Mitchell Jackson Project Area
Lincoln County, Montana

Final Engineering Evaluation/Cost Analysis

Contracts W9128F20D0019 and W9128F23F0120

July 2024

Prepared for:

U.S. Department of Agriculture Forest Service, Northern Region
26 Fort Missoula Road
Missoula, MT 59804

Prepared by:

North Wind-CDM Advantage JV, LLC
1425 Higham Street
Idaho Falls, ID 83402

Under Contract to:

U.S. Army Corps of Engineers, Omaha District
1616 Capitol Avenue
Omaha, NE 68102

Table of Contents

List of Exhibits

List of Figures

List of Tables

Appendices

List of Acronyms and Abbreviations

ABS	activity-based sampling
Advantage JV	North Wind-CDM Advantage JV, LLC
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
BMP	best management practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DEQ	Montana Department of Environmental Quality
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
f/cc	fibers per cubic centimeter of air
Grace	W.R. Grace and Company
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IFTDSS	Interagency Fuels Treatment Decision Support System
kg/m^3	kilograms per cubic meter
kV	kilovolt
LA	Libby amphibole asbestos
MCL	maximum contaminant level
MWH	MWH Americas, Inc.
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFS	National Forest System
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NTCRA	non-time-critical removal action
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCM	phase contrast microscopy
PCME	phase contrast microscopy-equivalent
PLM-VE	polarized light microscopy – visual area estimation
PPE	personal protective equipment
PRSC	post-removal site control
RAO	removal action objective
RI	remedial investigation
Site	Mitchell Jackson Project Area
SNOTEL	snow telemetry
STEL	short-term exposure limit
TBC	to be considered information
TCRA	time-critical removal action
TEM	transmission electron microscopy
TWA	time-weighted average
USACE	U.S. Army Corps of Engineers

U.S.C.	United States Code
USFS	U.S. Department of Agriculture Forest Service
USFWS	U. S. Fish and Wildlife Service
UTV	utility task vehicle
°F	degree Fahrenheit
%	percent
=	equal to

Executive Summary

Introduction and Purpose

The U.S. Army Corps of Engineers (USACE) Omaha District tasked the North Wind-CDM Advantage JV, LLC (Advantage JV) to support the U.S. Department of Agriculture Forest Service (USFS) for a non-time-critical removal action (NTCRA) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) for the Mitchell Jackson Project Area (referred to herein as the site) in the Kootenai National Forest of northwest Montana. This engineering evaluation/cost analysis (EE/CA) report for the site, which surrounds Operable Unit (OU) 3 of the Libby Asbestos Superfund Site, was developed under Contracts W9128F20D0019 and W9128F23F0120 to support the NTCRA.

The EE/CA was prepared in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (U.S. Environmental Protection Agency [EPA] 1993). In addition, the cost estimates developed for analysis of each removal action alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000b).

The purpose of the EE/CA is to document the environmental review and removal action selection process and provide a framework for evaluating and selecting alternative approaches. The EE/CA identifies removal action objectives (RAOs) of the NTCRA and analyzes the effectiveness, implementability, and cost of removal action alternatives that may be used to satisfy the RAOs. Results of the EE/CA, along with the response decision, will be summarized in an Action Memorandum after review and response to public comments on the EE/CA.

Site Location

The site generally encircles the former Libby Vermiculite Mine that is within OU3 of the Libby Asbestos Superfund Site. The site is located east-northeast of Libby, Montana, in Lincoln County along Montana Highway 37 (Figure 2-1). The interior boundary of the site is the current Libby Asbestos Superfund Site OU3 boundary. An interdisciplinary USFS team developed the exterior boundaries based on topography and geographical features (ridges, water bodies, and roads), fire modeling efforts, and assessment of fuels[1] conditions influencing the potential for wildland fire start, intensity, and movement into OU3.

Site History

Prospectors first located vermiculite deposits in the early 1900s on Rainy Creek northeast of Libby. Vermiculite was mined from the early 20th century to the early 1990s. The vermiculite deposit at the mine also contains an assemblage of amphibole asbestos minerals, including (in order of decreasing abundance) winchite, richerite, and tremolite, with lower levels of magnesio-riebeckite, edenite, and magnesio-arfvedsonite (Meeker et al. 2003), which are referred to collectively as Libby amphibole asbestos (LA). Over time, vermiculite became a product used in

[1] Fuels are defined as combustible wildland vegetative materials, living or dead.

insulation, feed additives, fertilizer/soil amendments, construction materials, absorbents, and packing materials. Many people used vermiculite products and off-specification materials for insulation in their houses in Libby and soil additives in their gardens. In 1963, W.R. Grace and Company (Grace) bought the former Libby Vermiculite Mine and associated processing facilities and operated them until 1990. Operations at the former Libby Vermiculite Mine included blast and drag-line mining and milling of the ore. Dry milling was done through 1985, and wet milling was done from 1985 until closure in 1990. Before its closure in 1990, the Libby Vermiculite Mine produced approximately 80 percent (%) of the world's supply of vermiculite.

Since 1999, EPA has been conducting response actions at the Libby Asbestos Superfund Site to address the unprecedented human health impacts associated with widespread contamination in and near the cities of Libby and Troy, Montana. The Libby Asbestos Superfund Site was listed on the Superfund National Priorities List in 2002 and consists of eight OUs. Investigation and cleanup were completed in 2018, except for OU3, for which a feasibility study is currently in progress.

The subject of this EE/CA, the site, generally encircles but is not part of OU3 (or any OU) of the Libby Asbestos Superfund Site.

Site Features

The site is a forested area east-northeast of Libby, Montana, on National Forest System (NFS) lands generally surrounding OU3 of the Libby Asbestos Superfund Site. The site is generally mountainous and comprised of several drainages. Elevations at the site range from approximately 2,080 feet above mean sea level (amsl) on the Kootenai River to 6,040 feet amsl on Blue Mountain.

NFS roads primarily facilitate motorized vehicle access, which enable USFS to respond to wildland fires. In total, the site includes 163.8 miles of existing system roads under differing jurisdictions, including roads that cross in and out of OU3 from NFS lands that may be used for access. Of these, 60% are NFS roads, 6% are state highways, 3% are county roads, and 29% are private roads. NFS roads in the site are a combination of yearlong open, seasonally open, yearlong gated, and barriered roads.

There are 26.5 miles of recreational trails in the site, 95% of which are on USFS-managed lands. These trails include 2.2 miles of the Rainy Divide trail that crosses through OU3. Several miles of the Rainy Divide trail and part of the Alexander Mountain trail follow along the ridge at or near the OU3 boundary in the eastern portion of the site.

An electric bulk power transmission line (115 kilovolts [kV]) runs through the center and southern portions of the site and also passes through OU3.

Historically and culturally significant features associated with Native Americans as well as historical logging operations are located within the site or in adjacent areas.

Existing Vegetation

The site is heavily vegetated. Assessment of current vegetation conditions occurred during summer and fall 2022. Biophysical settings on NFS lands within the site were characterized as follows: 3% as subalpine (717 total acres) along the northern ridgeline and in the middle of the Alexander Inventoried Roadless Area, 19% as warm/moist (3,860 acres), and 78% as warm/dry (16,043 acres). Warm/moist areas are typically found in the northern part of the site, on northern aspects, or in draws. Warm/dry areas comprise most of the southern half of the site and on southern aspects throughout.

Current conditions consist of overstocked stands dominated by Douglas-fir trees with a minority of ponderosa pine and western larch. This predominance of Douglas-fir and areas of high stem densities contribute to the presence of insects and disease. Within the site, root diseases, dwarf mistletoe, Douglas-fir beetle, and western pine beetle are the most common and destructive forest diseases and insects.

