA and Douglas-fir percent of stand BA. In their system, if percent stand BA in Douglas-fir was 30-50, and stand BA 120 to 250 then hazard was high. For values greater than those resulted in hazard being very high.

Douglas-fir beetle prefers old trees because of their abundance of food and lower defense mechanisms and so the oldest, largest trees are the most susceptible. Furniss (1962), when studying the infestation patterns of Douglas-fir beetle that trees from 150 to 250 years old were exclusively attacked. Weatherby and Thier (1993) used an age of 120 years as a threshold for susceptibility in their DBF risk rating system. Randall and Tensmeyer (1999) used an average stand age of 80-120 years as a parameter for a hazard rating of moderate, with age greater than 120 a parameter for a hazard rating of high or greater.

Douglas-fir beetle shows a preference for attacking large-diameter trees. Negron noted that they rarely attack trees less than 6 inches d.b.h. (Negron 1998). Weatherby and Thier (1993) included a stand average d.b.h. of all Douglas-firs greater than 9 inches d.b.h. as a threshold for susceptibility in their DFB risk rating system. Randall and Tensmeyer (1999) used an average Douglas-fir diameter of 10-14 inches d.b.h. a parameter for a hazard rating of moderate, with greater than 14 a parameter for a hazard rating of high or greater.

Also, damage by fires has been shown to initiate Douglas-fir beetle attack. Douglas-fir injured by fires, especially by crown scorch, attract and can be susceptible to DFB (Furniss 1965, Cunningham et al. 2005, Hood and Bentz 2007). Cunningham et al. (2005) found that 1 year after a fire event the Douglas-fir beetle selected and attacked large-diameter Douglas-fir with 60–80 percent bole char, 60–80 percent crown volume scorch, and 50–70 percent probability of mortality due to fire. Hood and Bentz (2007) found that beetles were attracted to trees with high levels of crown scorch but not cambium injury. Hood and Bentz (2007) study also suggested that that tree size, stand conditions, and host availability were slightly more important in determining the likelihood of beetle attacks than fire injuries sustained by trees.

ADS data suggests that DFB is present at endemic levels. Stand-level data is available for only a portion of the stands within the project area and so we did not be model DFB hazard on the landscape. We discuss DFB hazard on the landscape from available exam data and the effects of alternatives on DFB hazard in individual treatment units.

Available data does show that many heavily forested stands in the project area contain mature Douglas-fir which is susceptible to bark beetles. Of the FVS grid-intensification plots in the project area, 60 percent could be classified as high hazard under Randall and Tensmeyer's (1999) rating scheme.

Western Spruce Budworm

Western spruce budworm's (*Choristoneura fumiferana*) primary hosts are Douglas-fir, Engelmann spruce, and true firs. Western spruce budworm (WSB) feeds on foliage, staminate flowers and developing cones (Fellin and Dewey 2012). WSB infestations can be prolonged, widespread and destructive. Regeneration and young stands are particularly vulnerable when growing beneath a canopy of overstory trees because larvae disperse from the overstory and feed on the small trees below. WSB's greatest impact in mature stands is reduced growth, although repeated defoliation sometimes results in top-killing and tree mortality. Multi-story, dense stands are especially prone to developing high levels of WSB and susceptible to WSB damage (Carlson and Wulff 1989). Trees severely defoliated by the WSB may be predisposed to one or more species of tree-killing bark beetles, mainly the Douglas-fir beetle, and the fir engraver beetle (*Scolytus ventralis*). Budworm populations are usually regulated by combinations of several natural factors such as insect parasites, vertebrate and invertebrate predators, and adverse weather conditions. If stands become heavily defoliated during prolonged outbreaks, starvation can become important in regulating WSB populations (Fellin and Dewey 2012).

Swetnam and Lynch (1993) studied WSB outbreaks in New Mexico from 1690 to 1989 using tree ring records and found that WSB outbreaks tended to be cyclical with periods varying from 20-33 years, duration within stands of about 11 years. They observed that budworm activity in the 1900's was unusually severe and tended to be more synchronous among stands than during earlier centuries, which they suggested was due to changes in stand structures due to man's influence. Ryerson et al. (2003) in a reconstruction of SPB in the San Juan Mountains, Colorado, did not find significant 20th-century changes in the frequency of outbreak occurrence or magnitude of growth reduction.

Acreage affected by WSB declined in 2010 yet continues to be present in the project area. Many of the stands in the project area are multi-story and dense, with a high proportion of the stocking being in susceptible species. Of the FIA grid-intensification plots, 60 percent have greater than one-half of the BA stocking in WSB host species and in another 20 percent, although BA stocking of WSB host species is less than 50 percent, the TPA stocking in host species is high due to the large number of small trees. Additionally, all of the stands surveyed via FIA grid-intensification plots can be considered multi-story; that is, exhibiting tree canopies that are differentiated into layers at two or more vertical levels, a structure conducive to sustaining budworm populations and damaging understory trees or regeneration.

White Pine Blister Rust

White pine blister rust (*Cronartium ribicola*) has led to a rapid and precipitous decline in whitebark pine throughout Montana (appendix B). Five units proposed for prescribed burning (Units 76, 79, 82, 83, 88) are shown in available data to contain whitebark pine. Although little data is available concerning the condition of whitebark pine in those units, Forest and Inventory Analysis data for the Helena NF recorded white pine blister rust on about 19 percent of the live whitebark pine trees in the plots. However, blister rust surveys of whitebark pine in two stands south of the Stonewall project area on the Helena National Forest done in 2007 and 2009 found 74 and 97 percent WPBR infection levels (see WBP Survey_granite.xls and WBP Survey_redmtn6253.xls in project records). Given that the purpose of the blister rust surveys was to closely examine trees for the presence of blister rust, we suspect infection levels within the project area to be closer to the survey values than that shown in FIA data. Also, given the widespread presence and impacts of the disease throughout the Intermountain West (appendix B), there is no reason to believe that the condition is not similar to other places in the state.

Dwarf Mistletoe

Dwarf mistletoes (DMT, *Arceuthobium spp*.) are a family of native parasitic plants that extract water and nutrients from living conifers. DMT reduces tree vigor, causing irregular branching, branch kill, and top kill. Premature death eventually follows, usually aided by secondary bark beetles (Hawksworth and Johnson 1989). The parasitic activity of DMT causes reduced tree diameter and height growth, decreased cone and seed production, direct tree mortality, or predisposition of other pathogens and insects (Geils et al. 2002). In the long term, DMT in heavily invested seral-species stands can accelerate the shift toward climax non-host tree species (Geils et al. 2002). Stand data shows that in the project area, lodgepole pine is being affected in many stands by *A. americanum* at levels ranging from light to heavy. In most of the stands the infected overstory has been recently killed by MPB but remaining smaller understory lodgepole is probably infected also.

Armillaria

Stand data indicates that several stands contain root rot pockets, probably by armillaria root disease (*Armillaria ostoyae*) although the stand data did not definitively establish armillaria as the cause. The root rot pockets appear to be generally small. Armillaria root disease can result in tree mortality, growth reduction and wood decay.

Armillaria can infect all conifers found in the area, but susceptibility varies between the species. The general descending order of susceptibility to armillaria root disease is: ponderosa pine, lodgepole pine, Douglas-fir, western larch, Engelmann spruce, and subalpine fir (McDonald et al. 1987). Tree growth and vigor also affects susceptibility to armillaria, although study results are mixed. Filip and Goheen (1995) found that precommercially thinning 10- to 20-year-old mixed species stands significantly increased tree growth but after 10 years, difference in crop-tree mortality between thinned and unthinned stands was not statistically significant. In ponderosa pine, Filip and Goheen (1995) found that 20 years following precommercial thinning, crop-tree mortality in unthinned plots was twice that of thinned plots. In the same plots, Filip et al. (2009) found that seven years after commercial thinning was in leave trees less than thinned plots than in unthinned plots. Armillaria root rot is difficult to control because disease is nearly impossible to eliminate from a site (Rippy et al. 2005). The impacts of armillaria root disease can be reduced by:

- Favoring more resistant/tolerant tree species.
- Maintaining tree species diversity.
- Reforesting stands with locally adapted species suitable to the site.

- Promoting tree vigor by minimizing stress and avoiding wounds.
- Reducing inoculum sources through the uprooting of stumps and removal of woody debris

See more about tree mortality and damage for proposed units from insects and disease in chapter 1.

Stand Structures and Species Compositions

It can be useful to display stand species compositions and structures through the use of "diameter distributions" which display the number of trees present within diameter ranges. In this analysis, we display example stand diameter distributions in terms of trees-per-acre (TPA) within 2-inch diameter-at-breast-height (d.b.h.) classes. Note that within the diameter distribution scheme used in this analysis, what is displayed as the "1-inch" d.b.h. class displays the TPA for trees less than a 1-inch d.b.h.; the 2-inch d.b.h. class displays TPA for trees greater than or equal to 1 inch and less than three inches, and so on. The 1-inch d.b.h. class is often not displayed because the large number of trees in that class makes it difficult to see the species compositions of larger d.b.h. classes.

Figure 18 displays the diameter distribution for Stand 42303130. The stand has an estimated 1,442 total TPA live with 610 in the 1-inch class (not displayed) and 201 TPA dead due largely to the recent bark beetle outbreak (not displayed). The stand has about 167 ft^2 of basal area. The distribution is a very steep "reverse-J" shape with large numbers of trees in the smallest d.b.h. classes indicating that it is multi-story with a dense understory.

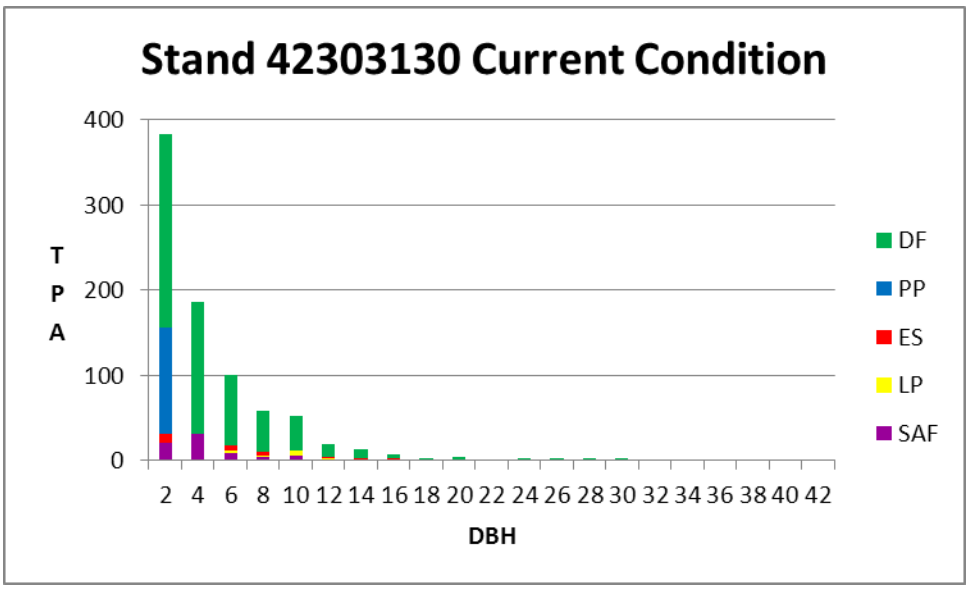

Figure 18. Stand 42303130 current condition diameter distributions

Figure 19 displays the diameter distribution for a plantation in the Stonewall Project Area. The species composition and diameter distribution suggests that the stand was planted to ponderosa pine and Douglas-fir, the trees forming the 4-inch to 10-inch d.b.h. class. The trees in the 1-inch and 2-inch d.b.h. classes are likely naturally established.

Plantation current condition diameter distribution

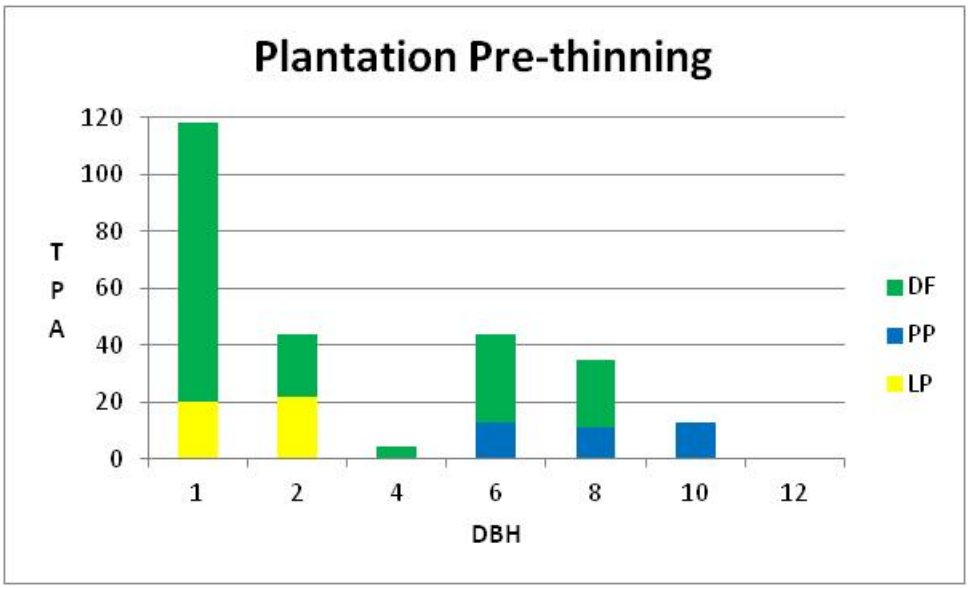

Figure 19. Plantation current condition diameter distributions

Figure 20 displays the current condition of Stand 41502088 in the Stonewall Project area. Dead and live trees are displayed to show the degree of mortality due to the recent mountain pine beetle outbreak. Most of the larger lodgepole pines have been killed. The stand is proposed for a harvest/regeneration treatment in this analysis.

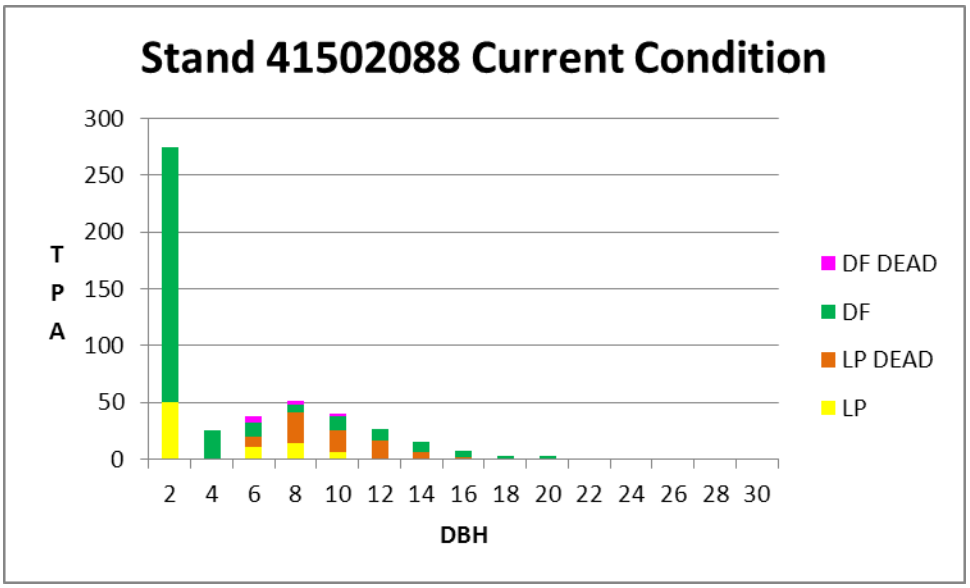

Figure 20. Stand 41502088 current condition diameter distributions

Figure 21 and figure 22 display the current condition of Stand 42502089 in the Stonewall Project area. Only live trees are displayed. The stand currently has 317 TPA and 110 ft^2 BA. Figure 22 displays the diameter distribution with the smallest size class removed so that the minor lodgepole pine and ponderosa pine components show up better. The figures display a stand average species composition but it should be noted that the distribution of ponderosa pine and lodgepole pine in the stand area was very clumpy.

Mortality in the stand shows an average of 4 TPA dead for lodgepole and ponderosa pine and 15 TPA dead for Douglas-fir greater than 10 inches d.b.h. The low average mortality for ponderosa and lodgepole pine reflects the proportion of stocking in the stand. Other stand data indicates that most of the larger lodgepole within the stand have died. The mortality for Douglas-fir indicates that Douglas-fir beetle may have impacted the stand in the last few years.

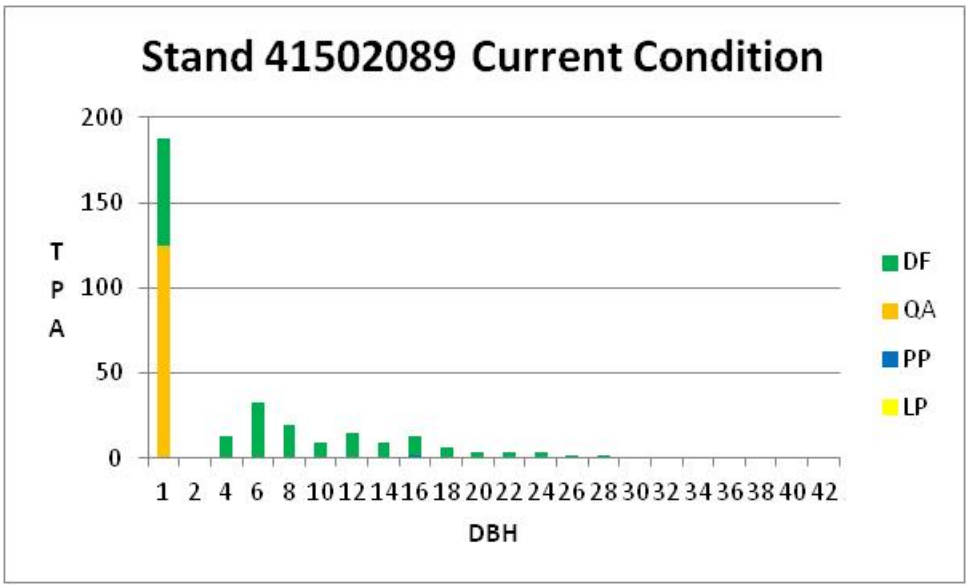

Figure 21. Stand 41502089 current condition diameter distributions all d.b.h. classes

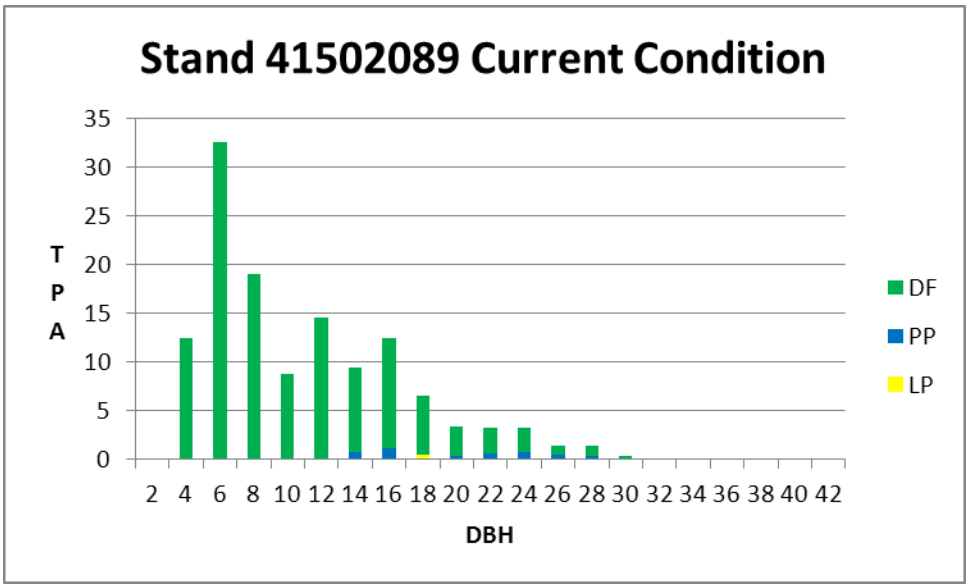

Figure 22. Stand 41502089 current condition diameter distribution without 1-inch d.b.h. class

Figure 23 displays the diameter distribution for Stand 415020066. Live and dead trees are displayed. The stand has about live 717 TPA and 187 feet^2 BA. It is proposed to have a pre-commercial thin and to have dead trees removed in the Stonewall Project.

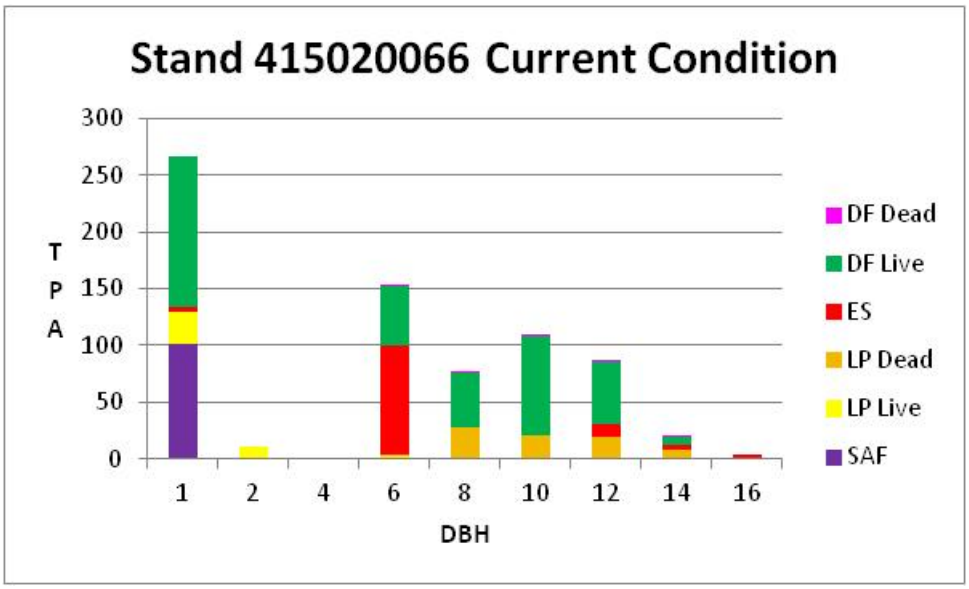

Figure 23. Stand 415020066 current condition diameter distributions

Figure 24 displays the diameter distribution for Stand 41502043. Live and dead trees are displayed. The stand has about live 385 live TPA, 126 dead TPA and 90 ft^2 BA. It is proposed to be thinned under alternative 2 and underburned under alternative 3 in the Stonewall Project.

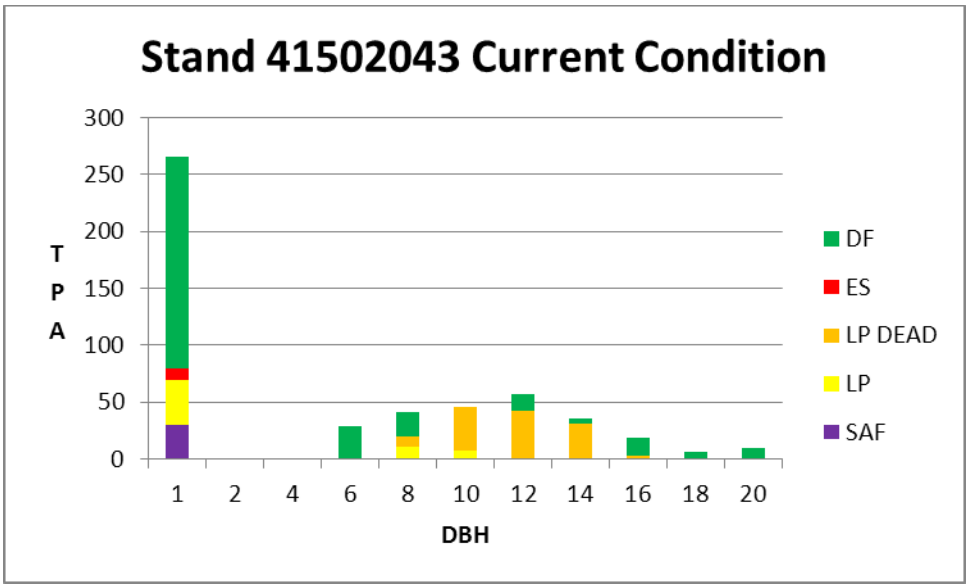

Figure 24. Stand 41502043 current condition diameter distribution

Figure 25 displays the diameter distribution for Stand 415020056. Live and dead trees are displayed. The stand has about live 575 live TPA, 239 dead TPA and 73 ft^2 BA. It is proposed to be regenerated under alternative 2 and underburned under alternative 3 in the Stonewall Project.

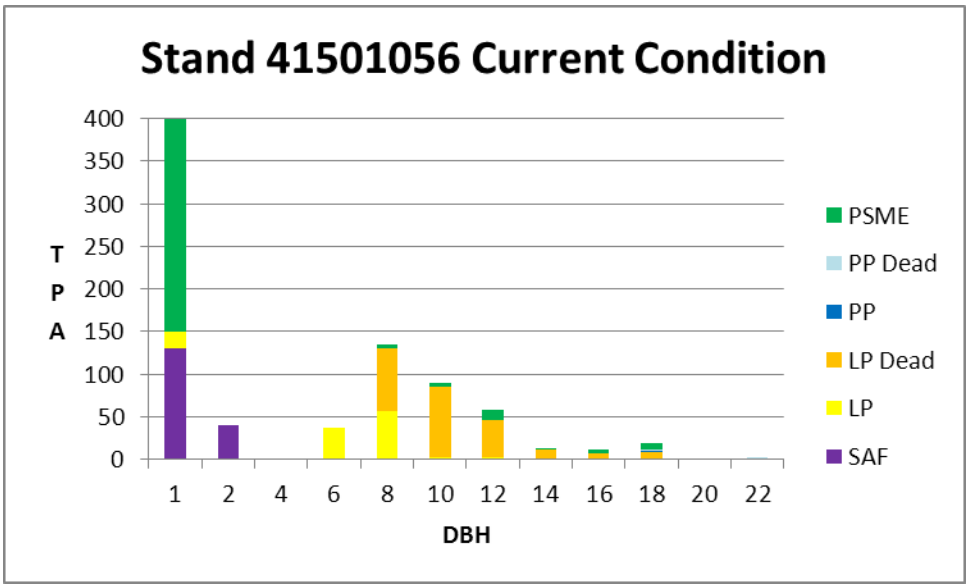

Figure 25. Stand 41501056 current condition diameter distributions

Tree Species of Interest

Ponderosa Pine

VMap data classifies 147 acres (about 0.6 percent) of the project area as having ponderosa pine as the dominant tree species with greater than 40 percent of the total tree canopy cover. About 32 percent of the area is within the Ponderosa pine/Douglas-fir BpS indicating that following the FRCC system based upon the physical setting and potential vegetation community we could expect to find ponderosa pine in a substantial portion of the area. Exams are available for only a portion of the project area, but available exams in proposed treatment units show ponderosa pine as a minor component (less than10 percent of stocking) in about 23 percent of the proposed treatment area and as a substantial component (equal to or greater than10 and less than 40 percent) on about 37 percent of the proposed treatment area.

The available data indicates that ponderosa pine is present on a substantial portion of the landscape, roughly ranging from about 32 to 60 percent, but is the major species on a very small portion of the landscape. The ponderosa pine can be considered as a seral species.

Quaking Aspen

VMap data does not show any quaking aspen-dominated stands within the project area which indicates that quaking aspen within the project did not dominate in sufficiently large area to be classified as the VMap data was created. Available exam data shows that aspen can be found in a number of units proposed for treatment, but always as a minor component. Although not observed and recorded in stand exams, very small aspen clones may be found in other units. The aspen can be considered seral to either subalpine fir or Douglas-fir, depending upon the unit and site. In many unit exams, the aspen is simply recorded as being present, as rare, or as a trace; while in several other units it comprises a substantial, although still minor, portion of the stocking(e.g.. Unit 3). Comments concerning the aspen in unit exams range from “suppressed in the understory” to “vigorous in the overstory, but proportionally not much suckering.” In general, we can characterize aspen in proposed units and the project area as: (1) small clones, (2) heavily competing with to suppressed by conifers, and (3) a minor stand component (with a few exceptions).

Western Larch

VMap data does not classify any area as being dominated by western larch indicating that the species is not present in sufficient quantities to be classified. Western larch is present in the project area, but available exam data for proposed treatment units shows the species as a minor component on about 3 percent of the proposed treatment area, except for one stand, which is a plantation. Available data, then, suggests that western larch is a very minor component on the landscape and in almost all stands, but many sites in the area could probably support it.

Whitebark pine

VMap data shows whitebark pine as the dominant tree species on about four percent of the project area, most in the highest elevations in the north side of the area. Available data mentions the species as present in treatment within Groups 6, 7, and 8, (Units 76, 79, 82, 83, 88) and although not recorded in available treatment unit diagnosis sheets (see analysis file), available FIA grid intensification plots in the project area recorded whitebark pine as present within about 11percent of the plots. There are only 16 FIA grid intensification plots within the project area, but they are uniformly distributed whereas the treatment units, except for the treatment units listed above, are generally lower elevation.

As stated above, a substantial portion (19 percent) to most (74 to 97 percent) of the whitebark pine on the Helena NF area can be considered infected by white pine blister rust (appendix B). In all FIA plots on the Helena NF, about 27 percent of the whitebark pine trees recorded were dead.

Whitebark pine in the Stonewall Project units is considered seral to subalpine fir. On sites where it is a seral species in the Northern Rocky Mountains, whitebark pine depends upon fire to maintain its dominance or presence (Arno 2001, Keane 2001, Kendall and Keane 2001, Morgan and Murray 2001). In the absence of fire, subalpine fir has increased in presence, and the combination of increases in subalpine fir and whitebark pine mortality and lack of regeneration due to white pine blister rust and mountain pine beetle have resulted in a decline in whitebark pine.

Environmental Consequences

Spatial and Temporal Context for Effects Analysis

We used three spatial scales for the effects analysis that follows. The spatial scale used depends upon the measurement indicator discussed. First, we discuss treatment effects on individual trees or classes of trees, for example, the increase in growth, vigor or size of small aspen clones due to the removal of competing conifers. Second, we discuss treatment effects on stand-level or unit-level attributes, for example, changes in species compositions. Third, we discuss treatment effects on a landscape scale, for example, the mixture of stand structures over the landscape. We chose the project area as the largest spatial scale for this analysis because it includes all Forest System land that: (1) includes the proposed treatment areas, (2) is bounded on the north, northwest, and west sides by drainage divides, and (3) at about 24,000 acres, is sufficiently large to analyze and discuss effects to forest vegetation on a landscape-level without ‘diluting’ the magnitude of the effects with a large area.

The year 2010 is the existing condition baseline used for this analysis. Proposed treatment stands were last examined in fall 2009 and 2010, briefly visited in summer 2010, and the last ADS survey used in this analysis was done in 2010. Short-term effects refer to effects over the 10-year period from the time the activity was accomplished which, for the purpose of modeling in this analysis, is assumed to be the year 2012 (although we do not know exactly when the activity would be accomplished). Long-term effects refer to effects from 10 to 50 years from the time the activity was accomplished. All pertinent past activities and events are incorporated into the previous existing condition discussion. In the cumulative

effects analysis that follows, cumulative effects are discussed as changes in the existing condition due to present and future activities, including the effects of the alternative being discussed.

Connected Actions, Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

Past Activities

Past activities that have shaped the existing condition discussed and displayed in this document include: (1) 3,872 acres of harvest/regeneration treatments, (2) 373 acres of other harvests cutting and 382 acres of hazardous tree removal treatments, (3) 822 acres of pre-commercial thinning, and (4) 7,922 acres of fuels treatments from 1950 to present (table 10), although some of these treatments were on the same area and so the acreages are not accumulative. In addition to the management actions, vegetation has been shaped by (1) 87 acres in the Snow/Talon Fire (2003), (2) 261 acres in the Keep Cool Fire (2006), and (3) insect and disease activity as discussed previously. Other past actions, such as livestock grazing and recreational activities have played a small role in shaping forest vegetation in the project area, or played a localized role. As mentioned above, these activities have been considered in describing the current condition.

Present Activities

Appendix C displays all of the past, ongoing and foreseeable projects identified by the HNF for possible consideration in this analysis. Activities that when combined with the proposed activities could contribute to cumulative effects were considered in this analysis. Some of the activities listed are not considered in this analysis because they are (1) outside of the analysis area used in this analysis, or (2) have no effect on the forest vegetation issue indicators addressed in this analysis, or (3) have such a small effect on the forest vegetation issue indicators used in this analysis that they are inconsequential to the analysis.

Effects Common to All Alternatives

The continuing effects on forest species composition and structures due to fire exclusion, succession, insect infestations, and diseases would be the same under all alternatives for areas not proposed for treatment in Alternatives 2 and 3. In the short term, these changes would be slight but in the long term could be substantial. These effects would be the continuing decline in area within all Biophysical Settings in the earlier vegetation-fuel classes and an increase in the later vegetation-fuel class. In general terms, (1) overall stand structures would become more closed-canopy and multi-story, and (2) species compositions would become more dominated by climax, shade-tolerant tree species, which would largely be subalpine fir.

Insects and Diseases

Mountain Pine Beetle

In stands receiving no treatment, mountain pine beetle activity would continue to some degree, but as discussed above, we suspect that the recent mountain pine beetle epidemic in the project area has probably peaked would decline to endemic levels in the short term because the supply of host trees has been depleted. MPB risk would be lower than before the recent epidemic into the long-term because stands are moving successionally from dominance by lodgepole pine toward Douglas-fir and subalpine fir.

Douglas-fir Beetle

Douglas-fir beetle in the short term would continue at recent levels. In the long-term due to the increase in Douglas-fir stocking, tree size, and total stand stocking, Douglas-fir beetle populations can be expected to increase and an outbreak would most likely occur.

Western Spruce Budworm

In the short term WSB populations are likely to continue at current levels. In the long-term WSB populations can be expected to increase due to an increase in host species-Douglas-fir and subalpine fir-dominance on the landscape and the increase in multiple-storied stand structures.

Dwarf Mistletoe

Dwarf mistletoes would continue in the short term at levels described above, and in the long-term would increase in presence and degree of impact. Lodgepole pine dwarf mistletoe would continue to increase the impacts of lodgepole pine and would accelerate the decline of lodgepole pine as a stand component.

Armillaria

In the short term armillaria root disease pockets would generally remain as described above, growing slowly larger. In the long-term the disease would have greater impacts in stands and on the landscape due (1) to the increase in dominance by tree species such as subalpine fir, Engelmann spruce, and Douglas-fir which are less resistant than seral species such as ponderosa pine and lodgepole pine, and (2) due to increases in stand stocking leading to deceases in tree vigor and disease resistance.

Species of Interest

Ponderosa Pine

As mentioned above, ponderosa pine is a shade-intolerant seral species on habitat types found in the project area and over time would decline in presence and eventually disappear without disturbance. It is a relatively long-lived species and to the decline and disappearance would be a long-term process punctuated by rapid declines brought about by events such as the recent mountain pine beetle outbreak.

Quaking Aspen

Quaking aspen as a relatively short stature and very shade-intolerant seral species would continue to decline from its already small presence and without disturbance would almost disappear. Aspen stems are relatively short-lived but the decline and disappearance would continue into the long-term.

Western Larch

As with ponderosa pine, western larch is a shade-intolerant but relatively long-lived seral species on habitat types found in the project area and in the long-term would decline in presence and eventually disappear without disturbance.

Whitebark Pine

Whitebark pine is a shade-intolerant seral species on almost all habitat types found in the project area and over time would decline in presence and almost disappear without disturbance.

Effects Common to All Action Alternatives

Effects common to all action alternatives include the effects of different proposed treatment regimes, the differences between the action alternatives being largely the amount of treatment area and in several

proposed treatment units, the proposed treatment regime. Treatments proposed in this project are described in eight treatment groups (USDA Forest Service 2010b):

Prescription Groups

Group 1 (Intermediate Harvest)

Detailed information concerning biophysical settings found in each treatment unit can be found in table 12. Detailed information concerning the biophysical settings found within this treatment group, and the proportion of the treatment group within the BpS can be found in table 13. Detailed information concerning the forest type and species composition of individual units within this group can be found in table 10. This group contains Douglas-fir, lodgepole pine, and mixed-species forest types mostly on Douglas-fir and ponderosa pine-Douglas-fir BpS with small inclusions of shrubland and barren BpS. Detailed information about the habitat types found within units in this prescription group can be found in table 11. This prescription group is dominated by Douglas-fir (36%) and subalpine fir (59%) habitat types with minor amounts of unknown habitat types.

Treatment objectives for this group are to develop mature, open forests comprised mostly of fire-resistant species. The proposed treatments would thin live trees, remove dead trees, and prescribe burn surface fuels. All tree thinning would be "from below" to favor retaining larger trees over smaller trees except that thinning regimes would favor retaining smaller trees of a more desirable species over larger trees of a less desirable species, and would favor keeping smaller, healthier-and-disease-free trees over larger, diseased trees. In general, the species preference for retention would be aspen, western larch, ponderosa pine, Douglas-fir, lodgepole pine, Engelmann spruce, and subalpine fir in descending order. This general order of preference may be modified for individual stands to address management objectives such as retaining species diversity, site factors, and other stand-specific factors such as relative species presence as noted in individual stand/unit prescriptions. Although not showing as present in these units, whitebark and limber pine would be retained if found.

Trees would be thinned to an average spacing of 20 to 40 feet (109 to 27 TPA), but spacing could vary widely. Thinning would be by hand and/or machine.

All cut live and dead trees of merchantable size would be removed for utilization except those needed to meet other resource concerns (e.g., snag and downed large woody debris requirements).

Following thinning and removal, units would be underburned or jackpot burned to reduce fuels.

Figure 26 displays the post-treatment species composition and structure for Stand 42303130 which partially forms Unit 46. The stand area is within the ponderosa pine-Douglas-fir BpS and is currently mostly ELSC with a minor component of BMSC and a very minor component of AESP which is a former lightly-forested meadow that is filling in. The effects of the proposed treatment would be to reduce the subalpine fir, Engelmann spruce, lodgepole pine, and Douglas-fir component and retain the ponderosa pine component. Stocking would be reduced to 258 TPA and 77 BA. The stand would have an almost “flat” diameter distribution and would be open and almost single-story but would still be uneven-aged.

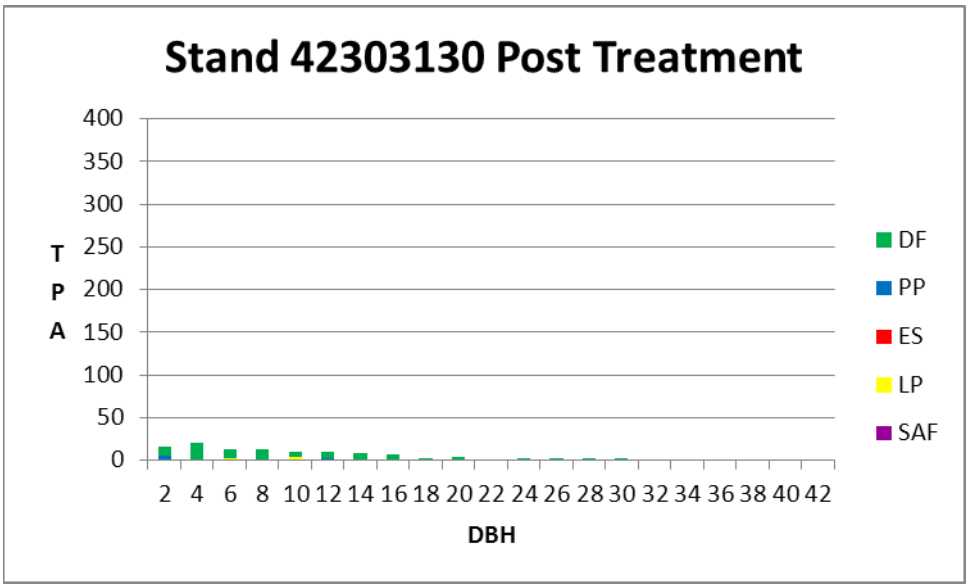

Figure 26. Stand 42303130 post thin and burn treatment

We displayed figure 26 above in the same vertical scale as figure 1 above for a direct comparison between the current and post-treatment condition. In figure 27 below we change the vertical scale to better display the species composition.

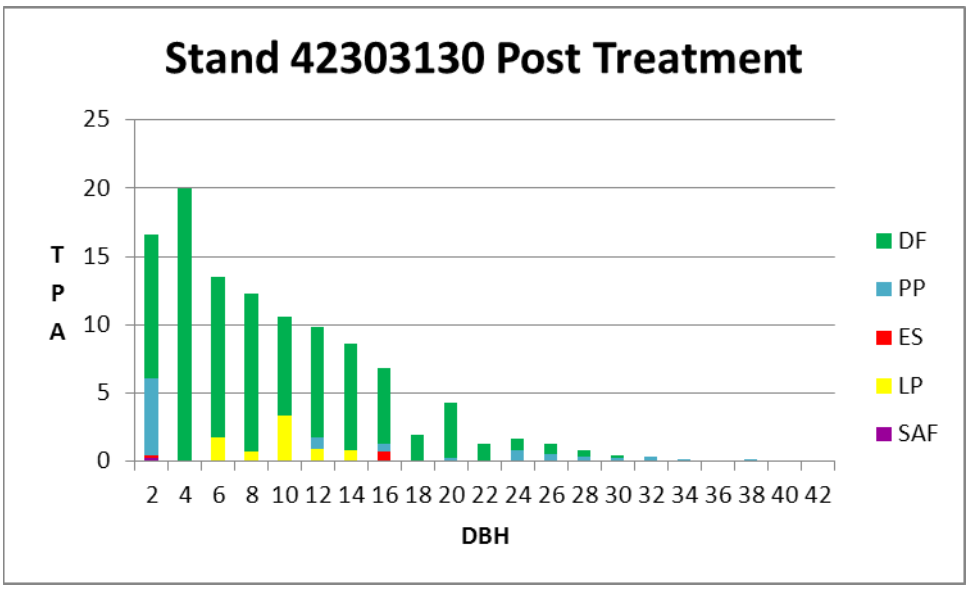

Figure 27. Stand 42303130 post thin and burn treatment

Other treatment units in this prescription group (appendices I and L) vary from that shown above somewhat in species composition and current structure, BpS, and vegetation-fuel classes. The general effects of the treatment would be as shown above; (1) diameter distributions would become much "flatter" and (2) shade-tolerant and fire-intolerant tree species would decline in representation and shade-intolerant and fire-tolerant tree species would increase in relative representation. In terms of vegetation-fuel classes, treatment effects would be to (1) move ELSC to DLSO, (2) retain DLSO, (3) retain CMSO, (4) move BMSC to CMSO, and (5) retain AESP.

Growth and vigor in the remaining trees would increase. Opening up the stand and prescribed burning can be expected to initiate a wave of tree establishment but the magnitude of the establishment would be moderated by overstory stocking. In the long-term, without additional treatments, the stand would again develop a dense understory and move back toward the current condition. Future treatments would be required to continue increasing ponderosa pine as a stand component and retain the open nature of the stands.

Group 2 (Precommercial Thinning)

Detailed information concerning biophysical settings found in each treatment unit can be found in table 12. Detailed information concerning the biophysical settings found within this treatment group, and the proportion of the treatment group within the BpS can be found in table 13. Detailed information concerning the forest type and species composition of individual units within this group can be found in table 10.This group contains Douglas-fir, lodgepole pine, and mixed-species forest types mostly on dry Douglas-fir, moist Douglas-fir, and ponderosa pine-Douglas-fir BpS with small inclusions of shrubland, shrubland-grassland, and barren BpS. Detailed information about the habitat types found within units in this prescription group can be found in table 11. This prescription group is dominated by Douglas-fir (50%) and subalpine fir (47%) habitat types with minor amounts of other habitat types.

This group consists of previous harvest/regeneration units that are proposed for precommercial thinning. Treatments would thin small diameter trees of little to no merchantable value. All tree thinning would be from below but would favor retaining smaller trees of a more desirable species over larger trees of a less desirable species, and would favor keeping smaller, healthier-and-disease-free trees over larger, diseased trees. In general, the species preference for retention would be aspen, western larch, ponderosa pine, Douglas-fir, lodgepole pine, Engelmann spruce, and subalpine fir in descending order. Post-thinning average tree spacing would range from 12 to 20 feet (109 to 303 TPA). Thinning would be by hand and/or machine, depending upon tree size. In several units, thinning slash would be piled by hand and burned. Figure 28 displays an example plantation from the Stonewall area after thinning.

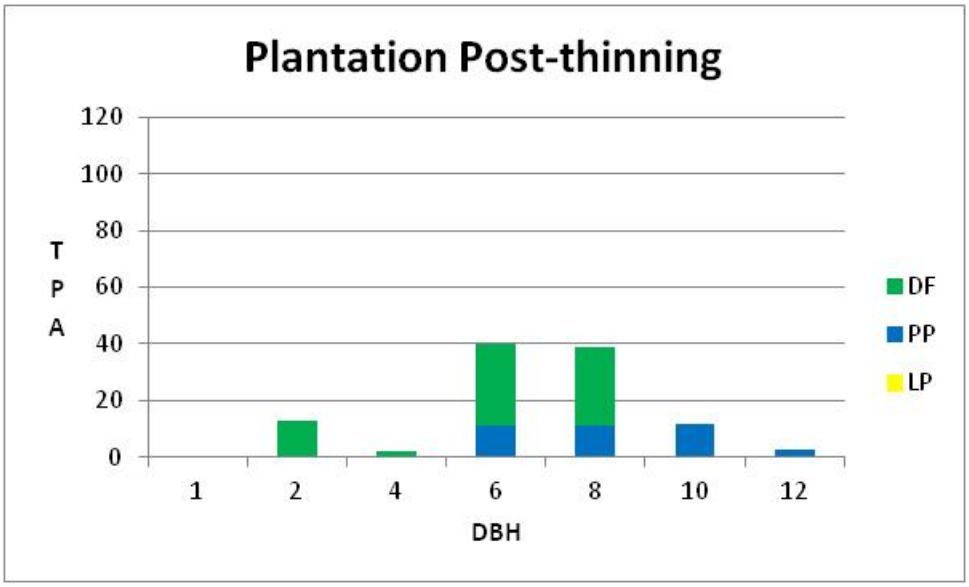

Figure 28. Plantation post-thinning diameter distribution

Following treatment, the stands would be more uniformly-sized because the smaller, slower-growing trees have mostly been removed. All of the stands would be more open and classified as CMSO. Growth and vigor would increase. In the long-term, trees would grow larger and canopy cover would increase,

transitioning the stands into DLSO or ELSC depending upon the amount of canopy cover at the time the trees area greater than greater than nine inches d.b.h.

Group 3 (Seedtree and Shelterwood Harvest/Regeneration)

Detailed information concerning biophysical settings found in each treatment unit can be found in table 12. Detailed information concerning the biophysical settings found within this treatment group, and the proportion of the treatment group within the BpS can be found in table 13. Detailed information concerning the forest type and species composition of individual units within this group can be found in table 10. This group contains lodgepole pine and mixed-species forest types mostly on dry Douglas-fir and ponderosa pine-Douglas-fir BpS with small inclusions of shrubland, shrubland-grassland, and barren BpS. Detailed information about the habitat types found within units in this prescription group can be found in table 11. This prescription group is dominated by Douglas-fir (41%) and subalpine fir (47%) habitat types with minor amounts of other habitat types.

This group includes stands that have been severely impacted by the recent bark beetle outbreak but which do contain overstory trees that can be retained as seed sources and as shelter for seedlings. Treatments proposed are seedtree and shelterwood harvest/regeneration systems. Most trees, except as needed for shelter and seed production would be removed. In some of the shelterwoods, trees would be retained in groups; in others, the remaining trees would be relatively evenly distributed. All cut live and dead trees of merchantable size would be removed for utilization except those needed to meet other resource concerns (e.g., snag and downed large woody debris requirements). Many of the units would be burned to reduce fuel loads and prepare sites for natural regeneration or planting. Many of the units may be planted with some combination of ponderosa pine, Douglas-fir, and western larch where needed to regenerate the stands to the desired seral and fire-resistant species.

Figure 20 shows an example stand in the Stonewall Project area that is proposed for a shelterwood treatment. The diameter distribution displays the current condition including dead trees. Most of the lodgepole pine in the stand was killed except for the very small trees and a few between six and 10 inches d.b.h. Figure 29 shows the stand immediately following a shelterwood treatment. Other stands in this group would vary in the species, remaining numbers of trees retained, and the distribution of the remaining trees but the general characteristics of the treatment, that is, a very open stand with a residual single-layer overstory would be the same.

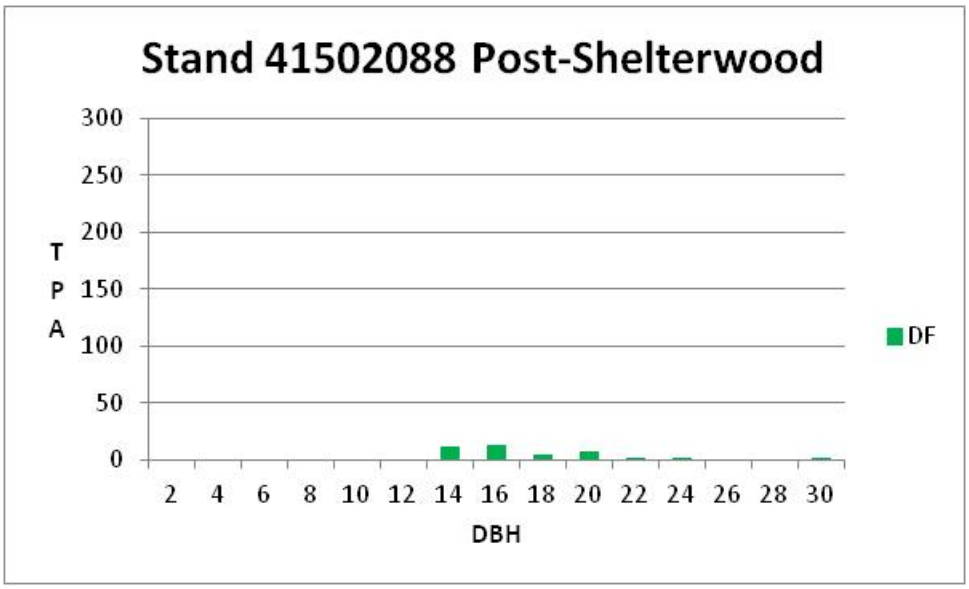

Figure 29. Stand 41502088 post-shelterwood

Following treatment, all of the stands would be classified as AESP. In the long-term, the stands would regenerate and transition out of AESP into CMSO. Many of the stands would develop in a two-story structure depending upon the number of seed and shelter trees retained.

Group 4 (Clearcut Harvest/Regeneration)

Detailed information concerning biophysical settings found in each treatment unit can be found in table 12. Detailed information concerning the biophysical settings found within this treatment group, and the proportion of the treatment group within the BpS can be found in table 13. Detailed information concerning the forest type and species composition of individual units within this group can be found in table 10. This group contains the lodgepole pine forest type mostly on dry Douglas-fir, moist Douglas-fir and ponderosa pine-Douglas-fir BpS with small inclusions of mountain grassland with shrubs. Detailed information about the habitat types found within units in this prescription group can be found in table 11. This prescription group is dominated by Douglas-fir (21%) and subalpine fir (75%) habitat types with minor area of other habitat types.

This group includes stands that have been severely impacted by the recent bark beetle outbreak. Treatments proposed are clearcut harvest/regeneration systems in which all trees would be removed except for scattered clumps or individuals. Retained trees would mostly be Douglas-fir, ponderosa pine, or western larch. All live and dead merchantable trees would be removed for utilization except those needed to meet other resource concerns. Following cutting and removal, units would be prescribed burned, the type of burn varying by individual unit fuels reduction and site preparation needs. Natural regeneration by Douglas-fir and lodgepole pine is expected to occur to some degree, and Douglas-fir, ponderosa pine, and western larch may be planted to achieve the desired species composition, the mixture differing by individual unit based upon site attributes.

Since this treatment is a “clearcut with reserves” there would be a very open distributed to clumpy overstory remaining following the treatment. Each unit’s tree distributions would vary to some degree in species, number of retained trees, and distribution, but general characteristics of the treatment, that is, a very open stand with a patches and individual trees scattered throughout would be the same.

Following treatment, all of the stands would be classified as AESP. In the long term, the stands would regenerate and transition out of AESP into CMSO. Many of the stands would develop in a two-story structure depending upon the number of seed and shelter trees retained.

Group 5 (Remove dead and dying trees, slash noncommercial-sized trees)

Detailed information concerning biophysical settings found in each treatment unit can be found in table 12. Detailed information concerning the biophysical settings found within this treatment group, and the proportion of the treatment group within the BpS can be found in table 13. Detailed information concerning the forest type and species composition of individual units within this group can be found in table 10. This group contains the mixed-species forest type on ponderosa pine-Douglas-fir BpS. Detailed information about the habitat types found within units in this prescription group can be found in table 11. This prescription group is dominated by Douglas-fir (60%) and subalpine fir (30%) habitat types. This group includes two treatment units (4 and 5) comprising about 25 acres. The treatments would remove dead and dying trees, slash noncommercial-sized trees, and reduce fuels by handpiling and burning. Post-thinning the units would have from 194 to 435 TPA (10-15 foot average spacing). All cut merchantable trees would be removed for utilization using ground-based equipment except as needed to meet other resource concerns. Figure 30 displays the post-thinning diameter distribution for Stand 415020066 in Unit 4. Unit 5 differs somewhat from Unit 4 in species composition, but the general effects of reducing the small tree stocking would be the same.

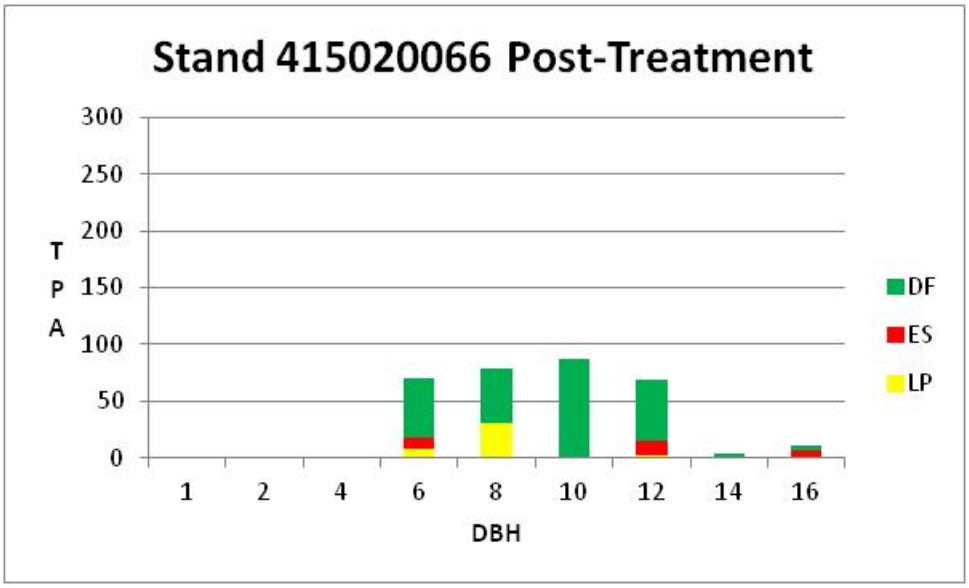

Figure 30. Stand 41020066 post-treatment

In terms of vegetation-fuel classes, the units would be moved to CMSO from DLSO or from ELSC to DLSO depending upon the pre-treatment class.

Group 6 (Low-intensity prescribed burning with 5-10 acre mortality patches)

Detailed information concerning biophysical settings found in each treatment unit can be found in table 12. Detailed information concerning the biophysical settings found within this treatment group, and the proportion of the treatment group within the BpS can be found in table 13. Detailed information concerning the forest type and species composition of individual units within this group can be found in table 10. This group contains the Douglas-fir forest type on dry Douglas-fir, moist Douglas-fir and ponderosa pine-Douglas-fir. Detailed information about the habitat types found within units in this

prescription group can be found in table 11. This prescription group is dominated by Douglas-fir (61 percent) and subalpine fir (38 percent) habitat types with minor area of a spruce habitat type.

This group includes three treatment units comprising about 449 acres. The treatments would cut small trees on portions of the treatment areas to create fuelbeds conducive to low-intensity prescribed burning. The prescribed burning would create openings less than 5 acres or in some cases up to10 acres, the opening size depending upon the unit. Units would be prescribe burned to reduce fuels, cause additional mortality of undesirable trees, and prepare sites for natural regeneration.

Figure 14 shows the current condition for Stand 41502089 which forms a part of proposed treatment Unit 2. Note that we did not display present dead trees to keep the chart simple. Figure 31 shows the stand immediately following a modeled low-intensity fire. The modeled fire would kill most of the small trees but few of the large trees. The modeled fire would kill only two TPA greater than 17 inches d.b.h. Immediately following the treatment the stand would have about 92 TPA, 88 square feet BA, and 17 TPA greater than 17 inches d.b.h. The quaking aspen is shown as being killed but tree regeneration by sprouting or seed was not being modeled in the exercise. Following the treatment the aspen can be expected to resprout and conifers to become established in the understory.

In the short term we can expect the stands in this group to be complexes of all five vegetation-fuel classes including about 15 percent of early-seral. The diameter distribution shown in Figure 31 is a “stand average” and does not display the high degree of variability within the post-treatment units within this group. In the long-term, natural regeneration through sprouting and conifer seeds, would form a new cohort in the understory. The new understory would also be very variable in the numbers of trees, with many young trees in the small openings, and few under the dense overstory groups. A mixture of species would become established, but conditions would favor seral species.

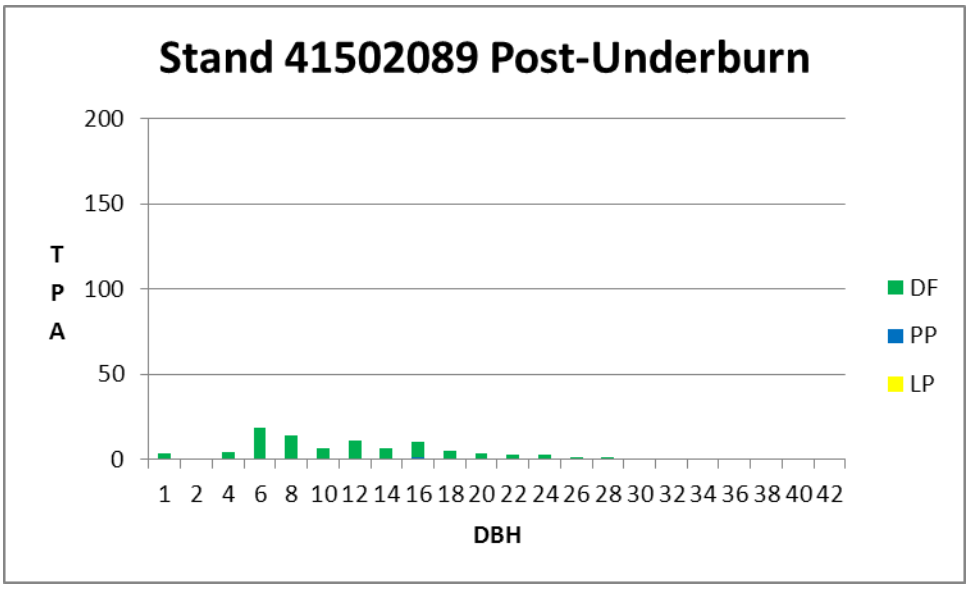

Figure 31. Stand 41502089 post-underburn treatment

Group 7 (Mixed-severity prescribed burning with 5, 10, 20 acre mortality patches)

Detailed information concerning biophysical settings found in each treatment unit can be found in table 12. Detailed information concerning the biophysical settings found within this treatment group, and the proportion of the treatment group within the BpS can be found in table 13. Detailed information concerning the forest type and species composition of individual units within this group can be found in

table 10. This group contains the Douglas-fir and lodgepole pine forest types on dry Douglas-fir and ponderosa pine-Douglas-fir BpS. Detailed information about the habitat types found within units in this prescription group can be found in table 11. This prescription group is dominated by Douglas-fir (91 percent) and subalpine fir (9 percent) habitat types.

This group includes three treatment units comprising about 410 acres. The treatments would cut small trees on portions of the treatment areas to create fuelbeds conducive to low-intensity prescribed burning. Where the opportunity exists, small trees would be cut to create small openings around available whitebark pine, ponderosa pine, western larch, and Douglas-fir trees to enhance the regeneration of those species. Units would be prescribe burned to reduce fuels, cause additional mortality of undesirable trees, and prepare sites for natural regeneration. The treatments would create patches of mortality up to 5, 10, or 20 acres depending upon the treatment unit (appendices K and L).

The general effects of these treatments would be similar to those in Group 6 but would be more variable with some larger patches of mortality. The cutting and burning would kill most of the small trees but few of the large trees. A mosaic of tree diameter distributions reflected in figures 2, 4-11, and 13-17 would be found within the treatment units due to the variable nature of the treatment.

Following the treatment the aspen can be expected to resprout and conifers to become established in the understory especially in the small patches of mortality and small, deliberately created openings. A number of species would become established, but conditions would favor the establishment of seral species.

In the short term we can expect the stands in this group to be highly-variable complexes of all five vegetation fuel classes including about 15 percent of early-seral. In the long term, natural regeneration through sprouting and conifer seeds would form a new cohort in the understory. The new understory would also be very variable in the numbers of trees, with many young trees in the small openings, and few under the dense overstory groups.

Group 8 (Mixed-severity prescribed burning with 30-75 acre mortality patches)

Detailed information concerning biophysical settings found in each treatment unit can be found in table 12. Detailed information concerning the biophysical settings found within this treatment group, and the proportion of the treatment group within the BpS can be found in table 13. Detailed information concerning the forest type and species composition of individual units within this group can be found in table 10. This group contains the Douglas-fir and lodgepole pine forest types on dry Douglas-fir, moist Douglas-fir, ponderosa pine-Douglas-fir and interior west lower subalpine BpS. Detailed information about the habitat types found within units in this prescription group can be found in table 11 This prescription group is dominated by Douglas-fir (23 percent) and subalpine fir (67 percent) habitat types with inclusions of rock and grass.

This group includes seven treatment units comprising about 4,604 acres. The treatments would cut small trees on portions of the treatment areas to create fuelbeds conducive to low-intensity prescribed burning. Where the opportunity exists, small trees would be cut to create small openings around available whitebark pine, ponderosa pine, western larch, and Douglas-fir trees to enhance the regeneration of those species. Units would be prescribe burned to reduce fuels, cause additional mortality of undesirable trees, and prepare sites for natural regeneration. The treatments would create patches of mortality up to 30 or 75 acres depending upon the treatment unit (appendix B).

The general effects of these treatments would be similar to those in Group 7 but would have larger patches of mortality. The cutting and burning would kill most of the small trees but few of the large trees in areas, but due to the variable nature of the burning, patches of dense small trees can be expected to

survive the fire. As with group 7, a mosaic of tree diameter distributions would be found within the treatment units due to the variable nature of the treatment.

Following the treatment the aspen can be expected to resprout and conifers to become established in the understory especially in the patches of mortality and deliberately created openings. A number of species would become established, but conditions would favor the establishment of seral species.

In the short term we can expect the stands in this group to be highly-variable complexes of all five vegetation-fuel classes including about 15 percent of early-seral. In the long term, natural regeneration through sprouting and conifer seeds would form a patchy new cohort in the stands.

Alternative 1 – No-Action

Direct and Indirect Effects

There would be no direct effects to vegetation under this alternative. Stand structures, stocking levels, species compositions, and susceptibility to diseases and insects would not change from that described above in the existing condition.

Biophysical Settings and Vegetation-fuel Classes

As succession continues, trees grow, understories fill in, and coverage increases, the proportion of vegetation-fuel class area in each BpS would continue to shift. The current condition displayed in table 14 is the result of those processes upon the reference condition and it can be expected that the direction of change reflected in table 14 would continue. Table 14 displays the relative current amount (Cur) and expected direction of future change (Dir) for each BpS/Vegetation-fuel class combination. With no action, we can expect the current condition to progress farther from the reference and desired condition.

Table 14. Alternative 1 BpS and vegetation-fuel class current and future direction of change

BpS	AESP	BMSC	CMSO	DLSO	ELSC
	Cur/ Dir	Cur/ Dir	Cur/ Dir	Cur/ Dir	Cur/ Dir
Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	VL/D	H/D	L/D	L/D	VH/I
Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	VL/D	H/D	L/D	L/D	VH/I
Ponderosa Pine-Douglas-fir	VL/D	VH/D	N/N	VL/D	VH/I
Interior West Lower Subalpine Forest	VL/D	L/D	L/D	VH/I	VH/I
Interior West Upper Subalpine Forest	N/N	L/D	L/D	H/I	VH/I

D – Declining
H – High (Yellow, Greater than desired but less than 180 percent of desired)
I – Increasing
L – Low (Orange, Greater than or equal to 20 percent but less than desired)
N – None
VH – Very High (Green, Greater than or equal to 180 percent of desired)
VL – Very Low (Red, none to less than 20 percent of desired)

Stand Structures and Species Compositions

General indirect effects on species compositions would be, in the short term and long term, stands continue to progress successionally with continuing decreases in seral species and increases in climax species (Fischer and Clayton 1983, Fischer and Bradley 1987). Species compositions on the subalpine fir

habitat types would continue to change as the seral species–ponderosa pine, lodgepole pine, whitebark pine, aspen, Douglas-fir, and Engelmann spruce–die out of the stands due to insect or competition-related mortality, to be replaced by subalpine fir. Species compositions on the Douglas-fir habitat types would similarly change with species composition shifting toward Douglas-fir. Succession can be a relatively slow process, punctuated by abrupt shifts such as that caused by the recent bark beetle mortality, which reduced the seral overstory and mid-story components in many stands. The changes that have taken place within the last few years due to the recent mountain pine beetle epidemic are substantial. In the short term, any further change would be relatively small and easily reversible, but in the long term, the change would be profound and difficult to reverse due to the absence of seral tree species present to provide seed for natural regeneration.

Along with the species composition shifts, shade-tolerant trees would increase and fill in lesser-stocked areas, including those created by the recent bark beetle mortality and natural openings (Copenheaver et al. 2009, Skinner 1995), making individual stands and the landscape more homogeneous and less structurally diverse.

Insects and Diseases

In this alternative, no actions would be taken. The effects described above for untreated stands under all alternatives would apply to stands in this alternative.

Species of Interest

Ponderosa Pine

As discussed above, with no action, ponderosa pine would decline in presence due to succession under this alternative and in the long-term would almost disappear from the landscape.

Quaking Aspen

As discussed above, with no action, quaking aspen, already a very minor component on the landscape would decline in presence due to succession under this alternative and in the long-term would almost disappear.

Western Larch

As discussed above, with no action, western larch, already a very minor component on the landscape would decline in presence due to succession under this alternative and in the long-term would almost disappear.

Whitebark Pine

As discussed above, with no action, whitebark pine, which has declined as a landscape component due to insects and diseases (volume 2, appendix B), would decline in presence due to succession under this alternative and in the long term, would almost disappear. On a very small portion of the landscape, on the highest elevation ridges, it may continue to survive as a component with subalpine fir.

Cumulative Effects

As mentioned above, all past activities are taken into account in this analysis in the current condition description and do not again need to be discussed in cumulative effects. Hence, cumulative effects in this analysis are the effects of the alternative being discussed, present, and foreseeable actions. Three ongoing activities: the Forestwide hazardous tree removal and fuels reduction HFRA project, continuing livestock grazing permits, and noxious weed treatments have the potential to affect forest vegetation.

Biophysical Settings and Vegetation-fuel Classes

Because of the very minor effects on forest vegetation from removing hazardous trees along roadsides, grazing livestock, and noxious weed treatments, cumulative effects for this alternative would be the same as direct and indirect effects discussed above.

Insects and Diseases

The current and ongoing activities would have no discernible effect on insect and disease levels in the project area. The insect and disease levels and risk would continue as described above for the direct and indirect effects.

Species of Interest

Ponderosa Pine, Western Larch, Whitebark Pine

Because of the very minor effects on stand species compositions from removing hazardous trees along roadsides, grazing livestock, and noxious weed treatments, cumulative effects for this alternative would be the same as direct and indirect effects discussed above.

Quaking Aspen

Removing hazardous trees along roadsides and noxious weed treatments would have very minor effects on this species. Continuing livestock grazing may have a localized impact on individual aspen clones within the grazing allotments ability to successfully regenerate through suckering. However, the effect of the grazing would be very minor because as discussed above, the condition of the aspen is what can be characterized as: a minor component in poor and declining condition due to competition with conifers.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

More information about compliance with standards and direction from the Forest Plan is in appendix B. Compliance of alternative 1 (no action) with Forest Plan forestwide standards pertinent to this vegetation discussion are displayed in volume 2, appendix B, table B-4. Compliance with management area standards is displayed in table B-5, and compliance with Forest Plan direction for regeneration harvest is displayed in table B-6.

Alternative 2 – Proposed Action

About 8,564 acres of treatment is proposed under this alternative. This is about 36 percent of the project area. The proposed treatments for each prescription group are shown in table 15 and figure 32. Total treatment acres for each prescription group are displayed in table 16. Treatment effects for each group are the same for alternatives 2 and 3 and are described in the Effects Common to All Action Alternatives section.

Table 15. Alternative 2 proposed treatments by prescription group and unit

Group	Unit	Treatment Type	Prescription	Regeneration	Acres
1	6	Intermediate Harvest	Improvement Cut, Underburn	N/A	14
1	7	Intermediate Harvest	Improvement Cut, Underburn	N/A	17
1	8	Intermediate Harvest	Improvement Cut, Underburn	N/A	62
1	15	Intermediate Harvest	Improvement Cut, Underburn	N/A	15
1	23	Intermediate Harvest	Improvement Cut, Underburn	N/A	29
1	24	Intermediate Harvest	Improvement Cut, Underburn	N/A	5
1	26	Intermediate Harvest	Improvement Cut, Underburn	N/A	65
1	28	Intermediate Harvest	Improvement Cut, Underburn	N/A	22
1	30	Intermediate Harvest	Improvement Cut, Underburn	N/A	14
1	31	Intermediate Harvest	Improvement Cut, Underburn	N/A	16
1	32	Intermediate Harvest	Improvement Cut, Underburn	N/A	45
1	33	Intermediate Harvest	Improvement Cut, Jackpot Burn	N/A	17
1	44	Intermediate Harvest	Improvement Cut, Underburn	N/A	97
1	45	Intermediate Harvest	Improvement Cut, Underburn	N/A	38
1	46	Intermediate Harvest	Improvement Cut, Jackpot Burn	N/A	251
1	47	Intermediate Harvest	Improvement Cut, Jackpot Burn	N/A	220
1	54	Intermediate Harvest	Improvement Cut, Jackpot Burn	N/A	20
1	55	Intermediate Harvest	Improvement Cut, Underburn	N/A	29
2	3	Intermediate Harvest	Precommercial Thin, Handpiling, Burn Piles	N/A	37
2	14	Intermediate Harvest	Precommercial Thin, Handpiling, Burn Piles	N/A	11
2	16	Intermediate Harvest	Precommercial Thin, Handpiling, Burn Piles	N/A	3
2	18	Intermediate Harvest	Precommercial Thin, Handpiling, Burn Piles	N/A	21
2	21	Intermediate Harvest	Precommercial Thin, Handpiling, Burn Piles	N/A	6
2	48	Intermediate Harvest	Precommercial Thin	N/A	141
2	49	Intermediate Harvest	Precommercial Thin	N/A	49
2	50	Intermediate Harvest	Precommercial Thin	N/A	49
2	51	Intermediate Harvest	Precommercial Thin	N/A	193
2	59	Intermediate Harvest	Precommercial Thin	N/A	16
2	60	Intermediate Harvest	Precommercial Thin	N/A	25

Group	Unit	Treatment Type	Prescription	Regeneration	Acres
2	61	Intermediate Harvest	Precommercial Thin	N/A	34
2	62	Intermediate Harvest	Precommercial Thin	N/A	37
2	63	Intermediate Harvest	Precommercial Thin	N/A	17
2	64	Intermediate Harvest	Precommercial Thin	N/A	30
2	65	Intermediate Harvest	Precommercial Thin	N/A	25
2	66	Intermediate Harvest	Precommercial Thin	N/A	26
2	67	Intermediate Harvest	Precommercial Thin	N/A	20
2	68	Intermediate Harvest	Precommercial Thin	N/A	15
2	69	Intermediate Harvest	Precommercial Thin	N/A	31
2	70	Intermediate Harvest	Precommercial Thin	N/A	39
2	71	Intermediate Harvest	Precommercial Thin	N/A	40
2	72	Intermediate Harvest	Precommercial Thin	N/A	85
2	73	Intermediate Harvest	Precommercial Thin	N/A	33
2	75	Intermediate Harvest	Precommercial Thin	N/A	148
3	1	Regeneration Harvest	Shelterwood (Group) with Reserves, Site Prep Burn	NRG DF/LP, Plant PP/WL	96
3	9	Regeneration Harvest	Seedtree with Reserves, Slashing, Handpiling, Burn Piles	NRG DF/LP	18
3	11	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG DF/LP/ES/AS, Plant PP	23
3	12	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG DF/LP/ES/AS, Plant PP	80
3	13	Regeneration Harvest	Seedtree with Reserves, Jackpot Burn	NRG DF/LP/AS	41
3	20	Regeneration Harvest	Seedtree with Reserves, Jackpot Burn	To Be Determined*	32
3	22	Regeneration Harvest	Shelterwood with Reserves, Site Prep Burn	NRG DF/LP	30
3	25	Regeneration Harvest	Seedtree with Reserves, Broadcast Burn	NRG DF/LP, Plant PP/WL	29
3	29	Regeneration Harvest	Shelterwood (Group) with Reserves, Slashing, Handpile/Burn	NRG LP/DF	25
3	34	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG DF/LP, Plant DF/WL	12
3	39	Regeneration Harvest	Seedtree with Reserves, Jackpot Burn	NRG LP/DF, Plant DF/PP	42
3	40	Regeneration Harvest	Seedtree with Reserves, Jackpot Burn	NRG LP/DF, Plant DF/PP	11
3	41	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG LP/DF, Plant DF/PP	12
3	42	Regeneration Harvest	Seedtree with Reserves, Jackpot Burn	NRG LP/DF, Plant DF/PP	65
3	43	Regeneration Harvest	Seedtree with Reserves, Jackpot Burn	NRG LP/DF, Plant DF/PP	104
3	53	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG DF/LP, Plant DF/WL	17

Group	Unit	Treatment Type	Prescription	Regeneration	Acres
3	57	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG DF/LP, Plant PP	93
3	58	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG DF/LP, Plant PP	15
4	10	Regeneration Harvest	Clearcut with Reserves, Jackpot Burn	NRG DF/LP, Plant PP	18
4	17	Regeneration Harvest	Clearcut with Reserves, Jackpot Burn	NRG LP/DF, Plant PP	38
4	19	Regeneration Harvest	Clearcut with Reserves, Jackpot Burn	To Be Determined*	15
4	27	Regeneration Harvest	Clearcut with Reserves, Site Prep Burn	NRG LP/DF, Plant DF/PP/WL	31
4	35	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF/WL	24
4	36	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF	20
4	37	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF/WL	8
4	38	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF/WL	7
4	52	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF/WL	22
4	56	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF/WL	17
4	74	Regeneration Harvest	Clearcut with Reserves, Site Prep Burn	NRG, plant	23
5	4	Intermediate Harvest	Sanitation, Slashing, Handpiling, Burn Piles	N/A	7
5	5	Intermediate Harvest	Sanitation, Slashing, Handpiling, Burn Piles	N/A	18
6	2	Prescribed Fire	Low Severity Fire, Openings <5 Acres	NRG PP/DF	146
6	76	Prescribed Fire	Low Severity Fire, Openings <10 acres	NRG DF/LP/WB	123
6	78	Prescribed Fire	Low Severity Fire, Openings <5 acres	NRG DF/LP/PP	38
6	85	Prescribed Fire	Low Severity Fire, Openings <5 acres	Natural Recovery	143
7	80	Prescribed Fire	Mixed Severity Fire, Openings <20 acres	Natural Recovery	326
7	86	Prescribed Fire	Mixed Severity Fire, Openings <10 acres	Natural Recovery	47
7	87	Prescribed Fire	Mixed Severity Fire, Openings <5 acres	NRG LP/DF/AS	36
8	77	Prescribed Fire	Mixed Severity Fire, Openings <30 acres	NRG LP/DF	736
8	79	Prescribed Fire	Mixed Severity Fire, Openings <30 acres	NRG LP/DF/PP/WB	337
8	81	Prescribed Fire	Mixed Severity Fire, Openings <30 acres	Natural Recovery	629
8	82	Prescribed Fire	Mixed Severity Fire, Openings <75 acres	Natural Recovery	776
8	83	Prescribed Fire	Mixed Severity Fire, Openings <75 acres	Natural Recovery	457
8	84	Prescribed Fire	Mixed Severity Fire, Openings <30 acres	Natural Recovery	831
8	88	Prescribed Fire	Mixed Severity Fire, Openings <30 acres	Natural Recovery	892

Table 16. Alternative 2 total treatment acres by prescription group

Group	Alternative 2 Acres
1	974
2	1,132
3	745
4	223
5	25
6	449
7	410
8	4,604
Totals	**8,564**

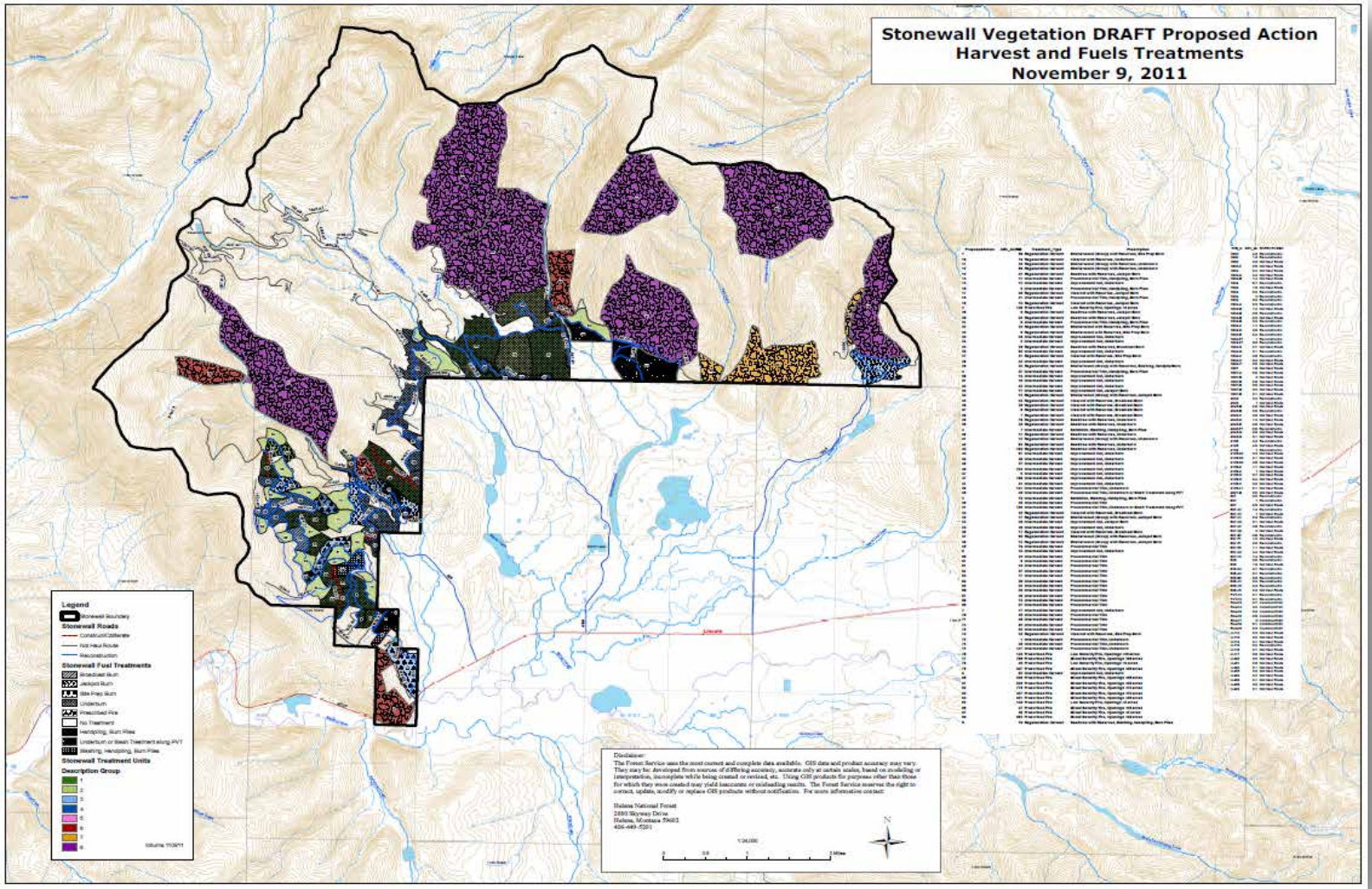

Figure 32. Alternative 2 (proposed action) harvest and fuels treatments

Design Features and Mitigation Measures

The Stonewall Vegetation Project has been designed with features that are intended to minimize or avoid potential adverse effects while meeting project objectives. In addition to the proposed action treatments described above for the treatment groups, design features would be implemented where applicable. A description of the project design features relating to silviculture and other resources is displayed in table 9, chapter 2.

The design features in table 9 pertaining to silviculture are: SILV-1, SILV-2, SILV-3, and SILV-4. This analysis is based on the implementation of all design features. Specific design features listed above that are applicable to vegetation include not only those designed specifically to protect vegetation, but also those designed to protect other resources such as water and soil.

Biophysical Settings and Vegetation-fuel Classes

Proposed treatments would change vegetation-fuel classes in the project area as described above. Table 17 displays our projected vegetative-fuel class matrix for each BpS under Alternative 2 (A2), the Current vegetation-fuel class matrix (Cur), and the desired (Ref) vegetation-fuel class matrix for the project area as discussed above. Table cells that are colored red or orange BpS/vegetation-fuel class combinations that are under-represented on the landscape, those that are colored green and yellow are over-represented, and no color in close to that desired. All but the CLSO, BMSC, and DLSO vegetation-fuel class for the upper subalpine fir BpS, the BMSC and DLSO vegetation-fuel classes for the lower subalpine BpS, and the DLSO vegetation-fuel class for the moist Douglas-fir BpS would move toward the desired levels. Four of the vegetation-fuel class/BpS combinations are within 20 percent of the desired condition and we consider them “close” to the desired. Note that because (1) the current condition may not fully reflect changes in vegetation-fuel classes due to the recent mountain pine beetle activity, and (2) changes in vegetation-fuel classes due to proposed treatments are modeled estimates, one must not take the current and Alternative 2 as precise values. The most important factors considered in this analysis are the direction and magnitude of vegetation-fuel class change due to the treatments and the relationship between the reference condition and the Alternative 2 direction and magnitude of change.

Table 17. Alternative 2 post-treatment, current and desired vegetation-fuel classes by BpS

BpS	AESP	BMSC	CMSO	DLSO	ELSC
	A2/ Cur/ Ref	A2/ Cur/ Ref	A2/ Cur/ Ref	A2/ Cur/ Ref	A2/ Cur/ Ref
Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	7/ 2/ 15	21/ 31/ 25	12/ 4/ 20	19/ 8/ 25	41/ 55/ 15
Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	6/ 1/ 15	22/ 35/ 25	14/ 5/ 20	18/ 10/ 25	39/ 50/ 15
Ponderosa Pine-Douglas-fir	14/ 1/ 15	16/ 31/ 10	11/ 0/ 25	24/ 1/ 40	35/ 67/ 10
Interior West Lower Subalpine Forest	5/ 1/ 20	15/ 21/ 40	12/ 7/ 10	32/ 25/ 5	37/ 46/ 25
Interior West Upper Subalpine Forest	3/ 0/ 20	21/ 22/ 25	11/ 11/ 25	27/ 22/ 15	38/ 46/ 15

Yellow – High (Greater than desired but less than 180 percent of desired)

Orange – Low (Greater than or equal to 20 percent but less than desired)
No Color – Within 20% of desired
Green – Very High (Greater than or equal to 180 percent of desired)
Red – Very Low (less than 20 percent of desired)

Species of Interest

Ponderosa Pine

The effects of this alternative would be to increase the presence of ponderosa pine as a stand component in treated stands, with the degree of increase varying depending upon the type of treatment and the individual stand. Depending upon the treatment and unit, ponderosa pine would increase due to (1) retaining PP over less preferred species during thinning increasing PP as a portion of future stand stocking relative to less preferred species, (2) increased natural establishment of PP, and (3) planting PP. The degree of PP increase is displayed in table 18. Ponderosa pine would increase to some degree on about 23 percent of the project area.

Table 18. Alternative 2 effects of treatment groups on ponderosa pine

Treatment	Degree Of Pp Increase	Acres
Group 1 –Intermediate Harvest	Increase in presence relative to less preferred species during thinning tree selection to long-term small increase in number of trees due to increased establishment in more open stands	845
Group 2 –Pre-commercial thin	Increase in presence relative to less preferred species, no increase in number of trees. Note that in some units PP is not currently present.	651
Group 3 - Seedtree and shelterwood harvest/regeneration	Substantial short and long-term increase due to planting and natural regeneration	633
Group 4 – Clearcut harvest/regeneration	Substantial short and long-term increase due to planting and natural regeneration	102
Group 5 - Remove dead and dying trees, slash noncommercial-sized trees	Increase in presence relative to less preferred species during thinning tree selection, small due to current “trace” presence	25
Group 6 – Low-intensity prescribed burning with 5-10 acre mortality patches	Increase in presence relative to other species due to higher ponderosa pine fire-tolerance and in tree numbers due to PP establishment in open areas	326
Group 7 – Mixed-severity prescribed burning with 5, 10, 20 acre mortality patches	Increase in presence relative to other species due to higher ponderosa pine fire-tolerance and in tree numbers due to PP establishment in open areas	374
Group 8 – Mixed-severity prescribed burning with 30-75 acre mortality patches	Increase in presence relative to other species due to higher ponderosa pine fire-tolerance and in tree numbers due to PP establishment in open areas	2,506

Quaking Aspen

The effects of this alternative would be to increase the presence of quaking aspen (AS) as a stand component where it is found in treated stands, with the degree of increase varying depending upon the type of treatment and the individual stand. Quaking aspen would increase due to (1) retaining aspen over less preferred species during thinning increasing its relative presence as a portion of future stand stocking, and (2) increased suckering of aspen due to increased growing space. Quaking aspen would increase to some degree on about 10 percent of the landscape.

Table 19. Alternative 2 effects of treatment groups on quaking aspen

Treatment	Degree Of As Increase	Acres
Group 1 –Intermediate Harvest	Increase in presence relative to less preferred species during thinning tree selection and increase in suckering, may be some top-killing of aspen during burning	547
Group 2 –Pre-commercial thin	Increase in presence relative to less preferred species during thinning tree selection and increase in suckering	402
Group 3 - Seedtree and shelterwood harvest/regeneration	Increase in suckering, may be some top-killing of aspen during burning	410
Group 4 – Clearcut harvest/regeneration	Increase in suckering, may be some top-killing of aspen during burning	15
Group 5 - Remove dead and dying trees, slash noncommercial-sized trees	Increase in presence relative to less preferred species during thinning tree selection, may be a small increase in suckering	25
Group 6 – Low-intensity prescribed burning with 5-10 acre mortality patches	May be some top-killing of existing stems, increased suckering due to increases in growing space	146
Group 7 – Mixed-severity prescribed burning with 5, 10, 20 acre mortality patches	May be some top-killing of existing stems, increased suckering due to increases in growing space	410
Group 8 – Mixed-severity prescribed burning with 30-75 acre mortality patches	May be some top-killing of existing stems, increased suckering due to increases in growing space	337

Western Larch

The effects of this alternative would be to increase the presence of western larch (WL) as a stand component with the degree of increase varying depending upon the type of treatment and the individual stand. Western larch would increase due to (1) retaining larch over less preferred species during thinning increasing its relative presence as a portion of future stand stocking, (2) planting larch in regeneration units, and (3) natural regeneration in regeneration units. Western larch would increase to some degree on about 3 percent of the project area.

Table 20. Alternative 2 effects of treatment groups on western larch

Treatment	Degree of WL Increase	Acres
Group 1 –Intermediate Harvest	Increase in presence relative to less preferred species during thinning tree selection, mostly small due to trace current stocking of WL	5
Group 2 –Pre-commercial thin	Increase in presence relative to less preferred species during thinning tree selection, mostly small due to small current stocking of WL	303
Group 3 - Seedtree and shelterwood harvest/regeneration	Substantial increase in numbers due to planting	184
Group 4 – Clearcut harvest/regeneration	Substantial increase in numbers due to planting	146
Group 5 - Remove dead and dying trees, slash noncommercial-sized trees	No increase expected due to lack of presence	0
Group 6 – Low-intensity	No increase expected due to lack of presence	0

Treatment	Degree of WL Increase	Acres
prescribed burning with 5-10 acre mortality patches		
Group 7 – Mixed-severity prescribed burning with 5, 10, 20 acre mortality patches	No increase expected due to lack of presence	0
Group 8 – Mixed-severity prescribed burning with 30-75 acre mortality patches	No increase expected due to lack of presence	0

Whitebark Pine

The effects of this alternative would be to increase the presence of whitebark pine (WB) as a stand component where it is found in treated stands, with the degree of increase varying depending upon the type of treatment and the individual stand (table 21). Whitebark pine would increase due to (1) retaining WB over less preferred species during thinning increasing its relative presence as a portion of future stand stocking, (2) natural regeneration in burning units. Whitebark pine would increase to some degree on about 17 percent of the project area.

Table 21. Alternative 2 effects of treatment groups on whitebark pine

Treatment	Degree Of Wb Increase	Acres
Group 1 –Intermediate Harvest	No increase expected due to lack of presence	NA
Group 2 –Pre-commercial thin	No increase expected due to lack of presence	NA
Group 3 - Seedtree and shelterwood harvest/regeneration	No increase expected due to lack of presence	NA
Group 4 – Clearcut harvest/regeneration	No increase expected due to lack of presence	NA
Group 5 - Remove dead and dying trees, slash noncommercial-sized trees	No increase expected due to lack of presence	NA
Group 6 – Low-intensity prescribed burning with 5-10 acre mortality patches	Increase in presence due to establishment in open areas	123
Group 7 – Mixed-severity prescribed burning with 5, 10, 20 acre mortality patches	Possible small increase in presence expected due to establishment in open areas of limited suitable habitat types only	Trace
Group 8 – Mixed-severity prescribed burning with 30-75 acre mortality patches	Increase in presence due to establishment in open areas	3,894

Insects and Diseases

Mountain Pine Beetle

Reducing tree stocking through thinning has been shown to reduce mountain pine beetle risk (appendix B). As discussed above, the recent mountain pine beetle epidemic has generally reduced the risk for a mountain pine beetle outbreak in most stands and over the landscape. The risk for a landscape-level MPB outbreak would be low into the long-term. There are, however stands containing live lodgepole, whitebark, or ponderosa pine trees in which stocking would be reduced under this project. In these treatment units (table 15), growth and vigor in the post-treatment pines would increase and MPB risk to

the individual trees or small groups of trees would be reduced into the long-term. The total proposed unit area in which any of these tree species can be found is 8,564 acres although it must be noted that they are a minor component in many units and have been reduced in presence by the recent outbreak.

Douglas-fir Beetle

Douglas-fir beetle (DFB) activity is also positively related to tree stocking. Thinning and prescribed burning activities would reduce the risk of losing additional large Douglas-fir in treated stands into the long-term. The total proposed unit area in which Douglas-fir can be found is 7,172 acres although it must be noted that Douglas-fir is a minor component in some units. Outside of the treatment units DFB activity would continue as discussed above for untreated stands.

Fires can increase the susceptibility of Douglas-fir to bark beetle attack by scorching tree crowns, basal cambium, and root systems, (appendix B). Wildfires, because of the conditions under which they burn and the damage to Douglas-fir they can cause, can substantially increase DFB mortality in the years following the fires. However, because prescribed burns are implemented under less severe fire weather and fuel moisture conditions than wildfires usually burn, they damage residual Douglas-fir less and so result in lower potential for DFB to increase (appendix B). In this alternative, about 7,172 acres containing large Douglas-fir would be prescribe burned, resulting in a relatively small increase in Douglas-fir beetle risk to individual large Douglas-fir and a very small increase in risk to Douglas-fir over the landscape. The increase in risk would be short term.