Wildland Fire Conditions and Occurrence

The generally heavily forested lands described above are found within and around the site and OU3. Some forest stands contain large amounts of surface, ladder, or canopy fuels, or a combination of fuel types. This existing fuels condition is the result of past land management practices and wildland fire suppression efforts, limited access because of human health risk concerns to forest workers from exposures to LA, changes in forest species composition, competition among trees for limited sunlight and other resources, and occurrence of root diseases and insects.

The predominance of Douglas-fir and areas of high stem densities also contribute to the potential for high-intensity wildland fire. Ponderosa pine and western larch are fire-adapted tree species; however, these forests have become more susceptible to wildland fire because of the accumulation of fuels. In addition, because of prevailing winds from the west/southwest, this forest condition presents the greatest concern for potential wildland fire movement into OU3.

Historically, the site experienced frequent low, mixed, and stand-replacing wildland fire severities across the landscape. Wildland fire suppression activities have contributed largely to missed wildland fire cycles over the past century, leading to an accumulation of fuels. Past regeneration harvesting has created blocks of regeneration that are smaller and more uniform than would have occurred under natural wildland fire regimes, which occurred over larger areas and left residual live tree patches and scattered fire-tolerant large live trees. In addition, routine fuels management practices, including harvest, were limited since the early to mid-2000s because the site was part of the OU3 Study Area to investigate the nature and extent of LA contamination.

There have been 76 wildland fires within the site between 1986 and 2021, burning more than 150 acres. Humans were responsible for starting 28% of the wildland fires while lightning caused most (72%).

As detailed in Appendix A-2, Interagency Fuels Treatment Decision Support System (IFTDSS) fire modeling indicates that 73% of the site would exhibit surface fire flame lengths greater than 4 feet under extreme burning conditions (modeled using a 97th percentile day to represent a

worst-case scenario). Another measure of fire susceptibility is canopy base height, which is the lowest aboveground height with enough canopy fuel to transition a fire from surface fuels into the tree crowns. About 82% of the site has a canopy base height of less than 3 feet, illustrating high connectivity between the surface and ladder fuels. Canopy bulk density is a measure of canopy fuel and denser canopies that enable fire spread. This is also a feature of the site, with 93% of the site area characterized by canopy bulk densities greater than 0.05 kilograms per cubic meter (kg/m^3). These conditions suggest that 67% of the site would support crown fire which can cause extreme fire behavior, long-range spotting, rapid-fire growth, and make control impossible until the weather changes or the fire reaches an area with less fuels or topography less favorable to spread.

These conditions would likely prevent direct attack by firefighters, meaning suppression efforts would require indirect tactics using mechanized equipment and aviation resources. Relative to indirect attack, direct attack fire suppression tactics minimize acres burned and shortens wildland firefighter duration and time commitment. In addition, direct attack is safter because it allows wildland firefighters to work immediately adjacent to the fire, which allows them to monitor fire behavior and escape into burned areas ("one foot in the black"). By contrast, indirect attack means firefighters are far removed from the fire for control options ("not seeing the fire") and places unburned fuel between them and the fire. These conditions violate two of the "18 Watchout Situations" for firefighter safety (National Wildfire Coordinating Group 2022).

As described in the Montana Climate Assessment, precipitation patterns are likely to shift to more precipitation in spring and less in summer, thereby lengthening the fire season. As such, there is increased probability of wildland fire, including increased size, frequency, intensity, and severity expected in the coming century. Rising temperatures and water stress are also likely to increase bark beetle survival and general tree mortality related to pathogen activity (Whitlock et al. 2017).

Without vegetation and fuels management, wildland fire hazard would increase over time as stand conditions continue to deteriorate in the analysis area because of overstocked stands, insects, disease, and wind. Eventually, wildland fires have a greater chance to burn in large continuous patch sizes because of the lack of breaks in the forest canopy and heavy fuel loading. This puts homes and private property at risk and increases the likelihood of spread into OU3 and the potential release of LA from source media (e.g., soil, bark, duff, and post-fire ash).

Human Health and Ecological Risk Assessment

Much of the site was within the boundary of the OU3 Study Area, the area evaluated in the Remedial Investigation (RI) and Human Health Risk Assessment (HHRA) to determine the extent of LA contamination around the former Libby Vermiculite Mine and establish the current OU3 boundary in 2017. The Final HHRA (EPA 2015) and Addendum (EPA 2018) quantify potential human health risks from exposure to LA in the OU3 Study Area and within OU3, respectively, after the delineation of the current OU3 boundary in 2017. More than 150 different exposure scenarios were evaluated as part of the risk assessment. To ensure protectiveness in consideration of cumulative exposures, an exposure scenario hazard quotient (HQ) value of 0.6 was identified as the threshold for identifying individual exposure scenarios that had the potential to contribute to unacceptable risks (MWH Americas, Inc. [MWH] 2016). The OU3 boundary was developed in consideration of the HQs for activity-based sampling (ABS) areas

throughout the forested area surrounding the mine. Outside OU3, the site for this EE/CA, LA contamination is not present at concentrations in site environmental media (e.g., soil, duff, and post-fire ash[2]) posing unacceptable human health risks when disturbed. However, within OU3, several LA exposure scenarios for forest workers, including wildland firefighters, estimated HQs greater than 0.6 for one or more ABS areas (EPA 2015). The risk of LA exposure to wildland firefighters in OU3 justifies this NTCRA to reduce the likelihood of intense wildland fire spreading from the site into OU3.

An ecological risk assessment indicated that ecological receptors (fish, benthic macroinvertebrates, amphibians, mammals, and birds) are unlikely to be adversely impacted by LA released to the environment from previous mining activities (EPA 2014).

Determination of Removal Action Scope

The general objective of a removal action, in accordance with CERCLA and the NCP, is to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release of hazardous substances or pollutants or contaminants to the environment.

The scope of the EE/CA is limited to wildland fire mitigation activities for USFS and contractor personnel at the site. The goal of the NTCRA is to modify fuels conditions that influence fire intensity across the landscape, thereby reducing the potential for wildland fire to spread into OU3 and the corresponding exposure and migration risks in OU3 from LA released from contaminated source media (e.g., soil, duff, and post-fire ash). This NTCRA is considered an early response action because the remedial action being led by EPA is expected to reduce the remaining exposure and migration risks from LA contamination in OU3 to acceptable levels for adequate protection of human health and the environment.

Removal Action Objectives

The following RAOs have been identified for this EE/CA:

1. Reduce fuels available at the site using vegetation management activities to lower wildland fire intensity and spread into the adjacent OU3, which could reduce exposure of wildland firefighters to LA released from contaminated soil, duff, or ash during and after a wildland fire.
    - *Rationale: There are identified unacceptable risks to wildland firefighters from exposure to LA within OU3 during understory burn dry mop-up as presented in the HHRA (EPA 2015).*
2. Reduce fuels available at the site using vegetation management activities to lower wildland fire intensity and spread into the adjacent OU3, which could reduce erosion and overland flow of LA-contaminated soil, duff, or ash to surface water during and after a wildland fire.

[2] Bark was investigated as part of the OU3 RI. However, it will not be discussed further in the EE/CA except as a contribution of LA to post-fire ash within OU3.

   - *Rationale: Following wildland fires in OU3, the post-fire ash containing LA (as well as contaminated soil and duff in the burned areas) is susceptible to redistribution and transport by erosion and runoff after precipitation events, thereby increasing the potential for migration of LA to nearby surface water bodies.*

3. Modify road networks in the site to limit human-caused fire starts and maintain or improve firefighter response to wildland fires to lower wildland fire intensity and spread into the adjacent OU3, which could reduce exposure of wildland firefighters to LA released from contaminated soil, duff, or ash during and after a wildland fire.