Western Spruce Budworm

As discussed above, western spruce budworm's primary hosts are Douglas-fir, Engelmann spruce, and true firs with multi-story, dense stands especially prone to developing high levels of WSB and susceptible to WSB damage. All treatments proposed in this alternative would reduce Douglas-fir, Engelmann spruce, and subalpine fir and so the predisposition of stands to be impacted by WSB on about 7,257 acres. These effects would continue into the long-term. On the remaining untreated area, WSB populations would continue as described above.

White Pine Blister Rust

The presence of white pine blister rust would not be reduced by the treatments because the treatments would attempt to minimize mortality to whitebark pine and would not attempt to directly reduce white pine blister rust infected trees. In a number of the prescribed burn units (chapter 2, table 9, Silv-2) small openings would be created to increase the regeneration of whitebark pine. Due to the past and current levels and impact of white pine blister rust on mature whitebark pine, cone-producing trees in the project area that would provide seed for whitebark pine regeneration may be relatively resistant to white pine blister rust (Hoff et al. 2001), therefore the treatments may be increasing the establishment of trees that are more resistant to the white pine blister rust than the past forest. However, the level of white pine blister rust resistance, or the type of resistance is not known for any of the potential whitebark pine seed trees in the project area. About 3,894 acres of unit area would be treated within which (1) whitebark pine would be thinned around which would increase tree vigor and the progression of the disease, and (2) the treatment would increase the establishment of whitebark pine in small openings. Thinning around the trees and creating small openings would comprise a small portion of the treated acreage, however.

Dwarf Mistletoe

The presence of dwarf mistletoes would in general be reduced due to (1) preference in retaining other species over lodgepole pine, (2) preference in retaining less infected trees over more infected trees in mechanical treatment units, (3) tendency for infected trees to be damaged and die from prescribed burning (Harrington and Hawksworth 1990, Conkin 2000, Conklin and Armstrong 2002), and (4) tendency for

infected tree branches to be damaged and die from prescribed burning (Harrington and Hawksworth 1990, Conkin 2000, Conklin and Armstrong 2002). Although the presence and magnitude of dwarf mistletoe is not mapped and it is not present on all unit acres, this alternative could potentially reduce dwarf mistletoe over about 8,516 acres containing lodgepole pine.

Armillaria

The presence of armillaria would not be directly reduced by the treatments, but treatments in stands would reduce both short-term and long-term impacts from the disease due to increases in more resistant tree species, promoting tree vigor, and reforesting to tree species suitable to the sites (Rippy et al. 2005).

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

More information about compliance with standards and direction from the Forest Plan is in appendix B. Compliance of alternative 2 with Forest Plan forestwide standards pertinent to this discussion are displayed in volume 2, appendix B, table B-7. Compliance with management area standards is displayed in table B-8, and compliance with Forest Plan direction for regeneration harvest is displayed in table B-9.

Alternative 3

About 6,564 acres of treatment is proposed under this alternative. This is about 27 percent of the project area. The proposed treatments for each unit are displayed in table 22 and figure 33. Total acres for each prescription group are displayed in table 23. Treatment effects for groups 1 through 8 are the same as described for alternative 2 above.

Table 22. Alternative 3 proposed treatments by group and unit

Group	Unit	Treatment Type	Prescription	Regeneration	Acres
1	15	Intermediate Harvest	Improvement Cut, Underburn	N/A	15
1	23	Intermediate Harvest	Improvement Cut, Underburn	N/A	29
1	24	Intermediate Harvest	Improvement Cut, Underburn	N/A	5
1	28	Intermediate Harvest	Improvement Cut, Underburn	N/A	22
1	46b	Intermediate Harvest	Improvement Cut, Jackpot Burn, Handpiling, Burn Piles	N/A	27
1	47b	Intermediate Harvest	Improvement Cut, Jackpot Burn, Handpiling, Burn Piles	N/A	9
1	47c	Intermediate Harvest	Improvement Cut, Jackpot Burn, Handpiling, Burn Piles	N/A	31
1	6	Intermediate Harvest	Improvement Cut, Underburn	N/A	14
1	7	Intermediate Harvest	Improvement Cut, Underburn	N/A	17
1	8	Intermediate Harvest	Improvement Cut, Underburn	N/A	62
2	14	Intermediate Harvest	Precommercial Thin, Handpiling, Burn Piles	N/A	11
2	16	Intermediate Harvest	Precommercial Thin, Handpiling, Burn Piles	N/A	3
2	3	Intermediate Harvest	Precommercial Thin, Handpiling, Burn Piles	N/A	37
2	48	Intermediate Harvest	Precommercial Thin, Underburn	N/A	141
2	50	Intermediate Harvest	Precommercial Thin	N/A	49
2	51	Intermediate Harvest	Precommercial Thin, Underburn or Slash Treatment along PVT	N/A	193
2	59	Intermediate Harvest	Precommercial Thin	N/A	16
2	61a	Intermediate Harvest	Precommercial Thin, Handpile Underburn	N/A	9
2	62	Intermediate Harvest	Precommercial Thin	N/A	37
2	63	Intermediate Harvest	Precommercial Thin	N/A	17
2	66	Intermediate Harvest	Precommercial Thin	N/A	26
2	67	Intermediate Harvest	Precommercial Thin	N/A	20
2	68	Intermediate Harvest	Precommercial Thin	N/A	15
2	69	Intermediate Harvest	Precommercial Thin	N/A	31
2	70	Intermediate Harvest	Precommercial Thin	N/A	39
2	71	Intermediate Harvest	Precommercial Thin	N/A	40
2	72	Intermediate Harvest	Precommercial Thin	N/A	85

Group	Unit	Treatment Type	Prescription	Regeneration	Acres
2	73	Intermediate Harvest	Precommercial Thin	N/A	33
2	75b	Intermediate Harvest	Precommercial Thin, Jackpot Burn, Handpiling, Burn Piles	N/A	20
3	1	Regeneration Harvest	Shelterwood (Group) with Reserves, Site Prep Burn	NRG DF/LP, Plant PP/WL	96
3	11	Regeneration Harvest	Shelterwood (Group) with Reserves, Underburn	NRG DF/LP/ES/AS, Plant PP	23
3	12	Regeneration Harvest	Shelterwood (Group) with Reserves, Underburn	NRG DF/LP/ES/AS, Plant PP	80
3	13	Regeneration Harvest	Seedtree with Reserves, Jackpot Burn	NRG DF/LP/AS	41
3	22a	Regeneration Harvest	Shelterwood with Reserves, Site Prep Burn	NRG DF/LP	22
3	25	Regeneration Harvest	Seedtree with Reserves, Broadcast Burn	NRG DF/LP, Plant PP/WL	29
3	34	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG DF/LP, Plant DF/WL	12
3	39	Regeneration Harvest	Seedtree with Reserves, Underburn	NRG LP/DF, Plant DF/PP	26
3	40	Regeneration Harvest	Seedtree with Reserves, Underburn	NRG LP/DF, Plant DF/PP	11
3	41	Regeneration Harvest	Shelterwood (Group) with Reserves, Underburn	NRG LP/DF, Plant DF/PP	12
3	42	Regeneration Harvest	Seedtree with Reserves, Underburn	NRG LP/DF, Plant DF/PP	65
3	43	Regeneration Harvest	Seedtree with Reserves, Underburn	NRG LP/DF, Plant DF/PP	104
3	53	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG DF/LP, Plant DF/WL	17
3	57	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG DF/LP, Plant PP	93
3	58	Regeneration Harvest	Shelterwood (Group) with Reserves, Jackpot Burn	NRG DF/LP, Plant PP	15
3	9	Regeneration Harvest	Seedtree with Reserves, Slashing, Handpiling, Burn Piles	NRG DF/LP	18
4	10	Regeneration Harvest	Clearcut with Reserves, Underburn	NRG DF/LP, Plant PP	18
4	27	Regeneration Harvest	Clearcut with Reserves, Site Prep Burn	NRG LP/DF, Plant DF/PP/WL	31
4	35	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF/WL	24

Group	Unit	Treatment Type	Prescription	Regeneration	Acres
4	36	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF	20
4	37	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF/WL	8
4	38	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF/WL	7
4	52	Regeneration Harvest	Clearcut with Reserves, Broadcast Burn	NRG LP, Plant DF/WL	22
4	74	Regeneration Harvest	Clearcut with Reserves, Site Prep Burn	NRG, plant	23
5	4	Intermediate Harvest	Sanitation, Slashing, Handpiling, Burn Piles	N/A	7
5	5	Intermediate Harvest	Sanitation, Slashing, Handpiling, Burn Piles	N/A	18
6	2	Prescribed Fire	Low Severity Fire, Openings <5 acres	NRG PP/DF	146
6	78	Prescribed Fire	Low Severity Fire, Openings <5 acres	NRG DF/LP/PP	38
6	85	Prescribed Fire	Low Severity Fire, Openings <5 acres	Natural Recovery	143
7	87	Prescribed Fire	Mixed Severity Fire, Openings <5 acres	NRG LP/DF/AS	36
8	79	Prescribed Fire	Mixed Severity Fire, Openings <30 acres	NRG LP/DF/PP/WB	337
8	82	Prescribed Fire	Mixed Severity Fire, Openings <75 acres	Natural Recovery	776
8	83	Prescribed Fire	Mixed Severity Fire, Openings <75 acres	Natural Recovery	457
8	84	Prescribed Fire	Mixed Severity Fire, Openings <30 acres	Natural Recovery	831
8	88	Prescribed Fire	Mixed Severity Fire, Openings <30 acres	Natural Recovery	865
9	17a	Prescribed Fire	Underburn	NRG LP/DF, Plant PP	38
9	19a	Prescribed Fire	Underburn	To Be Determined	15
9	20a	Prescribed Fire	Underburn	To Be Determined	24
9	29a	Prescribed Fire	Underburn	N/A	25
9	30a	Prescribed Fire	Underburn	N/A	14
9	31a	Prescribed Fire	Underburn	N/A	16
9	32a	Prescribed Fire	Underburn	N/A	45
9	44a	Prescribed Fire	Underburn	N/A	97
9	45a	Prescribed Fire	Underburn	N/A	38
9	80a	Prescribed Fire	Jackpot Burn	N/A	326
10	46a	Intermediate Harvest	Improvement Cut, Jackpot Burn, Handpiling, Burn Piles	N/A	223
10	47a	Intermediate Harvest	Improvement Cut, Jackpot Burn, Handpiling, Burn Piles	N/A	180

Table 23. Alternative 3 total treatment acres by prescription group

Group	Alternative 3 Acres
1	232
2	822
3	664
4	152
5	25
6	326
7	36
8	3,265
9	637
10	403
Total	**6,564**

For alternative 3, the interdisciplinary team developed two additional prescription groups.

Group 9: This group contains 10 units that are also described above and displayed in table 15 as being in groups 1, 3, and 4. These are a mixed group of units whose common characteristic is that the proposed treatment was changed to a low-intensity and low-severity underburn in Alternative 3. The units are mixed species and dominated (greater than one-half of the basal area) by either lodgepole pine (Units 17a, 19a, 20a, and 29a) or Douglas-fir (Units 30a, 31a, 32a, and 44a) with ponderosa pine, western larch, Engelmann spruce or aspen components. The average age in the units ranges from 85 to 150 years, average overstory diameter ranges from 11 to 16 inches d.b.h. and stocking can be considered high, or at least could be before the mountain pine beetle epidemic. Mountain pine beetle mortality ranges from high in the Douglas-fir units to severe in those dominated by lodgepole pine. Units 30a, 31a, 32a, and 44a are generally single-story but do have patches of understory, which is mostly Douglas-fir. Units 17a, 19a, 20a, and 29a are generally two-story (or were before the mountain pine beetle epidemic) with sapling and pole understories of mostly Douglas-fir with minor lodgepole pine and subalpine fir components.

Group 10: This group includes units 46a and 47a, which in Alternative 2 are proposed for treatment under Group 1. Treatments would be designed in a mosaic pattern to maintain cover and forage for wildlife while promoting ponderosa pine and aspen, and reducing ladder fuels. Portions of the stands would be thinned to (1) reduce understory competition from around large ponderosa pine trees, (2) thin heavily-stocked groups of trees on sites historically dominated by ponderosa pine, and (3) remove conifer competition from within and around quaking aspen.

To reduce understory competition around large ponderosa pine, and move areas toward or maintain multi-storied ponderosa pine structure, within 50 feet of ponderosa pine trees larger than 17 inches d.b.h. remove all but two trees. The retained trees should be of varied size and age classes.

In areas dominated by ponderosa pine, but lacking live trees greater than 17 inches d.b.h., trees would be thinned to 48 to 109 trees per acre depending upon tree size. Ponderosa pine snags greater than 17 inches d.b.h. would be favored for retention to meet Forest Plan direction for snags. Conifers less than 17 inches d.b.h. would be removed up to 100 feet of existing aspen patches. Post-thinning, slash would be jackpot burned or hand-piled and burned to reduce fuels. Treatments would affect up to 50 percent of these units.

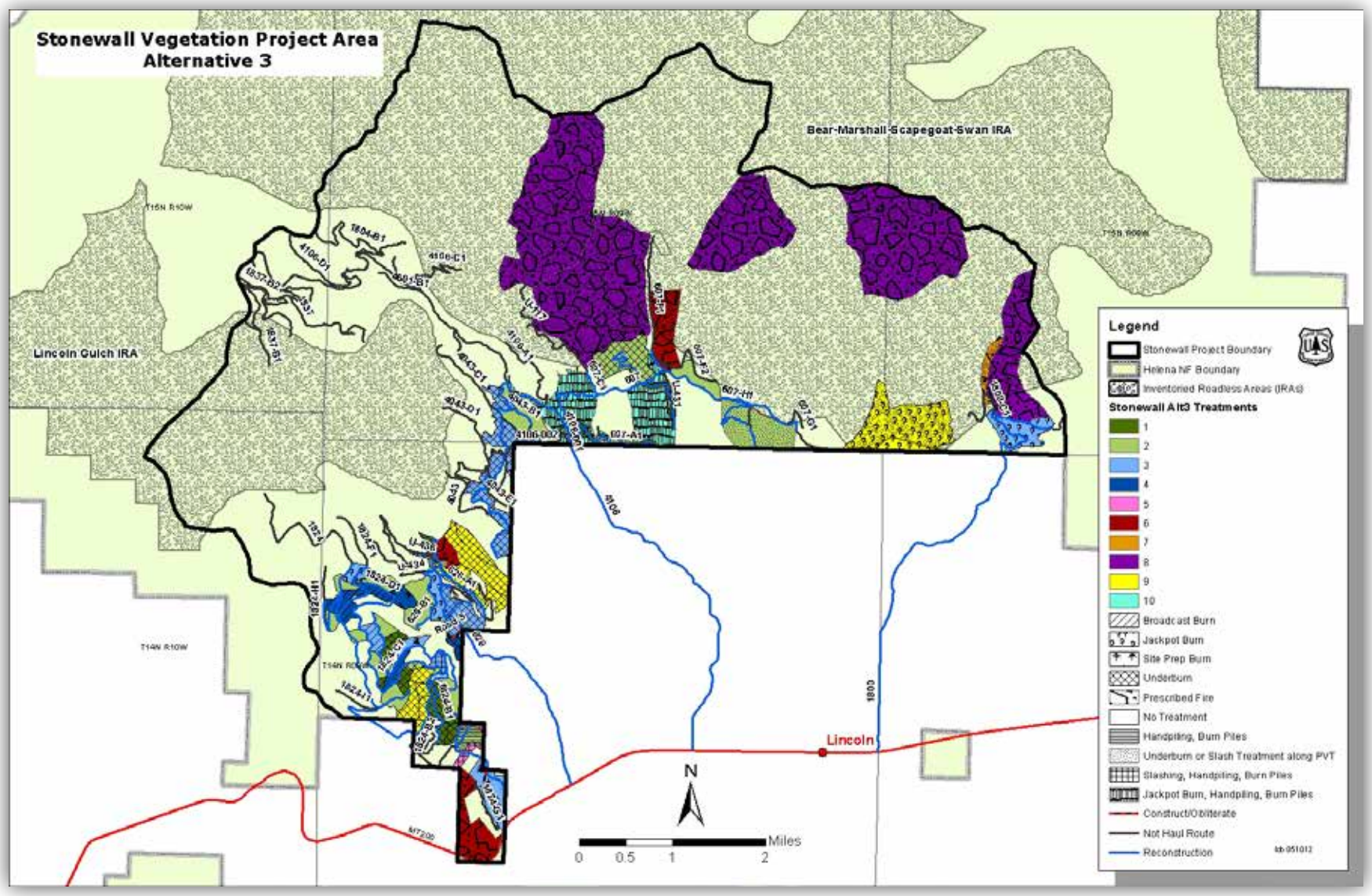

Figure 33. Alternative 3 harvest and fuels treatments

Direct and Indirect Effects

Prescription Groups

Group 9 effects would differ somewhat between those described above as dominated by lodgepole pine and those dominated by Douglas-fir. In Units 30a, 31a, 32a, and 44a, the low-intensity and low-severity underburns would result in sapling and pole tree mortality, with most of the mortality being in the saplings and few poles being killed. Due to the already single-story nature of the stands, the post-treatment diameter distributions would change little, and stand structures would not change. Figure 34 displays the projected post-underburn diameter distribution for Stand 41502043 (Unit 30a and part of Unit 32a). The dead trees are not being shown. The modeling exercise shows the very small trees being killed, but almost no trees above the 8-inch d.b.h. class when compared with the current condition (figure 24).

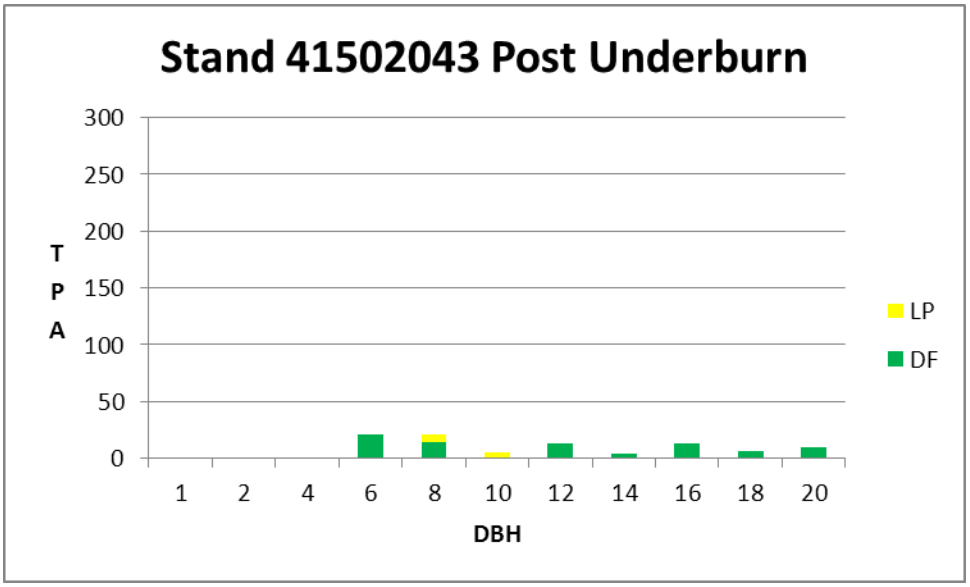

Figure 34. Stand 41502043 post underburn

In Units 17a, 19a, 20a, and 29a, which were two-story before the mountain pine beetle epidemic and are now more single-story, the underburn would also result in sapling and pole tree mortality with most of the mortality being to the saplings. Stand structures would not change, but the stand understories would be more open. Figure 35displays the projected post-underburn diameter distribution for Stand 41501056 (Unit 17a). The dead trees are not being shown. The modeling exercise shows many, but not all, of the very small trees being killed, but almost no trees above the 8-inch d.b.h. class when compared with the current condition (figure 25).

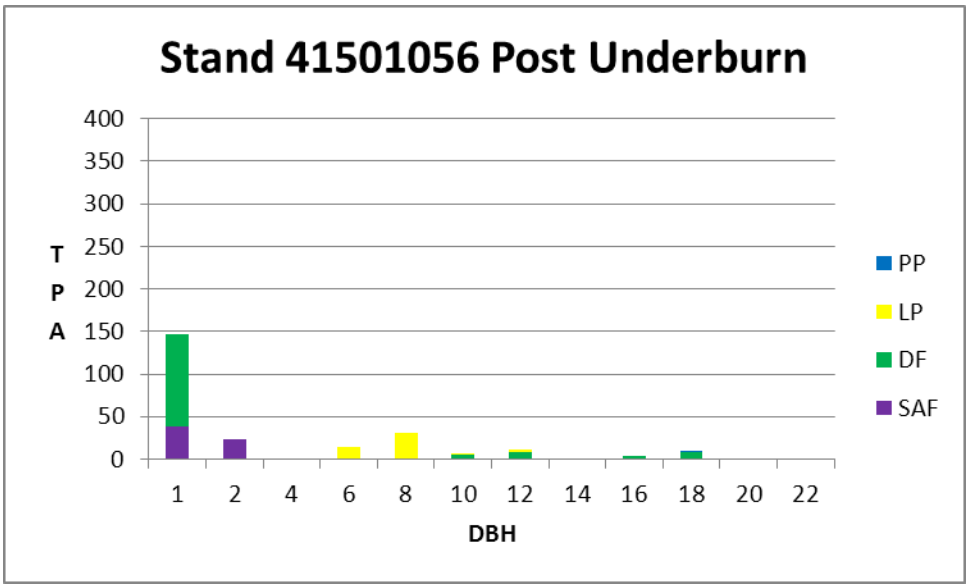

Figure 35. Stand 41501056 post underburn

Group 10 treatments would reduce stand mid-stories and understories and the stands would be more open, but since only up to one-half of the stand areas are being treated they would become patchier. Stand structures would not change.

Figure 36 and figure 37 display the projected post-underburn diameter distribution for Stand 42303130 (Unit 46a). Figure 36 scale is the same as shown above for the current condition (figure 18), and figure 37 scale has been changed to better display the larger trees. The post-treatment stand would have 974 TPA, with about 13 TPA greater than 17 inches d.b.h. About 632 TPA less than 1 inch in d.b.h. are not being displayed.

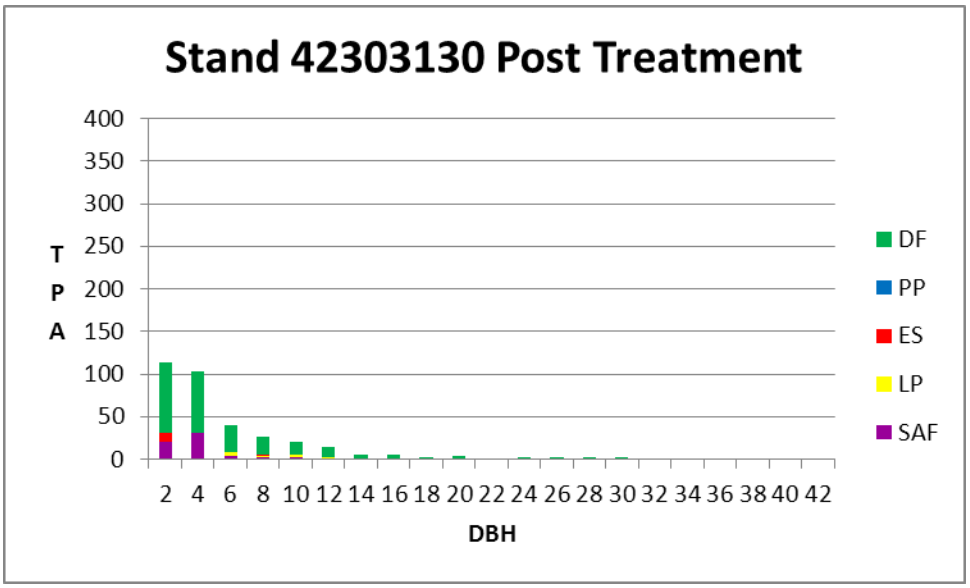

Figure 36. Stand 42303130 (Unit 46a) post-treatment in alternative 3

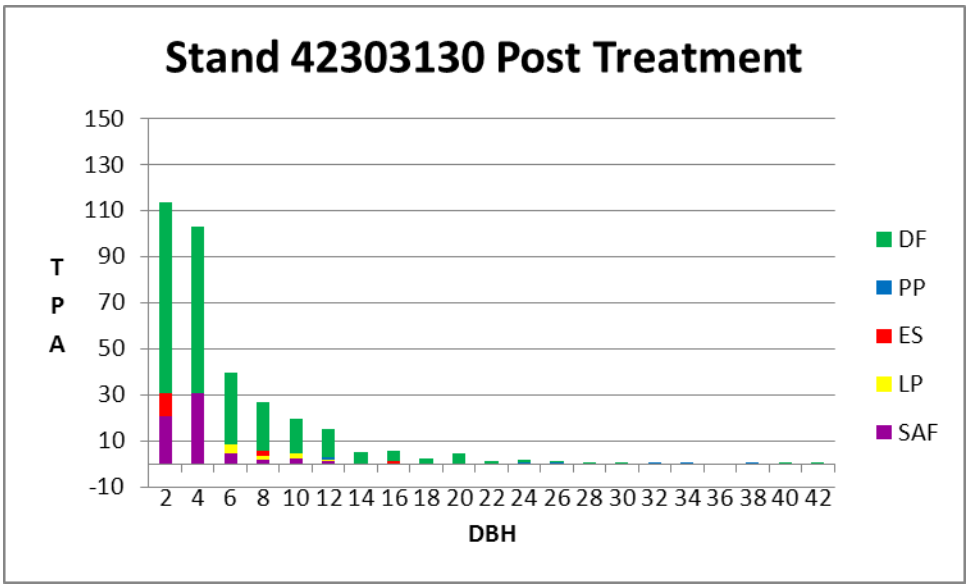

Figure 37. Stand 42303130 (Unit 46a) post-treatment in alternative 3

Biophysical Settings and Vegetation-fuel Classes

Proposed treatments would change vegetation-fuel classes in the project area as described above. Table 24 displays our projected vegetative fuel class matrix for each BpS under alternative 3 (A3), the current vegetation-fuel class matrix (Cur), and the desired (Ref) vegetation-fuel class matrix. Table cells that are colored red or orange BpS/vegetation-fuel class combinations are under-represented on the landscape, those that are colored green and yellow are over-represented, and no color is close to that desired. All but the CLSO, BMSC, and DLSO vegetation-fuel class for the upper subalpine fir BpS, the BMSC and DLSO vegetation-fuel classes for the lower subalpine BpS, and the DLSO vegetation-fuel class for the moist Douglas-fir BpS would move toward the desired levels. Four of the vegetation-fuel class/BpS combinations are within 20 percent of the desired condition and we consider them "close" to the desired.

Table 24. Alternative 3 post-treatment, current and desired vegetation-fuel classes by BpS

BpS	AESP	BMSC	CMSO	DLSO	ELSC
	A3/ Cur/ Ref	A3/ Cur/ Ref	A3/ Cur/ Ref	A3/ Cur/ Ref	A3/ Cur/ Ref
Douglas-fir Interior Northern and Central Rocky Mountains (Dry)	6/ 2/ 15	25/ 31/ 25	8/ 4/ 20	14/ 8/ 25	47/ 55/ 15
Douglas-fir Interior Northern and Central Rocky Mountains (Moist)	4/ 1/ 15	27/ 35/ 25	11/ 5/ 20	16/ 10/ 25	42/ 50/ 15
Ponderosa Pine-Douglas-fir	11/ 1/ 15	20/ 31/ 10	7/ 0/ 25	16/ 1/ 40	45/ 67/ 10
Interior West Lower Subalpine Forest	5/ 1/ 20	15/ 21/ 40	12/ 7/ 10	32/ 25/ 5	37/ 46/ 25

BpS	AESP	BMSC	CMSO	DLSO	ELSC
	A3/ Cur/ Ref	A3/ Cur/ Ref	A3/ Cur/ Ref	A3/ Cur/ Ref	A3/ Cur/ Ref
Interior West Upper Subalpine Forest	3/ 0/ 20	21/ 22/ 25	11/ 11/ 25	27/ 22/ 15	38/ 46/ 15

Yellow – High (Greater than desired but less than 180 percent of desired)
Orange – Low (Greater than or equal to 20 percent but less than desired)
No Color – Within 20% of desired
Green – Very High (Greater than or equal to 180 percent of desired)
Red – Very Low (less than 20 percent of desired)

Species of Interest

Ponderosa Pine

This alternative would increase ponderosa pine presence in treated stands, with the degree of increase varying depending upon the type of treatment and the individual stand. Depending upon the treatment and unit, ponderosa pine would increase due to (1) retaining PP over less preferred species during thinning increasing PP as a portion of future stand stocking relative to less preferred species, (2) increased natural establishment of PP, and (3) planting PP. The degree of PP increase is displayed in table 25. Ponderosa pine would increase to some degree on about 13 percent of the project area.

Table 25. Alternative 3 effects of treatment groups on ponderosa pine

Treatment	Degree of PP Increase	Acres
Group 1 –Intermediate Harvest	Increase in presence relative to less preferred species during thinning tree selection to long-term small increase in number of trees due to increased establishment in more open stands	181
Group 2 –Pre-commercial thin	Increase in presence relative to less preferred species, no increase in number of trees. Note that in some units PP is not currently present.	447
Group 3 - Seedtree and shelterwood harvest/regeneration	Substantial short and long-term increase due to planting and natural regeneration	547
Group 4 – Clearcut harvest/regeneration	Substantial short and long-term increase due to planting and natural regeneration	49
Group 5 - Remove dead and dying trees, slash noncommercial-sized trees	Increase in presence relative to less preferred species during thinning tree selection, small due to current “trace” presence	25
Group 6 – Low-intensity prescribed burning with 5-10 acre mortality patches	Increase in presence relative to other species due to higher ponderosa pine fire-tolerance and in tree numbers due to PP establishment in open areas	326
Group 7 – Mixed-severity prescribed burning with 5, 10, 20 acre mortality patches	Increase in presence relative to other species due to higher ponderosa pine fire-tolerance and in tree numbers due to PP establishment in open areas	0
Group 8 – Mixed-severity prescribed burning with 30-75 acre mortality patches	Increase in presence relative to other species due to higher ponderosa pine fire-tolerance and in tree numbers due to PP establishment in open areas	1168
Group 9 - Low-intensity and severity prescribed burning	Increase in presence relative to less fire-resistant species (Units 31a, 32a, 44a, 45a)	196
Group 10 – Mix of Intermediate	Increase in presence relative to less preferred species	200

Treatment	Degree of PP Increase	Acres
Harvest and no treatment	during thinning tree selection to long-term very small increase in number of trees due to increased establishment in more open stands	

Quaking Aspen

Alternative 3 would also increase the presence of quaking aspen (AS) as a stand component where it is found in treated stands, with the degree of increase varying depending upon the type of treatment and the individual stand. The degree of AS increase is displayed in table 26. Quaking aspen would increase to some degree on about 6 percent of the project area.

Table 26. Alternative 3 effects of treatment groups on quaking aspen

Treatment	Degree of AS Increase	Acres
Group 1 –Intermediate Harvest	Increase in presence relative to less preferred species during thinning tree selection and increase in suckering, may be some top-killing of aspen during burning	83
Group 2 –Pre-commercial thin	Increase in presence relative to less preferred species during thinning tree selection and increase in suckering	326
Group 3 - Seedtree and shelterwood harvest/regeneration	Increase in suckering, may be some top-killing of aspen during burning	396
Group 4 – Clearcut harvest/regeneration	Increase in suckering, may be some top-killing of aspen during burning	0
Group 5 - Remove dead and dying trees, slash noncommercial-sized trees	Increase in presence relative to less preferred species during thinning tree selection, may be a small increase in suckering	25
Group 6 – Low-intensity prescribed burning with 5-10 acre mortality patches	May be some top-killing of existing stems, increased suckering due to increases in growing space	146
Group 7 – Mixed-severity prescribed burning with 5, 10, 20 acre mortality patches	May be some top-killing of existing stems, increased suckering due to increases in growing space	36
Group 8 – Mixed-severity prescribed burning with 30-75 acre mortality patches	May be some top-killing of existing stems, increased suckering due to increases in growing space	337
Group 9 - Low-intensity and severity prescribed burning	May be some increase as a response to MPB mortality and prescribed burning	39
Group 10 – Mix of Intermediate Harvest and no treatment	Increase in presence due to competing conifer removal	<20

Western Larch

Alternative 3 would also increase the presence of western larch (WL) as a stand component with the degree of increase varying depending upon the type of treatment and the individual stand. Western larch would increase due to (1) retaining larch over less preferred species during thinning increasing its relative presence as a portion of future stand stocking, (2) planting larch in regeneration units, and (3) natural regeneration in regeneration units. The degree of WL increase is displayed in table 27. Western larch would increase to some degree on about 2 percent of the project area.

Table 27. Alternative 3 effects of treatment groups on western larch

Treatment	Degree of WL Increase	Acres
Group 1 –Intermediate Harvest	Increase in presence relative to less preferred species during thinning tree selection, mostly small due to trace current stocking of WL	5
Group 2 –Pre-commercial thin	Increase in presence relative to less preferred species during thinning tree selection, mostly small due to small current stocking of WL	197
Group 3 - Seedtree and shelterwood harvest/regeneration	Substantial increase in numbers due to planting	176
Group 4 – Clearcut harvest/regeneration	Substantial increase in numbers due to planting	91
Group 5 - Remove dead and dying trees, slash noncommercial-sized trees	No increase expected due to lack of presence	0
Group 6 – Low-intensity prescribed burning with 5-10 acre mortality patches	No increase expected due to lack of presence	0
Group 7 – Mixed-severity prescribed burning with 5, 10, 20 acre mortality patches	No increase expected due to lack of presence	0
Group 8 – Mixed-severity prescribed burning with 30-75 acre mortality patches	No increase expected due to lack of presence	0
Group 9 - Low-intensity and severity prescribed burning	Increase in presence relative to less fire-resistant species	38
Group 10 – Mix of Intermediate Harvest and no treatment	No increase expected due to lack of presence	0

Whitebark Pine

The effects of this alternative would be to increase the presence of whitebark pine (WB) as a stand component where it is found in treated stands, with the degree of increase varying depending upon the type of treatment and the individual stand (table 28). Whitebark pine would increase due to (1) retaining WB over less preferred species during thinning increasing its relative presence as a portion of future stand stocking, (2) natural regeneration in burning units. The degree of WB increase is displayed in table 28. Whitebark pine would increase to some degree on about 14 percent of the project area.

Table 28. Alternative 3 effects of treatment groups on whitebark pine

Treatment	Degree of WB Increase	Acres
Group 1 –Intermediate Harvest	No increase expected due to lack of presence	NA
Group 2 –Pre-commercial thin	No increase expected due to lack of presence	NA
Group 3 - Seedtree and shelterwood harvest/regeneration	No increase expected due to lack of presence	NA
Group 4 – Clearcut harvest/regeneration	No increase expected due to lack of presence	NA
Group 5 - Remove dead and dying trees, slash noncommercial-sized trees	No increase expected due to lack of presence	NA
Group 6 – Low-intensity	Increase in presence due to	NA

Treatment	Degree of WB Increase	Acres
prescribed burning with 5-10 acre mortality patches	establishment in open areas	
Group 7 – Mixed-severity prescribed burning with 5, 10, 20 acre mortality patches	No increase expected due to lack of presence	NA
Group 8 – Mixed-severity prescribed burning with 30-75 acre mortality patches	Increase in presence due to establishment in open areas	3,265
Group 9 - Low-intensity and severity prescribed burning	No increase expected due to lack of presence	NA
Group 10 – Mix of Intermediate Harvest and no treatment	No increase expected due to lack of presence	NA

Insects and Diseases

Mountain Pine Beetle

Under Alternative 3, treatments would reduce stocking on about 6,564 acres containing lodgepole, whitebark, or ponderosa pine trees. These treatments would reduce stocking and so mountain pine beetle risk with the effects lasting into the long term. However, as noted above, the recent mountain pine beetle epidemic has already reduced stocking in many stands, effectively reducing risk.

Douglas-fir Beetle

Under alternative 3, thinning and prescribed burning activities would reduce the risk of losing large Douglas-fir in treated stands into the long-term on at least 5,203 acres. Outside of the treatment units DFB activity would continue as discussed above for untreated stands.

Prescribed burning would result in a relatively small and short-term increase in Douglas-fir beetle risk to individual large Douglas-fir on about 3,031 acres. There would be a very small increase in risk to Douglas-fir over the landscape.

Western Spruce Budworm

All treatments proposed in this alternative would reduce Douglas-fir, Engelmann spruce, and subalpine fir and so the predisposition of stands to be impacted by WSB on about 5,288 acres. These effects would continue into the long term. On the remaining untreated area, WSB populations would continue as described above.

White Pine Blister Rust

As with alternative 2, the presence of white pine blister rust would not be reduced by the treatments, but small openings would be created to increase the regeneration of whitebark pine which may have some degree of resistance to the rust. About 2,265 acres of unit area would be treated within which the treatment would (1) thin around present whitebark pine, increasing vigor and the progression of the disease, and (2) increase the establishment of whitebark pine in small openings. The thinned areas and openings would comprise a small portion of the treated unit acreage.

Dwarf Mistletoe

As in alternative 2, the presence of dwarf mistletoes would in general be reduced due to (1) preference in retaining other species over lodgepole pine, (2) preference in retaining less infected trees over more infected trees in mechanical treatment units, (3) tendency for infected trees to be damaged and die from prescribed burning, and (4) tendency for infected tree branches to be damaged and die from prescribed

burning. Although the presence and magnitude of dwarf mistletoe is not mapped and is certainly not present on all unit acres, this alternative could potentially reduce dwarf mistletoe about 6,564 acres containing lodgepole pine.

Armillaria

The presence of armillaria would not be directly reduced by the treatments, but treatments in stands would reduce both short-term and long-term impacts from the disease due to increases in more resistant tree species, promoting tree vigor, and reforesting to tree species suitable to the sites (Rippy et al. 2005).

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

More information about compliance with standards and direction from the Forest Plan is in appendix B. Compliance of alternative 3 with Forest Plan forestwide standards pertinent to this discussion are displayed in volume 2, appendix B, table B-10. Compliance with management area standards is displayed in table B-11, and compliance with Forest Plan direction for regeneration harvest is displayed in table B-12.

Alternative Comparison

Purpose and Need: Enhance and Restore Aspen, western larch, and ponderosa pine species and habitats

To compare the three alternatives success in restoring and enhancing aspen, western larch, and ponderosa pine, in this analysis we compare (1) how the alternatives would result in within-stand changes in tree species compositions as a result of proposed treatments and the (2) proportion of the analysis area on which quaking aspen, western larch, and ponderosa pine would increase in presence. Since whitebark pine has been declining in presence due to disease and bark beetle activity and is now considered a sensitive species in Region 1, we also included it in this discussion. As discussed above, whether a treatment would result in an increase in a particular tree species depends upon the type of treatment, the characteristics of the tree species, and the current presence of the tree species in the area receiving the treatment. Treatments vary widely in the opportunity they provide to manipulate the presence of a particular species. Intermediate treatments provide a great deal of control through tree selection preferences applied during thinning if the tree species is present and regeneration treatments provide a great deal of control through control of seed sources and planting of preferred species. Prescribe burns provide opportunities to increase fire-tolerant or shade-intolerant early seral species such as ponderosa pine, western larch, and quaking aspen through killing competing fire-intolerant species and through creating open areas for regeneration although the degree of control is not great simply due to the variable nature of prescribed burning.

For alternative 2, tables 9, 10, 11 and 12 display the expected degree of increase for ponderosa pine, quaking aspen, western larch, and whitebark pine for each treatment group and acreage estimates over which those increases would occur. The same information for alternative 3 can be found in tables 16, 17, 18 and 19. In table 29 that follows, we summarize the effects of the three alternatives upon within-stand tree species compositions by treatment group and as a proportion of the landscape. Alternative 1 would continue the current condition in which the four species have declined in presence within stands and upon the landscape due to succession and the recent mountain pine beetle epidemic. In the long-term, those four species would continue to decline as succession continues. Alternatives 2 and 3 would result in an increase in the presence of all four species, with alternative 2 leading to the greatest increase due to the greater treatment area involved, and the greater area in regeneration and intermediate treatments which have the greatest potential for modifying species composition at the stand level.

Table 29. Alternative comparison for ponderosa pine, western larch, whitebark pine, and aspen

Issue Indicator	Alternative 1	Alternative 2	Alternative 3
Within stand changes in tree species compositions in proposed treatment units by prescription group	All groups: little short-term change from current condition, long-term widespread increase in Engelmann spruce (ES), subalpine fir (SAF), and Douglas-fir (DF) due to succession; long-term continuation of lodgepole in individual stands as it regenerates following the bark beetle epidemic and long-term landscape-level decline due to succession; long-term decrease in ponderosa pine, quaking aspen, western larch, and whitebark pine in individual stands and on the landscape	**Group 1**: reduce Engelmann spruce (ES), subalpine fir (SAF), lodgepole pine (LP), and Douglas-fir (DF) on 974 acres; increase in ponderosa pine (PP) on 845 acres, western larch (WL) on 5 acres, aspen (AS) on 547 acres, whitebark pine (WB) on 0 acres **Group 2**: reduce ES, SAF,LP, DF on 1,132 acres; increase PP on 651 acres, WL on 303 acres, AS on 402 acres, WB on 0 acres **Group 3**: reduce ES, SAF,LP, DF on 745 acres; increase PP on 633 acres, WL on 184 acres, AS on 410 acres, WB on 0 acres **Group 4**: reduce ES, SAF,LP, DF on 223 acres; increase PP on 102 acres, WL on 146 acres, AS on 15 acres, WB on 0 acres **Group 5**: reduce ES, SAF,LP, DF on 25 acres; increase PP on 25 acres, WL on 0 acres, AS on 25 acres, WB on 0 acres **Group 6**: reduce ES, SAF,LP, DF on 449 acres; increase PP on 326 acres, WL on 0 acres, AS on 146 acres, WB on 123 acres **Group 7**: reduce ES, SAF,LP, DF on 410 acres; increase PP on 374 acres, WL on 0 acres, and AS on 410 acres, WB on 0 acres **Group 8**: reduce ES, SAF,LP, DF on 8,564 acres; increase PP on 2,506 acres, WL on 0 acres, and AS on 337 acres, WB on 3,894 acres	**Group 1**: reduce Engelmann spruce (ES), subalpine fir (SAF), lodgepole pine (LP), and Douglas-fir (DF) on 232 acres; increase in ponderosa pine (PP) on 181 acres, western larch (WL) on 5 acres, aspen (AS) on 83 acres, whitebark pine (WB) on 0 acres **Group 2**: reduce ES, SAF,LP, DF on 822 acres; increase PP on 447 acres, WL on 197 acres, AS on 326 acres, WB on 0 acres **Group 3**: reduce ES, SAF,LP, DF on 664 acres; increase PP on 547 acres, WL on 176 acres, AS on 396 acres, WB on 0 acres **Group 4**: reduce ES, SAF,LP, DF on 152 acres; increase PP on 49 acres, WL on 91 acres, AS on 0 acres, WB on 0 acres **Group 5**: reduce ES, SAF,LP, DF on 25 acres; increase PP on 25 acres, WL on 0 acres, AS on 25 acres, WB on 0 acres **Group 6**: reduce ES, SAF,LP, DF on 326 acres; increase PP on 326 acres, WL on 0 acres, AS on 146 acres, WB on 0 acres **Group 7**: reduce ES, SAF,LP, DF on 36 acres; increase PP on 0 acres, WL on 0 acres, and AS on 36 acres, WB on 0 acres **Group 8**: reduce ES, SAF,LP, DF on 3,265 acres; increase PP on 1,168 acres, WL on 0 acres, and AS on 337 acres, WB on 3,894 acres **Group 9**: reduce ES, SAF,LP, DF on 637 acres; increase PP on 196 acres, WL on 38 acres, and AS on 39 acres, WB on 0 acres **Group 10**: reduce ES, SAF,LP, DF on 403 acres; increase PP on 200 acres, WL on 0 acres, and AS on <20 acres, WB on 0 acres

Issue Indicator	Alternative 1	Alternative 2	Alternative 3
Landscape-level changes in the presence of aspen, western larch, ponderosa pine, and whitebark pine	Short term would be no change in ponderosa pine, western larch, whitebark pine, slight increase in quaking aspen; long-term decline in all four species	**Ponderosa pine**: increase to some degree on about 23 percent of project area **Quaking aspen**: increase to some degree on about 10 percent of project area **Western larch**: increase to some degree on about 3 percent of project area **Whitebark pine**: increase to some degree on about 17 percent of project area	**Ponderosa pine**: increase to some degree on about 13 percent of project area **Quaking aspen**: increase to some degree on about 6 percent of project area **Western larch**: increase to some degree on about 2 percent of project area **Whitebark pine**: increase to some degree on about 14 percent of project area

Purpose and Need: Improve the mix of vegetation composition and structure across the landscape that is diverse, resilient, and sustainable to wildfire and insects

To compare how the three alternatives would improve the mix of vegetation composition and structure across the landscape, we compare (1) the expected within-stand changes in stand structures and species compositions in terms of tree diameter distributions for proposed treatment type groups, and (2) landscape-level changes in stand structures in terms of the proportion of change within BpS/vegetation-fuel class combinations.

In table 30 we display the expected effects of the three alternatives on within-stand species compositions. Under alternative 1, the current condition would persist, and the general track of tree species on the landscape would be toward increases in Douglas-fir, subalpine fir, and Engelmann spruce and decreases in the early seral species—ponderosa pine, quaking aspen, western larch, whitebark pine, and lodgepole pine. Lodgepole pine would regenerate in many areas in which it was a major component before the mountain pine beetle epidemic, becoming a component in mixed-species stands with Douglas-fir, Engelmann spruce, and subalpine fir. Treatments in both alternatives 2 and 3 would modify the current condition and increase ponderosa pine, western larch, quaking aspen, and whitebark pine as discussed above. Both alternatives would improve the mix of tree species in treated areas, resulting in tree species mixtures that would be more diverse and resilient. Alternative 2 would result in greater effects than Alternative 3 due to the greater acreage treated, and the greater acreage treated with intermediate and regeneration treatments.

In table 30 we compare the effects of the three alternatives on stand structures in terms of tree diameter distributions for proposed treatment type groups. Alternative 1 would continue the current condition in the short term and long term; stand understories would become denser and the stands more closed. Stand diameter distributions as displayed in figures 2 through 9 would remain the same in the short term and in the long term would tend to become more steeply weighted toward smaller diameters due to ingrowth and natural mortality of the larger diameter classes. Treatments in both alternatives 2 and 3 would modify the track that the stands are on with the degree and nature of the effects depending upon the type of treatment. Intermediate harvests (Groups 1 and 10) would “flatten” the diameter distributions by thinning small and mid-sized trees while retaining the largest trees—creating open multi-story structures. Precommercial thinning (Group 2) would create open, single-story stands by pre-commercially thinning even-aged, closed, single-story plantations. Regeneration treatments (Groups 3 and 4) would create even-aged stands with a small number of older and larger trees present as seed sources, shelter, or retention trees. Removing dead and dying trees and slashing undesirable understory trees (Group 5) would create stands that are open and almost single-story. Low-intensity prescribed burns (Groups 6 and 9) would flatten the diameter distributions due to killing many of the smaller diameter trees and would create stands that are more open

and still multi-story. Mixed-severity prescribed burns (Groups 7 and 8) would create areas that are mosaics of structures including open and closed single-story, open and closed multi-story, and early-seral grass/forb/shrub openings. The effects of all treatments would last into the long-term but eventually the stands would become more closed and multi-story as trees grow and as the stand understories fill in.

Table 30. Alternative comparison for stand structures

Alternative 1	Alternative 2	Alternative 3
All groups: little short-term change from current condition; long-term increase in stand understories as stands impacted by mountain pine beetle regenerate and as shade-tolerant trees continue to become established; single-story stands would become multi-story	**Group 1 (974 acres)**: Stand diameter distributions would become almost flat (figure 10) compared to the current condition (figure 2); stands would be open multi-story structure in the short term but would become more closed multi-story in the long term as understories become denser **Group 2 (1,132 acres)**: Stand diameter distributions would become more single-story (figure 11) compared to current condition (figure 2) due to thinning of small suppressed trees; stands would be open single story in the short term, becoming closed single-story in the long term **Group 3 (745 acres)**: Stands would have larger green trees remaining (figure 11); they would be single-story and very open in the short-term and would become two-story and less open in the long term as they regenerate **Group 4 (223 acres)**: Stands have only small groups and individual reserve trees remaining; they would be very open in the short term and would become single-story and less open in the long term as they regenerate **Group 5 (25 acres)**: Stand diameter distributions would become more single-story (figure 12) compared to the current condition (figure 2) due to thinning the understory; they would be open and almost single-story in the short term and would become closed and two-story in the long term as understories redevelop **Group 6 (449 acres)**: Stand diameter distributions would become a little flatter (figure 13) than the current condition (figure 4) due to prescribed burn mortality in small trees; they would be open multi-story in the short term and would become closed multi-story in the long term as understories redevelop **Group 7 (410 acres)**: Stand structures would be very complex with tree distributions reflected in figures 1,3,4,5,6,7,8,10,11, and 12 being found within the burn units due to the highly variable nature of the treatment **Group 8 (4,604)**: Same as for group 7	**Group 1 (232 acres)**: Same as for Alternative 2 **Group 2 (822 acres)**: Same as for Alternative 2 **Group 3 (664 acres)**: Same as for Alternative 2 **Group 4 (152 acres)**: Same as for Alternative 2 **Group 5 (25 acres)**: Same as for Alternative 2 **Group 6 (326 acres)**: Same as for Alternative 2 **Group 7 (36 acres)**: Same as for Alternative 2 **Group 8 (3,265 acres)**: Same as for Alternative 2 **Group 9 (637 acres)**: Stand diameter distributions would become flatter (figures 18 and 19) than the current conditions (figures 8 and 9) due to the smallest diameter trees being mostly killed by the treatments; they would become more open in the short term but structures would not change from their current single-story and 2-stories. In the long term the single-story stands would become more 2-story. **Group 10 (403 acres)**: Stand diameter distributions would become flatter (figure 20) compared to the current condition (figure 2); because only up to one-half of the stands would be treated, they would be a combination of open multi-story structure and closed structure in the short term but would become closed multi-story in the long term as understories become denser in the treated areas

In table 31 we compare the effects of the three alternatives on stand structures at the landscape level by comparing the proportion of change within Biophysical Setting/vegetation fuel class combinations. The table displays the percent of BpS area in each vegetation/fuel class for the current condition (Cur) discussed in the Stone Dry Vegetation Report (Milburn et al. 2009), the reference condition (Ref) discussed in the Stone Dry Vegetation Report, that estimated to occur under alternative 2 (A2), and that estimated to occur under Alternative 3 (A3). Note that as discussed above, the current condition is from the Stone Dry Vegetation Report (Milburn et al. 2009) which does not include an in-depth analysis of vegetation-fuel class changes due to the recent mountain pine beetle epidemic. As discussed above: (1) the current condition may not fully reflect changes in vegetation-fuel classes due to the recent mountain pine beetle activity, and (2) changes in vegetation-fuel classes due to proposed treatments are modeled estimates, therefore one must not take the current and alternative estimates as precise values. In this analysis, we use table 31 to discuss and compare the direction and magnitude of vegetation-fuel class change.

As discussed and displayed above, under alternative 1 in the short term the current condition would persist, which in general is below desired in (1) early seral and mid-seral open for all Biophysical Settings, (2) mid-seral closed in the two subalpine fir Biophysical Settings, and (3) in late-seral open for the two Douglas-fir and the ponderosa pine-Douglas-fir Biophysical Settings (table 14). Vegetation-fuel classes are above desired in all other combinations. Long-term trends under alternative 1 would be: decreasing early seral, mid-seral closed, mid-seral open, and late-seral open in almost all Biophysical Settings due to tree growth and filling in of stand understories (table 14). Both alternative 2 and alternative 3 would: (1) increase area in early-seral for all BpS, (2) decrease area in mid-seral closed for all BpS, (3) increase area in mid-seral open for all but upper subalpine BpS, (4) increase area in late-seral open for all BpS, and (5) decrease area in late-seral closed in all Bps. Alternative 2 would bring about greater change than alternative 3 due largely to the greater acreage treated. Both alternatives 2 and 3 would move the vegetation-fuel classes toward the reference condition, but largely due to the small portion of the analysis area proposed for treatment there would still be relatively great differences between present and reference condition for many BpS/vegetation-fuel class combinations.

Table 31. Alternative comparison for landscape-level stand structures

BPS	AESP	BMSC	CMSO	DLSO	ELSC
	CUR/A2/A3/REF	CUR/A2/A3/REF	CUR/A2/A3/REF	CUR/A2/A3/REF	CUR/A2/A3/REF
Douglas-fir Interior Northern and Central Rocky Mountains-Dry (23 percent of analysis area)	2/7/6/15	31/21/25/25	4/12/8/20	8/19/14/25	55/41/47/15
Douglas-fir Interior Northern and Central Rocky Mountains-Moist (24 percent of analysis area)	1/6/4/15	35/22/27/25	5/14/11/20	10/18/16/25	50/39/42/15
Ponderosa Pine-Douglas-fir (32 percent of analysis area)	1/14/11/15	31/16/20/10	0/11/7/25	1/24/16/40	67/35/45/10
Interior West Lower Subalpine Forest (14 percent of analysis area)	1/5/5/20	21/15/15/40	7/12/12/10	25/32/32/5	46/37/37/25

BPS	AESP	BMSC	CMSO	DLSO	ELSC
	CUR/A2/A3/REF	CUR/A2/A3/REF	CUR/A2/A3/REF	CUR/A2/A3/REF	CUR/A2/A3/REF
Interior West Upper Subalpine Forest (2 percent of analysis area)	0/3/3/20	22/21/21/25	11/11/11/25	22/27/27/15	46/38/38/15

Purpose and Need: Forest health in terms of reduced susceptibility (increased resistance) of individual stands and the landscape to diseases and insects found within the project area of concern

In table 32 we compare the three alternatives in terms of susceptibility to several insects and diseases that are impacting stands in the project area. Under alternative 1, in the short term there would be little change from the current condition, which in general is (1) low and long term decreasing risk for those insects and diseases dependent upon early seral trees such as the pines (e.g. mountain pine beetle), (2) higher and long-term increasing risk and impacts from those dependent upon Douglas-fir, subalpine fir, and Engelmann spruce, and (3) relatively low but long-term increase in susceptibility to armillaria which affects all conifers but for which pines and western larch are more resistant than the other conifers. Both alternatives 2 and 3 would generally reduce susceptibility to insects and diseases in treated stands and on the landscape. Exceptions to this would be white pine blister rust, for which we cannot say that the treatments would directly reduce the disease and Douglas-fir beetle for which the prescribed burning may increase risk in the treated areas to a small degree and short period of time. Over the landscape, both alternatives would increase resistance to insects and diseases by increasing tree species diversity and age class diversity, reducing stocking and so increasing individual tree resistance, and modifying structures. Alternative 2 would reduce susceptibility to a greater degree than alternative 3, largely because a greater area is being treated.

Table 32. Alternative comparison for insects and diseases

Alternative 1	Alternative 2	Alternative 3
Mountain pine beetle: risk would be low in most stands and at a landscape level due to the recent epidemic; increasing stocking would result in increased risk to remaining large ponderosa pine **Douglas-fir beetle:** little change in the short term; increasing risk in the long term due to increasing stocking and increases in presence of larger Douglas-fir **Western spruce budworm:** little change in the short term; long-term increase due to increases in host species and multi-story stands **White pine blister rust:** no change in levels from current condition	**Mountain pine beetle:** 8,506 acres of treatment would reduce risk to remaining pine trees into the long term **Douglas-fir beetle:** 7,172 acres of treatment would reduce risk to Douglas-fir into the long term with a possible small short-term increase in activity due to prescribed burning **Western spruce budworm:** Host species (Engelmann spruce, Douglas-fir, subalpine fir) would be reduced on about 7,172 acres with a shift toward non-host species **White pine blister rust:** rust would not be reduced directly by the treatments, treatments would promote natural regeneration from remaining whitebark pine which may be resistant to the rust and would increase vigor of white pine which have been thinned around reducing the progression of the disease **Dwarf mistletoe:** lodgepole pine dwarf mistletoe would potentially be reduced on about 8,516 acres containing lodgepole with a long-term decrease due to increases in non-host species **Armillaria root rot:** increase in short-term and long-term resistance to the disease where	**Mountain pine beetle:** 6,564 acres of treatment would reduce risk to remaining pine trees into the long-term **Douglas-fir beetle:** 5,203 acres of treatment would reduce risk to Douglas-fir into the long term with a possible small short-term increase due to prescribed burning **Western spruce budworm:** Host species (Engelmann spruce, Douglas-fir, subalpine fir) would be reduced on about 5,288 acres with a shift toward non-host species **White pine blister rust:** rust would not be reduced directly by the treatments, treatments would promote natural regeneration from remaining whitebark pine which may be resistant to the rust and increase vigor of white pine which have been thinned around reducing the progression of the disease **Dwarf mistletoe:** lodgepole pine dwarf mistletoe would potentially be

Alternative 1	Alternative 2	Alternative 3
Dwarf mistletoe: short term no increase from current levels; long-term impacts from lodgepole pine dwarf mistletoe in current infected understory trees **Armillaria root rot:** short-term little change from current condition; long-term increase due to increase in less susceptible species and stocking	found over 8,564 treatment acres	reduced on about 6,564 acres containing lodgepole with a long-term decrease due to increases in non-host species **Armillaria root rot:** increase in short-term and long-term resistance to the disease where found over 6,564 treatment acres

Transportation

Introduction

Vegetation management treatments proposed in the Stonewall project include precommercial thinning, commercial thinning, and regeneration harvest and prescribed burning. The objective is to restore the ecosystem to a historic or natural state or trajectory.

Proposed thinning and regeneration harvest treatments would include removal of material, and would therefore require haul route access. Haul route improvements are the primary topic addressed by this section.

Methodology

Region 1 Timber Strike Team engineers visited the project area and surveyed approximately 75 percent of the project haul routes, documenting improvement needs for haul vehicles and water quality improvements in line with Montana Best Management Practices (BMPs) (Logan 2001). The transportation planner then visited a sample of project roads in September 2010.

Geographic information systems (GIS) tools were used to track and analyze road location, mileage and density within the project area. The HNF Transportation Atlas (Helena National Forest 2011) was used for the analysis, which includes the inventory of routes. On-the-ground reconnaissance was completed on most project routes to observe current conditions and determine needs for short- and long-term treatments.

Incomplete and Unavailable Information

Engineering road surveys and accompanying road logs were completed for approximately 75 percent of the project haul routes. This information and the associated cost estimates were then extrapolated and applied to the remaining 25 percent of unsurveyed roads.

Overview of Issues

Comments pertaining to disclosing the effects of project activities on plants were identified from public scoping as nonsignificant (40 CFR 1501.7), and are addressed by the analyses in this section. Please refer to volume 2, appendix A of this document for a complete listing of the issues and an explanation of how the agency determined their disposition.

Indicators

Indicators used in this analysis to discuss how the alternatives would address the purpose and need for the project are:

- Existing road mileage and road density within the project area
- Proposed activities involving the existing transportation network for project implementation

Affected Environment

Existing Condition

An extensive road network exists within the project area to support community access and management activities of National Forest System (NFS) lands, including mining, grazing, and timber management. The 76.4 miles of existing roads located within the boundary of the Stonewall Project area equates to a road density of approximately 2.04 miles per square mile. The additional 11.3 miles of roads outside the project area are included in the transportation analysis because they connect to and provide access to the project area.

Primary project access routes from Montana State Highway 200 include Forest Roads 626, 1800, 1824 and 4106. Sections of these routes are under Lewis and Clark County jurisdiction and access NFS roads within the project area.

Table 33. Stonewall project area roads summary by jurisdiction

Road Mileage	Jurisdiction
3.3 miles	Private
1.5 miles	State of Montana
4.7 miles	Lewis & Clark County
78.2 miles	Forest Service

Environmental Consequences

The Responsible Official directed the interdisciplinary team that the Stonewall Project minimize changes to the Forest transportation system because the subsequent Route and Area Designation Process will be addressing travel management changes related to motor vehicle use. Therefore, the Stonewall Project transportation activities only accommodate the associated vegetation treatments.

Spatial and Temporal Context for Effects Analysis

Spatial analysis boundaries for transportation systems are limited to 75.6 miles of existing roads within the project area boundary and approximately 11.3 miles of roads outside, but adjacent to and accessing, the project area. A total of 86.9 miles of existing roads would be included in analysis for the Stonewall Vegetation Project.

Analysis timeframes for this project cover the schedule for implementation of the prescribed vegetation and fuels treatment, which is estimated to take up to 10 years from decision date. The proposed transportation system changes for this project are included.

Connected Actions, Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

The Forest Service would continue to apply recurrent road maintenance for National Forest System roads within the analysis area. Other routes in the analysis area and not on the Forest Transportation System would be maintained by the applicable owner and users. Road surface blading and culvert cleaning are typical annual maintenance tasks.

Under the Forestwide Hazardous Tree Removal and Fuels Reduction — Healthy Forests Restoration Act Project (Helena National Forest 2010), danger trees located within approximately 125 feet of open roads would be felled and removed to improve the safety of road users. Associated roads in the Stonewall Project area include National Forest System roads 1800, 1824, 4106, 607, 607-D1, 607-H1 and 626. In addition, treatments would occur to fell and remove danger trees in and adjacent to Pine Grove Campground and the Lincoln Cemetery, and Old Lincoln Townsite Administrative Sites. Haul roads associated with danger tree removal would include varying amounts of maintenance depending on condition of the road and magnitude of project use proposed on the road.

Two existing 48-inch diameter culverts in the project area are scheduled to be replaced under a separate Southwest Crown Collaborative Forest Restoration project effort. These are located on National Forest System Road 4106 at the crossings with Klondike and Theodore Creeks.

Finally, the Pine Grove Campground would continue to receive use and traffic during the open season from May 15 to November 15 each year.

Alternative 1 – No Action

Direct and Indirect Effects

Under the no action alternative, no changes would be made to the existing transportation network on and adjacent to the project area. Roads would continue to receive use for utilization and administration of NFS lands and access to locations such as Lincoln Gulch, Pine Grove Campground, private mining claims, and southern Scapegoat Wilderness. Roads would be maintained periodically to comply with BMPs. However, roads would not be improved to accommodate safe use of haul vehicles at this time.

Cumulative Effects

Under the no action alternative, there would be no cumulative effects or impacts on the project transportation network.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

The no action alternative complies with the HNF Forest Plan and State and Federal law.

Other Relevant Mandatory Disclosures

There are no other disclosures for the Stonewall Vegetation Project.

Summary of Effects

No changes would be made to the existing transportation network on and adjacent to the project area. There would be no cumulative effects or impacts on the project transportation network.

Alternative 2 – Proposed Action

Figure 38 that follows, displays the transportation system for the Stonewall Vegetation Project, alternative 2, by jurisdiction.

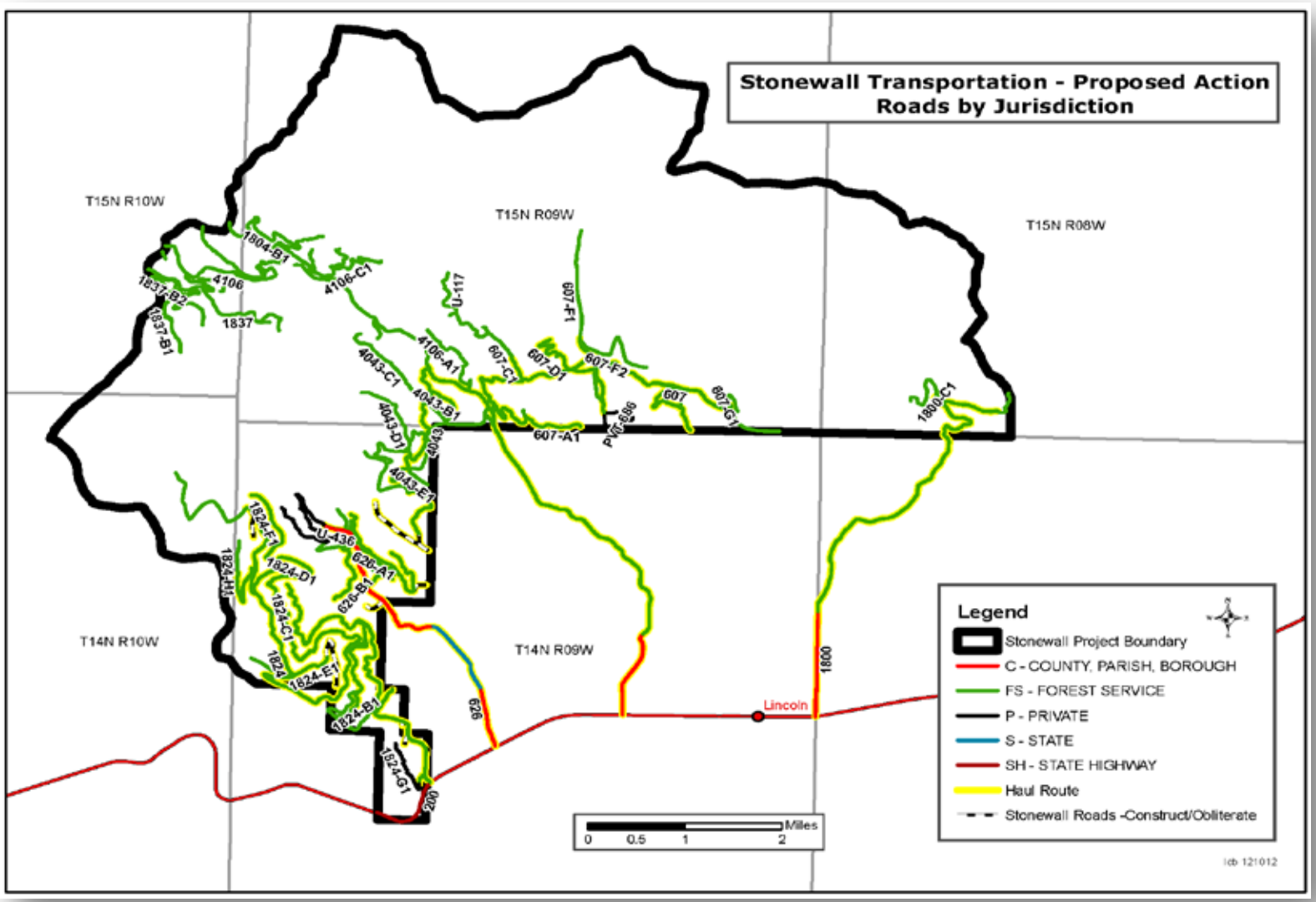

Figure 38. Transportation system for alternative 2-proposed action

Design Features and Mitigation Measures

The Stonewall Vegetation Project has been designed with features that are intended to minimize or avoid potential adverse effects while meeting project objectives. In addition to the proposed action treatments described in this section, design features would be implemented where applicable. A description of the project design features relating to transportation and other resources is displayed in table 9, chapter 2.

The design features in table 9 pertaining to transportation are RDS-1, through RDS-10. This analysis is based on the implementation of all design features. Project design features apply to both action alternatives. Specific design features listed above applicable to transportation are designed to protect other resources such as water and soil.

Direct and Indirect Effects

Under the proposed action, approximately 48.2 miles of roads would access vegetation treatment units and connect with Montana State Highway 200. Nearly 45.6 miles of existing roads would serve as project access and haul routes. Another 2.6 miles of new roads would be constructed to access treatment units. These roads would be closed, obliterated and rehabilitated immediately following vegetation treatments.

Existing road maintenance (45.6 miles) would involve improvement activities in accordance with BMPs, as well as work necessary to accommodate haul vehicles. This work includes the following activities: roadside brushing; surface blading and reconditioning; cleaning, repair, and new installation of drainage structures, including culverts, water bars, and rolling dips; aggregate surfacing; cattle guard cleaning and repair; minor realignment and curve widening to accommodate haul vehicles and trailers; and silt/sediment trap installation.

There are a few roads and road segments (including Forest Roads 626, 1800, 1824, and 4106) not under Forest Service jurisdiction and planned for use as timber haul routes. Before implementation, Forest Service coordination with the appropriate agency or landowner would be necessary in order to acquire the appropriate access and use agreement.

Approximately 2.6 miles of road would be built then obliterated immediately following timber removal, and would involve the minimal construction standard needed to provide short-term haul vehicle and equipment access to treatment units. This road work involves clearing vegetation, grubbing roots and stumps, excavating and shaping a travelled way, and installing drainage structures as necessary to ensure the road properly drains. These roads would be built to the minimum density, cost, and standard necessary for the intended need, user safety, and resource protection. These roads would be closed (e.g., gates, barricades) during operations to limit use to operators only. Intersections with roads would be blocked by rocks, wood or earthen berms, and would be slashed in and/or ripped and covered with slash or seeded within site distance of existing open roads to reduce potential for use after the project activities are completed. There would be no long-term changes to the amount of miles in the permanent road system or open road density in the project area under alternative 2.

Danger trees would be removed on all project roads, approximately 1½ tree lengths (e.g., 125 feet) from the roadway, as needed for safe hauling and project implementation. To provide for public safety, temporary warning and other signing in accordance with Forest Service signing standards would be used during project implementation. Haul routes would also be restricted or temporarily closed to provide for public safety. Existing open routes would be left in a similar condition and drainage structures shall be left in functional condition. Table 34 contains a breakdown of project roads by Helena National Forest LRMP Management Area.

Table 34. Summary of proposed action haul route miles by Forest Plan Management Area

Management Area	Project Haul Route Total Mileage	Roads Built then Obliterated Mileage
M1	2.18	-
T1	7.44	0.89
T2	8.04	-
T3	11.97	0.80
T4	7.24	0.92
Other Lands	11.32	-

See figure 38 for spatial information on the proposed action haul routes

In addition to haul-related work in accordance with BMPs, other additional restoration treatments would occur on project roads.

- A new culvert would be installed where National Forest System Road 626-B1 crosses the tributary to Lincoln Gulch, and a sediment filtering device (i.e., riprap, weed-free straw bales, filter fence, and/or slash filter windrows) would also be included at the crossing outlet.
- A sediment filtering device (i.e., weed-free straw bales, filter fence, bio-logs/waddles, and/or slash filter windrows) would be installed where National Forest System Road 607-E1 parallels Stonewall Creek.

See the separate Transportation Road Work and Costs spreadsheet available in the project record. Also see the Economic Resource Report for more information on project costs.

Cumulative Effects

Under the proposed action alternative, cumulative effects of past, present, and foreseeable actions are expected to have minor impacts on the project transportation network. Project haul routes would be maintained and improved in accordance with BMPs to accommodate haul vehicles. Sediment sites would be mitigated to reduce long-term sediment delivery. Annual road maintenance activities would also occur on National Forest System roads. It is expected that adjacent State and private roads would continue to receive annual maintenance also.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

The proposed action complies with the Forest Plan for the Helena National Forest, Forest Service policy, and State and Federal law.

Other Relevant Mandatory Disclosures

There are no other disclosures.

Summary of Effects

See figure 38 for more specific information regarding each road proposed for use during the project. See the separate Transportation Road Work and Costs spreadsheet available in the project record for more specific information about the proposed treatments.

Alternative 3

Figure 39 that follows displays the transportation system for the Stonewall Vegetation Management Project, alternative 3, by jurisdiction.

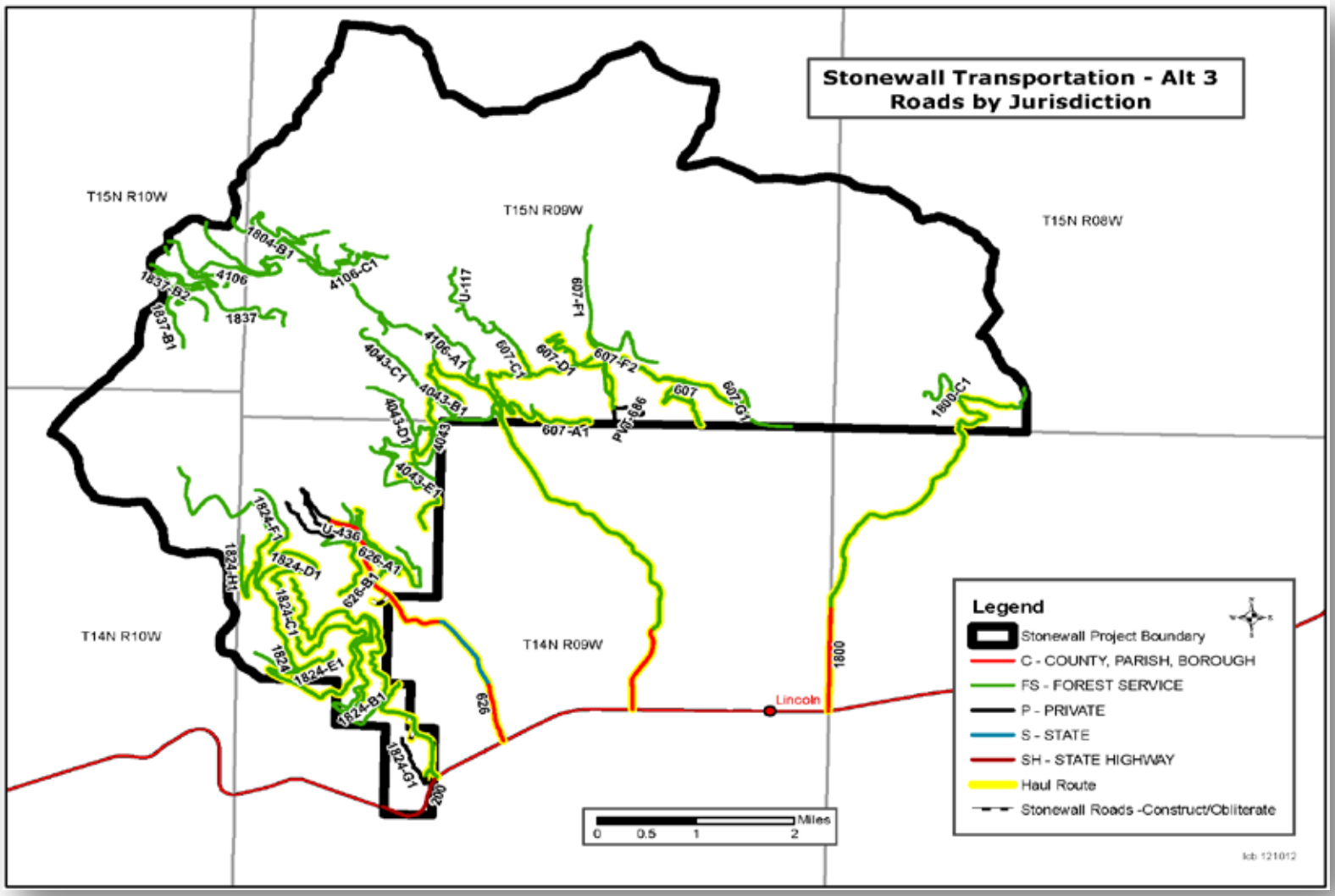

Figure 39. Transportation system for alternative 3

Direct and Indirect Effects

Effects of alternative 3 would be similar to alternative 2, however with slightly fewer miles of road use. Under alternative 3, nearly 44.3 miles of haul routes would be used to access vegetation treatment units and remove material in haul vehicles. Approximately 43.8 miles of existing roads would serve as project access and haul routes. Approximately 0.4 mile of road would be built then obliterated immediately following timber removal; these roads would be closed (e.g., gates, barricades) during operations to limit use to operators only.

Existing road maintenance (43.8 miles) would involve improvement activities in accordance with BMPs necessary to accommodate haul vehicles. This work includes the following activities: roadside brushing; surface blading and reconditioning; cleaning, repair, and new installation of drainage structures including culverts, water bars, and rolling dips; aggregate surfacing; cattleguard cleaning and repair; minor realignment and curve widening to accommodate haul vehicles and trailers; and silt/sediment trap installation.

There are a few roads and road segments (including Forest Roads 626, 1800, 1824, and 4106) not under Forest Service jurisdiction and planned for use as timber haul routes. Before implementation, Forest Service coordination with the appropriate agency or landowner would be necessary in order to acquire the appropriate access and use agreement.

Approximately 0.4 mile of road would be built then obliterated immediately following timber removal, and would involve the minimal construction standard needed to provide short-term haul vehicle and equipment access to treatment units. The construction work involves clearing vegetation, grubbing roots and stumps, excavating and shaping a travelled way, and installing drainage structures as necessary to ensure the road properly drains. These roads would be built to the minimum density, cost, and standard necessary for the intended need, user safety, and resource protection. These roads would be closed (e.g., gates, barricades) during operations to limit use to operators only. Intersections with roads would be blocked by rocks, wood or berms and would be slashed in and/or ripped and covered with slash or seeded within site distance of open roads to reduce potential for use after the project proposed harvest activities are completed. There would be no long-term changes to the amount of miles of permanent road system or open road density in the project area under alternative 3.

Danger trees would be removed on all project roads, approximately 1½ tree lengths from the roadway (e.g., 125 feet), as needed for safe hauling and project implementation. To provide for public safety, temporary warning and other signing in accordance with Forest Service signing standards would be used during project implementation. Haul routes would also be restricted or temporarily closed roads in active project areas to provide for public safety.

Existing open routes would be left in similar condition and drainage structures shall be left in functional condition. Table 35 that follows, contains a breakdown of project roads by Helena National Forest LRMP Management Area.

Table 35. Summary of Alternative 3 haul route miles by Forest Plan Management Area

Management Area	Project Haul Route Total Mileage	Roads Built then Obliterated Mileage
M1	2.18	-
T1	6.03	0.13
T2	8.04	-
T3	10.19	0.10
T4	6.49	0.18
Other Lands	11.32	-

See figure 39 for spatial information on the alternative 3 haul routes.

In addition to haul-related work in accordance with BMPs, other additional restoration treatments would occur on project roads.

- A new culvert would be installed where National Forest System Road 626-B1 crosses the tributary to Lincoln Gulch, and a sediment-filtering device (i.e., riprap, weed-free straw bales, filter fence, and/or slash filter windrows) would also be included at the crossing outlet.
- A sediment-filtering device (i.e., weed-free straw bales, filter fence, bio-logs/waddles, and/or slash filter windrows) would be installed where National Forest System Road 607-E1 parallels Stonewall Creek.

See the Transportation Report (Bielecki 2012) for estimated roadwork items and associated cost estimates. Also see the Economic Resource Report (Lahey 2012) for more information on project costs.

Cumulative Effects

Under Alternative 3, cumulative effects of past, present, and foreseeable actions are expected to have minor impacts on the project transportation network. Project haul routes would be maintained and improved in accordance with BMPs to accommodate haul vehicles. Sediment sites would be mitigated to reduce long-term sediment delivery. And annual road maintenance activities would also occur on NFS roads and also on adjacent State and private roads.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Alternative 3 complies with the Forest Plan for the Helena National Forest, Forest Service policy, and State and Federal law.

Other Relevant Mandatory Disclosures

There are no other disclosures for the Stonewall Vegetation Project.

Summary of Effects

Figure 39 displays specific location and information regarding each road proposed for use during the project. See the separate Transportation Road Work and Costs spreadsheet available in the project record for more specific information regarding road treatments and costs regarding the roads proposed for the project.

Fire and Fuels

Introduction

Portions of the Stonewall Vegetation Project area are in the Wildland Urban Interface (WUI) identified in the Tri-County Community Wildfire Protection Plan (2005) (figure 44). The project proposes various prescribed burning treatments on approximately 8,560 acres.

In this section, we discuss the existing condition and provide an overview of the fuels treatments and environmental effects of those treatments by alternative.

Methodology and Limitations

The fuels specialist made a field visit to the project area in 2010 to observe fuel conditions where treatments are being proposed. Fuels data was obtained from unit diagnoses, photos and the 2009 Helena National Forest Eastside Existing Vegetative Map (VMAP). The VMAP data was adjusted by forest personnel in an attempt to show the mountain pine beetle mortality in the project area. The data represents "post kill" data and is assumed to be a time period in the future once the red needles have fallen off the trees. Because of this adjustment, fire modeling of the existing crown fire potential is likely underestimated. Fire behavior fuel models used were derived from Scott and Burgan (2005) as a measure to display general changes in fuel profiles by vegetative cover type. All data was processed through the FlamMap fire behavior model (Finney 2006) to assess the distribution of fire behavior potential in the project area.

Post treatment modeling was also completed for the action alternatives to simulate the effects of the proposed treatments on fuel model and forest canopy characteristics including canopy cover, canopy bulk density, canopy base height, and canopy. The effectiveness of proposed treatments may not be accurately displayed in the modeling because the existing condition data also provided a foundation for modeling the alternatives. Given the uncertainty of any modeling exercise, the results are best used to compare the relative effects of the alternatives, rather than as an indicator of absolute effects (Graham et al. 2004).

Sources of Information

Information sources used for this analysis are listed below and represent some of the best available science obtainable at the time of report completion. There is a large body of literature that makes the case for treating fuels. There is even some controversy about the effectiveness of treatments of forest landscapes to reduce fire hazard. Please see Appendix 6 - Fuel Reduction Science–Selected Discussions from Literature, in the Fire/Fuels Report (Buhl 2015) in the project record for more information regarding treating fuels and ecological restoration science.

- Individual treatment unit diagnosis completed by Helena National Forest personnel and updated in the fall of 2009. These can be found in the project record.
- 30-meter Digital Elevation Model (DEM) Geographic Information Systems (GIS) raster layers from which we attained elevation, percent slope and aspect
- National Agricultural Imagery Program (USDA Farm Service Agency 2011) aerial photo digital imagery.
- Site visits during the summer of 2010
- GIS spatial data acquired from the Helena National Forest and other sources where noted:
    - VMAP spatial data including classification for tree dominance type, tree canopy cover class, and tree diameter.

- Helena National Forest Plan (USDA Forest Service 1986) management area boundaries
- Property ownership boundaries
- Project area boundary
- Historic wildfires
- Past management activities
- Wildland urban interface classification and boundaries
- Fire regime condition class (FRCC) data

· Scientific literature

· Other unpublished documents

Assumptions

A number of assumptions are made in this analysis and are listed below:

- Current Forest Plan and other pertinent management direction would continue indefinitely into the future
- No major disturbance, such as wildfire, blow down or insect epidemics would occur from the baseline year of 2010 until implementation is completed. This analysis discusses future risk and probable effects if a disturbance occurs. It is not a future projection of the occurrence.
- Regional Existing Vegetation Mapping Program (VMAP).
- Helena National Forest VMAP (post kill) PK and Stonewall_g data.
- The accomplishment time period is estimated to be 2015-2020
- FlamMap modeling can provide an estimate of the potential fire behavior before and after treatment.
- The Stonewall Vegetation Project area is sufficient to analyze and discuss effects to the fire and fuels resource.
- Information contained in the Stone Dry Fuels Report (Kurtz 2009) and the Stone Dry Vegetation Report (Milburn et al. 2006) and can also be applied to the Stonewall Vegetation Project area.

Overview of Issues

The purpose of this project as it relates to the fire and fuels resource includes the following needs:

· Develop a mix of vegetation composition and structure across the landscape that is diverse, resilient, and sustainable to wildfire and insects.

· Modify fire behavior to enhance community protection opportunities while creating conditions that allow the reestablishment of fire as a natural process on the landscape.

The issues summarized below were identified from internal and external scoping of the project, and are related to the fire and fuels resource.

Wildland Fire and Homes: Proposed treatments may be inefficient and ineffective in reducing home losses due to fire.

Fire Behavior: Proposed fuels reduction work would not reduce fire behavior.

Prescribed Burning: Concerns over risk of fire escaping burn boundaries during prescribed burning operations.

Measurement Indicators

The measures to assess how well each alternative meets the purpose and need are as follows:

- **Change in potential flame length within the project area -** The Stonewall Vegetation Project includes National Forest System lands adjacent to homes and private property. Desired flame lengths are generally less than 4 feet allowing for safe direct attack by fire crews. Flame lengths greater than 4 feet require deployment of additional resources such as dozers and aircraft. Deploying additional resources increases the time needed to apply successful fire suppression activities. Flame lengths beyond 8 feet increase the likelihood of torching, crowning and spotting. [8]
- **Change in the potential fire type -** Measured as acres of surface fire versus passive crown fire or active crown fire[9], low-severity surface fire allows for safe fire suppression activities as discussed above.

Affected Environment

Existing Condition

The existing condition of the project area has been shaped by decades of wildfire activity (figure 40) and suppression, past silvicultural treatments, fuels reduction and prescribed burning treatments, livestock grazing, noxious weeds, fire wood cutting and recreational activities (appendix C). Barrett et al. (1982) stated that after more than 80 years without fire, dense pole sized under stories of conifers (much of it relatively shade-tolerant Douglas-fir) have developed beneath the partially cut old-growth pine. In many stands in the Douglas-fir and grand fir series in western Montana, long-term fire exclusion, with or without partial cutting has now brought about dense overstocking and large, continuous buildups of fuels, particularly live, ladder fuels that could allow fires to crown and destroy the stand. Fellin (1979) noted the overstocking and shift in composition to more shade-tolerant species might also increase susceptibility to insects and diseases.

Fire Regimes

The natural or historic fire regime is a general classification of the role fire would play across the landscape in the absence of modern human intervention, but including the influence of burning by indigenous people. The natural or historical fire regimes are classified by numbers of years between fires (frequency) and fire severity, which reflects percent replacement on the dominant overstory vegetation. The native fire regime is perhaps the most important ecosystem process altered by fire exclusion (Arno and Brown 1991). The historical fire regimes created shifting mosaics of patches, processes and habitats on the Rocky Mountain landscapes (Agee 1993). Keane et al. (1996) noted that these landscapes tend to become more homogeneous as fire is removed, because succession would eventually advance all stands to similar communities dominated by shade tolerant species. Fires generally become less frequent and more severe with active suppression. Modern wildfires on late-seral landscapes tend to be larger, more intense and more severe because of high biomass loading and multi-layer stand structure. Fires on fire-altered landscapes may burn more area in fewer years, meaning that rare fire years, like 1910, may be especially

[8] Rothermel, Richard C. 1983 59

[9] **Surface Fire**: Fire that burns loose debris on the surface, which include dead branches, leaves, and low vegetation. Surface fire burns only in the surface fuelbed. **Passive Crown Fire**: consuming single or small groups of trees or bushes. **Active Crown Fire**: The surface fire ignites crowns and the fire spread is able to propagate through the tree canopy.

high in fire activity (Bessie et al. 1995). The increasing numbers of large, severe fires in 1fire-year would make suppression and control increasingly difficult further risking human life and property (Keane 2002).

Fire Regime Condition Class

Fire Regime Condition Class (FRCC) is an interagency, standardized tool for determining the degree of departure from reference condition vegetation, fuels and disturbance regimes (FRCC 2011). FRCC uses various parts of a biophysical setting (BPS)[10] by comparing the current conditions to documented reference conditions; then gives a rating for each BPS based on various factors including succession conditions, fire frequency[11] and fire severity[12]. The three condition classes FRCC uses to describe a BPS departure from reference condition are defined in the following table.

Table 36. The three condition classes as described in FRCC

Condition Class	Description
Low departure (<33%) from reference condition is defined as **Condition Class 1**	Vegetation composition, structure, and fuels are similar to those of the natural regime and do not predispose the system to risk of loss of key ecosystem components. Wildland fires are characteristic of the natural fire regime behavior, severity, and patterns. Disturbance agents, native species habitats, and hydrologic functions are within the natural range of variability.
Moderate departure (33-66%) from reference condition is defined as **Condition Class 2**	Vegetation composition, structure, and fuels are different from those of the natural regime and predispose the system to risk of loss of key ecosystem components. Wildland fires are moderately uncharacteristic compared to the natural fire regime behaviors, severity, and patterns. Disturbance agents, native species habitats, and hydrologic functions are outside the natural range of variability.
High departure (>66%) from reference condition is defined as **Condition Class 3**	Vegetation composition, structure, and fuels are very different from the natural regime and predispose the system to high risk of loss of key ecosystem components. Wildland fires are highly uncharacteristic compared to the natural fire regime behaviors, severity, and patterns. Disturbance agents, native species habitats, and hydrologic functions are substantially outside the natural range of variability.

(Hann and Bunnell, 2001; Hann and Strohm, 2003)

Biophysical Settings

Biophysical Settings (BpS) are land delineations based on the physical setting, (e.g. elevation and aspect) and the potential vegetation community that can occupy the setting. A national team has established in the FRCC system a set of descriptions for BpS found within regions of the United States (FRCC 2005). Helena National Forest ecologists, fuel specialists, and silviculturists reviewed the BpS descriptions applicable to the project area and determined that the descriptions could be used without modification (Milburn et al. 2009). For this analysis area, Helena National Forest personnel spatially assigned BpS based upon habitat type (Milburn et al. 2009). Detailed descriptions for each BpS can be found in project records and a more detailed discussion of each BpS can be found in Milburn et al. (2009).

[10] **Biophysical settings** (Bps) are the primary environmental settings used to determine a landscape's natural fire regime and fire regime condition class (Hann and Bunnell, 2001; Hann and Strohm, 2003

[11] **Fire frequency** is defined as the average number of years between fires or the mean fire interval (Baker and Ehle, 2001; Hann and Bunnell, 2001)

[12] **Fire severity** is defined as the effects of a fire on the vegetation and forest floor, and is measured in terms of surface and overstory fuel consumption and heat transference to the organic and mineral soil (DeBano et al. 1998).

The FRCC analysis was completed for the project area (Olsen 2010) including updates to the BpS classification. Data from that analysis was used for the Stonewall project and is summarized in the following sections.

Table 37 that follows, shows the current departure from reference condition for each biophysical setting located in the Stonewall Project area. The analysis shows fire frequency and fire severity are outside of the reference condition for the majority of the biophysical settings. The moderate and high departure ratings are of most concern and it is probable these areas would continue to move further from reference condition without management or fire disturbance. Refer to the FRCC NFMA Analysis (Olsen 2010) or the Silviculture Report (Amell and Klug 2015) for more information on biophysical settings.

Table 37. Current FRCC Rating for Biophysical Settings in Stonewall Project Area

Biophysical Setting	Percent Of Area	Fire Regime Condition Class Rating	Fire Frequency Severity Rating
	STONEWALL PROJECT AREA	CURRENT CONDITION	CURRENT CONDITION
Ponderosa Pine Douglas-Fir (Ppdf1)	32%	High (99%)	High (71%)
Douglas-Fir Warm (DFIR2-D)	23%	High (84%)	Mod (60%)
Douglas-Fir Cool (DFIR2-M)	24%	Mod (47%)	Mod (47%)
Lower Subalpine Fir (SPFI1)	13%	Mod (52%)	Low (12%)
Upper Subalpine Fir (SPFI2)	2%	Low (33%)	Low (24%)
Mountain Grasslands (MGRA3)	6%	Low (25%)	Low (25%)

Carbon Storage

The entire Atmospheric Carbon Report may be found in the project file (Amell and Klug 2013). Changes to atmospheric carbon release or storage resulting from the proposed activities for the action alternatives correspond to changes in forest vegetation cover and condition. The predicted effects of the proposed alternatives are described in qualitative and relative terms, as opposed to a quantitative analysis. The scale of carbon storage or release from the Stonewall Project is so minor relative to the scale of global or U.S. carbon storage and greenhouse gases (GHG) release that discussing the effects in detail would be meaningless.

Milburn et al. (2006) and the Stonewall Silviculture Report (Amell and Klug 2015) note forests in the Stonewall area have become denser, and late-seral fire-intolerant tree species have increased as a result of fire exclusion. Along with these changes there may have been an increase in stored carbon, however without a detailed and quantified analysis we are speculating. Fellows and Goulden (2008) found that carbon storage decreased with forest thickening due to increased mortality of large trees. Also, a substantial portion of the overstory and mid-story pine trees have recently been killed by mountain pine beetles and are no longer storing carbon, but have become sources for GHG. As the trees decay, GHG release would be relatively slow, but if and when wildfires burn in these stands a large portion of the decaying wood would be consumed (Skinner 2002, Knapp et al. 2005) and the carbon abruptly released. The recent mortality has most likely resulted in many stands now being sources of GHG rather than sinks. In the long term, as stands fill in and trees grow larger, the rate at which carbon is being stored would increase and the stands would eventually again become sinks rather than sources.

Due to increases in fire-intolerant trees and stand densities, future fires are anticipated to cause a great deal of mortality. This means the currently stored carbon would become relatively unstable with a high likelihood of such stands converting carbon sinks to sources for GHG emissions.

The general effects of activities proposed for the action alternatives would be similar and so we discuss them together; the major difference between the two alternatives being acres of area treated. About 8,564 acres would be treated under alternative 2 and 6,564 acres would be treated under alternative 3 within the 24,000-acre project area. Both alternatives comprise a variety of treatments including prescribed burning, live tree thinning with removal and fuels treatments, and dead tree cutting with removal and fuels treatments.