   - *Rationale: There are identified unacceptable risks to wildland firefighters from exposure to LA within OU3 during understory burn dry mop-up as presented in the HHRA (EPA 2015).*

4. Modify road networks in the site to limit human-caused fire starts and maintain or improve firefighter response to wildland fires to lower wildland fire intensity and spread into the adjacent OU3, which could reduce erosion and overland flow of LA-contaminated soil, duff, or ash to surface water during and after a wildland fire.

   - *Rationale: Following wildland fires in OU3, the post-fire ash containing LA (as well as contaminated soil and duff in the burned areas) is susceptible to redistribution and transport by erosion and runoff after precipitation events, thereby increasing the potential for migration of LA to nearby surface water bodies.*

Identification and Description of Removal Action Alternatives

The following removal action alternatives were identified for evaluation in this EE/CA:

- Alternative 1: Vegetation and Transportation Management Activities Using the Existing Road System
- Alternative 2: Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System

The subsections that follow present a brief description of each removal action alternative.

Alternative 1: Vegetation and Transportation Management Activities Using the Existing Road System

Alternative 1[3] would address the RAOs through a combination of vegetation and transportation management activities within the site. The vegetation management activities would modify fuels conditions to lower the wildland fire intensity in the site. Transportation management activities would limit human-caused fire starts, maintain or improve firefighter response to wildland fires within the site, and facilitate vegetation management activities.

[3] Alternative 1 is referred to as Alternative 3 in USFS documents associated with this project, including the fire modeling analysis in Appendix A. However, it is herein referred to as Alternative 1.

Alternative 1 includes a variety of vegetation management activities complemented by transportation management activities using the existing road system. Harvest vegetation management activities include clearcut with reserves, seed tree, shelterwood, commercial thinning, and improvement harvests. Harvest-related fuels management activities include mastication, underburning, and piling combined with burning or mastication. Some units proposed for harvest vegetation management activities are near streams. Unit boundaries would be adjusted during layout to exclude riparian corridors based on ground conditions. Harvest would not occur in riparian habitat conservation areas.

Other vegetation management activities proposed for Alternative 1 include pre-commercial thinning, slashing, and underburning. Fuels management in these units also includes mastication, underburning, and piling combined with burning. Noxious weed management activities are proposed, primarily along roads but also in off-road locations and along the 115 kV power transmission line. In addition, Alternative 1 proposes the use of drones to map cheatgrass population, primarily in the Alexander Inventoried Roadless Area and along the northern boundary with OU3. Access for proposed vegetation management activities would be facilitated by yearlong open, seasonally open, and yearlong gated roads. Temporary road construction would be used to access vegetation management units, as needed, but there would be no construction of new NFS roads. Use of the existing road system would require the realignment of 0.5 miles of the existing Lower Rainy Road[4] and 3.6 miles of temporary roads. In addition, 2.1 miles of undetermined roads, existing roads from an unknown past action or illegally created by users, would be added as NFS roads to support the proposed vegetation management and wildland fire response activities. Commercial removal of timber proposed in Alternative 1 would use a total of 98.4 miles of haul routes, 92 miles of which are NFS roads. Additional transportation management activities would be implemented to manage access for wildland fire response, change public motorized access to reduce the likelihood of human-caused fire starts, and to manage resources.

Alternative 2: Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System

Similar to Alternative 1, Alternative 2[5] would address the RAOs through a combination of vegetation and transportation management activities within the site. The vegetation management activities would modify fuels conditions to lower the wildland fire intensity in the site. Transportation management activities would limit human-caused fire starts, maintain or improve firefighter response to wildland fires within the site, and facilitate vegetation management activities.

Just as for Alternative 1, harvest vegetation management activities include clearcut with reserves, seed tree, shelterwood, commercial thinning, and improvement harvests. Proposed new NFS road construction allows for more vegetation management activities being proposed for Alternative 2 than Alternative 1, particularly in the warm and dry areas in the western part of the site. Because

[4] Lower Rainy Road is NFS road 4755, not to be confused with the paved road to the former Libby Vermiculite Mine known as Rainy Creek Road.

[5] Alternative 2 is referred to as Alternative 4 in USFS documents related to this work, including the fire modeling analysis in Appendix A. However, for purposes of the EE/CA it is herein referred to as Alternative 2.

of the high density of ladder fuels in this area and location along the OU3 boundary in the direction of general prevailing winds, vegetation management activities in this part of the site are considered particularly critical to reduce the likelihood of wildland fire to potentially move into OU3. Some units proposed for harvest vegetation management activities are near streams. Unit boundaries would be adjusted during layout to exclude riparian corridors, based on ground conditions. Harvest would not occur in riparian habitat conservation areas.

Other vegetation management activities proposed for Alternative 2 include pre-commercial thinning, slashing, and underburning. The same units proposed for pre-commercial thinning in Alternative 1 are also proposed for Alternative 2, with some mechanical thinning in the northern area of the site near proposed harvest units. Proposed hand slashing in the northern and eastern areas of the site are like those proposed for Alternative 1, with additional units in the western parts of the site. Some mechanical slashing is proposed in the north and east near proposed harvest units, and one unit is proposed near Blue Mountain. In Alternative 2, hand slashing is also proposed along the northern boundary with OU3, another critical location. Fuels management in these units also includes mastication, underburning, and piling combined with burning.

The same noxious weed management activities proposed for Alternative 1 are proposed for Alternative 2, which would occur primarily along roads but also in off-road locations and along the 115 kV power transmission line. The use of drones is proposed to map cheatgrass population, primarily in the Alexander Inventoried Roadless Area and along the northern boundary with OU3.

Just as proposed for Alternative 1, access for vegetation management activities proposed for Alternative 2 would be facilitated by yearlong open, seasonally open, and yearlong gated roads. Alternative 2 would similarly use temporary roads (4.3 miles), the realignment of 0.5 miles of the existing Lower Rainy Road, and 2.1 miles of undetermined roads added to the NFS to support the proposed vegetation management and wildland fire suppression activities. However, in addition to the transportation management activities proposed in Alternative 1, Alterative 2 also proposes the construction of new roads for permanent inclusion in the NFS and the use of currently barriered NFS roads, which allows for more vegetation management activities to be proposed. A total of 8.3 miles of new NFS roads are proposed, primarily in the western part and one road in the eastern part of the site, as well as the use of 4.1 miles of currently barriered roads (no wheeled motorized use) to allow administrative use for the implementation of vegetation management activities. Commercial removal of timber proposed in Alternative 2 would use a total of 117.6 miles of haul routes, 108.9 miles of which are NFS roads. Additional transportation management activities would be implemented to manage access for wildland fire response, change public access to reduce the likelihood of human-caused fire starts, and to manage resources.

Detailed Analysis and Comparative Analysis of Removal Action Alternatives

These removal action alternatives are evaluated and compared using the criteria specified in EPA's *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA 1993). This EE/CA evaluates the two removal action alternatives against the short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost, as well their subcriteria. Exhibit ES-1 presents the results of the detailed analysis for each removal action alternative to allow a

comparative analysis of the alternatives and identify the key trade-offs between them as presented in the EE/CA.

Recommended Removal Action Alternative

Taking into consideration the evaluation criteria presented in this EE/CA, the recommended removal action alternative for the site is Alternative 2: Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System. Both alternatives propose many of the same vegetation and transportation management activities, but the greater quantity of vegetation management activities and the construction of new NFS roads proposed in Alternative 2 more comprehensively address uncertainties related to environmental conditions at the site with respect to achieving the RAOs. The greater quantity of acres proposed for vegetation management activities in Alternative 2 would further modify fuels levels to lower the potential for the start and spread of intense wildland fires in the site. The transportation management activities proposed in Alternative 2, particularly the construction of new NFS roads, would maintain and improve wildland firefighter response within the site and facilitate the implementation of vegetation management activities, as well as limit human-caused fire starts through access controls. As such, increased quantities of activities proposed in Alternative 2 would further reduce the potential for the start and spread of wildland fires from the site into OU3, thereby further reducing the potential for unacceptable human health risks of wildland firefighter exposure to LA and migration of LA-contaminated media (e.g., soil, duff, and post-fire ash) to surface water.

Alternative 2 has higher long-term effectiveness and permanence than Alternative 1 because of the greater quantity of proposed vegetation and transportation management activities, most of which would occur in the critical western part of the site. Because of the prevailing wind direction, warm/dry biophysical setting, and buildup of fuels in this area—including locations along the OU3 boundary—there is greater likelihood of the start and spread of intense wildland fire from this part of the site into OU3 and therefore, greater need for vegetation management activities in this area. Alternative 2 also proposes slashing (by hand) along the northern OU3 boundary, which is adjacent to the ABS area within OU3 with the highest HQ value. The greater extent of transportation management activities proposed in Alternative 2, including new roads, would not only facilitate access for proposed vegetation management activities, but also improves access for wildland fire response. The new roads will also provide greater reliability for uncertainties if some roads become temporarily unusable because of fire, flood, or other factors.

Wildland fire behavior is a function of many factors beyond a forest manager's control, including temperature, humidity, and wind direction, meaning there is inherent uncertainty and randomness that influence fire intensity and spread. However, the greater extent of vegetation management and transportation management activities proposed in Alternative 2, particularly in critical locations in the western portion of the site, would further mitigate the likelihood of wildland fire spread into OU3 and the associated unacceptable exposure and migration risks from LA within the forested portions of OU3.

The subcriteria of Short-Term Effectiveness, Technical Feasibility, Administrative Feasibility, and Availability of Services are not substantially different between Alternatives 1 and 2. The most challenging risks come from the small segments of road construction and improvements in OU3; Alternative 2 proposes a small quantity of additional road work in OU3 requiring a corresponding

increase in the quantity of mitigation activities to minimize worker exposure to LA. However, the types of mitigation activities, with which USFS is already familiar, are the same for each alternative. Both removal action alternatives would comply with ARARs. While the cost of Alternative 2 is higher than Alternative 1, the increase in cost is considered proportional to the higher effectiveness for Alternative 2.

The added level of overall effectiveness based on Long-Term Effectiveness and Permanence subcriterion for Alternative 2 over Alternative 1 (Exhibit ES-1) given the similar outcomes for the other evaluation criteria justifies identifying Alternative 2 as the recommended removal action alternative for this NTCRA.

Exhibit ES-1 Summary of Comparative Analysis for Removal Action Alternatives

Removal Action Alternative	Description	Effectiveness					Implementability					Cost
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Technical Feasibility	Administrative Feasibility	Availability of Services and Materials	Support Agency Acceptance	Community Acceptance	Present Value Cost (Dollars)
1	Vegetation and Transportation Management Activities Using the Existing Road System	Acceptable	Will Comply	Moderate	None	Moderate to High	Moderate to High	High	Moderate to High	**NE**	**NE**	$34,721,000
2	Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System	Acceptable	Will Comply	Moderate to High	None	Moderate to High	Moderate to High	High	Moderate to High	**NE**	**NE**	$43,819,000

Notes

1. Appendix D presents the detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative used to arrive at the present value cost identified in the exhibit.
2. Costs are based on a 15-year period of analysis.

Legend for Qualitative Ratings System:

Effectiveness and Implementability

Overall Protection of Human Health and the Environment

- Unacceptable
- Acceptable

Compliance with ARARs

- None
- Will Comply

For Remaining Criteria

- None
- Low
- Low to Moderate
- Moderate
- Moderate to High
- High
- NE (Not Evaluated)

Cost

Present Value Cost in Dollars

This page intentionally left blank.

Section 1
Introduction

The U.S. Army Corps of Engineers (USACE) Omaha District tasked the North Wind-CDM Advantage JV, LLC (Advantage JV) to support the U.S. Department of Agriculture Forest Service (USFS) for a non-time-critical removal action (NTCRA) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) for the Mitchell Jackson Project Area (referred to herein as the site) in the Kootenai National Forest of northwest Montana. This engineering evaluation/cost analysis (EE/CA) report for the site, which surrounds Operable Unit (OU) 3 of the Libby Asbestos Superfund Site, was developed under Contracts W9128F20D0019 and W9128F23F0120 to support the NTCRA.

1.1 USFS Authority and Justification for NTCRA

USFS is authorized under CERCLA, 42 United States Code (U.S.C.) Section 9601 et seq., to respond as the lead agency to a release or threatened release of hazardous substances and/or a release or threatened release of any pollutant or contaminant that may present an imminent and substantial danger to public health or the environment on USFS-managed land. USFS does not have a cooperative agreement pertaining to this NTCRA, and this NTCRA is not operating pursuant to a contract executed under section 104(d)(1) of CERCLA or pursuant to a Superfund Memorandum of Agreement. Therefore, a support agency has not been identified for this NTCRA.

CERCLA's implementing regulations, codified in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, establishes the framework for responding to such releases and threatened releases. The NCP prescribes two processes for responding to releases: removal actions and remedial actions (NCP Sections 300.400 through 300.440). Previous investigations have led to the determination that the site presents a current or potential threat to public health or welfare or the environment, and that an NTCRA is appropriate at the site, according to 40 CFR, Section 300.415(b). This determination was formalized in an EE/CA Approval Memorandum, signed on February 20, 2024, by Leanne M. Marten (Regional Forester, Northern Region) and is included in the administrative record for the site (USFS 2024).

The EE/CA was prepared in accordance with the NCP and the *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (U.S. Environmental Protection Agency [EPA] 1993). In addition, the cost estimates developed for analysis of each removal action alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000b).

1.2 EE/CA Purpose and Scope

The purpose of an EE/CA is to document the environmental review and removal action selection process and provide a framework for evaluating and selecting alternative approaches. The EE/CA identifies the removal action objectives (RAOs) of the NTCRA and analyzes the effectiveness, implementability, and cost of removal action alternatives that may be used to satisfy the RAOs.

Results of the EE/CA, along with the response decision, will be summarized in an Action Memorandum after review and response to public comments on the EE/CA. Section 300.415 (b)(4)(i) of the NCP requires completion of an EE/CA for all NTCRAs.

This EE/CA was prepared to support the selection of a removal action alternative for the implementation of an NTCRA for the site. The risks of LA exposure to wildland firefighters and migration of LA-contaminated media to surface water from an intense wildland fire spreading from the site into OU3 justifies this NTCRA. Therefore, for purposes of this EE/CA, the focus of the NTCRA is wildland fire mitigation activities related to Libby amphibole asbestos (LA). These activities use vegetation and transportation management strategies to mitigate the potential impacts of wildland fire starts within the site. If fires were to spread from the site into OU3, there could be unacceptable human health risks from LA exposures and the increased potential for migration of LA to nearby surface water bodies.

Wildland fire suppression—the actions taken once a wildland fire start occurs and after the initial response—is outside the scope of this EE/CA. This EE/CA does not support a decision whether USFS would engage in suppressing a wildland fire at the site or the adjacent OU3 of the Libby Asbestos Superfund Site. That decision is specific to each wildland fire and will be determined by USFS on a case-by-case basis after thorough evaluation of all factors, which include public and firefighter safety, wildland fire location and behavior, weather forecasts, and resource availability.