The immediate direct and indirect effects of the action alternatives to atmospheric carbon would be a combination of results involving storage on-site, storage off-site, and release to the atmosphere. The net result would be less carbon stored within the forest. Carbon in treated units would be:

- Retained on site as live trees
- Retained on site as dead standing trees (snags) or coarse woody debris to be relatively slowly released to the atmosphere
- Removed from the forest for use in harvested wood products—which would be considered off-site storage
- Removed from the forest for burning as residential or industrial heat, or to produce electricity, which could be considered to be replacing the GHG emissions from fossil fuels
- Released to the atmosphere through prescribed burning, either directly through consumption or through killing small trees and making them sources rather than sinks

Activities proposed for the action alternatives would increase the stability of stored carbon in treated stands and on the landscape by pushing the stands toward dominance by early seral and fire-tolerant tree species. Activities are designed to create more of a mosaic of stand ages and structures on the landscape, which would decrease stand-level and landscape-level fire intensity and severity (Buhl 2015).

Carbon storage decreased in the project area due to the recent mountain pine beetle epidemic. Succession has resulted in denser stands of smaller average diameters, and a greater proportion of fire-intolerant trees. Although a high level of carbon is stored in the forests relative to what the site and forest types are capable of, the carbon is unstable due to susceptibility of stands and the landscape to severe wildfires. Alternative 1 would not change the condition. Alternatives 2 and 3 would result in some carbon being removed from the forest for storage elsewhere and some carbon being released. Due to the nature of the treatments and the small area treated, most of the carbon contained in live trees in the project area would remain on site. The affected forest lands in this proposal would remain forests, not converted to other land uses, and long-term forest services and benefits would be maintained. Stored carbon in treated stands and over the landscape would be more resistant to wildfires and so more stable in the long term.

Fire Frequency and Severity

A brief description of the reference fire frequency and fire severity for each biophysical setting in the Stonewall Project area as rated by FRCC is discussed below (Milburn et al. 2006) and displayed in table 38.

Ponderosa Pine Douglas-Fir (Ppdf1)

The reference fire frequency for this setting was a 22-year mean fire interval; the current frequency is 70 years. The reference severity, which represents the amount of over story mortality that would occur in a wildfire, was 24 percent while the current severity is 70 percent. Fire return interval and severity are very different from reference conditions. The amount of tree mortality from a wildfire would be substantially greater than what would be expected under reference conditions.

Douglas-Fir Warm (DFIR2-D)

The reference fire frequency for this setting was a 30-year mean fire interval; the current frequency is 70 years. The reference severity, which represents the amount of over story mortality that would occur in a wildfire, was 10 percent while the current severity is 70 percent. Fire return interval and severity are very different from reference conditions. The amount of tree mortality from a wildfire would be substantially greater than what would be expected under reference conditions.

Douglas-Fir Cool (DFIR2-M)

The reference fire frequency for this setting was a 30-year mean fire interval; the current frequency is 70 years. The reference severity, which represents the amount of overstory mortality that would occur in a wildfire, was 10 percent while the current severity is 70 percent. Fire return interval and severity are very different from reference conditions. The amount of tree mortality from a wildfire would be substantially greater than what would be expected under reference conditions.

Lower Subalpine Fir (SPFI1)

The reference fire frequency for this setting was a 111-year mean fire interval; the current frequency is 140 years. The reference severity, which represents the amount of over story mortality that would occur in a wildfire, was 67 percent while the current severity is 75 percent. Frequency and severity are not substantially different from reference conditions. A wildfire would not behave uncharacteristically due to those factors. The disparity of the vegetation fuel classes to the reference composition would likely cause greater over story mortality than under reference composition.

Upper Subalpine Fir (SPFI2)

The reference fire frequency for this setting was a 143-year mean fire interval; the current frequency is 140 years. The reference severity, which represents the amount of overstory mortality that would occur in a wildfire, is 57 percent while the current severity is 70 percent. The fire return interval is not different from the reference but the amount of tree mortality from a wildfire would be greater than what would be expected under reference conditions.

Mountain Grassland with Shrubs (MGRA3)

Wildland fires are characteristic of the natural fire regime behavior, severity, and patterns. While this setting would likely benefit from fire, it is characteristic of reference conditions.

Table 38. Fire frequency and severity by biophysical settings in the Stonewall Project area

Biophysical Setting	Reference Fire Frequency (MFI)*	Current Fire Frequency	Reference Fire Severity (%)	Current Fire Severity (%)
Ponderosa Pine Douglas-Fir (Ppdf1)	22 MFI	70 years	24%	70%
Douglas-Fir Warm (DFIR2-D)	30 MFI	70 years	10%	70%
Douglas-Fir Cool (DFIR2-M)	30 MFI	70 years	10%	70%
Lower Subalpine Fir (SPFI1)	111 MFI	140 years	67%	75%
Upper Subalpine Fir	143 MFI	140 years	57%	70%

Biophysical Setting	Reference Fire Frequency (MFI)*	Current Fire Frequency	Reference Fire Severity (%)	Current Fire Severity (%)
(SPFI2)				
Mountain Grassland with Shrubs (MGRA3)	Characteristic of reference condition	Characteristic of reference condition	Characteristic of reference condition	Characteristic of reference condition

*Mean Fire Interval (MFI)-An arithmetical index of fire frequency, expressed as the average number of fire intervals within a given time period (Firewords.net)

Fire History and Occurrence

Fire has been the major influence on vegetation patterns, composition, structure, function, age and development of both individual stands and the larger landscape (Arno 2000). Fire history data from the Interior Columbia Basin Ecosystem Management Project region (ICBEMP), which includes the Stonewall Project area, suggest that extensive fire activity occurred at least every ten to twenty years between the mid-1500s and the early 1900s (Barrett et al. 1997). Agee (1993) added that changing land use patterns and attempts to exclude fire have succeeded in greatly reducing the scope of fire on the landscape.

In the Stonewall area, 66 fires were reported from 1920 until 2011. Although many fires had no accompanying written information and therefore were not included in fire occurrence maps, this data does give a glimpse of the fire suppression history in the Stonewall area. Fires that escaped detection would not be included. The fire occurrence data was digitized as point source data from historical maps that portrayed fires by year, size class, and cause for 1920 to 1969. For the period from 1970 to 2009, fire occurrence information was developed from Kansas City fire database (KCFast). The records from this period have detailed information including acreage, cost, and physical location. The Snow/Talon fire burned 36,012 acres adjacent to the project area in 2003. The Keep Cool Fire burned 302 acres at the edge of the project area in 2006 and cost approximately one million dollars to suppress. In 2007, the Bull Mountain Fire burned 30 acres. In 2011, the Lone Point fire burned 3 acres within the Stonewall project area. In addition, the Porcupine fire burned 133 acres and the Arrastra Fire burned 472 acres, both within 1.5 miles of the project area.

The NFMA report (Kurtz 2009) includes the fire history within all ownerships in the Stone Dry watershed area, which includes the Stonewall project area. This report noted 188 fires were reported from 1920 through 2009. For 1920 to 1969, approximately 1,243 acres on all ownerships burned and during the period from 1970 to 2009, 125 fires burned approximately 531 acres within the watershed area. Therefore, no more than 1,774 acres or less than 4 percent of the project area has burned across all ownerships since 1920. Acreage for fire size classes are as follows: (A) less than 0.25 acres, (B) 0.26-9.9 acres, (C) 10-99 acres, (D) 100 – 299 acres, (E) 300-999, (F) greater than 1,000 acres. Figure 40 spatially displays the fire history of the project area.

Table 39 shows the fires per decade by size class within the Stonewall Project area. Acreage for fire size classes are as follows: (A) less than 0.25 acres, (B) 0.26-9.9 acres, (C) 10-99 acres, (D) 100 – 299 acres, (E) 300-999, (F) greater than 1,000 acres. Figure 40 spatially displays the fire history of the project area.

Table 39. Number of fires in the Stonewall Project area per decade by size class

DECADE	A	B	C	D	E	TOTAL
1920-1929	1					**1**
1930-1939	6	1				**7**
1940-1949	5					**5**
1950-1959	4	1	1			**6**
1960-1969	6		1			**7**
1970-1979	6	3	1			**10**
1980-1989	5	3	1			**9**
1990-1999	7	3		1		**11**
2000-2009	5	3			1	**9**
2010-Current		1				1
Total	**45**	**15**	**4**	**1**	**1**	**66**

Source: Stonewall_PrjBdyFirepts_092111.xlsx

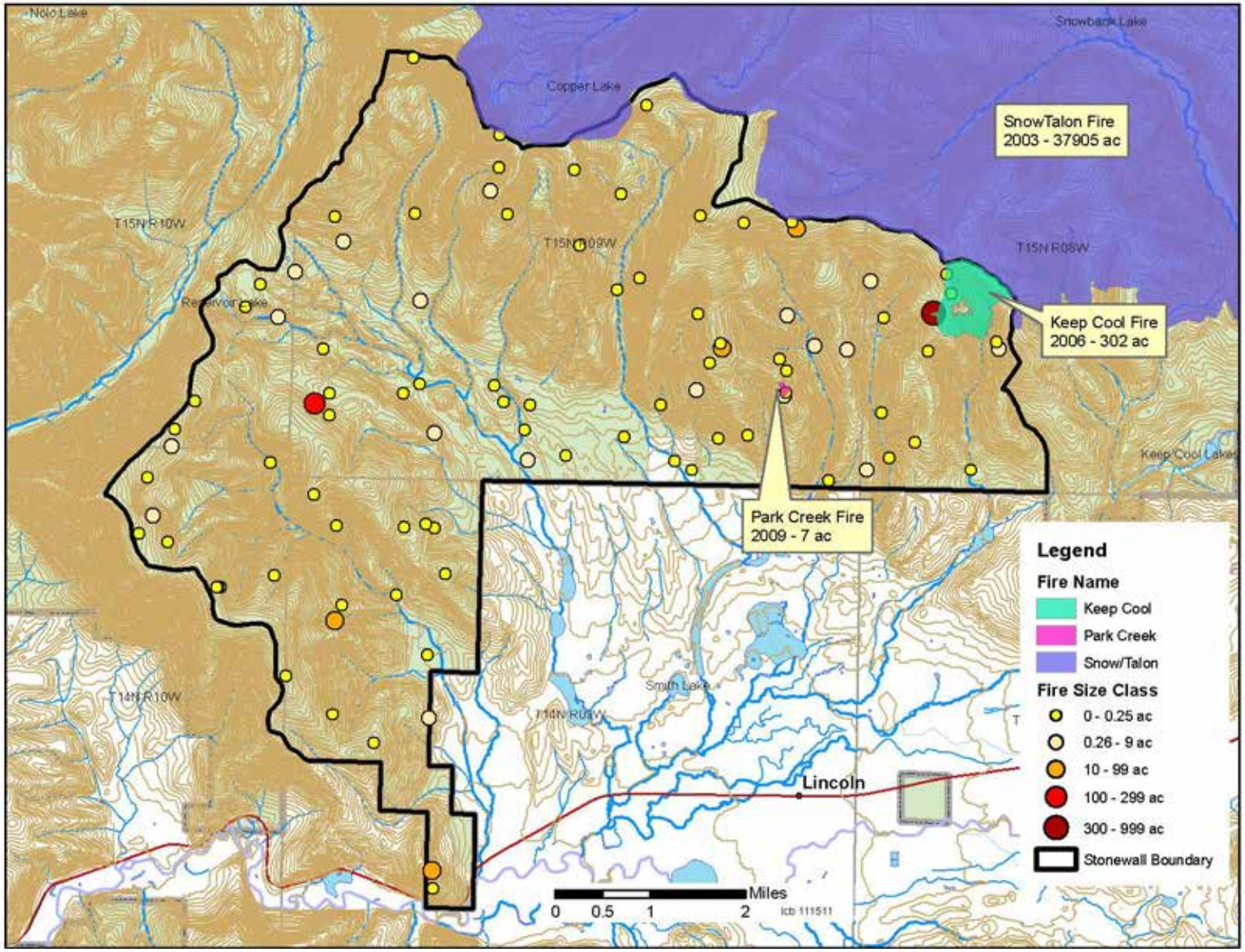

Figure 40. Fire History Map of the Stonewall Project Area

Fire Behavior and Fuel Condition

Fire behavior is driven by the combination of fuels, topography, and weather across the landscape. Surface fires spread according to the direction and speed of wind and the steepness of a slope. Passive crown fire encompasses a wide range of fire behavior from individual trees torching to nearly active crown fire. Active crown fire spreads rapidly and involves surface and canopy fuels and spreads from tree to tree through the canopy. Crown fires are more difficult to control and have more severe effects compared to a surface fire due to higher rates of spread, increased fire intensity, and increased probability of spot fires igniting ahead of the fire front. Fuel conditions exist in the project area that could contribute to high-intensity fire adjacent to private land.

Treatments that decrease surface, ladder and canopy fuels[13] generally make the area more resistant to stand-replacing wildfires. Keane and others (2002) state that since the early 1930s, fire suppression programs in the United States and Canada successfully reduced the amount of wildland fires in many Rocky Mountain ecosystems. This lack of fires within many forest and range landscapes has resulted in atypical accumulations of fuels that pose a hazard to many ecosystem characteristics.

A fire behavior fuel model represents the fuelbed characteristics necessary to predict surface fire behavior in fire behavior modeling systems. In 2005, Scott and Burgan presented a new set of fire behavior fuel models that expanded on the original 13 created by Anderson in 1982. Advantages of this new set include: increased precision in surface fire intensity prediction and subsequent crown fire behavior prediction, increased ability to simulate changes in fire behavior as a result of fuel treatments, and improved accuracy of fire behavior predictions outside of the severe period of the fire season (Scott and Burgan 2005). For these reasons the Scott and Burgan models are used in the fire behavior modeling systems used in this analysis. The distribution of fuel models mapped in the Stonewall project area is shown in table 40.

Thirty-two percent of the project area is mapped as fuel model TU1 which depicts a combination of forest litter[14] and a low load of grass and shrub fuel as the primary carrier of fire. Fuel model TU5 comprises 24 percent of the area. The primary carrier of fire in fuel model TU5 is heavy forest litter with a shrub or small tree understory which can likely lead to crown fire due to the abundance of ladder fuels (figure 41).

Fuel model TL5 comprises 27 percent of the project area. The primary carrier of fire in TL5 is a high load of conifer litter, slash and mortality fuel. Although fire behavior is relatively low in TL5 this fuel model also includes downed logs which can increase resistance to control by firefighters. With concentrations of dead fuels, individual trees or groups of trees may torch, and fire may continue through the crowns aided by high winds. Fuel model TL3 comprises 9 percent of the project area and consists of a moderate load of conifer litter. Flame lengths and spread rate are typically low with TL3. Five percent of the non-forested fuel models within the project area are mapped as GR1. The flame length and rate of spread in GR1 is low compared to other grass fuel models and is primarily used to represent the grassland areas.

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[13] *Surface fuel* is defined as fuel lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material downed logs, bark, tree cones, and living plants of low stature. *Ladder fuels* are defined as fuel that provides vertical continuity between surface fuel and canopy fuel strata, increasing the likelihood that fire will carry from surface fuel into the crowns of shrubs and trees. *Canopy fuels* are the foliage and fine branchwood of trees. (Scott 2008)

[14] Litter is defined as leaves, needles, fine twigs, and other organic material on the forest or grassland floor that have undergone little or no decomposition.

Figure 41. Photo showing understory ladder fuel component combined with overstory conifers

Table 40 Current distribution of fire behavior fuel models in the project area.

Fuel Model Code	Description	Acres	% Of Total
GR1 (101)	Short, sparse dry climate grass	1,243	5
GR2(102)	Low load, dry climate grass	295	1
GS2 (122)	Moderate load, dry climate grass-shrub	83	<1
TU1(161)	Low load, dry climate timber-grass-shrub	7,734	32
TU5(165)	Very high load, dry climate timber-shrub	5,669	24
TL3 (183)	Moderate load conifer litter	2,215	9
TL4(184)	Small downed logs	11	<1
TL5 (185)	High load conifer litter	6,568	27
TL7(187)	Large downed logs	31	<1
TL8 (188)	Long needle litter	147	<1

A current risk to a significant portion of the landscape in the project area is a stand-replacing fire event such as the one that occurred in 1988 during the Canyon Creek Fire[15] in the Scapegoat Wilderness, and in 2003 during the Snow-Talon Fire in the Copper Creek drainage northeast of Lincoln. The project area has

[15] The Canyon Creek Fire burned 247,000 acres of which approximately 160,000 acres burned in a single burning period, the largest ever recorded.

similar fuel types and weather patterns (table 42) that support the risk of stand-replacing fire. Other reasons include, (1) fire suppression within the Stone Dry area has been quite effective since records were kept in 1920, (2) the removal of fire as an important process has affected the current fire regime, (fire interval and fire severity), and (3) a substantial number of stands have been classified as mid- and late-seral closed canopy. The location of the town of Lincoln and the surrounding community is a concern for large wildfire in the project area, as north/northwest winds are common with cold fronts that would push a fire towards the community (Kurtz 2009).

A visual indicator of fireline intensity is flame length (Rothermel 1983). Flame length is widely used as a means to relate visible fire characteristics and interpret general suppression strategies. These flame-length classes and interpretations are familiar to fire managers and are widely accepted as an intuitive communications tool. Table 41 compares fireline intensity, flame length, and fire suppression difficulty interpretations.

Table 41. Fireline intensity interpretations

Fireline Intensity	Flame Length	Interpretations
Low	Less than 4 feet	Direct attack at the head and flanks with hand crews; hand lines should stop spread of fire
Moderate	4-8 feet	Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to stop fire spread. Equipment such as dozers, engines, and retardant aircraft can be effective.
High	8-11 feet	Fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the fire head are likely ineffective. This fire would require indirect attack methods
Very High	> 11 feet	Crowning, spotting, and major fire runs are probable; control efforts at the head are likely ineffective. This fire would require indirect attack methods

Table based on Rothermel (1983)

Geospatial fire modeling was used to evaluate the flame length and crown fire potential within the project area under a weather scenario conducive to high fire behavior on the Helena NF. Weather conditions that occurred during the Snow Talon Fire in 2003 were used for this scenario. The modeling was conducted for current and future scenarios under the proposed alternatives. The current condition results are summarized for the project in table 42 and visually displayed in figure 42.

Table 42. Potential fire behavior characteristics modeled with 25 mph upslope 20-foot winds.

Potential Fire Behavior Characteristic		Percent [A]
Flame Length	Less than 4 feet	32
	Greater than 4 feet	68
Fire Type	Surface Fire	65
	Crown Fire	35

[a] -Percent of burnable acres- Non-burnable acres are not shown in table

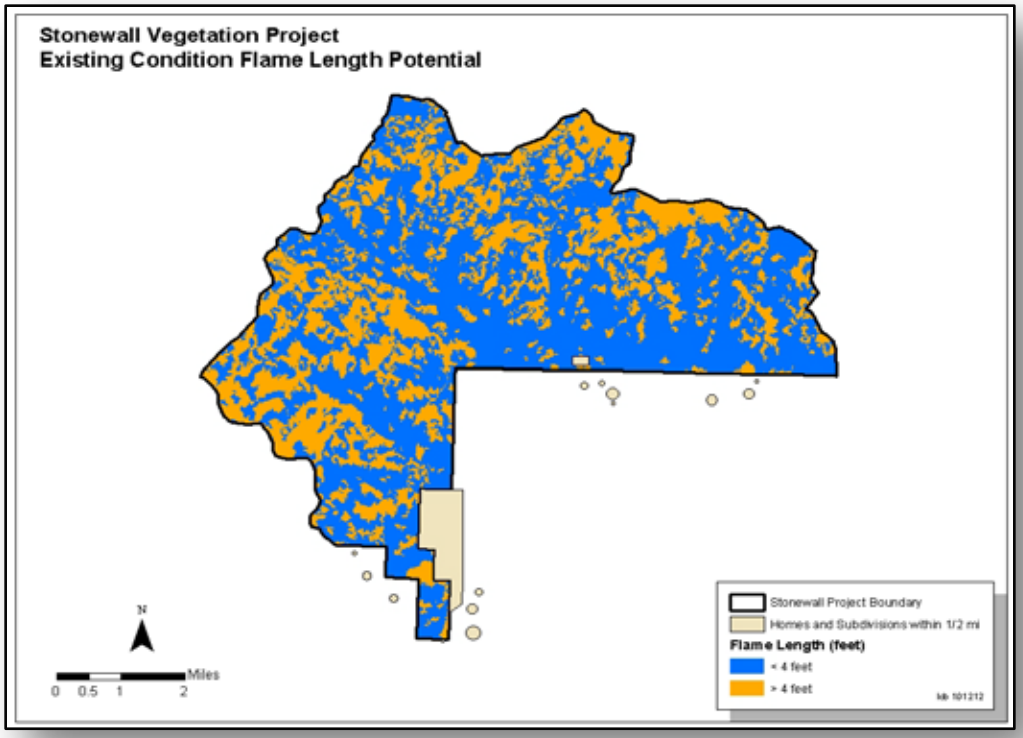

Figure 42. Existing condition fire behavior potential displayed as flame length

As shown in table 42, modeling suggests that 68 percent of the project area has potential fire behavior characteristics that would make direct suppression strategies ineffective or unsafe for firefighters. Portions of the project area exhibiting these conditions are of concern due to the proximity of private land. Conditions like these can lead to high acreage burned and significant adverse effects on resources.

Local fire managers state that significant fire spread on the HNF is generally due to spotting and wind-driven crown fires. The Snow Talon Fire in 2003 was an example of this type of fire behavior. In one afternoon the fire grew 20,000 acres due to heated fuels and the alignment of westerly winds as noted by Studebaker's Incident Management Team in the Lincoln Complex Operations Narrative (USDA 2003). Areas expected to experience crown fire have the potential for spotting. Figure 43 shows the areas that have the highest potential for crown fire in the project area. Fires initiating within these areas have the potential to spread through spotting and threaten private land adjacent to the project area.

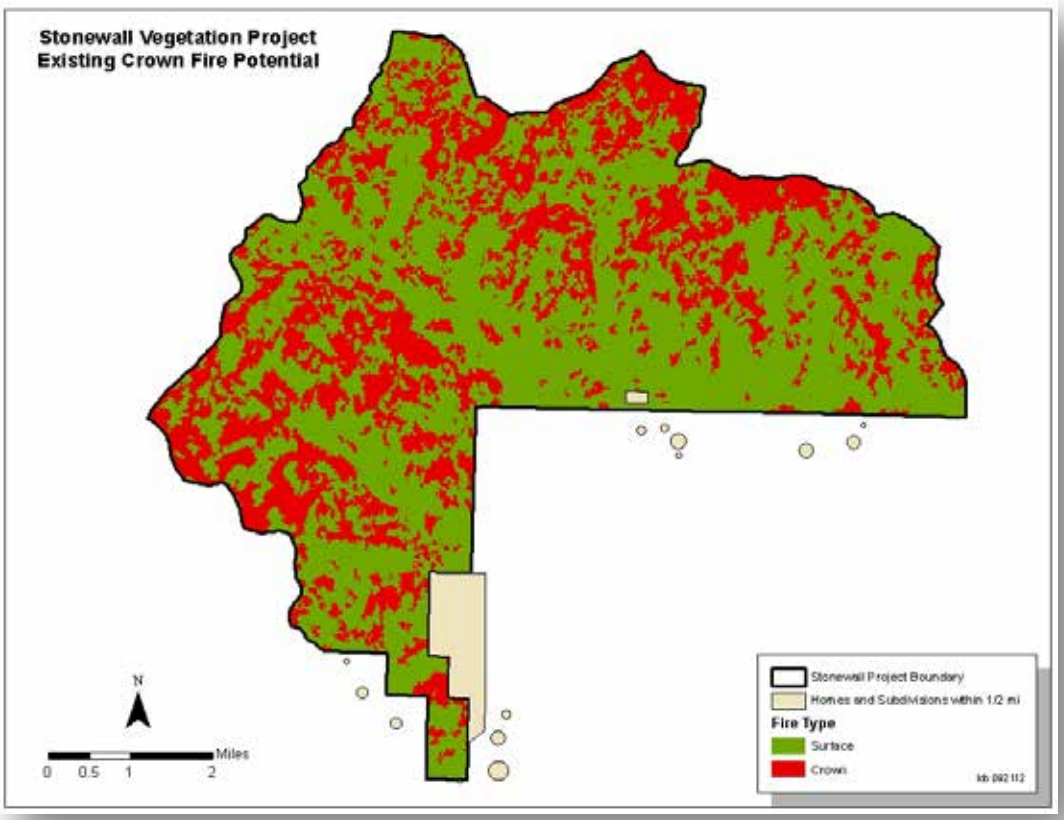

Figure 43. Existing condition fire behavior potential displayed by fire type

Wildland Urban Interface

The Tri-County Fire Working Group, which is composed of representatives from Broadwater, Jefferson and Lewis and Clark counties, developed the Regional Community Wildfire Protection Plan (CWPP 2010). Membership of the group includes individual citizens, local government, state and federal agencies, interested contractors and fire suppression departments. The CWPP identifies goals and objectives for mitigating wildland fire hazard. Some of the objectives are:

- Propose and implement projects to protect communities at risk from wildfire.
- Focus first on the wildland urban interface communities at risk.
- Encourage the Federal and State agencies to continue creating fire defensible space around homes that border agency land.

The CWPP defined the wildland-urban interface (WUI) as, "… the area within 4 miles from interface communities that possess a population density exceeding 250 people per square mile" (CWPP 2005). WUI boundaries were defined utilizing input from local residents, available GIS technology, known fuel hazards and fire history of the area, local topographic features, weather patterns and understanding the fire response and suppression capabilities in the area. Proposed projects in the WUI would become a priority for accomplishment and would be assigned a numerical value of risk based on the existing fuel hazard, number of people in the immediate area and past history of wildland fires starting in the

immediate area. Lincoln, Montana is identified as a “Community-at-Risk” in the Federal Register (CWPP 2005). The Fire Ignition Probability map showed the area surrounding Lincoln, including the Stonewall project area, as a moderate to high occurrence of fire starts based on the data years of 1990-2000. Portions of the Stonewall Project area are ranked as high to very high with regard to fuel hazard rating. These areas represent the potential for high intensity crown fires with extreme rates of spread.

Thirty-nine percent of the Stonewall project area is classified as wildland-urban interface. The CWPP further identifies the Stonewall project as a priority fuel hazard reduction project. The decision maker considered treatments recommended by the Lincoln Restoration Committee, along with treatments identified by forest specialists that would move towards Forest Plan goals for fuel reduction and increase habitat diversity for associated wildlife species.

Table 43 that follows displays the wildland-urban interface classifications within the Stonewall Vegetation Project area, approximate acres that lie within each classification and the proportion of the project area represented by each classification. Figure 44 shows spatially the WUI classifications within the project area.

Table 43. Wildland Urban Interface classifications within Stonewall Project area

Wui Classification	Acres	Proportion Of Project Area (%)
Outside WUI Zone	11,452	48
Low Risk	7,785	32
Moderate Risk	2,087	9
High Risk	1,502	6
Very High Risk	1,180	5
Total	**24,006**	**100**

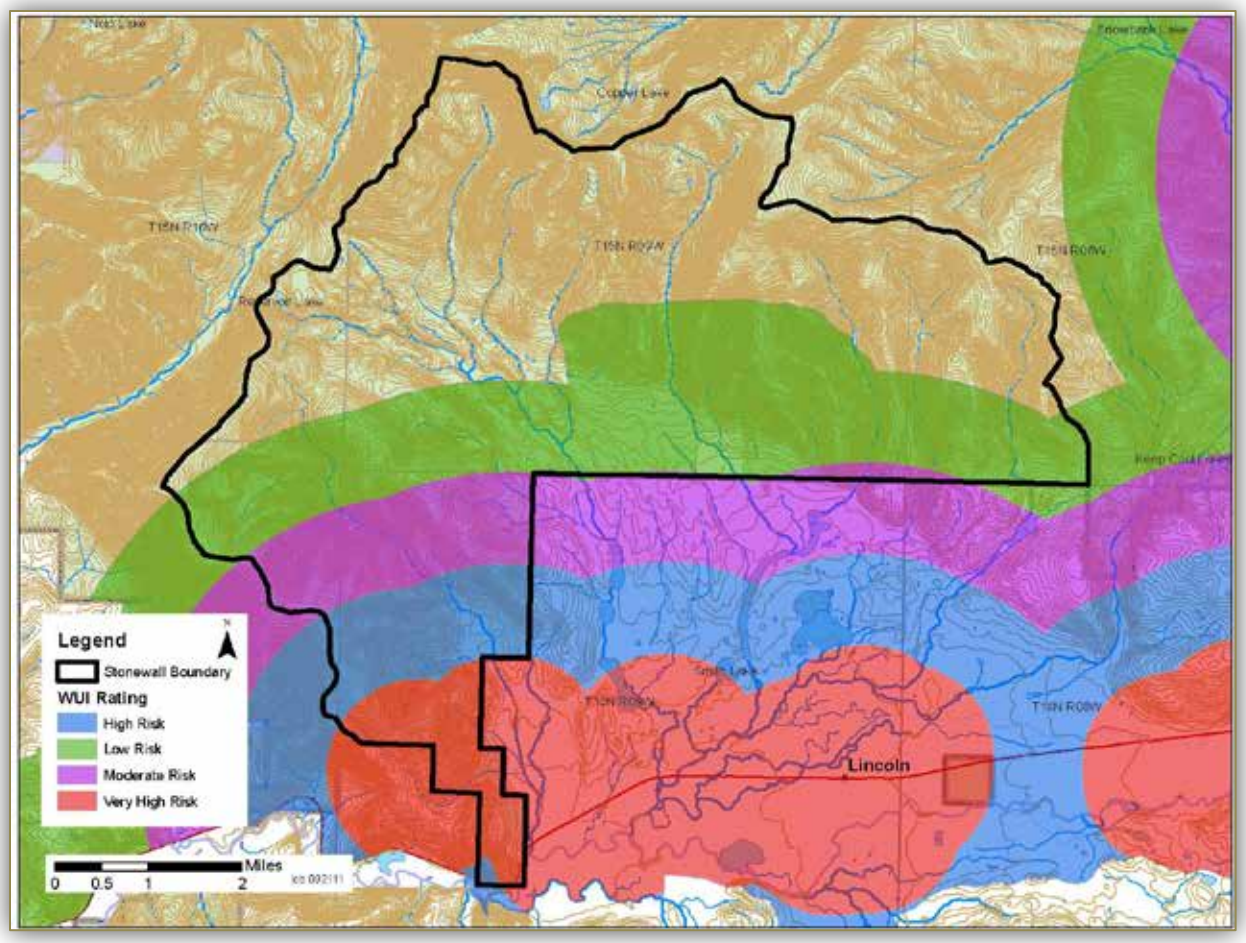

Figure 44. Fire risk ratings for Wildland Urban Interface within the Stonewall Project boundary

Environmental Consequences

Spatial and Temporal Context for Effects Analysis

Spatial Bounds: The spatial scale for effects analysis is dependent upon the measurement indicator and focused within the Stonewall project area boundary to assess treatment effectiveness in reducing fire behavior.

Temporal Bounds: The year 2010 is the baseline used for the existing condition and this analysis. It is estimated proposed treatments would be completed in approximately 10 years. Re-entry into the units for maintenance prescribed burning is desired to maintain treatment effectiveness and to continue restoration efforts.

Past, Present, and Foreseeable Activities and Connected Actions Relevant to Cumulative Effects Analysis.

Direct, indirect and cumulative effects for the fire and fuels resource consider the impacts of the alternatives when combined with fuel profile changes resulting from other activities including silvicultural treatments, wildfires and fuels reduction activities. These actions contributing to cumulative effects were selected because they have caused or have the potential to cause changes in fire behavior.

Past Activities

Past activities that have shaped the existing condition of the project area include wildfire, fire suppression, prescribed burning and other fuels reduction activities, silvicultural treatments and insect and disease activity. Previous fire (table 39) and fuels reduction or prescribed burning activities have influenced the project area. From 1950-present there has been approximately 7,922 acres[16] treated within the Stonewall project area. There have also been approximately 5,067 [17]acres of silvicultural treatments from 1950 to the present (Amell and Higgins 2014). Other past actions including livestock grazing, fire wood cutting, noxious weed treatment and recreational activities generally had a small or localized effect on fuels in the project area and have been considered in describing the current condition.

Current and Future Activities

Current and future activities predicted to influence the fire and fuels resource include a Forestwide hazard tree removal and fuels reduction project. This project involves removing hazardous trees up to 175 feet from the edge of road right-of-ways. This treatment would overlap portions of treatment units under the proposed action.

Connected Actions

Connected actions are considered necessary in order to implement proposed treatments. Fire control lines are a connected action to the fuels resource and are proposed with this project.

Prior to prescribed burning it may be determined control lines are needed to assure prescribed fire remains within designated unit boundaries. Control lines are defined as, “all constructed or natural fire barriers and treated fire edges used to control a fire” (NWCG 1994). This includes but is not limited to the following: black line, hand line, pruning, mowing, saw line and hose-lays. Control lines would occur along existing trails and ridgelines or in areas of thinner vegetation when feasible.

Alternative 1 – No Action

Direct Effects

There would be no direct effect to fuels under this alternative. The no-action alternative would not alter the fuel profile to reduce fire behavior and would not meet the purpose and need of this project. Potential fire behavior characteristics would be similar to those described under the existing condition and summarized in table 42. In the absence of human-caused or natural disturbance such as vegetation treatment activities and wildfire, there may be an increased accumulation of surface and ladder fuels due to insect and disease activity, blow down and the progression of forest succession.

Indirect Effects

Over time, the no-action alternative would indirectly lead to increased surface, ladder and crown fuels that affect flame length, contribute to the torching of trees, and make crown fire more likely (Peterson et al. 2005, Graham 2004). Increases in fuel loading would make overstory trees more susceptible to damage from wildfire. It is probable the fire-tolerant trees would continue to be replaced by trees that are less fire tolerant and therefore less resistant to stand-replacing fires. Wildfires that escape initial attack may impact adjacent private lands and other resource values. It is probable that another large wildfire, like the Snow

[16] The number of acres treated may also include overlap from areas that have been re-treated over the decades.
[17] The number of acres treated may also include overlap from areas that have been re-treated over the decades.

Talon fire, may threaten adjacent private lands. Direct suppression tactics by firefighting forces would not be as effective in the project area under the no-action alternative as compared with the results of the treatments proposed for the action alternatives. The no action alternative would restrict local fire managers from utilizing fire for meeting various land management objectives. Fire suppression activities would continue in the project area. Case studies of watersheds in two national parks in California found the impacts of suppression on fire return interval departure (FRID) were substantial. The results showed if all ignitions were allowed to burn, the fire return interval would have improved from a high departure rating to a low departure rating in one of the study areas. The author noted the consequences of suppressing fires included substantial impacts to the fire return interval which may have a substantial impact on an entire ecosystem (Miller 2012).

Average snag numbers were shown to exceed Forest Plan standards in all tree size classes without taking into account mortality in the years 2009 and 2010 (Amell and Higgins 2014). It was estimated snags greater than or equal to 7 inches d.b.h. ranged from 47-49 tons per acre, which is approximately 25 times the Forest Plan required level. Tree mortality, as a result of insect and disease activity and natural forest succession, would continue into the future and would exacerbate the amount of standing and downed fuels in the project area and adjacent to private land. These unprecedented fuel levels have the potential to significantly affect fire behavior should another wildland fire occur within or adjacent to the project area.

Cumulative Effects

Present or reasonably foreseeable future fuels reduction and vegetation management projects in the areas would complement other federal and private fuel reduction treatments that have occurred or are occurring by collectively reducing fire behavior (flame length and crown fire potential) within the areas they are applied by removing surface, ladder and crown fuels. Public firewood cutting has occurred in the project area and would continue into the future having a localized effect on fuels.

The Helena National Forest's has begun implementing the "Forest-Wide Hazardous Tree Removal & Fuels Reduction Project" (USDA Forest Service 2010). This project would remove hazardous trees within National Forest System roads rights-of-way and around administrative sites. The Stonewall Project area would benefit from this project due to a reduction in fuel loading once the activity fuel loading levels are reduced. Removing standing dead and down fuels in road rights-of-ways would provide safe areas for firefighters to initiate fire suppression activities. It is also expected that these areas would improve fire line construction efficiency.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

The no-action alternative would fail to achieve goals set forth in the National Fire Plan and would not comply with the Helena National Forest Land and Resource Management Plan direction. In addition, the no-action alternative would be unresponsive to the Tri-County Community Wildfire Protection Plan (2010), as well as the Lincoln Restoration Committee and Montana Forest Restoration Committee's recommendations.

Alternative 2 and Alternative 3

Project Design Features

The Stonewall Vegetation Project has been designed with features that are intended to minimize or avoid potential adverse effects while meeting project objectives. In addition to the treatments proposed for the action alternatives described in this section, design features would be implemented where applicable. A description of the project design features relating to fire and fuels and other resources is displayed in table 9, chapter 2.

The design features in table 9 pertaining to fire and fuels are FUEL-1 through FUEL-8. This analysis is based on the implementation of all design features. Project design features apply to both action alternatives. Specific design features listed above that are applicable to fire and fuels are designed to protect other resources such as water and soil.

Alternative 2 - Proposed Action, Treatment Descriptions

Group 1: This group includes 18 treatment units comprising about 974 acres. Treatment objectives for this group are to develop mature, open forests comprised mostly of fire-resistant species. The proposed treatments would thin live trees, remove dead trees, and prescribe burn surface fuels. All tree thinning would be "from below" to favor retaining larger trees over smaller trees except that thinning regimes would favor retaining smaller trees of a more desirable species over larger trees of a less desirable species, and would favor keeping smaller, healthier and disease-free trees over larger, diseased trees. In general, the species preference for retention would be aspen, western larch, ponderosa pine, Douglas-fir, lodgepole pine, Engelmann spruce, and subalpine fir in descending order. This general order of preference may be modified for individual stands to address management objectives such as retaining species diversity, site factors, and other stand-specific factors such as relative species presence as noted in individual stand/unit prescriptions.

Trees would be thinned to an average spacing of 20 to 40 feet (109 to 27 TPA), but spacing could vary widely. Thinning would be by hand or machine.

All cut, live trees of a merchantable size would be removed for utilization. All merchantable dead trees would be removed, except those needed to meet other resource concerns (e.g., snag and downed large woody debris requirements).

The thinning and removal units that follow would be underburned or jackpot burned to reduce fuels.

Group 2: This group includes 25 treatment units comprising about 1,132 acres. Treatments would thin small-diameter trees of little to no merchantable value. The thinning regime would generally be as described above for Group 1, except that post-thinning average tree spacing would range from 12 to 20 feet (109 to 303 TPA). Thinning would be by hand and/or machine, depending upon tree size. In several units, thinning slash would be piled by hand and burned.

Group 3: This group includes 19 treatment units comprising about 745 acres. Treatments proposed are seedtree and shelterwood harvest/regeneration systems (appendix B). Most trees, except as needed for shelter and seed production would be removed. In some of the shelterwood treatments, trees would be retained in groups; in others the remaining trees would be relatively evenly distributed. All cut, live trees of a merchantable size would be removed for utilization. All merchantable dead trees would be removed, except those needed to meet other resource concerns (e.g., snag and downed large woody debris requirements). Many of the units would be burned to reduce fuel loads and prepare sites for natural regeneration or planting. Many of the units may be planted with some combination of ponderosa pine, Douglas-fir, and western larch where needed to regenerate the stands to the desired seral and fire-resistant species.

Group 4: This group includes 11 treatment units comprising about 223 acres. Treatments proposed are clearcut harvest/regeneration systems in which all trees would be removed except for scattered clumps or individuals. Retained trees would mostly be Douglas-fir, ponderosa pine, or western larch. All live and dead merchantable trees would be removed for utilization. Following cutting and removal, units would be prescribe burned, the type of burn varying by individual unit fuels reduction and site preparation treatment need. Natural regeneration by Douglas-fir and lodgepole pine is expected to occur to some

degree and Douglas-fir, ponderosa pine, and western larch may be planted, the mixture differing by individual unit.

Group 5: This group includes two treatment units comprising about 25 acres. The treatments would remove dead and dying trees, slash non-commercial-sized trees, and reduce fuels by handpiling and burning. All cut merchantable trees would be removed for utilization using ground-based equipment except as needed to meet other resource concerns.

Group 6: This group includes three treatment units comprising about 449 acres. The treatments would cut small trees on portions of the treatment areas to create fuelbeds conducive to low-intensity prescribed burning. The prescribed burning would create openings less than 5 or 10 acres, the opening size depending upon the unit. Units would be prescribed burned to reduce fuels, cause additional mortality of undesirable trees, and preparing sites for natural regeneration.

Group 7: This group includes three treatment units comprising about 410 acres. The treatments would cut small trees on portions of the treatment areas to create fuelbeds conducive to low-intensity prescribed burning. Where the opportunity exists, small trees would be cut to create small openings around available whitebark pine, ponderosa pine, western larch, and Douglas-fir trees to enhance the regeneration of those species. Units would be prescribe burned to reduce fuels, cause additional mortality of undesirable trees, and prepare sites for natural regeneration. The treatments would create patches of mortality up to 5, 10, or 20 acres depending upon the treatment unit.

Group 8: This group includes seven treatment units comprising about 4,604 acres. The treatments would cut small trees on portions of the treatment areas to create fuelbeds conducive to low-intensity prescribed burning. Where the opportunity exists, small trees would be cut to create small openings around available whitebark pine, ponderosa pine, western larch, and Douglas-fir trees to enhance the regeneration of those species. Units would be prescribe burned to reduce fuels, cause additional mortality of undesirable trees, and prepare sites for natural regeneration. The treatments would create patches of mortality up to 30 or 75 acres depending upon the treatment unit.

Aspen is in a number of units proposed for treatment. The aspen can be considered seral to either subalpine fir or Douglas-fir, depending upon the unit and site. In many unit exams, the aspen is simply recorded as being present, as rare, or as a trace; while in several other units it comprises a substantial, although still minor, portion of the stocking, for example Unit 3. Comments concerning the aspen in unit exams range from “suppressed in the understory” to “vigorous in the overstory, but proportionally not much suckering.” In general, we can characterize aspen in proposed units and the project area as (1) small clones, (2) heavily competing with—to suppressed by— conifers, and (3) a minor stand component (with a few exceptions).

Whitebark pine can be found in several units from groups 6, 7, and 8. In general, the whitebark pine in the project area is considered highly infected by white pine blister rust, and can be considered seral to subalpine fir. On sites where it is a seral species in the Northern Rocky Mountains, whitebark pine depends upon fire to maintain its dominance or presence (Arno 2001, Keane 2001, Kendall and Keane 2001, Morgan and Murray 2001). In the absence of fire, subalpine fir has increased in presence, and the combination of increased subalpine fir and whitebark pine mortality, and lack of regeneration due to white pine blister rust and mountain pine beetle have resulted in a decline in whitebark pine.

Alternative 3 Treatment Descriptions

Groups 1-8: Under alternative 3, treatments for units in groups 1-8 would be the same as discussed previously under alternative 2. The treated areas would change from that discussed in alternative 2 because under alternative 3 several units are not proposed for treatment and 12 units are proposed for

treatment under new groups 9 and 10. Treatment acreages for alternatives 2 and 3 are displayed in Table 45.

Group 9: Under alternative 3, about 1,040 acres would be treated with a low-intensity and low-severity prescribed burn (underburn). The purposes of the underburn would be to reduce surface and ladder fuels (small trees) and so modify future fire behavior while minimizing impacts to stand overstory and midstory stocking from the prescribed burn.

Group 10: This group includes units 46a and 47a. Treatments would be designed in a mosaic pattern to maintain cover and forage for wildlife while promoting ponderosa pine and aspen, and reducing ladder fuels. Portions of the stands would be thinned to (1) reduce understory competition from around large ponderosa pine trees, (2) thin heavily-stocked groups of trees on sites historically dominated by ponderosa pine, and (3) remove conifer competition from within and around quaking aspen. Treatment guidelines are as follows:

- To reduce understory competition around large ponderosa pine, and move areas toward or maintain multi-storied ponderosa pine structure, within 50 feet of ponderosa pine trees larger than 17 inches d.b.h. remove all but two trees. The retained trees should be of varied size and age classes.
- In areas dominated by ponderosa pine, but lacking live trees greater than 17 inches d.b.h., trees would be thinned to 48 to 109 trees per acre depending upon tree size.
- Ponderosa pine snags greater than 17 inches d.b.h. would be favored for retention to meet Forest Plan direction for snags.
- Conifers less than 17 inches d.b.h. would be removed up to 100 feet of existing aspen patches.
- Post-thinning, slash would be jackpot burned or hand-piled and burned to reduce fuels.
- Treatments would affect up to 50 percent of these units.

Table 44 displays the proposed treatment acreages for the action alternatives by prescription group.

Table 44. Prescription group acres by alternative

Prescription Group	Alternative 2 Acres	Alternative 3 Acres
1	974	232
2	1,132	822
3	892	664
4	223	152
5	25	25
6	303	326
7	410	36
8	4,604	3,265
9	0	1,040
Total	**8,564**	**6,564**

Direct and Indirect Effects Common to Alternatives 2 and 3

Proposed treatments would reduce surface, ladder and crown fuels and change the fuel model profile, thereby decreasing the area with potential for flame lengths greater than four feet and reducing potential

crown fire risk. In addition, alternative 2 or 3 would reduce the risk of wildfire impacts to adjacent private lands and other resource values. Collins (2010) stated larger individual treatments have a greater potential to reduce fire behavior and slow fire spread, which ultimately impacts adjacent untreated stands and should enhance suppression opportunities and increase firefighter safety. By treating these areas, they become more resilient to stand-replacing wildfire and allow greater protection within the WUI zone. Minore (1979) noted that mixed-severity fires kill a large proportion of the most fire-susceptible tree species, such as subalpine fir, which tend also to be the shade-tolerant species favored by fire exclusion.

Barrett (et al 1982) concluded implications for management of wilderness and other natural areas (such as roadless areas) are that lightning fires may not be frequent enough to re-create pre-settlement conditions. It may be necessary to set prescribed fires to achieve initial fuel reduction for returning some ecosystems to pre-settlement conditions. Such human-ignited prescribed fires in wilderness natural areas may also be justifiable in terms of resuming an ancient approach of using fire to accomplish multiple objectives.

Treatments would also help fire managers introduce more low-intensity prescribed fire in the future. National Forest System lands and adjacent private lands would be positively affected from the reduction of hazardous fuels and subsequent modification of potential fire behavior. In addition breaking up the continuous horizontal and vertical fuels could warrant changing portions of the Stonewall project area from a Fire Management Unit[18] 1 (FMU) “full suppression” to FMU-2 “modified suppression” and allow fires to be managed for resource benefit. (Kurtz 2009)

Scientific findings indicates the most appropriate fuel treatment strategy is often thinning (removing ladder fuels and decreasing crown density) followed by prescribed fire, piling and burning fuels, and mechanical treatments. These treatments would provide maximum protection from severe fires in the future (Peterson 2005). Other research shows that areas treated before a fire begins can decrease severity (Strom and Fulé 2007, Peterson et al. 2005, Omi and Martinson 2004, Agee and Skinner 2005, Graham 2004, Pollet and Omi 2002, Fulé et al. 2001).