1.3 EE/CA Organization

The EE/CA report is organized as follows:

- **Executive Summary** – Summarizes the content of this EE/CA report.
- **Section 1, Introduction** – Discusses the purpose and organization of the EE/CA report.
- **Section 2, Site Characterization** – Summarizes site characterization and presents the nature and extent of contamination associated with the NTCRA.
- **Section 3, Removal Action Scope, Goals, and Objectives** – Presents the removal scope, schedule, and RAOs for the NTCRA.
- **Section 4, Identification and Analysis of Removal Action Alternatives** – Identifies removal action alternatives that may be used to satisfy the RAOs and evaluate the effectiveness, implementability, and cost of the alternatives.
- **Section 5, Comparative Analysis of Removal Action Alternatives** – Conducts a comparative analysis of removal action alternatives to each other with respect to effectiveness, implementability, and cost.
- **Section 6, Recommended Removal Action Alternative** – Recommends the removal action alternative that best meets the evaluation criteria.
- **Section 7, References** – Presents a list of sources used in the preparation of the EE/CA.

- **Appendix A, Fire History, Fuels Condition, and Modeling Reports** – Describes the behavior of some historical fires in the site vicinity and presents the results of Interagency Fuels Treatment Decision Support System (IFTDSS) modeling analysis of fire characteristics under current conditions and after implementing proposed vegetation management activities.
- **Appendix B, Identification of Potential Applicable or Relevant and Appropriate Requirements and To Be Considered Information** – Lists the potential chemical-, location-, and action-specific applicable or relevant and appropriate requirements (ARARs) and to be considered information (TBC) for this NTCRA.
- **Appendix C, Detailed Analysis of Alternatives** – Presents the individual alternatives analysis against the EE/CA evaluation criteria.
- **Appendix D, Costs** – Provides detailed cost spreadsheets, including cost summaries and present value analysis for each removal action alternative.

This page intentionally left blank.

Section 2
Site Characterization

2.1 Site Location

The site generally encircles the former Libby Vermiculite Mine that is within OU3 of the Libby Asbestos Superfund Site. The site is located east-northeast of Libby, Montana, in Lincoln County along Montana Highway 37 (Figure 2-1). The site consists of lands in all or parts of Townships 30, 31, and 32 North and Ranges 29, 30, and 31 West Principle Meridian of Montana in Lincoln County, Montana. The interior boundary of the site is the current Libby Asbestos Superfund Site OU3 boundary. An interdisciplinary USFS team developed the exterior boundaries based on topography and geographical features (ridges, water bodies, and roads), fire modeling efforts, and assessment of fuels[6] conditions influencing the potential for wildland fire start and movement into OU3.

The southern boundary is Highway 37, which parallels the Kootenai River. These features provide access and can serve as a potential barrier to wildland fire movement from starts that may occur to the south of the river.

The eastern boundary follows National Forest System (NFS) Road 228, from Highway 37 to north of Libby Dam, then moves to land managed by USACE along Koocanusa Reservoir north to Jackson Creek. Because of the typical wind direction, wildland fire would not be expected to move into the site from a start east of the road and water bodies.

The northern boundary starts along Jackson Creek, then goes northwest toward Blue Mountain using roads and ridgelines that divide drainages and aspects. The boundary generally captures areas previously identified as needing vegetation management[7] (USFS 2016) and the Rainy Creek drainage. Vegetation management activities beyond Jackson Creek into the North Fork of Jackson creek drainage would not likely contribute to limiting wildland fire potential for OU3 based on the change of aspect, vegetation, and wind direction.

The western boundary uses ridgelines that reflect topographic changes and connects into a variety of roads that can serve as access for both vegetation management activities and wildland fire suppression. This boundary reconnects to Highway 37 to the west of the OU3 boundary. The western boundary captures areas previously identified as needing vegetation management (USFS 2016) to the northwest of OU3 but extends a greater distance to the west because of the potential for fast-moving wildland fires driven by the prevailing winds from the southwest and the dry and southwest-facing aspects. The western and northern boundaries encompass Tubb Gulch, Mitchell Creek, the headwaters of Doak and Rainy Creeks, and tributaries to Jackson Creek.

---

[6] Fuels are defined as combustible wildland vegetative materials, living or dead.

[7] While other documents pertaining to the site may refer to these activities as "treatments," the activities herein are referred to as "vegetation management activities" because "treatment" has a specific meaning related to contaminants in CERCLA and the NCP.

2.2 Site History

Prospectors first located vermiculite deposits in the early 1900s on Rainy Creek northeast of Libby. Vermiculite was mined from the early 20th century to the early 1990s. The vermiculite deposit at the mine also contains an assemblage of amphibole asbestos minerals, including (in order of decreasing abundance) winchite, richerite, and tremolite, with lower levels of magnesio-riebeckite, edenite, and magnesio-arfvedsonite (Meeker et al. 2003), which are referred to collectively as LA. Over time, vermiculite became a product used in insulation, feed additives, fertilizer/soil amendments, construction materials, absorbents, and packing materials. Many people used vermiculite products and off-specification materials for insulation in their houses in Libby and soil additives in their gardens. In 1963, W.R. Grace and Company (Grace) bought the former Libby Vermiculite Mine and associated processing facilities and operated them until 1990. Operations at the former Libby Vermiculite Mine included blast and drag-line mining and milling of the ore. Dry milling was done through 1985, and wet milling was done from 1985 until closure in 1990. Before its closure in 1990, the Libby Vermiculite Mine produced approximately 80 percent (%) of the world's supply of vermiculite.

Since 1999, EPA has been conducting response actions at the Libby Asbestos Superfund Site to address the unprecedented human health impacts associated with widespread contamination in and near the cities of Libby and Troy. The Libby Asbestos Superfund Site was listed on the Superfund National Priorities List (NPL) in 2002. The Libby Asbestos Superfund Site consists of eight Ous. Investigation and cleanup were completed in 2018, with the exception of OU3, for which a feasibility study is currently in progress.

The subject of this EE/CA, the site, generally encircles but is not part of OU3 (or any OU) of the Libby Asbestos Superfund Site.

2.3 Site Topography, Setting, and Site Features

The site is a forested area east-northeast of Libby, Montana, on NFS lands generally surrounding OU3 of the Libby Asbestos Superfund Site. The site is generally mountainous and comprised of several drainages. Elevations at the site and OU3 range from approximately 2,080 feet above mean sea level (amsl) on the Kootenai River to 6,040 feet amsl on Blue Mountain.

NFS roads primarily facilitate motorized vehicle access, which enable USFS to respond to wildland fires with ground resources. In total, the site includes 163.8 miles of existing system roads under differing jurisdictions, including roads that cross in and out of OU3 from NFS lands that may be used for access. Of these, 60% are NFS roads, 6% are state highways, 3% are county roads, and 29% are private roads. NFS roads in the site are a combination of yearlong open, seasonally open, yearlong gated, and barriered roads (Figure 2-2).

There are 26.5 miles of recreational trails in the site, 95% of which are on USFS-managed lands. These trails include 2.2 miles of the Rainy Divide trail that crosses through OU3. Several miles of the Rainy Divide trail and part of the Alexander Mountain trail follow along the ridge at or near the OU3 boundary in the eastern part of the site (Figure 2-2).

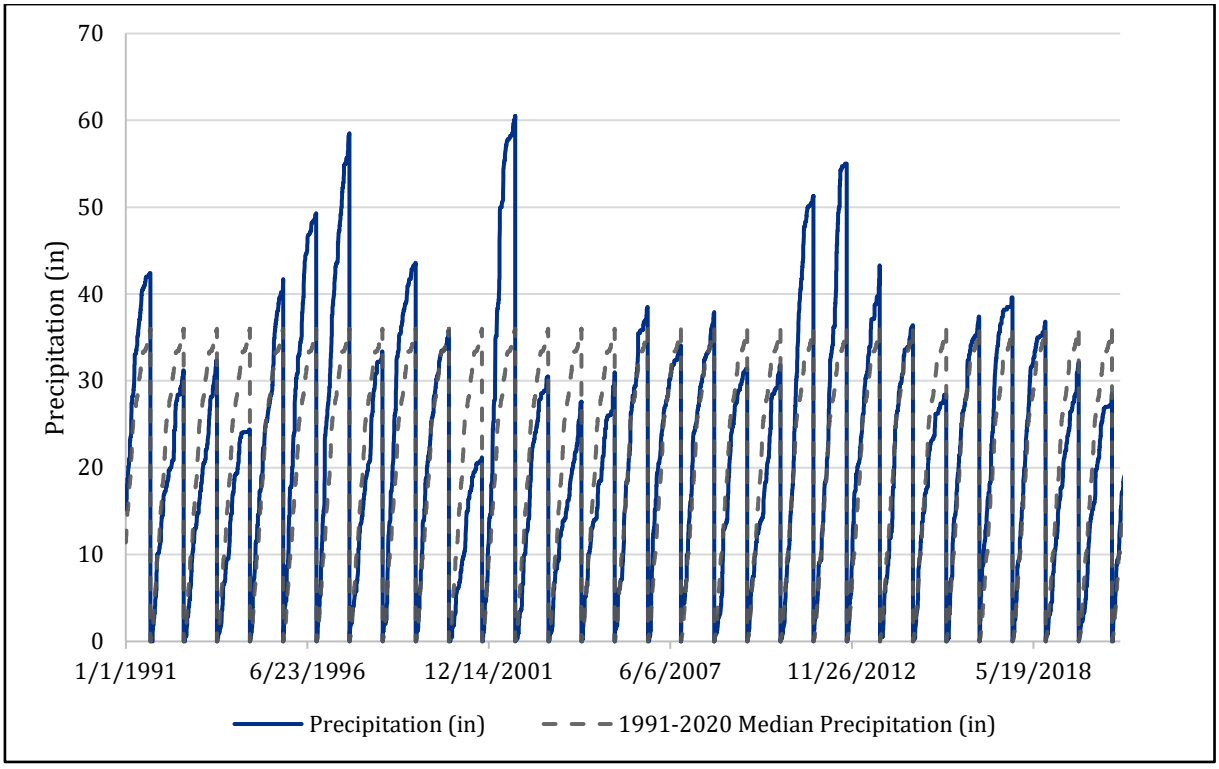
An electric bulk power transmission line (115 kilovolts [kV]) runs through the center and southern portions of the site and also passes through OU3 (Figure 2-2).

Historically and culturally significant features associated with Native Americans as well as historical logging operations are located within the site or in adjacent areas.

2.4 Climate and Potential Climate Change Impacts

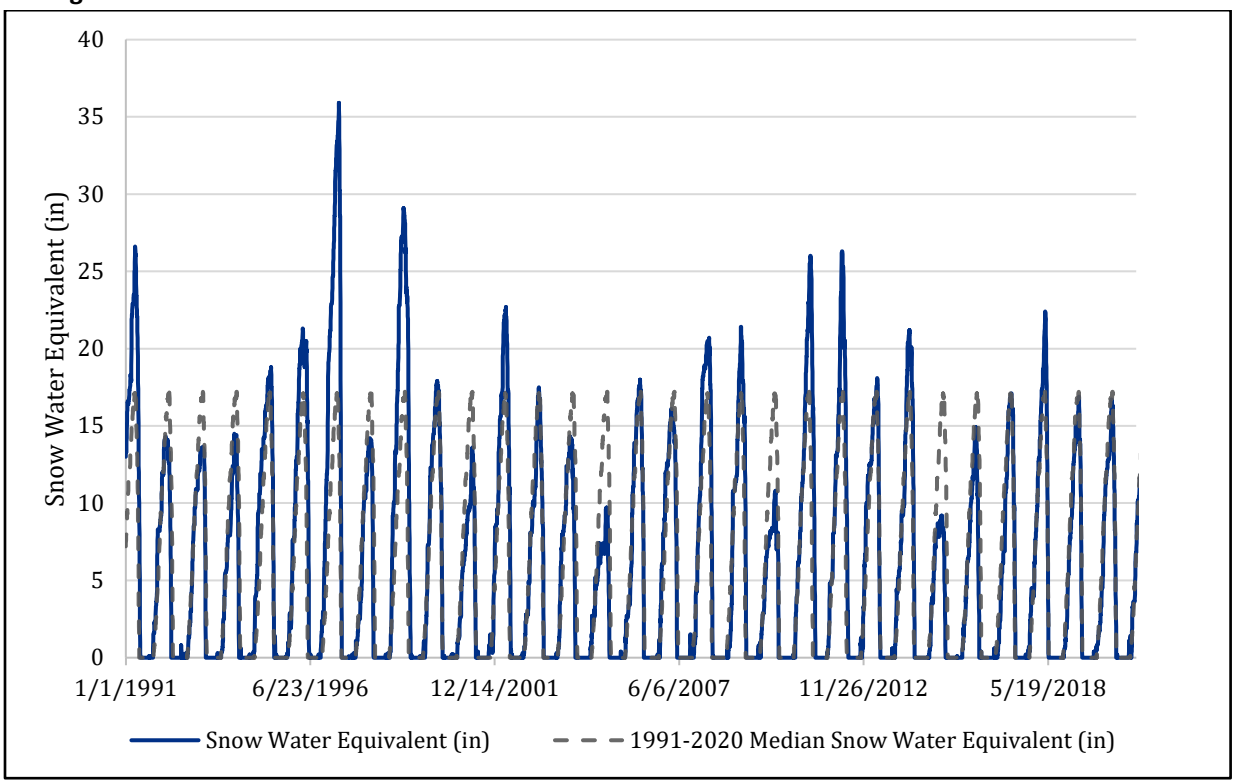
The predominant wind direction within the Kootenai National Forest is from southwest to northeast (Appendix A). Temperature data for Weather station USR0000MLIB in Libby for the period of 2001 to 2022 is available online from the National Oceanic and Atmospheric Administration (NOAA). Average minimum and maximum temperatures in the summer were 47.6 and 85.9 degrees Fahrenheit (°F), respectively, and in the winter were 22.3 and 39.2°F, respectively (NOAA 2023). The total average annual precipitation measured at the Banfield Mountain Snow Telemetry (SNOTEL) site 311,[8] located approximately 9 miles north of the former Libby Vermiculite Mine, for 1991 through 2020 was 37.5 inches (Natural Resources Conservation Service 2024). November through March are typically the wettest months of the year, and August and September are typically the driest (NOAA 2024). Exhibit 2-1 shows the total precipitation at the Banfield Mountain SNOTEL site for the 30-year period from 1991 through 2020, relative to the median precipitation over this period. Exhibit 2-2 shows the total snow water equivalent (the amount of water available in snow) at the Banfield site relative to the corresponding median over the same period.

Exhibit 2-1 Total Precipitation Relative to Median at Banfield Mountain, Montana, 1991 through 2020



[8] Precipitation data from Banfield Mountain SNOTEL Site 311 was used for consistency with the analyses within OU3, as presented in the Kootenai Development and Impoundment Dam Hydrology Report (MWH/Stantec 2017) and Draft Phase 2 Technical Memorandum #2 (Stantec 2023).

Exhibit 2-2 Total Snow Water Equivalent Relative to Median at Banfield Mountain, Montana, 1991 through 2020



The Montana Climate Assessment summarizes how climate change has and is projected to impact northwestern Montana. Historical observations show that annual average temperatures, including daily minimums, maximums, and averages, have risen across Montana between 1950 and 2015. In northwestern Montana, the average temperature has risen by 0.39°F per decade over this period. This has resulted in earlier snowmelt and earlier peak in spring runoff, reducing late summer water availability. Projections suggest that these shifts will likely continue. Average annual precipitation is not predicted to change, but precipitation patterns are likely to shift to more precipitation in spring and less in summer (Whitlock et al. 2017).