Reinhardt et al. (2010) noted post-harvest slash treatment (mastication, whole tree yarding or no treatment) were not as important as harvest and prescribed fire treatments over time. “This may be because the slash treatments affected the surface fuels only and not the subsequent development of the stand. Thinning and prescribed fire, which change stand structure and composition, have much more lasting effects on fuels and fire potential.” However, in extreme weather conditions, such as drought and high winds, fuel treatments may have little effect on fire spread or severity (Pollet and Omi 2002).

Treatments on National Forest System land would reduce fire intensity and crown fire potential but may not directly protect all homes. Studies indicate that wildfire mitigation focused on structures and their immediate surroundings is the most effective way to reduce structure ignitions (Cohen 1999, 2000, 2003; Scott 2003). While individual home-by-home treatments can also help reduce the risk of loss to individual homes, relying solely on such treatments would forego strategic opportunities for controlling fires within this wildland urban interface area. Although homes in the path of a wildfire are perhaps the most immediately recognized value at risk, research shows that treatments need to go beyond the home ignition zone for other resource values (Graham 2004).

A study conducted by Graham and others (2009) of wildfires during the summer of 2007 that burned over 500,000 acres within central Idaho found that the limited loss of structures and resource damage was

[18] Fire Management Unit is a unique land management area defined by land objectives, topographic features, values to be protected, political boundaries, fuel types, or major fire regimes. (2011 Helena FMP)

largely due to the existence of the fuel treatments and how they interacted with suppression activities. In addition to modifying wildfire intensity[19], the burn severity[20] to vegetation and soils within the areas where the fuels were treated was generally less compared to neighboring areas where the fuels were not treated. They noted that by modifying the fire behavior, the fuel treatments presented suppression opportunities that otherwise may not have been available. These opportunities ranged from providing locales to conduct burnouts[21], to the location of both hand and machine constructed fire lines. In particular, the mechanical fuel treatments were very effective in creating conditions where surface fires dominated. Because of the lower intensity of the surface fire in these areas, there were safe zones for firefighters and crews who could then readily suppress the numerous spot fires that often occurred. Their observations suggest fuel treatments that create irregular forest structures and compositions, both within and among stands, tend to produce wildfire resilient forests. Miller (2012) found that fires allowed to play their natural role created additional fuel breaks and reduced fuel loading.

Fire modeling suggests the proposed treatments would effectively reduce fire behavior. Following implementation of a chosen alternative, the treated areas should exhibit surface fire under the modeled conditions, making fire suppression efforts safer and more effective. With these alternatives, desired fuel loadings and fire behavior characteristics would be achieved and natural or prescribed fire could occur with less risk.

Little is known about treatment longevity but a few studies suggest that benefits to fire effects are limited to about 10-15 years (Finney et al. 2005). Collins et al. (2010) noted that in dense fire-excluded stands, multiple burns would be needed to achieve more long-lived effects.

Baker (2009) noted the need for land managers to reduce vulnerable fuels near housing, infrastructure, roads and other locations where human-set fires could spread into restoration areas. Implementing the alternatives would meet the collaborative restoration vision for the Southwestern Crown of the Continent, which includes prescribed fire and natural ignitions as tools to restore species composition and structure in a predictable and beneficial manner. As climate change modifies forest ecology, fire management is appropriately adjusted. Forest restoration and fuel management activities facilitate the reduction of wildfire management costs while re-establishing natural fire regimes (Southwestern Crown Collaborative 2010).

Impacts of the treatments on standing dead trees would differ according to the various treatments. Regeneration harvest and intermediate harvest treatments are expected to reduce snag numbers, thereby reducing fuel-loading levels. Many of these treatments are located adjacent to private land, and it is expected treatments would reduce fuel loading to acceptable levels meeting fire and fuels management objectives. Post mechanical treatment burning may generate a small degree of mortality; however, it is not expected to negatively affect the fire and fuels resource. In units proposed for mixed-severity prescribed burning only, there would be substantial mortality in the neighborhood of 60 TPA, however it must be noted that almost 80 percent of the dead trees would be between 7 and 12 inches d.b.h. (Amell and Higgins 2014).

[19] Fire intensity is defined as the amount of energy of heat release per unit time.
[20] Fire severity is defined as the effect of a fire on ecosystem properties, usually defined by the degree of soil heating or mortality of vegetation.
[21] Burnout is defined as the act of setting fire inside a control line to consume fuel between the edge of the fire and the control line.

Cumulative Effects Common to Alternatives 2 and 3

Past wildland fire events have had an effect on the landscape and would continue in the future. Decades of fire suppression in many western forests have resulted in high tree densities from infilling with shade-tolerant, fire-sensitive tree species. Cumulative effects from wildfires and past management activities are discussed in the existing condition section. The existing condition has been influenced by fire exclusion and large fires, as well as natural and artificial activities including insects and disease and past timber harvest. It is impossible to predict when wildfire may occur in the future, or the subsequent effects of that fire.

Alternative 2 or 3 combined with other fuels reduction activities previously discussed under the no action alternative, would modify fire behavior by contributing to the overall reduction of surface, ladder, and crown fuels, thereby reducing fire intensity and crown fire potential within and adjacent to the project area. There is an indeterminate amount of fuels reduction activities (Fire Wise) work occurring on private lands adjacent to the project area. These combined treatments would complement the purpose and need goals for fire and fuels management by modifying fire behavior to enhance community protection opportunities, while creating conditions that allow for the re-establishment of fire as a natural process on the landscape.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Alternative 2 and 3 comply with Helena National Forest Land and Resource Management Plan goals, standards, and guides and National Fire Plan goals. The alternatives are responsive to the Tri-County Community Wildfire Protection Plan, and the Lincoln Restoration Committee and Montana Forest Restoration Committee's recommendations and objectives, and are in-line with the collaborative group's 13-Guiding Principles.

Alternative 2 – Proposed Action

With alternative 2, we are proposing to treat approximately 8,564 acres, which is equivalent to about 36 percent of the project area. The proposed treatments include under burning, jackpot and broadcast burning[22]. Site preparation burning is proposed, and would take place after harvesting is completed to prepare areas for tree planting. Prescribed burning is proposed as a stand-alone treatment in 15 units. Most of the prescribed burn only units are located in inventoried roadless areas. Where there is sparse vegetation in these units, small-diameter trees (less than 6 inches d.b.h.) would be cut and scattered. Cutting small trees ensures there are adequate surface fuels to carry the fire.

Helena National Forest personnel developed eight prescription groups to describe thinning and prescribed burning treatments for the proposed action. Prescription groups 1-5 would receive a silvicultural treatment prior to a prescribed burning treatment. Silvicultural treatments are discussed in detail in the DEIS (Amell and Klug 2015) and include precommercial thinning, intermediate harvest and regeneration harvest. Prescribed burning involves controlled application of fire to natural or activity created fuels. Natural

[22] Under burn is defined as a fire that is constrained to surface fuel and therefore has a low to moderate fireline intensity (less than 300 kW/M) (2008 Firewords v1.0.2).

Jackpot burning is prescribed burning of concentrations of woody fuels.

Broadcast burning is a prescribed burning activity where fire is applied generally to most or all of an area within well-defined boundaries for reduction of fuel hazard, as a resource management treatment, or both (NWCG 2011).

accumulated fuels and activity fuels generated as a result of harvest would be offered as fire wood to the public in areas where there is a large amount. In other areas, fuels would be piled and burned or underburned to reduce fuel loading levels.

In prescription groups 6-8, prescribed burning is proposed as a stand-alone treatment on 5,463 acres. The objective is to reduce surface, ladder and canopy fuels and break up contiguous vegetation. These treatments would reduce potential fire behavior and provide fire managers the opportunity to reintroduce fire to the landscape. Prescribed burning would be conducted using ground or aerial firing methods. Approximately 5,014 acres would be burned with varying fire intensities resulting in mixed-severity fire[23] effects. The majority of these units are typically high-elevation lodgepole pine stands with concentrations of subalpine fir and whitebark pine intermixed. The mixed-severity units are strategically placed to break up the continuous vegetation within the higher elevations, promote age class diversity, aspen regeneration and enhance whitebark pine habitat by creating openings suitable for regeneration (Kurtz 2009). Individual mixed-severity fires typically leave a patchy, erratic pattern of mortality on the landscape that fosters development of highly diverse communities (Arno et al. 2000). Overall, these fires kill a large proportion of the most fire-susceptible tree species, such as subalpine fir, and a smaller proportion of fire-resistant species including ponderosa pine, western white pine and whitebark pine, which are replaced successionally by shade tolerant species with fire exclusion (Arno et al. 1997). To meet objectives, approximately 20-60 percent of prescribed fire units would be blackened, creating a mosaic[24] of burned and unburned patches. Areas of prescribed burn units would result in mixed-severity fire effects with portions of the overstory canopy being blackened. Overstory canopy openings from approximately 5 acres to less than 75 acres are desired. The range of openings varies depending on the prescription group.

Of the 5,463 acres proposed for prescribed burning (without harvest), the remaining 449 acres would have low-intensity fire applied and are expected to result in low-severity fire effects. These units are primarily low-elevation, open Douglas-fir or mixed Douglas-fir/ponderosa pine stands with intermittent lodgepole pine. Low-intensity and prescribed fire would retain or promote open stands, reduce encroachment , retain large-diameter Douglas-fir and ponderosa pine, reduce the risk of crown fire, and reintroduce fire into a fire-adapted ecosystem. To meet objectives, estimated overstory canopy openings would equate to less than 20 percent in these units. These openings would range from 5 acres to approximately 10 acres.

Slashing[25] treatments using chainsaws are proposed in prescription groups 6-8 (prescribed-burning units) prior to burning. Slashing small trees increases surface fuel loading to ensure there is sufficient fuel to carry the fire. This enables fire managers more flexibility in accomplishing prescribed fire objectives at lower temperatures, higher relative humidity and creates varying fire intensity levels. Fire intensity variations would create a mosaic burn more representative of a natural fire (see appendix B, table B-1 for treatment descriptions by unit).

All prescribed burning would occur when weather and fuel conditions are favorable. All burning would take place under the guidelines in the prescribed fire burn plan developed specifically for project-related burning activities. Prescribed burn plans address parameters for weather, air quality, contingency resources and potential escapes. Table 45 displays the prescription groups and the approximate number of acres that would receive prescribed burning treatments.

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[23] Mixed Severity Fire is a broad fire severity classification that refers to fire effects intermediate between the low severity and replacement severity (FRCC Guidebook 2010).
[24] Mosaic Fire is any landscape-scale mixed fire that has scattered patches across the fire perimeter, resulting in a mosaic of burned and unburned patches (Hann 2004).
[25] Slashing involves cutting small-diameter trees less than 6 inches diameter breast height (d.b.h.).

Table 45. Proposed burning treatments and approximate acres of prescription group for alternative 2

Group	Group Treatment Title	Acres*
1	Prescribed under burning and jackpot burning following harvest	974
2	Pile burning following harvest	1,132
	Under burning or slash treatment adjacent to private	
	Under burning following harvest	
3	Prescribe under burning, jackpot and broadcast burning following harvest	745
	Site prep burning following harvest	
	Pile burning following harvest	
4	Prescribe under burning, jackpot and broadcast burning following harvest	223
	Site prep burning following harvest	
5	Piling and burning of excess fuels following harvest	25
6	Low Severity Prescribed Fire, canopy openings of approximately 5 to 10 acres	449
7	Mixed Severity Fire, canopy openings of approximately 5 to 20 acres	410
8	Mixed severity fire, canopy openings of approximately 30 – 75 acres	4,604
	Total	**8,564***

*The total represents the total acres of prescription groups, not all acres would be treated.

Fire modeling was used to evaluate the potential flame length associated with fireline intensity and crown fire under alternative 2. The results for potential flame length for alternative 2 are shown in table 46 and visually displayed in figure 45. Fire type potential is also summarized in table 46 and displayed in figure 46.

Table 46 Fire behavior potential under alternative 2

Potential Fire Behavior Characteristic		PERCENT [A]
Flame Length	<= 4 feet	89
	> 4 feet	11
Fire Type	Surface	87
	Crown	13

[a] -Percent of burnable acres- Non-burnable acres are not shown in table

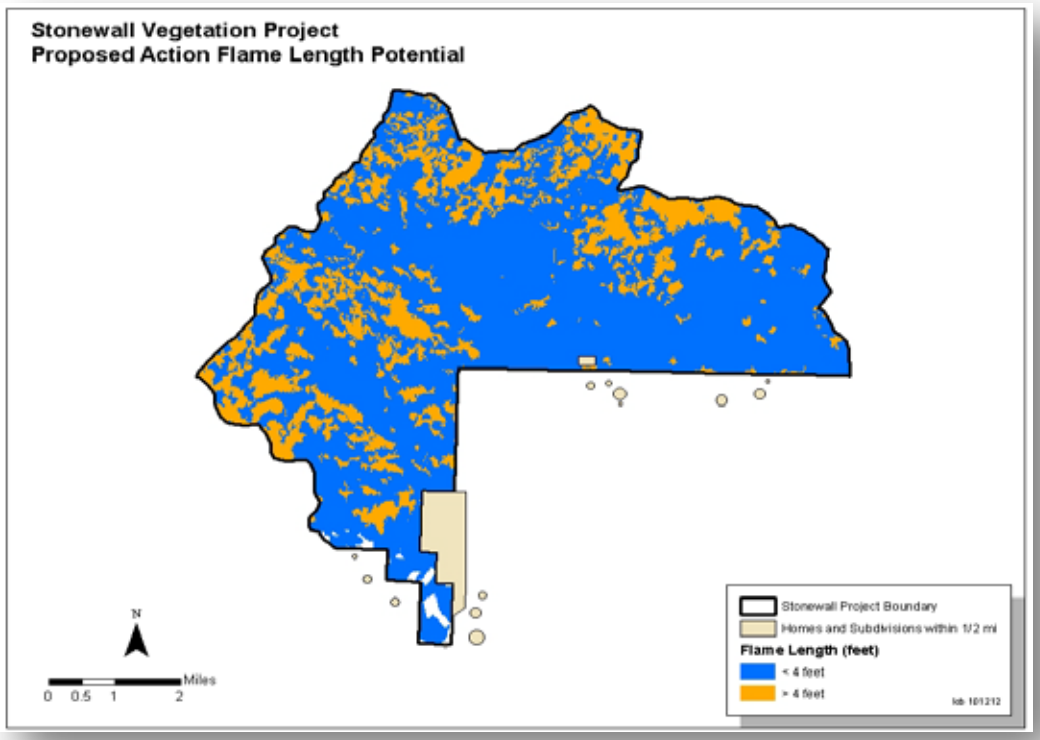

Figure 45. Alternative 2 – proposed action fire behavior potential displayed as flame length

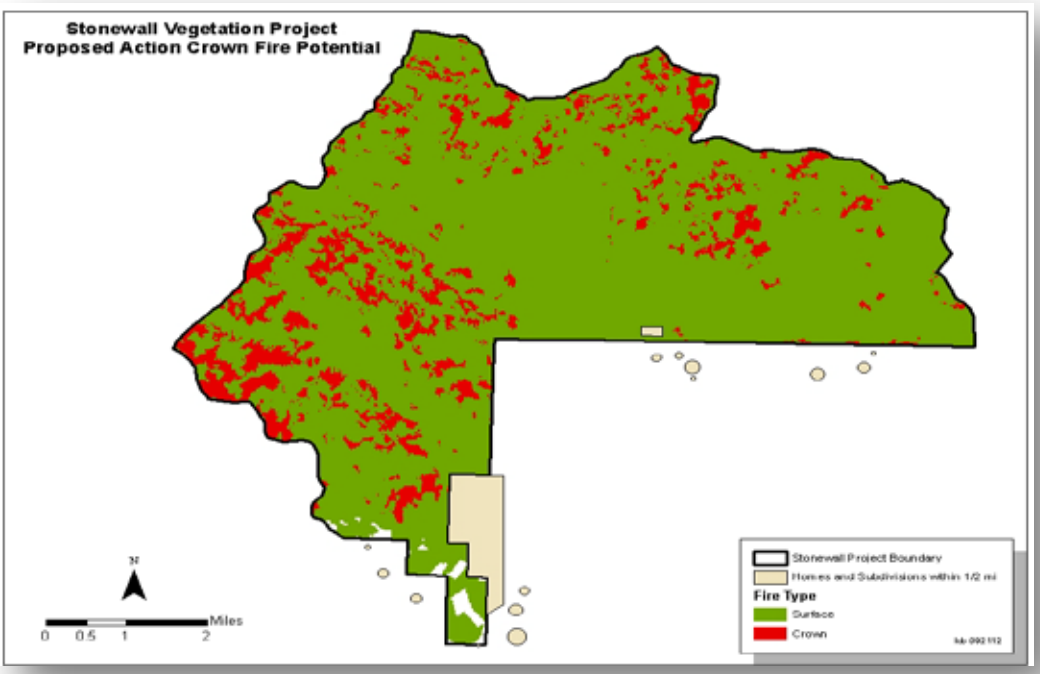

Figure 46. Alternative 2 – proposed action fire behavior potential displayed by fire type

Maximum Management Area (MMA)

Maximum Management Areas (MMAs) have been identified for the Stonewall Project area. A maximum management area is a pre-identified boundary that allows a prescribed fire to exceed the unit boundary. An MMA generally follows natural barriers, old fire scars and access points. MMA treatment areas would enable fire managers more flexibility in implementing prescribed burning operations. Establishing MMAs was determined to be an important component of implementing this project because there are contiguous fuels with few natural barriers, limited access into remote units, more complexity in prescribed fire prescriptions due to location of burn units and the existing and projected condition of vegetation and fuels. As long as the prescribed fire stays within the MMA boundary, it does not have to be declared a wildfire and can be managed as a prescribed fire as long as the following conditions are met. The anticipated effects of a prescribed fire that leaves unit boundaries and encroaches into the pre-defined MMA area would be similar to the effects expected within prescribed burn units. Vegetation in MMA areas would exhibit similar post-burn conditions as prescribed burn units, and it is estimated no more than 50 percent of each MMA would be burned. Project Design Features (pdfs) are established to minimize impacts to resources throughout the project area, and would also apply to MMA areas. All burning in MMA areas would take place under guidelines set forth in a prescribed fire burn plan developed specifically for this project area. Prescribed burn plans address parameters for weather, air quality, and contingency resources.

- Any fire that moves outside the prescribed burn unit boundary has to meet burn plan prescriptions and objectives for resource benefit.
- Total burned area within the MMA would not exceed 50 percent
- If the 50 percent margin is reached, acres from the units not yet burned would be dropped to not exceed 50 percent
- A prescribed fire that exceeds the MMA would be declared a wildfire.
- Ignition operations would not occur outside prescribed unit boundaries.

Alternative 3

Some units in alternative 3 were dropped from treatment, unit boundaries were modified and treatment methods changed as compared to alternative 2. Under alternative 3 we are proposing to treat 6,564 acres, approximately 27 percent of the project area (table 47). Prescription groups 9 and 10 were developed for this alternative, and include low-intensity under burning. Group 9 includes approximately 1,040 acres in 10 units. Treatment units or portions of units were removed from prescription groups 1, 3 and 4 and added to group 9. Low-severity under burning in these units would reduce surface and ladder fuels while minimizing impacts to overstory residual trees. Prescription group 10 includes units 46a and 47a, which were originally included in Group 1 under alternative 2. Treatments in group 10 would be designed to maintain cover and forage for wildlife while still meeting fuels management objectives by reducing fuels.

Table 47. Proposed burning treatment and total acres of prescription groups under alternative 3

Group	Group Treatment Title	Acres
1	Prescribed under burning following harvest	232
2	Pile burning following harvest	822
	Under burning or slash treatment adjacent to private	
	Under burning following harvest	
	Pile burning and under burning	
3	Prescribe under burning, jackpot and broadcast burning following harvest	664
	Site prep burning following harvest	
	Pile burning following harvest	
4	Prescribe under burning and broadcast burning following harvest	152
	Site prep burning following harvest	
5	Piling and burning of fuels following harvest	25
6	Low intensity and low severity Prescribed Fire, with canopy openings of less than 5 acres	326
7	Mixed severity fire, with canopy openings of 5-20 acres	36
8	Mixed severity fire, with canopy openings of 30-75 acres	3,265
	Mixed severity fire, openings <75 acres	
9	Low intensity, Low severity Jackpot and under burning	637
10	Jackpot and/or hand pile burning activity fuels as needed	403
	Total	**6,564***

*The total represents the total acres of prescription groups, not all acres would be treated.

Fire modeling was used to evaluate the potential flame length associated with fireline intensity and crown fire under alternative 3. The modeled outcomes are summarized in table 48 and visually displayed in figure 47. Fire type is also summarized in table 48 and displayed in figure 48. Under alternative 3, the fuel profile is modified over less area than under alternative 2, resulting in less overall change in fire behavior.

Table 48. Fire behavior potential under alternative 3

Potential Fire Behavior Characteristic		Percent
Flame Length	<= 4 feet	76
	> 4 feet	24
Fire Type	Surface	85
	Crown	15

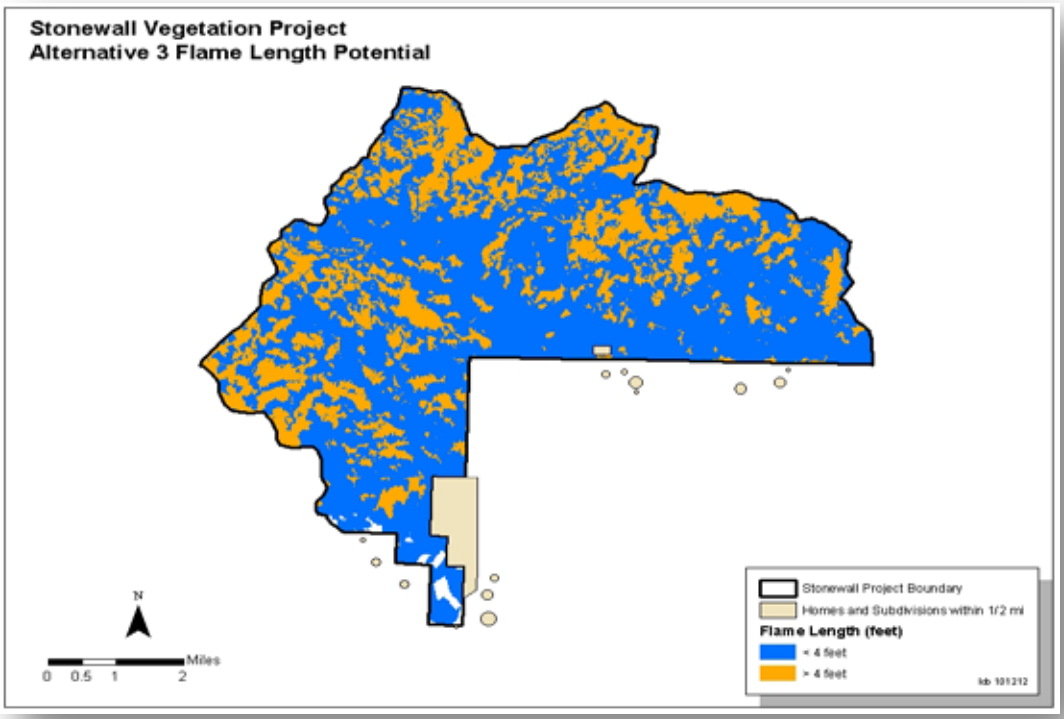

Figure 47. Alternative 3 fire behavior potential displayed as flame length

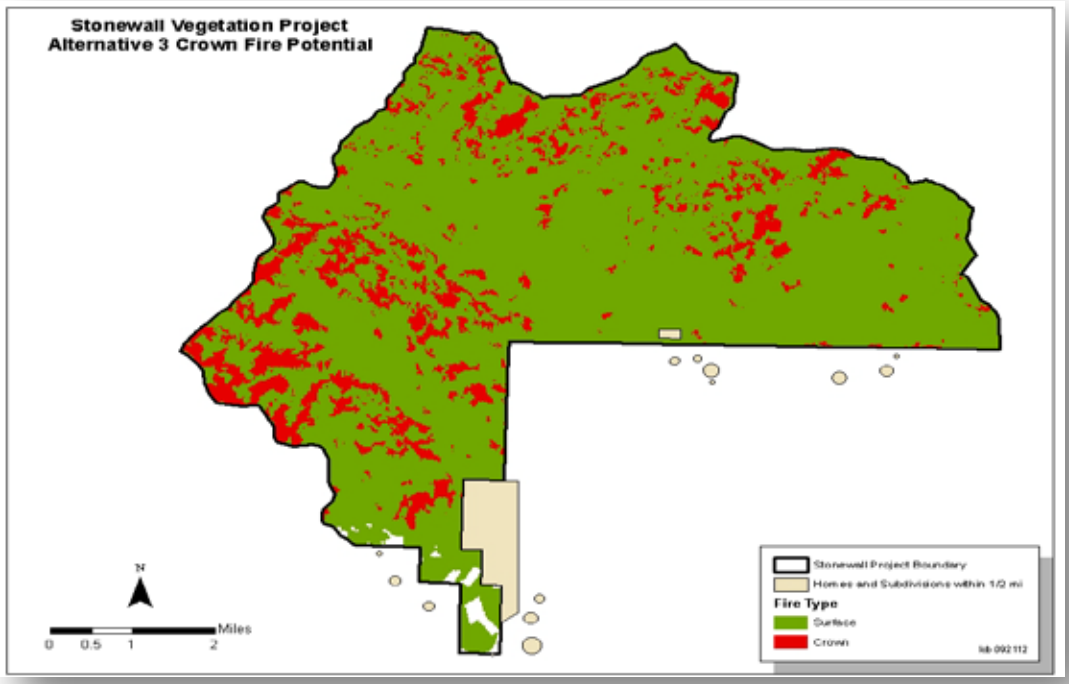

Figure 48. Alternative 3 fire behavior potential displayed by fire type

How the Alternatives Meet the Identified Issues

The following issues or concerns were identified for this project during the scoping period. The alternatives would address the issues as follows.

1. Identified Issue/Concern: Wildland Fire and Homes: Proposed treatments may be inefficient and ineffective in reducing home losses due to fire.

Proposed treatments would reduce surface, ladder and crown fuels and change the fuel model profile, thereby decreasing the area with potential for flame lengths greater than four feet and reducing potential crown fire risk. In addition, alternative 2 or 3 would reduce the risk of wildfire impacts to adjacent private lands and other resource values. By treating these areas, they become more resilient to stand-replacing wildfire and allow greater protection within the WUI zone.

2. Identified Issue/Concern: Fire Behavior: Proposed fuels reduction work will not reduce fire behavior.

Fire modeling suggests the proposed treatments would effectively reduce fire behavior. Following implementation of a chosen alternative, the treated areas should exhibit surface fire under the modeled conditions, making fire suppression efforts safer and more effective. With these alternatives, desired fuel loadings and fire behavior characteristics would be achieved and natural or prescribed fire could occur with less risk.

3. Identified Issue/Conern: Prescribed Burning: Concerns over risk of fire escaping burn boundaries during prescribed burning operations.

All prescribed burning would occur when weather and fuel conditions are favorable. All burning would take place under the guidelines in the prescribed fire burn plan developed specifically for project-related burning activities. Prescribed burn plans address parameters for weather, air quality, contingency resources and potential escapes.

Summary

The mechanical treatments proposed would reduce surface fuels, raise canopy base heights by reducing ladder fuels and stand density, resulting in modified fire behavior potential. The result would be safer, more efficient and direct initial attack of unwanted fires by fire suppression forces.

The prescribed burn treatments would reduce fuels and break up contiguous vegetation to create a heterogeneous fuelscape so that areas with high fire behavior potential are interspersed with areas of mixed and low fire behavior potential, thereby limiting the potential for high-intensity crown fire to spread towards the WUI. Fire management has evolved over time and fire managers look for opportunities to manage fire for multiple objectives. Reintroducing fire to the landscape and allowing it to occur as a natural process is desired in order to move the landscape toward the desired condition as outlined in the LRMP.

The Stonewall Vegetation Project would be important to the success of future fire suppression efforts and complements past treatments and those currently occurring or being proposed on adjacent federal, state and private lands.

Air Quality

Introduction

The smoke from combustion contains a number of pollutants, including microscopic particles referred to as “particulate matter” (PM). Exposure to PM can cause significant health problems, especially for people suffering from respiratory illnesses. Smoke also adversely affects the clarity of the air, or visibility. The Environmental Protection Agency (EPA) has revised the air quality standards to provide improved health and visibility protection. With these standards in place land managers must consider using techniques that minimize prescribed fire emissions and the adverse impacts of smoke on public health and the environment. Careful planning and cooperation among land managers, air quality regulators, and local communities ensures that prescribed fire, clean air and public health goals can be met.

This analysis describes the existing condition of the air quality resource within the project area and evaluates the potential effects of the proposed action and the no-action alternative. We used the best available science in this analysis; however, we understand that opposing science exists. A literature review listing the opposing science sent to the project in public comment scoping responses, and the accompanying Forest Service response, is in the project record at the Lincoln Ranger District.

Methodology

Analysis of smoke production used current versions of FOFEM 5 (First Order Fire Effects Model), CONSUME 2.1, and SIS (Smoke Impact Spreadsheet) smoke production models (Schaaf and Norville 2002). Embedded in SIS is a module that calculates emissions using FOFEM 5 and the CONSUME 2.1 Pile Wizard. A dispersion module is also incorporated into the spreadsheet that calculates down-wind concentrations using the CALPUFF dispersion model. The use of each model is recommended through guidance specific to USDA Forest Service Region 1 Forests, and encouraged by State open burning regulations defining Best Available Control Techniques for prescribed wildland open burning in ARM 17.8.601(1)(a)(iii).

Threshold for Significance

The threshold for significance is the Federal and State regulatory standard of 35 µg/m³ for PM2.5 and how the modeled PM2.5 emissions compare with the regulatory standard.

Assumptions and Variables Used In the Models:

All model runs were conducted using the following vegetation types: SAF 210 Interior Douglas-fir and SAF 218 Lodgepole Pine. For alternative 1 analysis, it was assumed a natural wildfire burning during the summer would burn 230 acres per day, the wildfire was burning through fuel model G with a natural fuel load, and the meteorological values and mixing heights used resulted in an excellent ventilation index. An additional model run for alternatives 2 and 3 was conducted using slash fuel loading conditions for a prescribed burn in the fall. It was assumed the entire burn unit selected for modeling would be ignited all at once to show the maximum result of emissions that could be produced under the circumstances.

For alternatives 2 and 3 pile burning, it was estimated there would be 15 piles burned per day with forty-minute ignition intervals. The piles were modeled as 25 feet wide by 10 feet high with a 10 percent packing ratio.

Limitations

Because model inputs are constant and there is no avenue to incorporate variability due to landscape, weather changes or human factors, the models do not precisely determine the exact amount of smoke or

pollutant released. The possibility of increased smoke production and duration of smoke release exists due to the potential for multiple day burn windows, unpredicted stable air masses settling over the burn area and unexpected changes in weather conditions. Given the uncertainty of any modeling exercise, the results are best used to compare the relative effects, rather than as an indicator of absolute effects (Graham et al. 2004).

Spatial and Temporal Context for Effects Analysis

Spatial Bounds

A maximum perimeter distance of 50 miles was considered for effects. This allows for consideration of the effects to Class 1 areas.

Temporal Bounds

The time span of 1-5 days was chosen because smoke from prescribed burning is usually transitory in nature and impacts to air quality are expected to be relatively short lived, lasting 1-5 days after ignition is completed.

Measurement Indicators

The measurement indicator is the predicted smoke emissions ($PM_{2.5}$) on sensitive receptors up to 50 miles downwind of the project area.

Overview of Issues

There is concern about the possible effects on human health from smoke as a result of prescribed burning operations. There is also concern the proposed project would negatively affect air quality and visibility in the surrounding communities and nearby wilderness areas.

Indicators

The measurement indicator is the predicted smoke emissions ($PM_{2.5}$) on sensitive receptors up to 50 miles downwind of the project area and how that compares with appropriate Federal and State regulatory standards and requirements.

Affected Environment

Existing Condition

Analysis Area

The project area lies within Montana/Idaho Airsheds 3B and 6. A portion of the project area lies in Powell County with the remainder in Lewis and Clark County. Airsheds are defined and managed by Montana Department of Environmental Quality (MDEQ).

Air Quality

Air quality within the project area is generally good. Limited local emission sources exist including residential wood burning, debris burning, road dust, light industry, vehicles, construction equipment and wildland fire. The greatest emissions occur during the winter from residential wood burning stoves used for indoor heat. Wildland fires can produce substantial emissions in the summer and fall for short to moderate durations.

Generally, dispersion of emissions within the project area is good due to the terrain and wind activity. There is consistent wind dispersion during much of the year. Up valley winds during the day and down valley winds (cold air drainage) at night can dominate more than overall prevailing wind direction on ridge tops. Inversions sometimes develop in the valley during winter burning periods with stable atmospheres.

Visibility at Class 1 Areas

The Clean Air Act (1963) establishes as a national goal "the prevention of any future, and the remedying of any existing impairment of visibility in mandatory class 1 Federal areas which impairment results from manmade air pollution" (42 U.S.C. §7491 et seq.).

The Clean Air Act Amendment of 1977 designated wilderness areas existing at that time to be class 1 areas. Areas designated Wilderness after 1977 are classified as class 2, unless they are additions to existing class 1 areas.

The class 1 areas nearest to the Stonewall Vegetation Project area are the Scapegoat Wilderness, 1 air mile north, the Bob Marshall Wilderness approximately 18 air miles northwest, Mission Mountain Wilderness 48 air miles northwest, Gates of the Mountains 36 air miles southeast and the Flathead Reservation 40 air miles west. These areas could be affected by the proposed project during periods of atmospheric stability.

The Clean Air Act also allows the states to designate future wilderness areas as class 1 using normal state processes. These national park and wilderness areas are afforded visibility protection from anthropogenic sources of air pollution, including emissions from prescribed burning. Montana has twelve mandatory class 1 federal areas as outlined in 40 CFR 81.417. Figure 49 displays the geographic locations of Montana's mandatory class I federal areas:

Visibility impairment is a basic indicator of air pollution. The EPA has determined that regional variation in visibility needs to be addressed. The Regional Haze Regulations for Protection of Visibility in National Parks and Wilderness Areas (1997) are intended to improve visibility or visual air quality in 156 national parks and wilderness areas across the country. These regulations apply to all states, including those that do not have class 1 areas, because pollution that occurs in those states may contribute to impairment in other states or class 1 areas and must be accountable. The regional haze regulations propose "presumptive reasonable progress targets" for improving visibility in each class 1 area. The progress targets are described in terms of deciviews, a measure for describing perceived changes in visibility. For example, a deciview of zero represents pristine conditions.

A requirement of Prevention of Significant Deterioration (PSD) in class 1 areas is that new stationary sources must have a PSD permit. A stationary source is a source of pollution well defined, such as a smokestack. The Stonewall Vegetation Project is not considered a major stationary source and is not subject to the PSD permitting requirement.

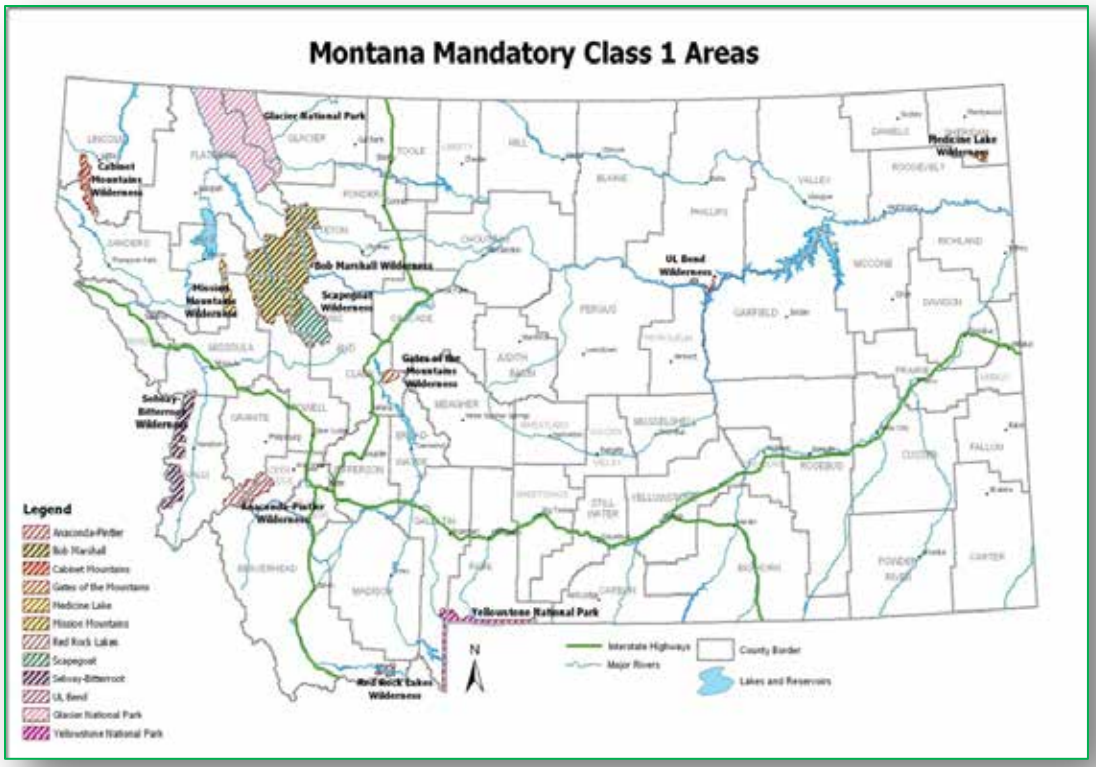

Figure 49. Montana Class 1 Area Map

Pollutants

Airsheds can include both attainment and nonattainment areas; designations EPA uses to describe the air quality in a given area for any of six common pollutants referred to as “criteria pollutants.” The pollutants are: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2) and particulate matter (PM). Carbon monoxide in high concentrations can be extremely hazardous to humans and animals, but its health impacts are usually only significant for personnel directly exposed to smoke (e.g. firefighters) (Hardy et al. 2001).

In addition to effects on health, some pollutants may also contribute to the formation of ozone in the atmosphere (Malm 1999). Lead at low levels can cause health problems either by inhalation or ingestion. Nitrogen dioxide may cause increased respiratory illnesses and harm lung function in people with existing respiratory illnesses. Breathing ozone can also trigger health problems and worsen bronchitis and asthma. Sulfur dioxide may also have adverse respiratory effects on humans with existing respiratory illnesses.

The main pollutants monitored for prescribed fire emissions are particulate matter. Particulate matter is fine material, of any substance, in sizes small enough to remain suspended in air for long periods.

Two standards apply to particulate matter and they are distinguished by the size of particulate matter described. PM_{10} describes all fine particles no larger than 10 microns in size. These particles can be harmful to human health because their small size allows them to bypass the filtration of the upper respiratory system and become lodged deep within the lungs. Particles with diameters between 2.5 and 10 micrometers are referred to as "coarse." Sources of coarse particles include crushing or grinding operations and dust from paved or unpaved roads. Other particles may be formed in the air from the

chemical change of gasses; they are indirectly formed when gases from burning fuels react with sunlight and water vapor. These can result from fuel combustion in motor vehicles, at power plants and in other industrial processes. PM_{10} has been the pollutant particulate level standard against which EPA has been measuring Clean Air Act compliance.

The description $PM_{2.5}$ refers to particles that are no larger than 2.5 microns (approximately 1/30th the average width of a human hair). These are harmful in the same way as larger PM_{10} particles, but can lodge even deeper in the lungs due to their smaller size, and are associated with serious health problems and premature mortality. Particulate matter also has an adverse effect on maximum sight distance and scenic visibility. Sources of fine particles include all types of combustion activities (motor vehicles, power plants, wood burning) and certain industrial processes. The particulate level $PM_{2.5}$ would have the most significant impact in the project area as well as the area and people surrounding the project area, and is the focus of this analysis.

Nonattainment Areas

If a community does not attain the National Ambient Air Quality Standard (NAAQS) for one or more pollutants, the EPA would designate it a nonattainment area. States must demonstrate to the public and the EPA how a nonattainment area would meet the NAAQS, based upon the control of emission sources. Such demonstrations employ control plans that are part of each State Implementation Plan (SIP), including emissions from prescribed fire.

Lewis and Clark County is in nonattainment for Sulphur Dioxide (SO_2) and Lead (Pb) as determined by the EPA: Criteria Pollutant Area Summary Report (Green Book) (EPA 2011b).

Smoke-sensitive Areas

Smoke-sensitive areas are defined as:

> "The distance and direction of sensitive areas should be disclosed. These are areas that could be impacted by the proposed burning activity and are considered sensitive due to legislation, air quality concerns, or public concerns. Examples of sensitive areas are Class I areas, non-attainment areas, impact zones identified by the Montana / Idaho State Airshed Group, or major transportation corridors near or downwind from the proposed burning activity and population centers. To be consistent with other air quality permitting, it is suggested that areas within a 100 km radius, especially those areas downwind, should be identified" (Acheson et al. 2005).

Table 49 displays a list of some of the sensitive receptors that could be impacted by smoke out to 50 miles from the project area (list is not all-inclusive). A mapped overview of the potential smoke impact area is in figure 2 in appendix A of this document.

Fugitive Dust from Vehicle Traffic on Unpaved Roads

Fugitive road dust is a result of motorized vehicle use on dry unpaved roads and is caused by the force of the wheels moving across the road surface causing pulverization of surface material. Dust is then lofted by the rolling wheels and the turbulence caused by the vehicle itself. This air turbulence can persist for a period of time after the vehicle passes. The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Variables that influence the amount of dust produced include the average vehicle speed, vehicle weight, number of wheels per vehicle, the road surface texture, and the fraction of road surface material classified as silt as well as the moisture content of the road surface. The moisture content of the road surface has the greatest influence on the amount of fugitive dust produced.

Several activities may contribute to fugitive dust effects within the project area including equipment and vehicle travel on forest roads during mechanical and prescribed burning operations, as well as felling, skidding and piling of material at landing sites. These activities are not anticipated to result in significant impacts to regional air quality because of the transitory nature of fugitive dust, and therefore were not modeled for this analysis.

Table 49. Summary of sensitive receptors adjacent to or near the project area

Sensitive Receptors	Direction To Location Of Potential Receptor	Approximate Distance (Miles) From Project Area To Potential Receptor
Seeley Lake Community	NW	38
Ovando	W	15
Helmville	SW	12
Deerlodge	S	42
Helena	SE	37
Wolf Creek	SE	25
Augusta	N	37
Drummond	SW	26
Phillipsburg	SW	49
Lincoln Community	SE	4
Missoula Impact Zone	W	44
Flathead Reservation (class-1)	W	44
Bob Marshall Wilderness (class 1)	N	20
Scapegoat Wilderness (class 1)	N	1
Gates of the Mountains (class 1)	E	40
State Highway 279	E	10
State Highway 200	S	adjacent
US Highway 287	E	24
Interstate Highway 90	S	25
State Highway 83	W	27

Environmental Consequences

Effects Common to All Action Alternatives

There is concern about the possible effects on human health caused by smoke generated from prescribed burning operations under the action alternatives. There is also concern the proposed project would negatively affect air quality and visibility in the surrounding communities and nearby wilderness areas.

Alternative 1 – No Action

Direct Effects

This alternative has no direct effect on air quality because no treatment activities are proposed.

Indirect Effects

Under this alternative, no treatments would occur and there would be no anthropogenic emission contribution to degrade air quality. However, this alternative could lead to increased accumulation of ground fuel due to insect and disease activity and continuous natural forest succession. This accumulation

of ladder and ground fuels may lead to an increased probability of high intensity wildfire in the future which could result in air quality degradation. Air quality can be degraded by smoke from wildfires to the point of human illness in some instances. Hardy (2001) noted emissions from wildfire are typically greater than emissions from a prescribed fire on the same acreage due to greater emission factor, fuel consumption, and fire intensity. Wildfires are also known to result in high levels of emissions, and associated NAAQS violations. Smoke from wildfire can cause visual impacts to the surrounding area and create hazardous driving conditions on adjacent state, county, and Forest Service roads for extended periods of time. Should a wildfire occur, dust emissions from fire suppression equipment could also show a marked increase. In the short-term air quality impacts from alternative 1 would be less because prescribed burning and pile burning would not occur. In the long term, the no-action alternative would not meet the purpose and need of this project, which includes modifying fire behavior to enhance community protection. For example, under the no action alternative the emissions from a hypothetical wildfire was modeled and the results are displayed in table 3 that follows.

The modeling results include projected emissions from a 230-acre wildfire scenario burning during the summer. The estimated $PM_{2.5}$ concentration is 153.47 µg/m³ 0.1 mile downwind of the hypothetical wildland fire exceeding the $PM_{2.5}$ threshold of 35µg/m³.

Table 50. $PM_{2.5}$ concentrations from wildfire burning under no action alternative

Downwind Distance from Wildland Fire Scenario (miles)	24-Hour Average $PM_{2.5}$ Concentrations (µg/m³)
0.1	153.47
1.0	17.61
5.0	6.01
10.0	4.11
20.0	2.51
30.0	1.80
40.0	1.40
50.0	1.14

Cumulative Effects

There are no activities proposed for the no-action alternative, therefore it does not have a direct effect on air quality. This alternative does have the potential for a major indirect effect if a wildfire were to occur in the untreated project area.

Previous wildfire activity and increasing conifer mortality due to insect and disease can influence the amount of material available for consumption in the event of a future wildfire.

Emissions sources contributing to particulate matter and other pollutants would continue to be present. These sources include wood burning stoves, vehicle exhaust, emissions from recreational campfires, emissions associated with prescribed fire, fugitive dust and wildfires within or near the project area. Wildfire frequency is expected to continue as it has been observed in the past. An unwanted wildfire could lead to negative cumulative effects and would be dependent upon the size and intensity of the wildfire. Visibility impairment and human health impacts due to sudden and dramatic pollutant release are likely with a large wildfire event. Cumulative effects of smoke are unknown because the intensity and size of a wildfire is unknown. Research indicates wildfires can produce nearly twice the amount of smoke as prescribed fire (Huff et al. 1995).

Alternative 2 and 3

Alternatives 2 and 3 propose the same type of fuel treatments including; jackpot burning, pile burning, underburning, site preparation burning and mixed- and low- severity prescribed fire. Air quality modeling focused on prescribed fire and landing pile burning. Although alternative 2 would include more acres of all prescribed burning, only a certain number of acres could be burned per day under either alternative. Therefore, the daily effects of both alternatives are described here together. Table 51 shows the total acres for each alternative.

Table 51. Acre comparison by treatment for each alternative

Treatment	Alternative 2	Alternative 3
Underburning	1,824	1,648
All other burning including Jackpot, Site Prep	752	878
Prescribed Fire	5,463	3,627
Total	**8,039**	**6,053**

Table 52 and table 53 show the modeling results for a prescribed burn scenario conducted in the fall and for a pile-burning scenario conducted in the winter.

The projected $PM_{2.5}$concentration at .01 mile downwind is well below the Federal NAAQS and State MAAQS 24-hour average concentration threshold of 35µg/m³ for both scenarios. Since the nearest class 1 area is approximately 1 mile away, the results further show there would be no significant impacts to any class 1 area (figure 50). The smoke concentrations from prescribed burning operations under these alternatives are expected to be within NAAQS and state of Montana air quality standards. Montana's smoke management program is EPA-certified, and the prescribed fire activities associated with the Stonewall Vegetation Project would meet Clean Air Act General Conformity Rule requirements.

Table 52. Alternatives 2 and 3 prescribed burning concentrations

Results For A Fall Prescribed Burn Scenario	
Downwind Distance from Burn Unit (miles)	**24-hour Average $PM_{2.5}$ Concentrations (µg/m³)**
0.1	26.15
1.0	8.71
5.0	3.79
10.0	2.38
20.0	1.34
30.0	.92
40.0	.72
50.0	.62

Table 53. Alternative 2 and 3 pile burn concentrations

Results For A Landing Pile Burn Scenario	
Downwind Distance From Pile (Miles)	**24-Hour Average $Pm_{2.5}$ Concentrations (µg/M³)**
0.1	31.27
1.0	13.25
5.0	4.28
10.0	.96
20.0	.30
30.0	.13
40.0	.11
50.0	.094

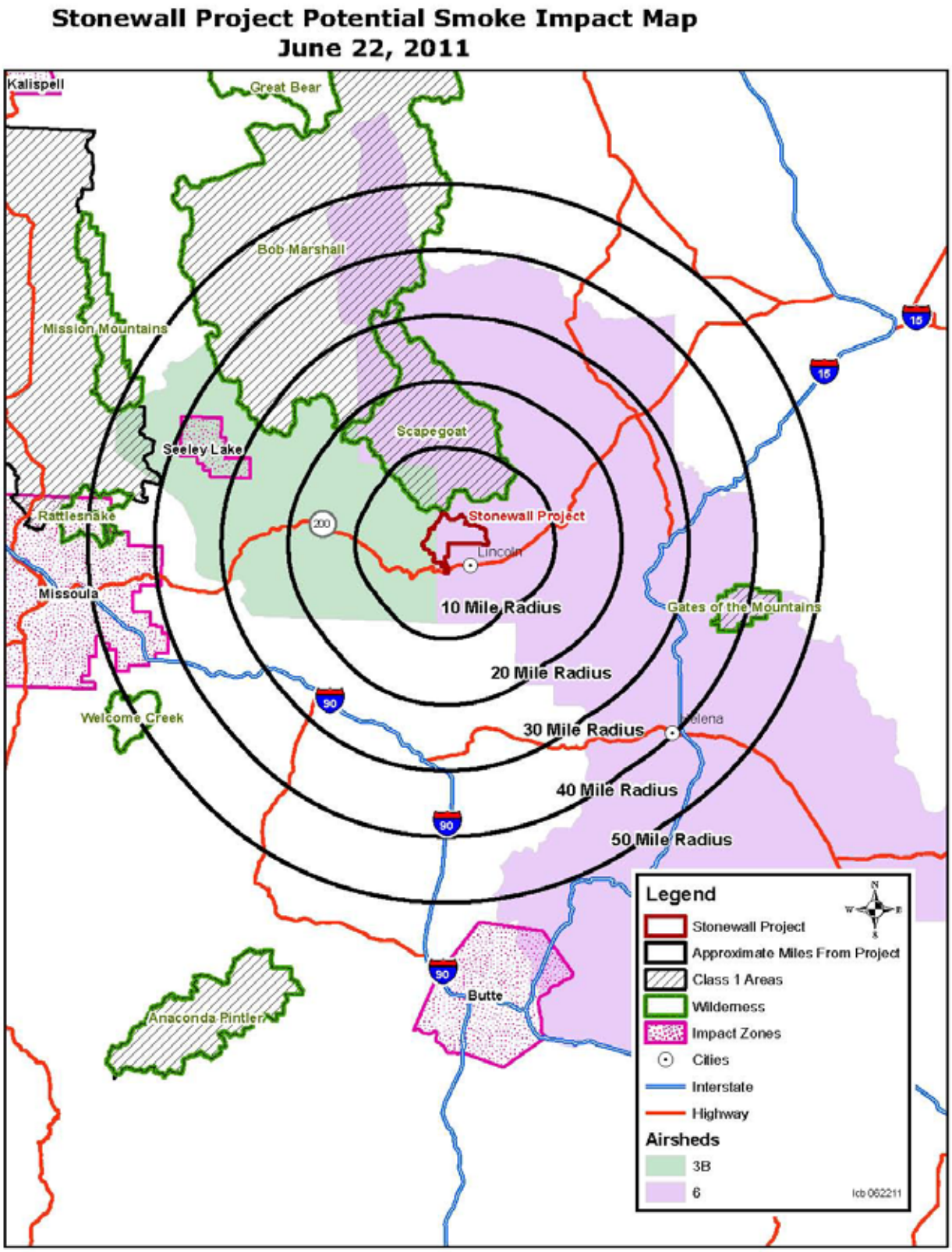

Figure 50. Stonewall Project potential smoke impact map

Project Design Features

All prescribed burning would be implemented in full compliance with the Montana Department of Environmental Quality (MDEQ) air program with coordination through the Montana/Idaho Airshed Group and reported to the Airshed Coordinator on a daily basis.

Burning would be dependent upon site conditions and weather conditions. Notice of the pile and prescribed burning timeframes, or burn windows, would be shared with the public through paper notices and announcements on the Forest website.

Direct Effects

Prescribed burning treatments would have direct, short-term impacts on air quality in the project area and possibly to regional air quality.

Prescribed fire treatments for this project would occur during the spring and/or fall seasons and when weather conditions and dispersion forecasts are favorable. Burning of landing piles and hand piles generally occur during late fall, early winter or spring, and typically after an area has received significant rain or snow to prevent the pile from spreading and reduce the risk of escape. All burning operations are conducted under the guidelines set forth in a prescribed fire burn plan developed by fire managers specifically for the project area. Prescribed burn plans address parameters for weather, air quality and contingency resources. All burning would occur over the life cycle of the project estimated at 5 to 10 years. Transitory smoke as a result of implementation of alternative 2 or 3 could produce some smoky days in the local area, and may also result in the form of nuisance smoke, smell, or haze. Smoke would also be expected to settle into the lower draws and drainages during the evening hours following ignition. This would most likely occur during the burn smoldering phase.

Indirect Effects

One objective of the project is to modify fire behavior to enhance community protection in the event of a future wildfire. Wildfires present a risk to public health and result in damage to both the environment and property. Wildfires are known to result in high levels of emissions and associated NAAQS violation and worst visibility. Vegetation management treatments provide the opportunity on a long-term basis to reduce the magnitude of wildfire air quality problems. According to (Wiedinmyer and Hurteau 2010) wide-scale prescribed fire application can reduce CO_2 fire emissions for the western US by 18 to 25 percent. The total amount of pollutants released by prescribed burning under alternative 2 and 3 would be spread out over several years and would occur when emissions would be unlikely to have significant adverse effects on human health and visibility. After implementation, it is estimated that subsequent wildfires in the project area could produce less pollutants due to less fuel available to burn.

Cumulative Effects

Cumulative effects on air quality as a result of the implementation of alternative 2 or 3 would result in an incremental decrease in air quality as pollutants from this project combine with other particles produced by the implementation of other aspects of this project, specifically fugitive road dust. Emitted pollutants from fire do have an effect on an area, which depends on atmospheric conditions at the time of the fire. Pollutants from fires can be cumulative with emissions from many local and regional sources, including other fires, vehicles, industrial sources, buildings and agriculture. Because of the widespread and short-lived impacts of emissions from fire, no other projects were explicitly considered for cumulative impact analysis. It is impossible to predict what pollution sources may be present at the time of a fire occurring at an unspecified date in the future.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

All prescribed burning would be implemented in full compliance with MDEQ air program with coordination through the Montana/Idaho Airshed Group. All action alternatives would meet Forest Plan Standards for air quality by following coordination requirements. The project complies with the Federal Clean Air Act.

Habitats of Special Concern

Introduction

This section discusses snag and old growth availability as well as proposed treatment effects in the Stonewall Vegetation Project analysis area.

Methodology

The discussion below identifies information sources, analysis assumptions and analysis methods used. Information sources are not described in detail. For details concerning individual information sources see the Vegetation Section and the Stonewall Silviculture Report (Amell and Klug 2015). All information for this section was provided by the Helena National Forest or was acquired from the Region 1 and 4 Forest Health Protection Program.

Information Used

Information used in this analysis includes:

- Individual treatment unit diagnosis completed by Helena National Forest personnel and last updated in fall 2009
- Formal stand exam data collected for selected stands by Helena National Forest personnel
- Forest Inventory and Analysis (FIA) “grid intensification” sample plot data collected by the HNF contained in the Field Sampled Vegetation database (FSVeg)
- Informal exam data collected, and stand diagnosis data collected and produced during the fall of 2009 and 2010 by HNF personnel
- Site visits during the summer of 2010
- Past management activity data located in the Forest Service Activity Tracking System (FACTS) database
- GIS spatial data acquired from the Helena National Forest including:
    - VMAP spatial data including classification for tree dominance type, tree canopy cover class, and tree diameter
    - Helena National Forest Plan (USDA Forest Service 1986) Management Area boundaries
    - 2001-2010 aerial insect and disease detection (ADS) survey data
    - Project area boundary
    - Historic fire activities
    - Past management activities
    - Old-growth

- Other documents as referenced in the Stonewall Vegetation Project Old Growth and Snag report (Amell and Higgins 2014).

Assumptions

Ecosystems are dynamic, American public desires and expectations change, and climatic conditions change. These factors require that a number of assumptions, from great to small, be made in any analysis. In this analysis we do not include as assumptions that natural processes which are certain to happen would continue to happen. For example, succession is a natural process constantly occurring due to differences in plants abilities to colonize, survive, grow, and propagate as conditions change. The process of succession would always happen and we do not consider it an assumption that it would do so. We do include as assumptions factors such as climate change-the direction, magnitude, and effects of which cannot yet be considered as "known"-and the occurrence or non-occurrence of disturbances such as wildfires which can modify the direction of succession.

Assumptions we make in this analysis applying to both old growth and snags include:

- Management direction displayed above would continue indefinitely into the future
- In the long-term time frame of the analysis, no additional major disturbances, such as wildfire or bark beetle epidemics would occur: the analysis concerns future risk and probable effects if the disturbance occurs and is not a future projection of the occurrence of any disturbance
- Climate change has occurred to some degree and will continue to occur in the future. Ramifications of a changing climate for the project area are likely to be (Karl et al. 2009):
    - More of the winter precipitation will fall as rain
    - Snow levels will raise in elevation
    - Snow melt will occur earlier in the spring
    - The late-spring to summer dry season (fire season) will increase in length
    - Summer dry seasons will be drier and warmer
    - Prolonged drought periods will increase, but their occurrence will probably be variable
    - Storms will become more intense with a larger portion of annual precipitation falling in the heaviest storms
    - Night-time minimum temperatures will increase
    - Growing season and number of frost-free days will increase
    - Wildfires are likely to become more frequent and the area burned averaged annually likely greater
    - Weather conditions conducive to bark beetle mortality are likely to become more frequent
- The accomplishment time period is estimated to be 2015-2020
- No unforeseen occurrences such as fire, blowdown, or insect mortality would occur from 2010 until the time of implementation

Additional assumptions used for the old growth analysis include:

- Climate changes will most likely bring about some change in site characteristics leading to climax plant community changes, but the direction and magnitude of the changes are unknown and would be very small within the time frame of this analysis

- Minimum stand characteristics found in Green et al. 1992 (errata corrected 2005, 2007, 2008) are appropriate to define old growth in the project area
- Designated old growth does not have to meet minimum tree characteristics described in Green et al. 1992 (errata corrected 2005, 2007, 2008) to be managed as old growth to meet the Forest Plan standard
- Intensive stand examinations provide the best data available for quantifying stand characteristics
- The algorithm (R1 Old Growth Utility, FSVeg) is the best tool available to identify stands that have old-growth characteristics
- Since 10 acres is the minimum old growth stand size in Forest Plan old growth management direction, stands, or combinations of stands, of less than 10 contiguous acres are not designated as old growth for determining Forest Plan compliance, but are included in an assessment of old growth
- FVS modeling can provide a reasonable estimate of the magnitude and direction of proposed treatment effects on stand species compositions, tree diameter distributions and tree establishment
- Stands with old growth characteristics exist outside of 3rd-order drainages. The Forest Plan Desired Future Condition of the Forest (USDA 1986) states that old growth in the first decade "will be well distributed over the forest" and that in the fifth decade that "a good balance will be scattered throughout the Forest." To maintain old growth benefits within the project area outside of the 3rd-order drainages, we are assuming that there is a desire to manage some of the stands within the project area outside of the 3rd-order drainages as old growth

Additional assumptions used for the snag analysis include:

- FIA grid intensification plot data can provide an average of snag numbers at the landscape level in the year the plot data was collected
- Past harvest/regeneration activities would contain no snags
- ADS data provide a reasonable estimate of trees killed by bark beetles at the landscape level
- ADS mortality estimates need to be adjusted remove trees greater than seven inches d.b.h.
- FVS modeling of proposed prescribed burning can provide mortality estimates that can be used to estimate snag additions to landscape-level snag levels
- Adequate snags would be retained to meet Forest Plan standards through implementation of Stonewall Vegetation Project Design Features. In particular, "WL-5" would be applied to intermediate and regeneration units to retain snags in all cutting units to ensure snags are well distributed throughout the project area
- No snags would be created or removed in pre-commercial thin units
- In treatment units where tree removal is followed by prescribed burning a very small degree of mortality from the prescribed burning can be expected to occur, but for simplicity sake in this analysis, we are assuming no mortality in these units of trees greater than seven inches d.b.h.
- In units being prescribed burned, we are assuming no loss due to burning of snags

Helena National Forest Old Growth Identification and Analysis Process

Other information sources use the term "watershed" to denote the area drained by a stream. In this analysis we use the term "drainage" to be consistent with Forest Plan direction. As mentioned above the HNF identifies old growth when drainages are proposed for a management entry that could affect the old growth. The HNF designates old growth primarily where there is stand-level inventory data (stand exam)

available to confirm characteristics. Since stand exams are typically completed when vegetation projects are proposed, the majority of these inventories are focused in timber management emphasis areas. Wilderness areas, as well as many roadless areas and non-timber management areas receive few exams. Stand-level inventories have also typically targeted the most productive stands with a high probability of containing commercial timber for sampling which provides an incomplete sample of stands within each third-order drainage analyzed. Due to incomplete sampling, the inventories recorded a minimum amount of old growth.

Following Forest Plan direction, old growth is identified in this process to represent five percent of each 3rd-order drainage. The stream order is a method of numbering streams as part of a drainage basin network where the smallest un-branched mapped tributary is called "first order" and the stream receiving the tributary is called "second order", and so on (USDA Forest Service 1986). In HNF spatial data, there are two 3rd-order drainages within the project area, "0203" which encompasses about 4,849 acres and "0204A" which encompasses about 6,834 acres. The rest of the project area (11,198 acres) is not within a 3rd-order drainage. The two 3rd-order drainages comprise about 49 percent of the project area, with 51 percent of the project area not within a 3rd-order drainage. In this analysis we analyzed old growth for each 3rd-order drainage to show consistency with the Forest Plan, and we evaluated old growth for the entire project area (including outside of 3rd-order drainages) to show that old growth is being retained at a landscape-level.

Based upon available data, stands at least 10 acres in size (or smaller in adjacent groups) are designated first. If these areas do not constitute five percent, additional areas are designated which may not meet old growth definitions yet, but are the "next best thing" to be managed to meet them in the future. Old growth is not a static condition and can be affected by insect and disease activity, wildfires, and forest management. When stand characteristics change substantially, the stand is no longer considered old growth. Stands designated as old growth are reviewed at the project scale when treatments are proposed including a review of proposed treatment units for old growth characteristics. For further details of the HNF old growth analysis see Milburn (2009).

Identifying and designating old growth on the HNF progressed through several steps:

1. Stand exams were used to identify stands with old growth characteristics. The R1 Inventory Analysis Team ran a FSVeg utility that compared exam data with activity data in FACTS to determine if exams were still representative, that is they did not have an activity was more recent than the exam. Those exams without more recent overlapping activities were considered "clean." The "clean" exams list was most recently updated against FACTS in 2007. Clean stands for the HNF were then run through the R1 Old Growth Utility in FSVeg to identify old growth. This report identified stands that meet minimum criteria (Green et al.1992, errata corrected 2005, 2007, 2008). The data report included an estimate of years until stands could become old growth. This utility can also be used to analyze FIA data to determine old growth quantity at broad scales.
2. The results of the previous process were combined with other GIS layers such as 3rd-order drainage boundaries, past activities, insect aerial detection surveys (ADS), and the project area boundary. Stands that the previous process indicated met minimum old growth characteristics were checked to determine if any changes have occurred since the exam. A combination of photo interpretation and walkthrough exams was used to validate the results in the third-order drainage. Stands outside of the 3rd-order drainage did not receive this validation step. Stands that had changes to minimum characteristics were not counted as old growth. Non-adjacent stands smaller than 10 acres were eliminated from the 3rd-order drainage at this time from consideration for meeting Forest Plan Standards, however these small areas were checked against proposed treatments to determine if any old growth would be affected by the proposal. No such overlaps occurred in the 3rd-order drainage.

Small stands outside of the 3rd-order drainage were not eliminated from the data nor were they removed from potential treatment units.

3. Each 3rd-order drainage affected by the proposal was assessed. If the drainage had at least five percent of stands meeting minimum old growth characteristics, these stands were used to select approximately five percent to designate for old growth management under the Forest Plan. Old growth in excess of five percent was not designated to manage for old growth, but remained identified for purposes of habitat analysis and assessing if treatments overlapped with existing old growth. Stands were selected for old growth management favoring: (1) the oldest, (2) largest stands or greatest contiguous area, (3) elevation below 6000 feet, (4) riparian areas, (5) management areas other than T-1 through T-5, and (6) non-pine forest types in areas heavily infested with mountain pine beetle. In this process, old growth characteristics discussed by Green et al. 1992 (errata corrected 2005, 2007, 2008) were the primary designation criteria with the other Forest Plan prioritization criteria used as a guide when possible.
4. In drainages with less than 5 percent old growth identified in the previous step, additional areas to manage as old growth were selected as the "next best thing", using the same criteria (oldest, largest, below 6000 feet elevation, riparian, non-timber emphasis). Other factors such as wildlife habitat needs were considered. The inventoried stands that best meet the most considerations were selected to designate for old growth management.
5. Proposed treatment units were evaluated to assess whether they could be old growth, particularly where there is no stand exam available for the assessment described above in the first step. Specialists used photo interpretation to identify other old growth, followed by a sample of walkthrough exams. Additionally, HNF personnel conducted diagnoses and informal plots in all units to identify where more intensive exams were needed to determine if the stand was old growth. Diagnosis plots were informal in number and placement, but measured minimum old growth criteria. Areas that had at least one of the old growth minimum criteria, were at least 10 acres, and had no past exam were scheduled for an intensive exam. Based upon the intensive exams, two proposed treatment units (2 and 46) were considered to be partially composed of stands (41502089 and 42303130 respectively) that qualified as old growth.

Based on the findings of all the above information, all areas of old growth identified from steps 1-4 were removed from proposed treatment units within the 3rd-order drainage. However, outside of the 3rd-order drainage there are stands within proposed treatment units in one or both of the action alternatives and one stand is partially within the 3rd-order drainage. These stands are discussed individually starting on page 222.

In the above process, to meet Forest Plan direction, old growth is identified and designated at the stand level and analyzed at the 3rd-order drainage level. It can also be informative to estimate the amount of old growth on a broad landscape scale. Utilizing FIA grid intensification plots, the HNF Summary Database can be used to make statistically viable estimates of old growth presence on the HNF, but from the FIA plots alone, the old growth cannot be spatially located. The HNF summary database was also used to depict the abundance of old growth habitat type groups.

About 51 percent of the analysis area is outside of mapped 3rd-order drainages. In this area, we assessed stands identified above in Step 1 using available NAIP imagery, ADS survey data, and available stand exam data to determine if the stands had been impacted by the recent mountain pine beetle outbreak and so would no longer qualify as old growth. Stands considered not impacted by the outbreak to a level that would not be considered old growth, were retained and discussed, and are displayed in this evaluation of old growth for the landscape assessment.

Snag Analysis Process

The Helena Forest Plan provides for snags to be "managed at 70 percent of optimum (average 2 snags per acre) within each 3rd-order drainage" (emphasis added). In this analysis, we discuss snags within each of the two 3rd-order drainages and for the entire project area. The two 3rd-order drainages together comprise about 49 percent of the project area.

The snag analysis process involves three steps:

Average snags per acre present in 2008 by d.b.h. class were computed from FIA grid intensification plot data and a "base level" of snags computed for each third-order drainage and the project area

Average total snags created by insect activity from 2008 to 2010 for each third-order drainage and for the whole project area were computed from ADS spatial and tabular data and adjusted using FIA grid intensification plot data to represent only snags 7 inches or larger. The adjusted snag numbers were then added to the base level.

FVS was used to model mortality for prescribed-burn only treatments which was then applied to treatment areas to compute snag additions due to the burns.

Following the assumption that snags would be reduced to 2 snags per acre to meet Forest Plan standards (Stonewall Vegetation Project Design Criteria WL-5) in mechanical treatments, excepting pre-commercial thinning, we computed the average snag reduction due to the treatments and applied that to the third-order drainage and project area estimates.

Affected Environment

Existing Condition

Snags

In 2007 and 2008, the Helena National Forest measured "FIA grid intensification" plots within the Stonewall project area. These plots include all tree mortality through 2008. Within all plots in the project area, there was an average of about 40 snags per acre greater than or equal to 7 inches d.b.h. (table 54) in 2008. For this analysis, we used this average as a uniform 2008 "base level" of snags per acre greater than 7 inches d.b.h. for the 3rd-order drainages and for the project area.

Table 54. Snags per acre by d.b.h. class from 2008 FIA intensification plot data

d.b.h. Class	Average Number of Snags per Acre
≥ 7" and < 12"	26
≥ 12" and < 20"	13
≥ 20"	1
Total	40

The base level average cannot be directly applied to the entire 3rd-order drainage areas or project area forested land because past harvest/regeneration activities cannot be expected to have many, if any, snags and no FIA grid intensification plots were located within past harvest/regeneration activities. Since past harvest/regeneration activities are not represented in the FIA grid intensification plots, the base level snag estimates would overestimate snag numbers. For this exercise, we assumed that past harvest/regeneration activities would have no snags and adjusted FIA grid intensification plot snag estimates down based upon

the proportion of the area in 3rd-order drainage and the project area that was treated by past harvest/regeneration activities. Our adjusted average 2008 snags per acre (SNA) greater than 7 inches was: 36 SNA for drainage 0203, 35 SNA for drainage 0204A, and 35 SNA for the entire project area.

Since the adjusted FIA grid intensification plot snag estimates from the previous step did not take into account mortality from 2008 to 2010, we then adjusted the 2008 average SNA for each 3rd-order drainage, and for the project area, to take into account mortality in the years 2009 and 2010 using Aerial Damage Survey (ADS) data. To show the magnitude of the mortality, figure 51 displays accumulative mortality from ADS spatial data for the years 2009 and 2010 by estimated dead trees per acre (TPA) class. ADS mortality estimates, however are ocular estimates of dead tree numbers of all sizes, although it is reasonable to conclude that the estimates are largely of overstory trees because of the difficulty of seeing and estimating dead tree numbers in stand mid-stories and understories from the air.

For this analysis, we computed a weighted average ADS SNA for each 3rd-order drainage and for the project area. Weighted average tree mortality for the years 2009 and 2010 are: 9 trees per acre (TPA) for drainage 0203, 7 TPA for drainage 0204A, and 8 TPA for the entire project area. We then adjusted the ADS weighted averages using FIA grid intensification plot data. In the FIA grid intensification plots, 68 percent of the dead pine trees were 7 inches or larger in d.b.h. The adjusted weighted average tree mortality for the years 2009 and 2010 are: 6 trees per acre (TPA) for drainage 0203, 5 TPA for drainage 0204A, and 5 TPA for the entire project area. Adding the ADS estimated mortality to that estimated from FIA Intensification plots indicates that snag numbers greater than or equal to 7 inches in 2011 to be: 42 SNA for drainage 0203, 41 SNA for drainage 0204A, and 40 SNA for the entire project area.

The estimates given above are most likely underestimated. At the time of this initial analysis, 2011 ADS data was not available which would increase average snag levels. The ADS estimates may also have underestimated snag numbers in individual stands. Stonewall project proposed treatment units were visited during 2008 and revisited in 2009. Assessments of stand conditions including snag estimates for individual units can be found in project records and are summarized here. Snag estimates for trees greater than 6 or 7 inches d.b.h. range from zero to “lots.” Of the units where snag numbers were estimated, snags range from 0 to 400 with an average of about 160 snags per acre. Note that the individual stand estimates from site visits are included here only to establish the context that the snag numbers discussed in this analysis are most likely underestimated and are not included in the estimates discussed.

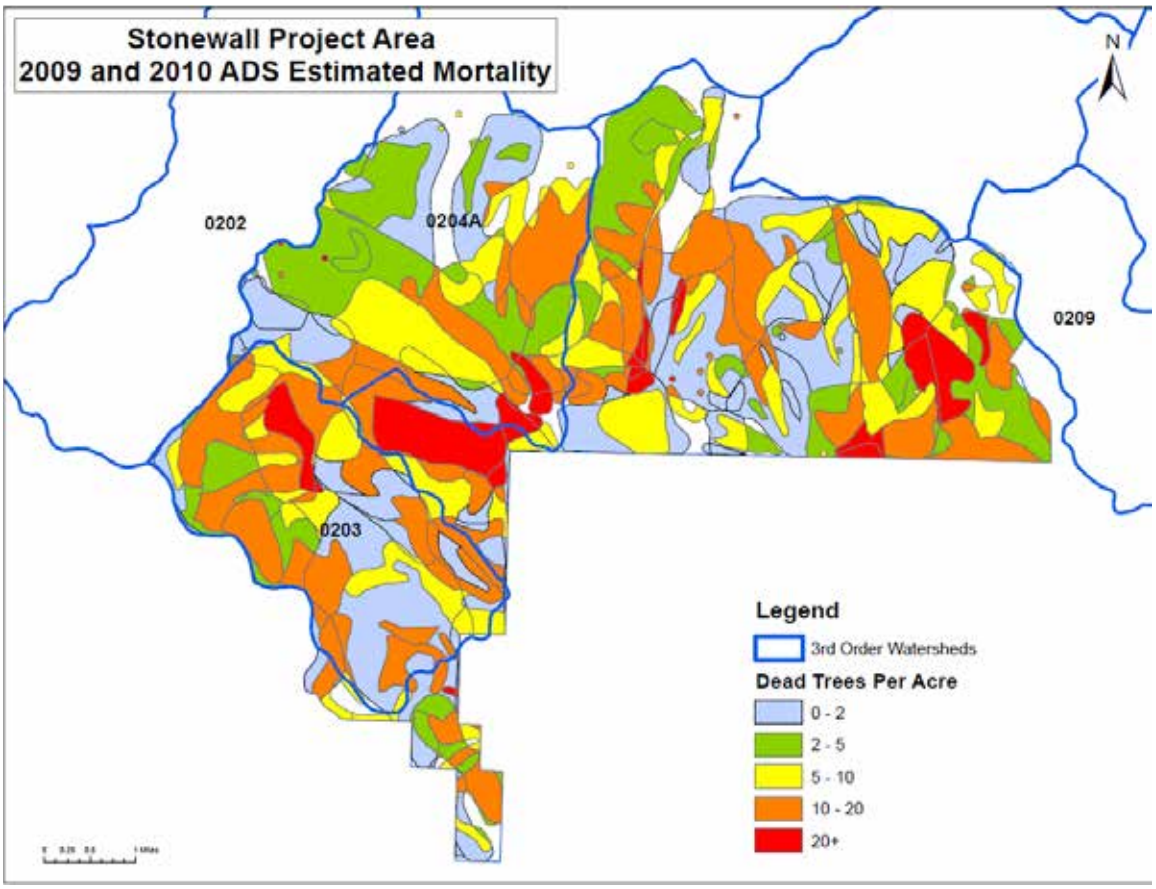

Figure 51. Aerial damage survey estimated mortality for 2009 and 2010

The best currently available information, indicates that at least partially due to recent bark beetle activity, snag levels average over twenty times the minimum levels required by the Forest Plan in the two 3rd-order drainages analyzed and over the Stonewall Vegetation Project area. Due to the recent bark beetle mortality, snags are very abundant in the Stonewall Vegetation Project area.

Old Growth

Old Growth within 3rd-order Drainages

Five percent of the 0203 and 0204A 3rd-order drainages were designated to be managed as old growth. Five stands in 0203 (247 acres) were designated and 15 in 0204A (345 acres, table 55 and table 56). Note that in table 55, one stand less than 10 acres in size was designated as old-growth management because it is adjacent to another designated old-growth stand.

Table 55. 3rd-order drainage designated old growth data

Drainage ID	Stand ID	Old Growth Type	Habitat Type Group	Elevation	Habitat Type	Vertical Structure	Currently OG	Acres
0203	41403075	DF	Cool and Moist to Wet	6131	SAF/menziesia	C	Yes	42
0203	41403071	DF	Cool and Moist to Wet	5475	SAF/menziesia	1	Yes	31
0203	41403093	DF	Cool and Wet	5541	SAF/queencup beadlily	C	Yes	38
0203	41403058	DF	Cool and Wet	5322	SAF/queencup beadlily	C	Yes	23
0203	41403048	ES-SAF	Cool and Moist to Wet	6147	SAF/menziesia	C	Yes	113
0204A	42301052	DF	Cool and Moist	5192	SAF/twinflower	C	Yes	36
0204A	42301033	ES-SAF	Cool and Moist to Wet	5751	SAF/menziesia	1	No	18
0204A	41401087	ES-SAF	Cool and Wet	5730	SAF/queencup beadlily	1	No	14
0204A	41401084	ES-SAF	Cool and Wet	6192	SAF/queencup beadlily	2	No	18
0204A	41401083	ES-SAF	Cool and Moist to Wet	6099	SAF/menziesia	C	Yes	20
0204A	41401099	ES-SAF	Cool and Moist to Wet	6464	SAF/menziesia	C	Yes	37
0204A	41401054	ES-SAF	Cool and Wet	5638	SAF/queencup beadlily	C	Yes	19
0204A	42301002	ES-SAF	Cool and Wet	5735	SAF/queencup beadlily	2	Yes	4
0204A	41401051	ES-SAF	Cool and Wet	5855	SAF/queencup beadlily	3	No	19
0204A	42303048	DF	Cool and Dry to Moist	6226	SAF/beargrass	2	Yes	18
0204A	42302109	DF	Cool and Dry to Moist	5746	SAF/beargrass	C	Yes	24
0204A	42303035	DF	Cool and Dry to Moist	6172	SAF/beargrass	2	No	13
0204A	42302096	DF	Cool and Moist to Wet	5793	SAF/menziesia	C	No	33

Drainage ID	Stand ID	Old Growth Type	Habitat Type Group	Elevation	Habitat Type	Vertical Structure	Currently OG	Acres
0204A	42302091	ES-SAF	Cool and Wet	5895	SAF/queencup beadlily	C	No	23
0204A	42302095	DF	Cool and Dry to Moist	5902	SAF/beargrass	C	No	49

1 – Single-story
2 – Two-story
C – Multiple-story
DF – Douglas-fir
ES-SAF – Engelmann spruce-subalpine fir
SAF/queencup beadlily – subalpine fir-twincup beadlily
SAF/beargrass – subalpine fir-beargrass
SAF/menziesia – subalpine fir-
SAF/twinflower – subalpine fir-twinflower

Designated old growth is Douglas-fir and Engelmann spruce-subalpine fir (table 56). All of the designated old growth is in subalpine fir habitat types. On these habitat types the Douglas-fir can be considered seral and the Engelmann spruce-subalpine fir old growth can be considered late-seral to climax. About 63 percent of the old growth designated is Douglas-fir and 38 percent is Engelmann spruce-subalpine fir.

Table 56. 3rd -order drainage designated old growth, type and acres

Third-Order Drainage	Old Growth Type	Acres
0203	DF	134
	ES-SAF	113
	Total	247
0204A	DF	173
	ES-SAF	172
	Total	345

Unit 46 of the Stonewall Vegetation project crosses a 3rd-order drainage boundary. This unit includes 43 acres that meet old-growth characteristics, field verified by 2010 stand exam (table 57). These stands are part of other old growth considered in this analysis and are not part of the designated old growth to meet Forest Plan direction. The Stonewall Vegetation Project proposes treatment in the 43 acres of unit 46 that meet old-growth characteristics.

Table 57. Other field verified old growth within a 3rd-order drainage

Stand ID	Unit	Old Growth Type	Habitat Type Group	Habitat Type	Vertical Structure	Acres*
42303130	46	DF	Cool and Moist	SAF/twinflower-twinflower	C	163

* Acres cited here are delineated stand acreages and not proposed unit acreages, the unit areas include more than one stand.

** Stand 41502046 includes 43 acres within the 3rd-order drainages, however, the 43 acres of this stand is not part of the 5 percent designated old growth to meet the Forest Plan direction. Approximately 120 acres of stand 41502046 is located outside 3rd-order drainages.

Figure 32 displays the old growth in the project area, for both designated stands within 3rd-order drainages and “Other Old Growth” that is not designated or is located outside 3rd-order drainages.

Old Growth Outside 3rd-order Drainages

About 51 percent of the Stonewall project area is outside 3rd-order drainages with approximately 611 acres of stands with old growth characteristics (175 acres were field verified by 2010 stand exam). The 611 acres of old growth is about five percent of the project area located outside 3rd-order drainages. Although not covered explicitly by Forest Plan direction, we recognize old growth is a landscape feature and in this analysis identify and assess the availability of old growth stands, and analyze effects as if these stands were to be managed for old growth.

Stand 41502089 partially forms Unit 2 and is in the warm-and-very-dry habitat group for which the minimum number of trees greater than 17 inches d.b.h. required to be classified as old growth is four. Stand 41501130 partially forms Unit 46 and is in the cool-and-moist habitat group for which the minimum number of trees greater than 17 inches d.b.h. required to be classified as old growth is seven.

The lower portion of proposed prescribe burn Unit 81 contains three stands that, from available stand exam data, could potentially qualify as old growth (table 58). These three stands are within the warm-and-moist habitat type group in which the minimum number of trees greater than 19 inches d.b.h. required to qualify for old growth is five.

Table 58 displays the old growth stands in the project area located outside 3rd-order drainages.

Table 58. Old growth stands outside 3rd-order drainages

Unit ID	Stand ID	Old Growth Type	Habitat Type Group	Habitat Type	Vertical Structure	Acres
	41502023	DF	Cool and Dry to Moist	SAF/beargrass	C	10
81	42201139	DF	Warm and Moist	DF/snowberry-pinegrass	C	37
81	42201147	DF	Warm and Moist	DF/snowberry-pinegrass	2	53
81	42201152	DF	Warm and Moist	DF/snowberry-pinegrass	2	22
	42202023	ES-SAF	Cool and Dry to Moist	SAF/beargrass-huckleberry	C	29
	42202038	DF	Cool and Dry to Moist	SAF/beargrass-huckleberry	1	86
	42202054	ES-SAF	Cool and Moist to Wet	SAF/menziesia	C	76
	42202067	DF	Cool and Moist to Wet	SAF/menziesia	C	100
	42301068	DF	Cool and Moist	SAF/twinflower	1	8
	42301087	DF	Cool and Moist	DF/huckleberry	C	15
2	41502089	DF	Warm and Very Dry	DF/snowberry-bluebunch wheatgrass	C	55
46	42303130	DF	Cool and Moist	SAF/twinflower-twinflower	C	120

1 – Single-story

2 – Two-story
C – Multiple-story
DF – Douglas-fir
ES-SAF – Engelmann spruce-subalpine fir
SAF/queencup beadlily – subalpine fir-twincup beadlily
SAF/beargrass – subalpine fir-beargrass
SAF/menziesia – subalpine fir-
SAF/twinflower – subalpine fir-twinflower
Acres cited here are delineated stand acreages and not proposed unit acreages, the unit areas include more than one stand. Stand 41502046 includes 43 acres within the 3rd-order drainages, however, the 43 acres is not part of the five percent designated old growth to meet the Forest Plan direction. Approximately 120 acres of stand 41502046 is located outside 3rd-order drainages.

The following discussions display a more detailed breakdown of the current diameter distribution in Units 81, 2 and 46, proposed for treatments. Diameter information is displayed by species present (Douglas fir [DF], Engelmann spruce [ES], subalpine fir [SAF], ponderosa pine [PP], lodgepole pine [LP]).

Figure 52 displays the current diameter distribution for Stand 42201139, which forms part of Unit 81. The stand currently has about 118 trees per acre (TPA) of which 31 are greater than 19 inches in diameter at breast height (d.b.h.).

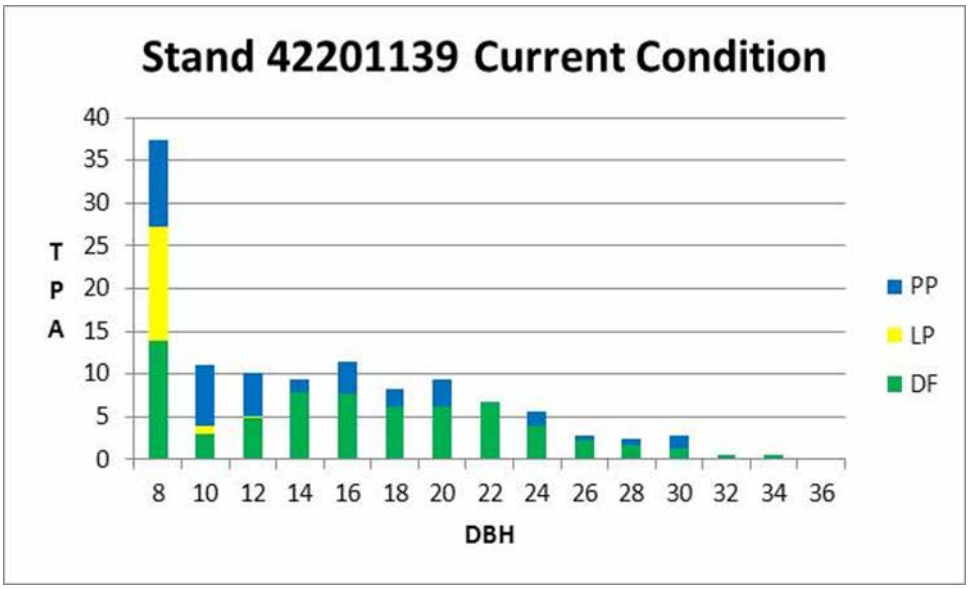

Figure 52. Stand 42201139 (Unit 81) current condition

Figure 53 displays the current diameter distribution for Stand 42201147, which also forms part of Unit 81. The stand currently has about 498 trees per acre (TPA) of which 18 are greater than 19 inches in diameter at breast height.

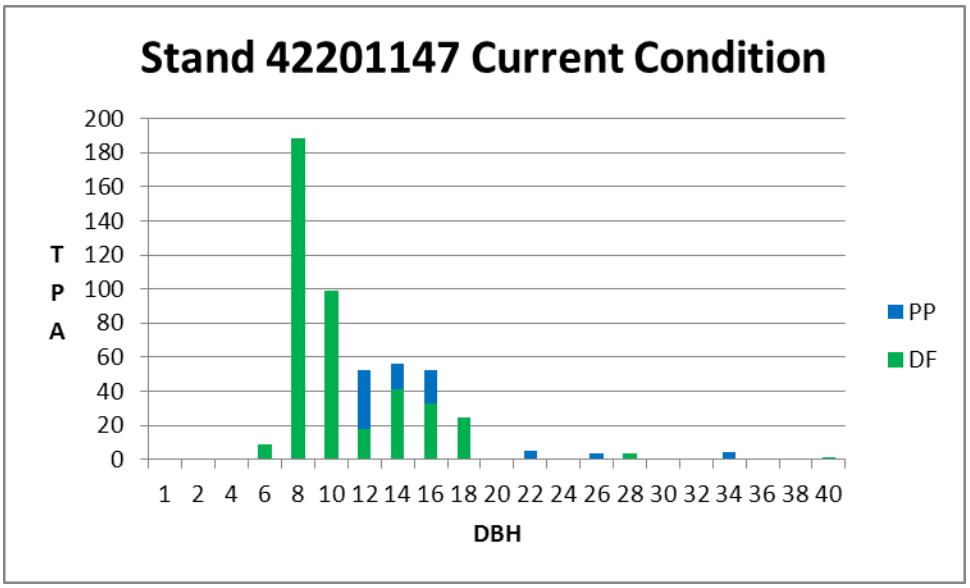

Figure 53. Stand 42201147 (Unit 81) current condition

Figure 54 displays the current diameter distribution for Stand 42201152, which also forms part of Unit 81. The stand currently has about 62 trees per acre (TPA) of which 29 are greater than 19 inches in diameter at breast height.

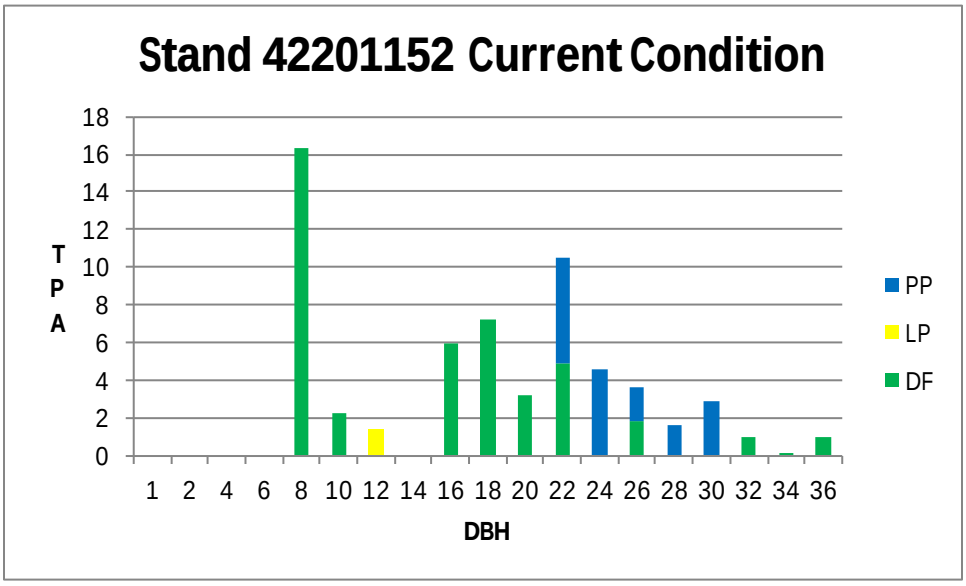

Figure 54. Stand 42201152 (Unit 81) current condition

Figure 55 displays the current diameter distribution for Stand 41502089, which forms part of Unit 2. The stand currently has about 317 TPA of which about 20 are greater than 17 inches d.b.h. Note that the relatively large number of trees in the 1-inch d.b.h. class is not being displayed to better display the distribution in larger trees.

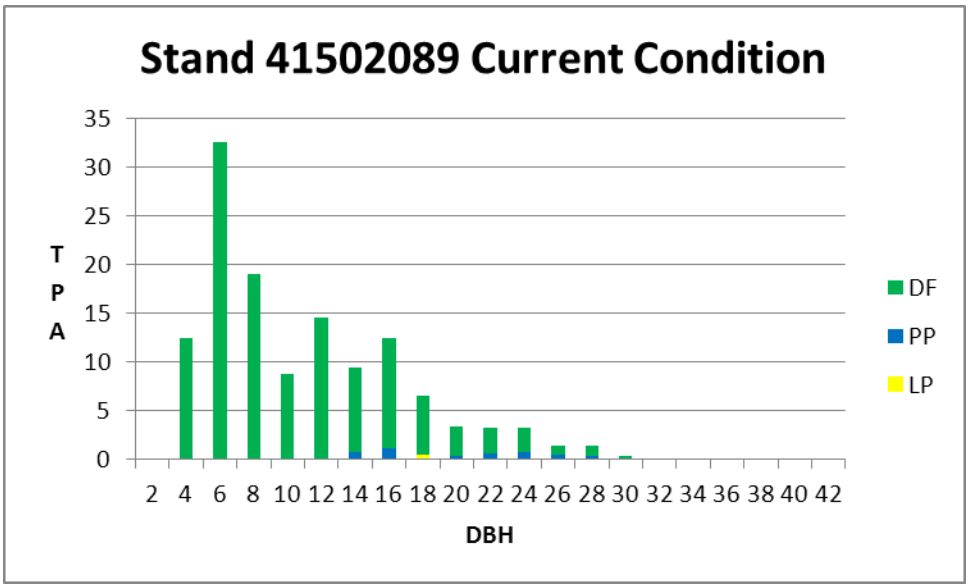

Figure 55. Stand 42201089 (Unit 2) current condition

Figure 56 displays the current diameter distribution for Stand 42303130, which forms part of Unit 46. The stand currently has about 1,442 TPA of which about 13 are greater than 17 inches d.b.h. Note that the trees in the smallest diameter class are not being shown so that larger trees can be better displayed.