2.5 Surface Water

The site includes several creeks and streams (Figure 2-3). Some, such as Jackson Creek in the northeast and Doak Creek in west, were used to establish the site boundaries. Creeks and streams in the northern, eastern, and southern parts of the site flow into the Kootenai River and Lake Koocanusa. The upper reaches of Doak Creek discharge from the western boundary of the site into Pipe Creek, which discharges into the Kootenai River west of Libby. The widths of riparian habitat conservation areas along each creek or stream depend on the category of stream or water body, as described in the Land Management Plan for the Kootenai National Forest (referred to herein as the Forest Plan) (USFS 2015).

The site is hydrologically connected to OU3. Upper Rainy Creek, originating at an elevation of 5,000 feet amsl between Blue Mountain and the North Fork of Jackson Creek, discharges into OU3 from the northern part of the site. In OU3, Fleetwood Creek joins Rainy Creek above the tailings impoundment and Carney Creek enters Rainy Creek just over half of a mile below the tailings

impoundment. Rainy Creek discharges into the Kootenai River. The upper reaches of Alexander Creek, west of Alexander Mountain, flow southeast from OU3 and through the site before entering the Kootenai River. The Kootenai River discharges south out of Lake Koocanusa, formed after the construction of the Libby Dam, then west to northwest along the southern boundary of the site and OU3 toward Libby.

As described in Section 2.9, there are 71 acres of mapped wetlands in the site, mostly located along the northeastern boundary near Jackson Creek (Figure 2-3).

2.6 Existing Vegetation

The site is heavily vegetated. Assessment of current vegetation conditions occurred during summer and fall of 2022. Biophysical settings on NFS lands within the site were characterized as follows: 3% as subalpine (717 total acres) along the northern ridgeline and in the middle of the Alexander Inventoried Roadless Area, 19% as warm/moist (3,860 acres), and 78% as warm/dry (16,043 acres). Warm/moist areas are typically found in the northern part of the site, on northern aspects, or in draws. Warm/dry areas comprise most of the southern half of the site and on southern aspects throughout. The predominant warm/dry areas are characterized by vegetation conditions that have shifted away from the desired species composition, structure, pattern, and processes for dryland landscapes described in the Forest Plan.

Current conditions consist of overstocked stands dominated by Douglas-fir trees with a minority of ponderosa pine and western larch. Root diseases, dwarf mistletoe, Douglas-fir beetle, and western pine beetle are the most common and destructive forest diseases and insects occurring within the site. This predominance of Douglas-fir and areas of high stem densities contribute to the observed presence of insects and disease.

Ponderosa pine and western larch are both long-lived and drought-tolerant tree species found within the site. The natural range of ponderosa pine occurs in the warm and dry biophysical settings, primarily in the western and southern portions of the site. However, the accumulation of fuels has made these forests more susceptible to wildland fire, drought, diseases, and insects. In the more moist and productive areas within the site (north and east), tree establishment and growth contribute to fuels conditions and impair the health of desired western larch, which are shade intolerant.

Cheatgrass, a non-native annual grass found throughout the western United States, is of particular interest for fuels reduction at the site. Because of its tendency to form continuous monocultures and to dry and cure into a flammable material early in the summer, cheatgrass creates an environment where fire seasons are extended and wildland fires start easily and have high rates of spread.

2.7 Wildland Fire Conditions and Occurrence

The generally heavily forested lands described above are found within and around the site and OU3. Some forest stands contain large amounts of surface, ladder, or canopy fuels, or a combination of fuel types. This existing fuels condition is the result of past land management practices and wildland fire suppression efforts, limited access because of human health risk concerns to forest workers from exposures to LA, changes in forest species composition,

competition among trees for limited sunlight and other resources, and occurrence of root diseases and insects.

The predominance of Douglas-fir and areas of high stem densities also contribute to the potential for high-intensity wildland fire. Ponderosa pine and western larch are fire-adapted tree species; however, these forests have become more susceptible to wildland fire because of the accumulation of fuels, which increases fire intensity and causes higher amounts of tree mortality. In addition, because of prevailing winds from the west/southwest, this forest condition presents the greatest concern for potential wildland fire movement into OU3.

Historically, the site experienced frequent low, mixed, and stand-replacing wildland fire severities across the landscape. Nearly a century of wildland fire suppression activities have contributed to missed wildland fire cycles, leading to an accumulation of fuels. Past regeneration harvesting has created blocks of regeneration that are smaller and more uniform than would have occurred under natural wildland fire regimes, which occurred over larger areas and left residual live tree patches and scattered fire-tolerant large live trees. Additionally, routine fuels management practices, including harvest, were limited since the early to mid-2000s while much of the site was part of the OU3 Study Area to investigate the nature and extent of LA contamination. The presence of LA complicates routine USFS operations, so only minimal vegetation management activities have occurred in the project area in the 21st century.

There have been 76 wildland fires within the site between 1986 and 2021. Humans were responsible for starting 28% of the wildland fires while lightning caused most (72%). Exhibit 2-3 and Figure 2-4 summarize the temporal and geographic occurrence of these fires. Wildland fire history for the site was derived from records maintained in the geographic information system library for the Kootenai National Forest.

Exhibit 2-3 Wildland Fire History and Occurrence in the Mitchell Jackson Project Area

Decade	Number of Fires	Acres Burned
1980s (1986–1989)	8	1
1990s (1990–1999)	25	55
2000s (2000–2009)	31	17
2010s (2010–2019)	10	78.2
2020s (2020–2021)	2	0.2

Wildland fires can spread in any direction but are strongly influenced by wind direction and fuel availability, and typically follow an upslope/updrainage path. As detailed in Appendix A-1, in the summer months, the prevailing wind pattern in the Kootenai National Forest is generally from the southwest to the northeast, which has driven the spread of historical fires such as the 2017 Caribou Fire and the 2022 Weasel Fire. These fires started under a ridge of high pressure, which causes a relatively stable atmosphere that is typical in the northern Rockies during summer. However, when this high pressure breaks down, it is like opening a chimney damper letting the hot air rise and causing surface winds to move up and faster, which allows fire to spread more intensely and transition from a surface fire to a crown fire.

The lands in the part of the site west of OU3 have some of the warmest and driest forest types. Fire starts in these warm and dry western areas will likely burn with the most intensity and highest rates of spread. In addition, the topography aligns with the general southwesterly flow of weather patterns, resulting in greater likelihood for the potential of a fire start in the western part of the site to spread into OU3, located in the center of the site. The 2017 West Fork Fire, which occurred just west of the site, exemplifies the potential for rapid and intense fire spread from the western portion of the site into OU3 because of similar terrain, dry habitat types, and fuels conditions. The West Fork Fire started by a lightning strike from mid-slope on a west aspect, spreading across steep terrain overstocked with Douglas-fir, and spread approximately 4 miles in 2 days from the southwest to northeast direction with long-range spotting (Appendix A-1).

As detailed in Appendix A-2, IFTDSS fire modeling indicates that 73% of the site would exhibit surface fire flame lengths greater than 4 feet under extreme burning conditions (modeled using a 97th percentile day to represent a worst-case scenario). Approximately 82% of the site has a canopy base height (the lowest aboveground height with enough canopy fuel to transition a fire from surface fuels into the tree crowns) of less than 3 feet, illustrating high connectivity between the surface and ladder fuels. Canopy bulk density is a measure of canopy fuel and denser canopies, enabling fire spread. This is also a feature of the site, with 93% of the site area characterized by canopy bulk densities greater than 0.05 kilograms per cubic meter (kg/m^3). These conditions suggest that 67% of the site would support crown fire, which can cause extreme fire behavior, long-range spotting, and rapid growth, and make control impossible until the weather changes or the fire reaches an area with less fuels or topography less favorable to spread.