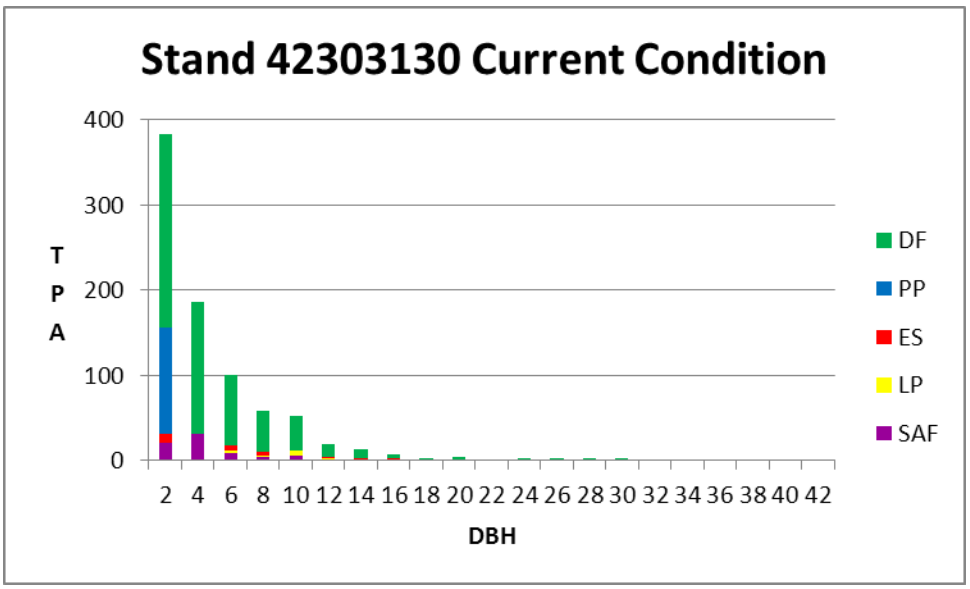

Figure 56. Stand 423031130 (Unit 46) current condition

Environmental Consequences

Spatial Context for Effects Analysis

The spatial scales used in this analysis are the two 3rd-order drainages within the project area, for Forest Plan Consistency old growth and snags, the project area for landscape scale evaluations, and for selected individual proposed treatment areas, the individual stand. We chose the project area as the largest spatial scale for this analysis because it includes all Forest System land that: (1) includes the proposed treatment

areas, (2) is bounded on the north, northwest, and west sides by drainage divides, and (3) at about 24,000 acres, is sufficiently large to analyze and discuss effects to forest vegetation on a landscape-level without 'diluting' the magnitude of the effects with a large area.

Temporal Context for Effects Analysis

The year 2010 is the existing condition baseline used for this analysis. Proposed mechanical treatment stands were examined in fall 2009 and 2010, briefly visited in summer 2010, and the last ADS survey used in this analysis was done in 2010. Short-term effects refer to effects over the 10-year period from the time the activity would be accomplished estimated between 2015-2020, and long-term effects refers to effects from 10 to 50 years from the time the activity would be accomplished. All pertinent past activities and events are incorporated into the previous existing condition discussion. In the cumulative effects analysis that follows, cumulative effects are discussed as changes in the existing condition due to present and future activities, including the effects of the alternative being discussed. Connected Actions, Past, Present, and Foreseeable Activities

Past Activities

Past activities that have shaped the existing condition discussed and displayed in this document include: (1) 3,872 acres of harvest/regeneration treatments, (2) 373 acres of other harvests cutting, (3) 822 acres of pre-commercial thinning, and (4) 7,922 acres of fuels treatments from 1950 to present (Amell and Klug 2015), although some of these treatments were on the same area and so the acreages are not accumulative. In addition to the management actions, vegetation has been shaped by: (1) 87 acres in the Snow/Talon Fire (2003), (2) 261 acres in the Keep Cool Fire (2006), and (3) insect and disease activity as discussed previously and in the Stonewall Vegetation Project Silviculture Report (Amell and Klug 2015). Other past actions, such as livestock grazing and recreational activities have played a small role in shaping forest vegetation in the project area, or played a localized role. As mentioned above, these activities have been considered in describing the current condition.

Present and Foreseeable Activities

All past, ongoing and foreseeable projects identified by the HNF for possible consideration in this analysis are displayed in volume 2, appendix C. Many of the activities listed are not considered in this analysis because they are: (1) outside of the analysis area used in this analysis, or (2) have no effect on snags and old growth addressed in this analysis, or (3) have such a small effect on snags and old growth that they are inconsequential to the analysis.

Activities currently ongoing in the project area considered in this analysis are displayed in volume 2, appendix C.

Effects Common to All Alternatives

Snags

The forested landscape will experience additional bark beetle mortality from the ongoing mountain pine beetle (MPB) epidemic. The levels of additional mortality are a matter of speculation, but available research indicates that mountain pine beetle epidemics continue until the available bark beetle habitat is sufficiently reduced that epidemic levels can no longer be sustained (Cole and Amman 1969, Cole and Amman 1980, Klein et al. 1978, Mitchell and Preisler 1991). Mountain pine beetles strongly favor infesting the trees of larger diameter each year and over the life of the infestation infesting smaller trees each year until the average host tree diameter declines to a point that the tree habitat cannot produce sufficient numbers of beetles to maintain the outbreak (Cole and Amman 1969, Cole and Amman 1980). The outbreaks are relatively short, lasting about 6 years (Cole and Amman 1969, Cole and Amman 1980).

Given the magnitude of the mortality that has occurred in the project area as of this writing, we suspect that the epidemic is declining.

The lodgepole pine snags will start falling in 3 to 5 years after death (Bull 1983, Mitchell and Preisler 1998). Snag fall rates depend on tree species, tree size, cause of death, and environmental conditions that could affect the speed of bole decay (Bull 1983, Mitchell and Preisler 1998). For lodgepole pine, Bull (1983) found that eight years after death about 75 percent of the snags less than 25 cm had fallen and 42 percent of the snags greater than 25 cm had fallen. Mitchell and Preisler (1998) in their study of mountain pine beetle killed snags in Oregon found that tree size was not a factor in unthinned stands and that in unthinned stands, 50 percent were down in 9 years and 90 percent were down in 14 years.

In the short- term, snag numbers would be very high, but in the long-term snag numbers would decline greatly as the lodgepole pine snags fall down.

Old Growth

Effects to designated old growth in the two 3rd-order drainage are the same under all alternatives because no activities are proposed in designated old growth in these drainages. Following the process described above, about five percent of each 3rd-order drainage is designated to manage as old growth. All old growth would continue to develop successionally under all alternatives. Changes would be slight in the short term, but could be substantial in the long term. Single-story and two-story stands would become more multi-story. Closed canopies would remain closed, and open stands would become closed over time. Down woody fuels would continue to accumulate.

About 68 percent of the designated old growth is Douglas-fir type. With continuing succession, more small trees would become established with the species composition trending toward subalpine fir (Fischer and Clayton 1983). These stands are susceptible to Douglas-fir beetle (DFB), western spruce budworm (WSB), and root disease. ADS data appears to indicate that DFB has consistently declined in recent years, while WSB infestation was extensive in 2009, substantially less was recorded in 2010 (Amell and Klug 2015). Douglas-fir beetle tends to infest large and old Douglas-fir and heavily stocked stands. Their impacts can also be affected by weather conditions, for example droughts that reduce host tree vigor. With increasing stocking, tree size and age over time, we can expect DFB to continue to impact the stands to some degree, increasing with the next droughty period. Since forests in the area, including the old growth stands, are progressing toward dominance by Douglas-fir and subalpine fir, we can expect the impacts of WSB to continue if not increase. Diseases would continue to impact stands at current levels.

In the long term, dense forest conditions with multiple-layer stands and increasing surface fuels would support increasingly intense fire behavior and severe fire effects (Buhl 2015). Stand replacement fire would become more likely on the landscape and old growth stands more susceptible to the impacts.

Alternative 1 – No Action

Direct and Indirect Effects

Snags

Under this alternative there would be no direct effects to snag levels. The current conditions described above would not change. The indirect effects of no action would be as described above as effects common to all alternatives.

Old Growth

Under this alternative there would be no direct effects to old growth. The current conditions described above would not change. The indirect effects of no action would be as described above as effects common to all alternatives.

Cumulative Effects

Snags

In the Forestwide Hazard Tree Removal Project, the Forest would cut trees determined to be hazardous within 75 to 175 feet from the edge of the road. About 382 acres proposed for treatment under the Hazard Tree Removal Project within the Stonewall project area. Firewood cutting would also occur in close proximity to open roads and remove some of the available snags.

The hazard reduction treatments would remove snags from about 382 acres, which is two percent of the project area. About one percent of 3rd-order drainage 0203 and two percent of drainage 0204A would be affected. This would reduce a small number of snags within the project area. The effects on each 3rd-order drainage would be of a similar magnitude. Given the large number of snags available—many times the Forest Plan requirements—the effect of the treatment would be slight. The long-term cumulative effects would be as described above for the indirect and direct effects.

Old Growth

The Forestwide Hazard Tree Removal Project did not impact old-growth stands in the 3rd-order drainage. There is one designated old-growth stand within range allotments in the project area. Livestock grazing would have no impact of the old growth nature of the stand. There are no known invasive plant locations within designated old growth, so there would be no effects from herbicide treatments. The cumulative effects of no action for old growth are as discussed above for direct and indirect effects.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Proposed Stonewall Project alternative 2 treatments would impact about 44 percent of drainage 0203, 19 percent of drainage 0204A and 37 percent of the project area. For detailed information concerning the individual treatments see the Silviculture Report (Amell and Klug 2015)

Snags

Impacts of the treatments on standing dead trees would differ, with intermediate and regeneration treatments reducing dead tree numbers and prescribed burns increasing dead tree numbers. In treatment units where tree removal is followed by prescribed burning, we can expect a relatively small degree of mortality from the prescribed burn, but for simplicity sake in this analysis, we are assuming no mortality in these units of trees greater than seven inches d.b.h. In units which are proposed for mixed-severity prescribed burning only, there would be substantial mortality but almost 80 percent of the dead trees would be between seven and 12 inches d.b.h. In prescription group nine which was developed for alternative 3, there would be substantial mortality in understory seedling and sapling trees, but we are assuming in this analysis that there is no mortality of larger trees.

Prescribed fires can burn up snags also, but recently created snags that are in the low snag decay classes are not prone to burn. Horton and Mannan (1988) found in Arizona ponderosa pine forests that snags in decay class IV burned more frequently than lower decay classes, and Stephens and Maghaddas (2005) found that post-treatment density of snags greater than 15 cm d.b.h. in decay class one increased in fire-

only and mechanical plus fire treatments but that there were no statistical difference between snag volumes or density in other size and decay classes. These studies indicate that snag losses due to burning would be low and in this analysis we are assuming no loss.

Table 59 displays the number of treatment acres for alternative 2 and percent of area within each 3rd-order drainage and the project area. Snag numbers would be reduced to about two snags/acre in the intermediate and regeneration treatments, and as modeled, increase by about 74 to 76 snags/acre in the moderate severity burns (modeled burn mortality minus ADS mortality), and would not change in the rest of the project area. Post-treatment snag numbers would decrease to about 38 snags per acre in drainage 0203, increase to 47 snags per acre in drainage 0204A, and increase to 46 snags per acre in the project area, which are about 21 to 24 times the Forest Plan minimum requirements.

Table 59. Acres and percent of area within 3rd-order drainage and project area by treatment classes

Treatment	Drainage/Project Area	Acres	Percent of Area
Intermediate and Regeneration	0203	1,210	25
	0204A	218	3
	Project Area	3,100	37
Prescribed Burning	0203	859	18
	0204A	1,050	15
	Project Area	5,463	24

Old Growth

As mentioned previously, proposed Stonewall Project alternative 2 treatments would impact about 44 percent of drainage 0203, 19 percent of drainage 0204A and 37 percent of the project area. No designated old growth would be treated in the 3rd-order drainages (figure 57).

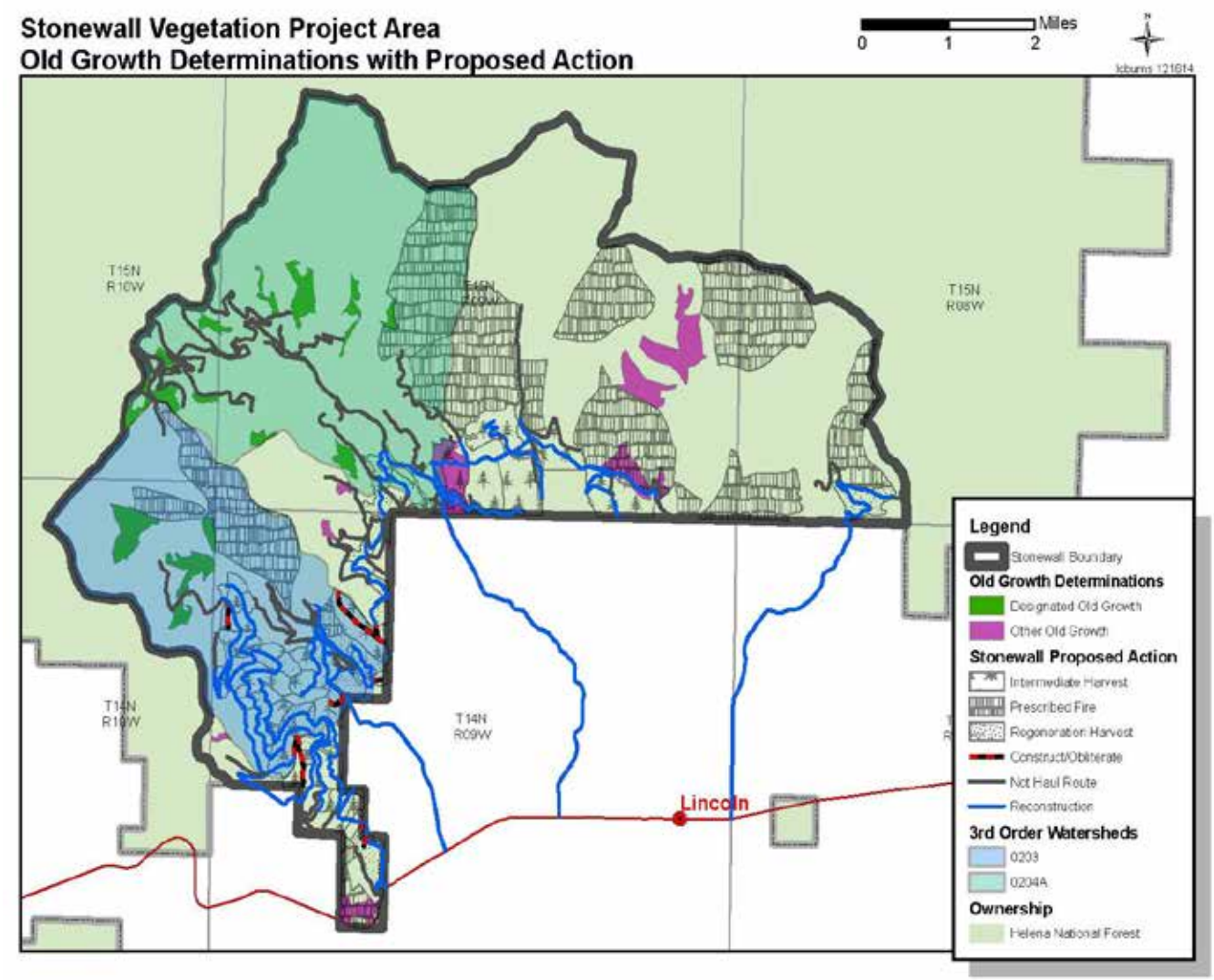

Figure 57. Alternative 2 (proposed action) units and old growth stands

In the project area outside 3rd-order drainages, stand data collected in 2010 indicate that there are two stands having old-growth characteristics within proposed Stonewall Vegetation Project units (Stand 41502089 is within Unit 2, Stand 42303130 is within Unit 46). Less recent stand exam data indicates that there are three stands that may potentially qualify as old growth (Stands 42201139, 42201147, and 42201152) in prescribed burn Unit 81. These stands are displayed in figure 57 as "Other Old Growth."

A mixed-severity prescribed burn which would create openings less than 30 acres in size is proposed for Unit 81. The three potential old growth stands are in the lower portion of the unit and within those stands the prescribed burn would be conducted as an underburn to minimize mortality in the large trees-see design criteria in the Stonewall Silviculture Report (Amell and Klug 2015).

Figure 58 displays the post-treatment diameter distribution for stand 42201139. Compared to the current condition (figure 52), the prescribed burn would reduce stocking up to the 16-inch d.b.h. class, above which the mortality would be slight. Post-treatment, the stand would still have about 96 TPA of which about 31 TPA would be greater than 19 inches d.b.h. and the stand would still be considered old growth (Green et al. 1992, errata corrected 2005, 2007, 2008).

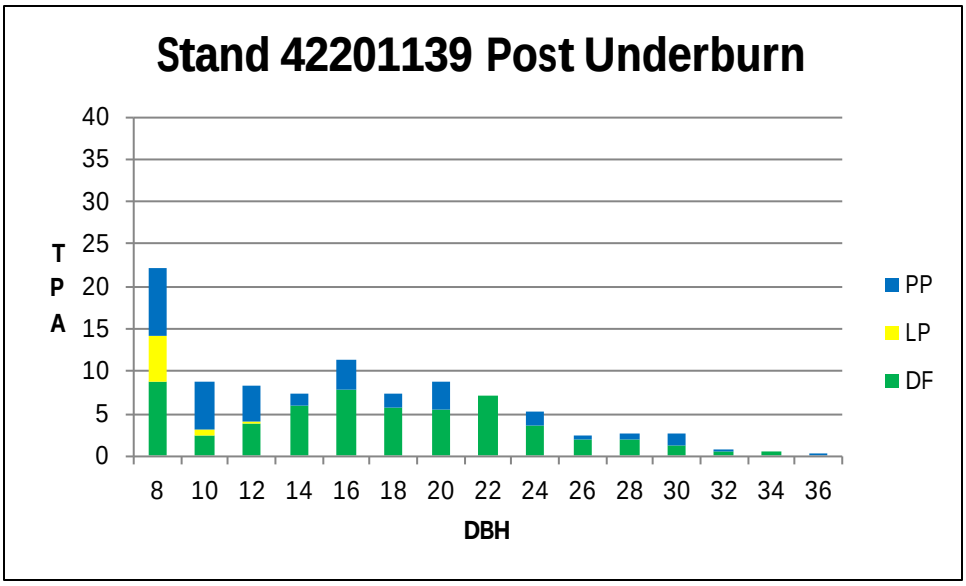

Figure 58. Stand 42201139 (Unit 81) post-underburn condition

Figure 59 displays the post-treatment diameter distribution for stand 42201147. Compared to the current condition (figure 53), the prescribed burn would reduce stocking up to the 22-inch d.b.h. class, above which the mortality would be slight. Post-treatment, the stand would still have about 250 TPA of which about 11 TPA would be greater than 19 inches d.b.h. and the stand would still be considered old growth (Green et al. 1992, errata corrected 2005, 2007, 2008).

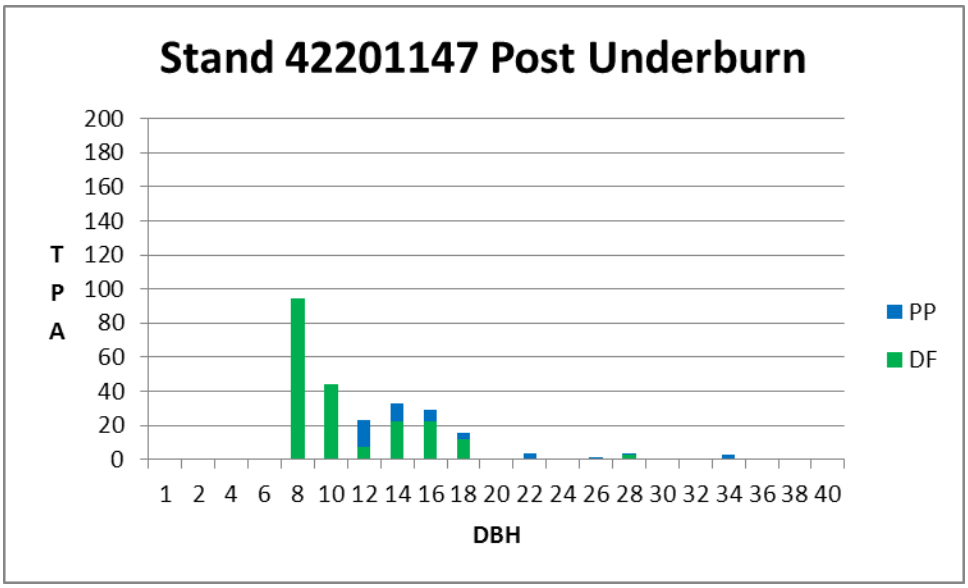

Figure 59. Stand 42201147 (Unit 81) post-underburn

Figure 60 displays the post-treatment diameter distribution for stand 42201152. Compared to the current condition (figure 54), the prescribed burn would reduce stocking up to the 18-inch d.b.h. class, above which the mortality would be slight. Post-treatment, the stand would still have about 53 TPA of which about 28 TPA would be greater than 19 inches d.b.h. and the stand would still be considered old growth (Green et al. 1992, errata corrected 2005, 2007, 2008).

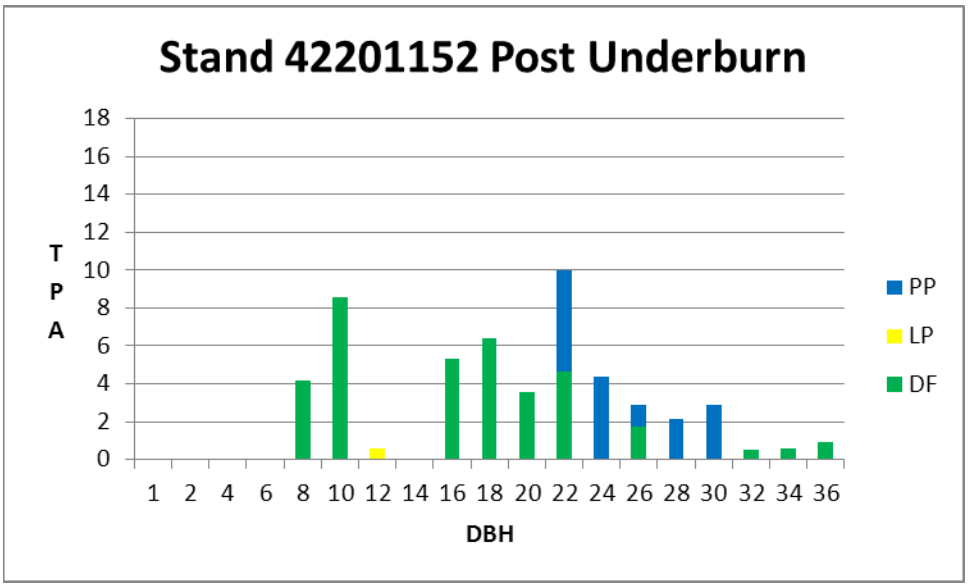

Figure 60. Stand 42201152 (Unit 81) post-underburn

Unit 2 is proposed under both action alternatives for prescribed burning with a low-severity fire. The proposed treatment can be expected to kill many small trees but very few large ones. Figure 61 displays the FVS-modeled post-treatment species composition and diameter distribution for Stand 41502089. The post-treatment diameter distribution, when compared with the current condition in figure 55 indicates that most, but not all, of the very small trees would be killed by the underburning with decreasing numbers of trees killed with increasing d.b.h. Above the 18-inch d.b.h. class mortality would be slight. The stand would have about 17 TPA greater than 17 inches d.b.h. following treatment and would still be considered multiple-canopy old growth.

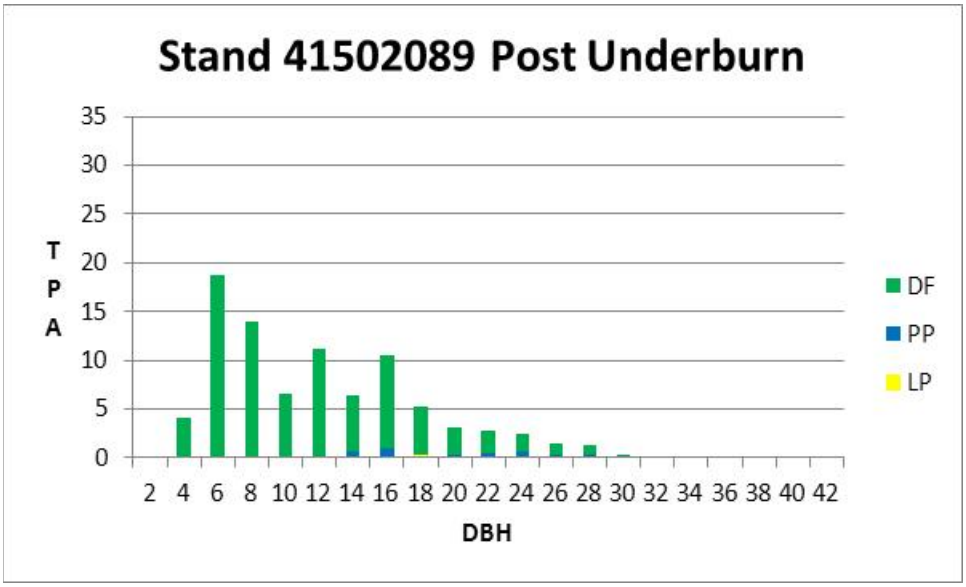

Figure 61. Stand 41502089 (Unit 2) post-underburn

Unit 46 is proposed under this alternative for an intermediate harvest in which both commercial and pre-commercial trees would be thinned, followed by a prescribed underburn as a fuels treatment. The proposed treatments can be expected to remove many small trees but very few large ones. Figure 62 and

figure 63 display the FVS-modeled post-treatment species composition and diameter distribution for Stand 42303130. Note that the scale for figure 62 is the same as in the current condition (figure 56) and the scale for figure 63 has been changed to better display the larger trees.

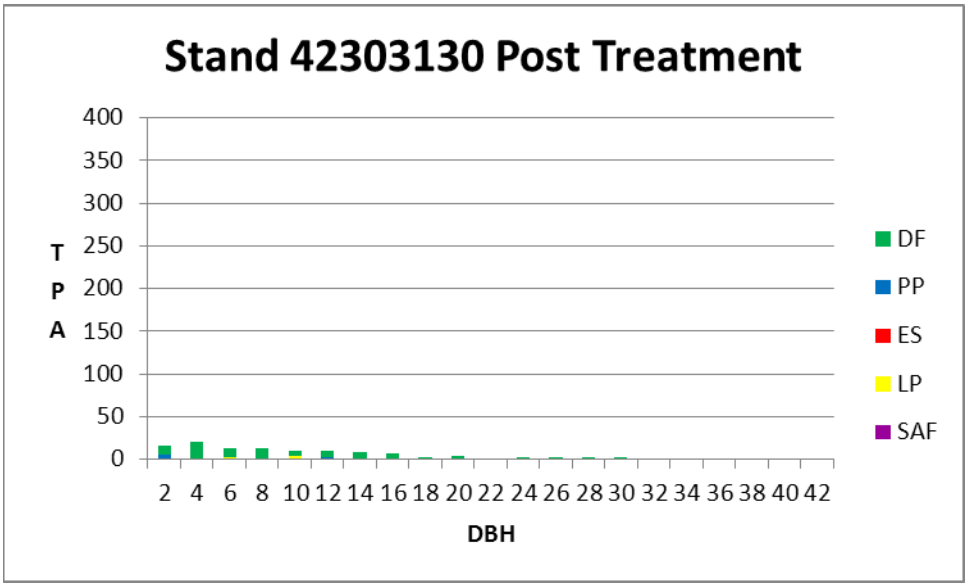

Figure 62. Stand 42303130 (Unit 46) post-treatment

The proposed treatments would remove many, but not all, of the small trees and would create an open stand with a relatively flat diameter distribution. Above the 18-inch d.b.h. class no trees would be removed and mortality from the underburn would be slight. Post-treatment the stand would have about 258 TPA with about 12 TPA greater than 17 inches d.b.h. (note: TPA less than 1 inch d.b.h. are not displayed). Following treatment it would still be considered multiple-canopy old growth.

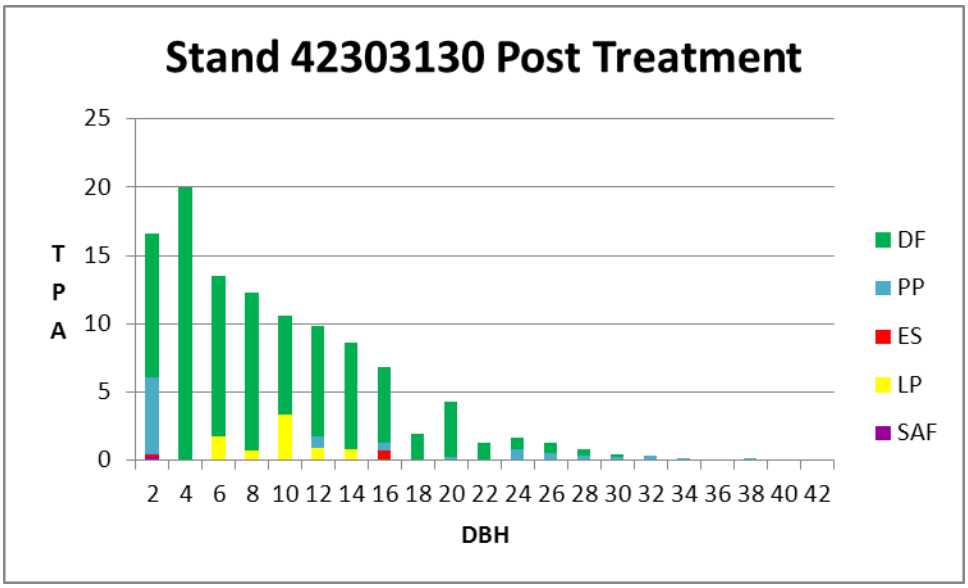

Figure 63. Stand 42303130 (Unit 46) post-treatment

Cumulative Effects

Snags

As mentioned above, the hazard reduction treatment would remove snags along area roads from about one percent of 3rd-order drainage 0203, two percent of drainage 0204A, and two percent of the project area. As described above, under alternative 2, snag levels would still be available at 21 to 24 times the Forest Plan minimum requirements. Cumulative effects would still be that level.

Old Growth

As discussed above, activities other than the Stonewall Vegetation Project that are or may occur within the project area would have no impact on old growth forests. Cumulative effects of this alternative would be as described above for the direct and indirect impacts.

Summary and Forest Plan Consistency

Snags

As discussed and displayed above, given the recent mountain pine beetle epidemic, snags in the project area are abundant and far exceed forest plan requirements. Under alternative 2, the intermediate and regeneration treatments would reduce snag levels to the forest plan requirements within the treatment units and the mixed-severity prescribed burns would increase snag levels within the burn units. After the treatments are done, snag levels would slightly decrease in the 3rd-order drainage 0203, slightly increase in the 3rd-order drainage 0204A, and slightly increase in the project area. They would still exceed 19 times the forest plan requirements.

Old Growth

As discussed and displayed above, no designated old growth in 3rd-order drainages would be treated under this project. Forest Plan direction regarding old growth would be met. Outside of the 3rd-order drainages, three stands (42201139, 42201147, and 42201152) that have old-growth characteristics would be prescribed burned; one stand that has been verified by a recent stand exam (41502089) would be prescribed burned, and one stand that has been verified by a recent stand exam (42303103) would be thinned and prescribed burned.

All of the stands proposed for treatment would be changed by the treatments, with species compositions “pushed” toward dominance by seral fire-tolerant conifers, and stand structures “pushed” to or toward open, but still multi-story, structures with relatively flat diameter distributions. Following treatments, these stands would still qualify as old growth.

Alternative 3

Snags

Snag numbers for alternative 3 would differ slightly from alternative 2, but given the magnitude of the recent mortality and the large number of snags within the analysis area, the difference would be slight. Table 60 displays the number of treatment acres for alternative 3 and percent of area within each 3rd-order drainage and the project area. If snag numbers are reduced to two snags/acre in the intermediate and regeneration treatments, and as modeled, increase by about 74 to 76 snags/acre in the moderate severity burns (modeled burn mortality minus ADS mortality), and don’t change in the rest of the project area, the average snag numbers would decrease to 41 snags per acre in drainage 0203, increase to 47 snags per acre in drainage 0204A, and increase to 48 snags per acre in the project area. Post-treatment snag numbers would still be about 21 to 24 times the Forest Plan minimum requirements.

Table 60. Alternative 3, acres and percent of area within 3rd-order drainage and project area by treatment classes

Treatment	Drainage/Project Area	Acres	Percent of Area
Intermediate and Regeneration	0203	716	15
	0204A	218	3
	Project Area	2,118	9
Prescribed Burning	0203	244	5
	0204A	1,046	15
	Project Area	4,445	19

Old Growth

In this alternative, Unit 81 would not be treated. The condition for Stands 42201139, 42201147, and 42201152 would remain as described above for the current condition and alternative 1.

Unit 2 would be treated the same under alternative 3 as alternative 2 and the effects would be the same as described above.

The treatment area for Unit 46 would remain the same, but treatments for most of Unit 46 would change. Unit 46 in alternative 3 is split into Unit 46a and 46b. Unit 46b (27 Acres) would have the same treatment as described above for alternative 2 Unit 46 with the same treatment effects. In Unit 46a, which includes 93 acres of Stand 42303130, the treatment would be modified and is referred to in the Stonewall Vegetation Project as “prescription Group 10.”

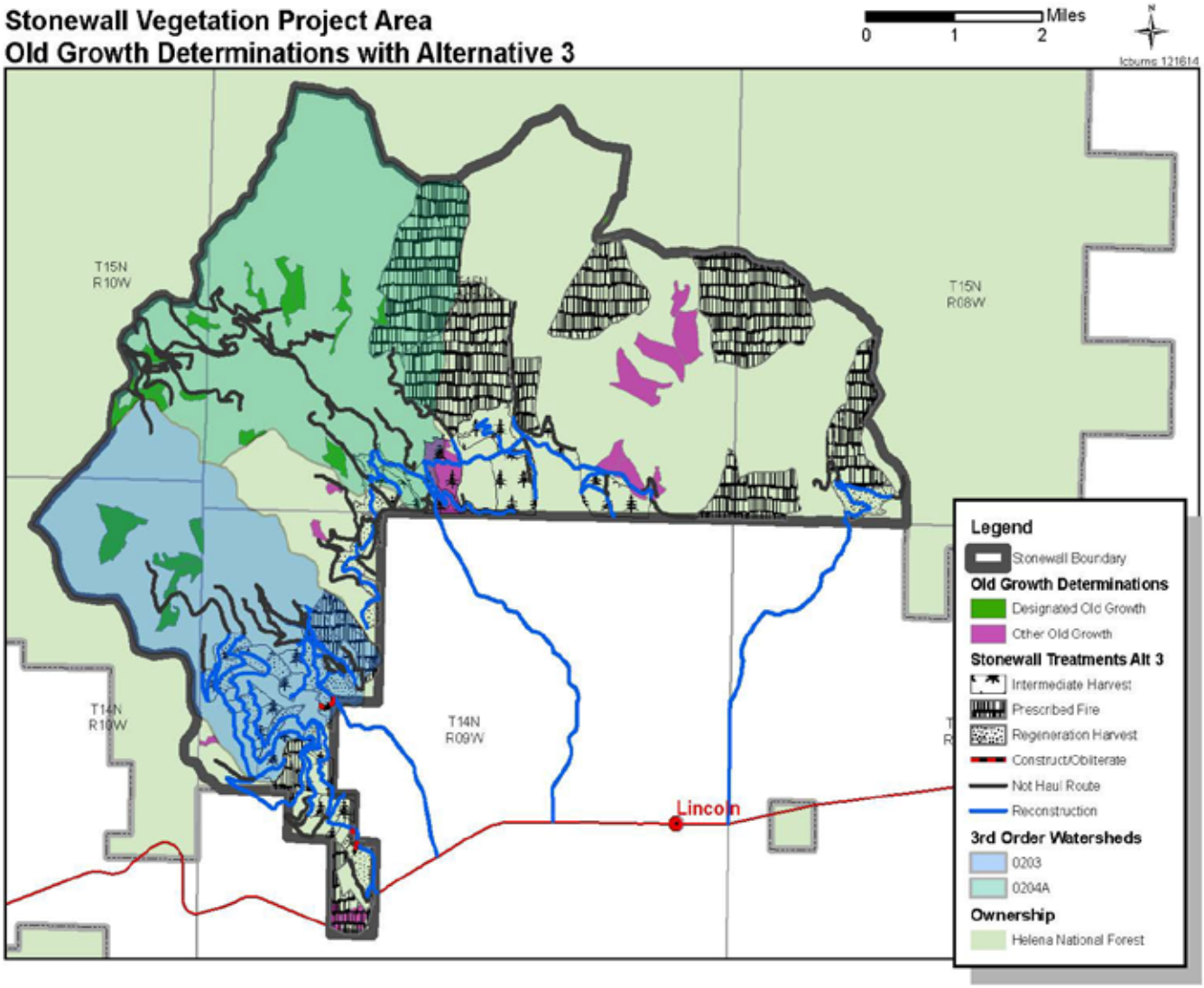

Figure 64. Alternative 3 Units and old-growth stands

Group 10. This group includes Units 46a and 47a. Treatments would be designed in a mosaic pattern to maintain cover and forage for wildlife while promoting ponderosa pine and aspen, and reducing ladder fuels. Portions of the stands would be thinned to: (1) reduce understory competition from around large ponderosa pine trees; (2) thin heavily-stocked groups of trees on sites historically dominated by ponderosa pine, and (3) remove conifer competition from within and around quaking aspen.

- To reduce understory competition around large ponderosa pine, and move areas toward or maintain multi-storied ponderosa pine structure, within 50 feet of ponderosa pine trees larger than 17 inches d.b.h. remove all but two trees. The retained trees should be of varied size and age classes.
- In areas dominated by ponderosa pine, but lacking live trees greater than 17 inches d.b.h., trees would be thinned to 48 to 109 trees per acre depending upon tree size.
- Ponderosa pine snags greater than 17 inches d.b.h. would be favored for retention to meet Forest Plan direction for snags.

- Conifers less than 17 inches d.b.h. would be removed up to 100 feet of existing aspen patches.
- Post-thinning, slash would be jackpot burned or hand-piled and burned to reduce fuels.
- Treatments would affect up to 50 percent of these units.

For Stand 42303130 in Unit 46a, up to one-half of the area (47 acres) would be thinned and the fuels reduced, the other one-half of the stand would not be treated. Note that this is the stand area not the unit area because the unit is composed of more than one stand. The post-treatment diameter distribution would be similar to that shown in figure 65 and figure 66. The scale for figure 65 is the same as shown above for the current condition (figure 56).

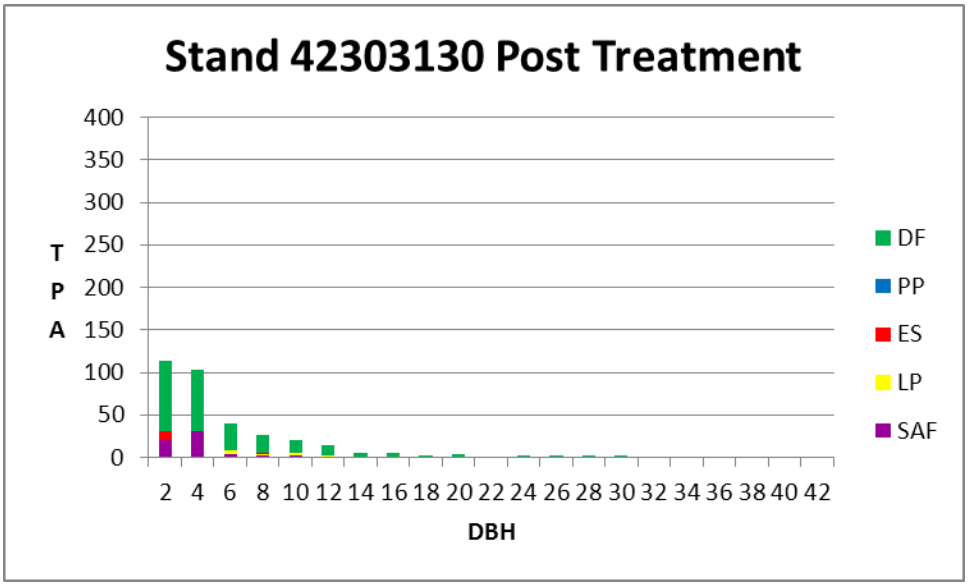

Figure 65. Stand 42303130 (Unit 46) post-treatment in alternative 3

The scale for figure 66 has been changed to better display the larger trees. The post-treatment stand would have 974 TPA with about 13 TPA greater than 17 inches d.b.h. In figure 65 and figure 66, about 632 TPA less than one inch in d.b.h. are not displayed. Post-treatment, the stand would still qualify as old growth.

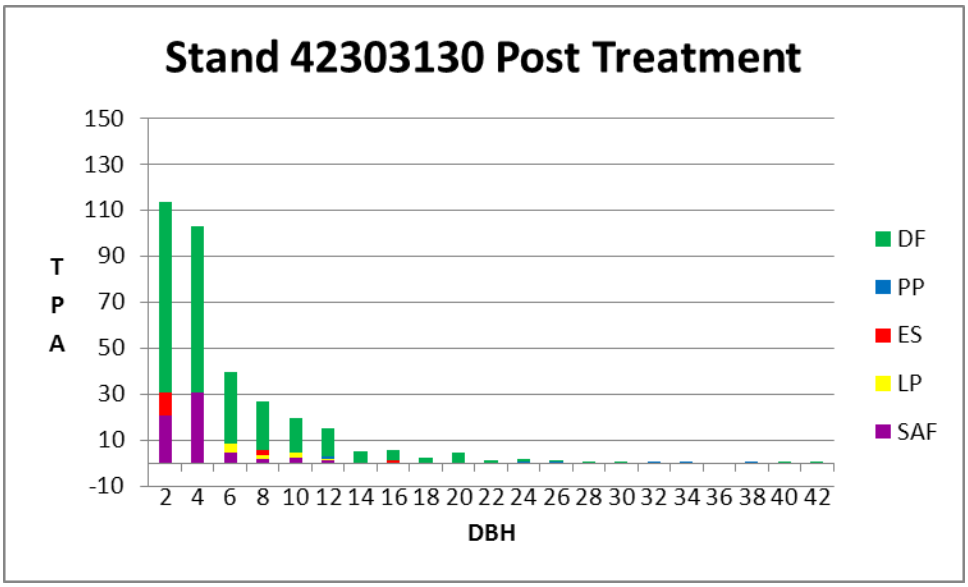

Figure 66. Stand 42303130 (Unit 46) post-treatment in alternative 3

Cumulative Effects

Snags

The hazard reduction treatment would remove snags from about 1 percent of 3rd-order drainage 0203, 2 percent of drainage 0204A, and approximately 2 percent of the project area. Considering the numbers of snags available accross the project area as a result of the mountain pine beetle epidemic, the hazard reduction represents a small amount of snag removal. As described above, under alternative 3, snag levels would still be available at 21 to 24 times the Forest Plan minimum requirements. Cumulative effects would still be that level.

Old Growth

As discussed above, activities other than the Stonewall Vegetation Project that are or may occur within the project area would have no impact on old growth forests. Cumulative effects of this alternative would be as described above for the direct and indirect impacts.

Summary and Forest Plan Consistency

Snags

Under alternative 3, the intermediate and regeneration treatments would reduce snag levels to the forest plan requirements and the prescribed burns would increase snag levels. After the treatments are done, snag levels would slightly decrease in the 3rd-order drainage 0203, slightly increase in the 3rd-order drainage 0204A, and slightly increase in the project area. They would still exceed 20 times the forest plan requirements.

Old Growth

As discussed and displayed previously, no designated old growth in 3rd-order drainages would be treated under this project. Forest Plan direction regarding old growth would be met. Outside of the 3rd-order drainages, one stand of old growth (41502089) would be prescribe burned, and one stand of old growth (42303103) would be partially thinned and the fuels burned.

Both stands proposed for treatment would be changed by the treatments, with species compositions "pushed" toward dominance by seral fire-tolerant conifers, and stand structures "pushed" toward open, but still multi-story, structures with flatter than current diameter distributions. They would still qualify as old growth following the treatment.

Wildlife

Introduction

This section analyzes impacts to wildlife and wildlife habitat from federal activities proposed in the Stonewall Vegetation Project (SVP) Environmental Impact Statement (EIS). It considers regulatory direction related to the wildlife resource, describes the current wildlife habitat conditions that exist within the Stonewall Vegetation Project area, and evaluates effects to federally proposed, threatened and endangered and regionally sensitive (sensitive) species, Helena National Forest (HNF) management indicator species (MIS) and migratory birds. Because wildlife distribution and use is determined by both site-specific and landscape-level conditions, a multi-scale analysis is presented that looks at specific stands proposed for treatment (fine filter analysis), as well as landscape considerations (coarse filter analysis) such as the availability of habitat within and adjacent to the project area. More information on federally listed threatened and endangered (TE) species can also be found in the Stonewall Vegetation Project Biological Assessment (BA)(Reitz 2013).

Regulatory Framework

The principle laws and management direction relevant to wildlife for this project include the; National Forest Management Act of 1976 (NFMA), the Endangered Species Act (ESA) of 1973, the Migratory Bird Treaty Act (MBTA) of 1918 (as amended), the Forest Service Manual (FSM 2600), Montana's Comprehensive Fish and Wildlife Strategy (2005), and the Helena National Forest Land and Resource Management Plan (Forest Plan) (USDA Forest Service 1986).

More information regarding this management direction is available in chapter 1. Forest Plan goals and objectives related specifically to wildlife are available in the Stonewall Vegetation Project Biological Assessment (Reitz 2013), which is available in the project record.

Method of Analysis

Analysis Process

National Forest Management Act (NFMA) regulations (1976) require that habitat be managed to support viable populations of native and desired nonnative vertebrates within the planning area (36 CFR 219.19). USDA regulation 9500-004, adopted in 1983, reinforces the NFMA viability regulation by requiring that habitats on national forests be managed to support viable populations of native and desired nonnative plants, fish, and wildlife. The following five-step process used in this analysis assesses changes in wildlife habitat and determines possible effects to viability:

Step 1: Pre-field Assessment - Once the initial proposed action was developed, information was collected to identify the wildlife present condition or affected environment. This information included aerial photos, GIS data, past timber sale activity, existing wildlife surveys, Forest and District monitoring data, and vegetation data and information on insect and disease related mortality.

Step 2: Field Assessment - Sites proposed for treatment were visited by a biologist(s). During this review, observations and incidental sign of wildlife were recorded, and habitat conditions identified in the pre-field assessment were validated.