These conditions would likely prevent direct attack by firefighters, meaning suppression efforts would require indirect tactics using mechanized equipment and aviation resources. Relative to indirect attack, direct attack fire suppression tactics minimize acres burned and shortens wildland firefighter duration and time commitment. In addition, direct attack is safter because it allows wildland firefighters to work immediately adjacent to the fire, which allows them to monitor fire behavior and escape into burned areas ("one foot in the black"). By contrast, indirect attack means firefighters are far removed from the fire for control options ("not seeing the fire"), placing unburned fuel between firefighters and the fire. These conditions violate two of the "18 Watchout Situations" for firefighter safety (National Wildfire Coordinating Group, 2022).

As described in the Montana Climate Assessment, precipitation patterns are likely to shift to more precipitation in spring and less in summer, thereby lengthening the fire season. As such, there is increased probability of wildland fire, including increased size, frequency, intensity, and severity expected in the coming century. Rising temperatures and water stress are also likely to increase bark beetle survival and general tree mortality related to pathogen activity (Whitlock et al. 2017).

Without vegetation and fuels management, wildland fire hazard would increase over time, as stand conditions continue to deteriorate in the analysis area because of overstocked stands, insects, disease, and wind. Eventually, wildland fires have a greater chance to burn in large continuous patch sizes because of the lack of breaks in the forest canopy and heavy fuel loading, putting homes and private property at risk and increasing the likelihood of spread into OU3 and the associated release of LA from source media (e.g., soil, duff, bark, and post-fire ash).

2.8 Surrounding Land Use and Population

The largest population center near the site is the City of Libby, which is the seat of Lincoln County. Libby consists of a small "downtown" core with populated areas spreading in several directions, primarily along highways and stream valleys. Businesses are focused in the downtown core and along U.S. Highway 2 and Highway 37. Based on the 2020 Census, approximately 2,800 people reside within the city limits of Libby and approximately 10,000 people reside in the general area of Libby (zip code 59923), which includes the populated areas outside the city limits (U.S. Census Bureau 2022).

Historically, natural resources extraction industries such as logging and mining supported Libby's economy. Over time, mining operations and sawmills have closed, and tourism is playing an increasing role in the local economy of Libby (MWH Americas, Inc. [MWH] 2016). The land surrounding the former Libby Vermiculite Mine is managed for multiple uses by USFS and by a private forest company for vegetation management activities, including logging. Because of concerns of disturbing potential LA-contaminated media, timber harvesting, fuels management, and other management activities described in the Kootenai National Forest Plan are not presently allowed in OU3 (MWH 2016). The public uses the area for recreational activities such as camping, hunting, and firewood gathering. Mining operations in OU3 ceased in 1990, and access to mined property is restricted by signs and locked gates, but trespassers may occasionally enter on foot (MWH 2016).

Site land falls mainly within the Kootenai National Forest, which is managed by USFS (20,620 acres of 26,464 acres in the site). Twenty acres owned by the United States are managed by USACE for Lake Koocanusa and the Kootenai River, and 4,194 acres are owned by Stimson Lumber Company for vegetation management activities, including commercial logging. Other private lands (primarily residential) in the site total 1,631 acres, mostly located along the southern boundary. However, 99% of USFS-managed land within the site fall within the wildland–urban interface boundary defined in the 2023 Lincoln County Community Wildfire Protection Plan (Nelson 2023). Private lands that occur in a checkerboard-like manner around the northern half of the site are currently managed with timber management objectives. Several residential developments, including Em Kayan Village, River's Edge Community Park, the River Run community, and the Big Bend community, are within or adjacent to the site boundaries.

Approximately 65% of the NFS lands within the site are designated as Management Area 6, which is "general forest" management area. These lands have existing roads, trails, and structures, as well as signs of past and ongoing activities to manage the forest vegetation. Because of the site's proximity to town, residences, the Kootenai River, and Lake Koocanusa, the area experiences regular recreational use, including both motorized and non-motorized activities. The remaining NFS land management area designations also reflect this recreational use. Two and 3% of NFS lands within the site are designated as eligible Wild and Scenic River area and Primary Recreation area, respectively, both associated with the Kootenai River. The remaining 30% is designated as Management Area 5a (backcountry) associated with the Alexander Inventoried Roadless Area, totaling approximately 6,715 acres and located in the southeast part of the site, adjacent to and overlapping the OU3 boundary.

2.9 Sensitive Populations and Environments

2.9.1 Vulnerable or Sensitive Populations

Executive Order 12898, issued in 1994, and Executive Order 14096, issued in 2023, require federal agencies, to the greatest extent practicable and permitted by law, to identify, analyze, and address disproportionate and adverse human health and environmental effects (including risks) and hazards of Federal activities, including those related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns. These Executive Orders identify several population groups of concern due to the potential for disproportionate and adverse human health and environmental effects (and risks) based on race, ethnicity, national origin, low-income, and disability status. Tribal affiliated and Indigenous Peoples, and those engaged in cultural or subsistence practices are also explicitly addressed.

As part of this EE/CA, U.S. Census Bureau data (U.S. Census Bureau 2023), EJScreen (EPA 2024), and the Council on Environmental Quality Climate and Economic Justice Screening Tool (U.S. Federal Government 2024) were used to identify census tracts that are considered disadvantaged according to various burden thresholds. There are three U.S. Census tracts identified as including or adjacent to the site: tracts 30053000300, 30053000200, and 30053000100.

Tract 30053000300 includes the site. This area is not classified as low income; however, it is classified as experiencing high unemployment and is within a disadvantaged census tract as of 2010. This census tract had a reported 2022 American Community Survey five-year "Unemployment Rate" of 13.7%. The national value over the same period was 5.3%.

Tract 30053000200 represents a high-residential area compared to the adjacent tracts and encompasses the community of Libby, Montana. This area is classified as low income and is within a disadvantaged census tract; however, is not classified as experiencing high unemployment. This tract had a reported 2022 American Community Survey five-year "Per Capita Income in the Past 12 Months" of $25,278. This is 61% of the national per capita income, which was $41,261 during the same period.

Tract 30053000100 is within 5 kilometers (3.1 miles) of the project area and is classified as low income, experiencing high unemployment, and is within a disadvantaged census tract. This tract had a reported 2022 American Community Survey five-year "Per Capita Income in the Past 12 Months" of $30,631. This is 74% of the national per capita income which was $41,261 during the same period. The unemployment rate for the tract was reported in 2022 as 6.6%. The national value over the same period was 5.3%.

Tracts 30053000100 and 30053000200 are also susceptible to environmental impacts due to current and historical intrinsic and extrinsic factors such as proximity to the Libby Asbestos Superfund Site (abandoned mine land), level of inhalable particles in the air, and projected wildfire risk. The Kootenai National Forest and surrounding public land remains in use by Native people, including members of the Kootenai Tribe of Idaho and Confederated Salish and Kootenai Tribes.

Although the site is within 5 kilometers (3.1 miles) of U.S. Census tracts where burden thresholds were exceeded, removal action alternatives identified in this EE/CA (Section 4) would not cause any relocations nor result in disproportionate and adverse human health or environmental burdens. The removal action alternatives identified in this EE/CA are expected to reduce wildland fire intensity and wildland fire spread to mitigate exposure and migration risks in OU3 from LA liberation from contaminated source media (e.g., soil, duff, and post-fire ash) that could impact the nearby community. Therefore, there are no contemplated environmental justice concerns with the removal action alternatives identified in this EE/CA.

2.9.2 Sensitive Environments

EPA defines sensitive environments as "a terrestrial or aquatic resource, fragile natural setting, or other area with unique or highly-valued environmental or cultural features" (EPA 1991), which includes wetlands and habitat for endangered or threatened species (EPA 1992c). There are 71 acres of mapped wetlands in the site, mostly along the northeastern boundary near Jackson Creek (Figure 2-3). The U.S. Fish and Wildlife Service (USFWS) categorizes most of these wetlands as freshwater forested shrub wetlands with some dispersed freshwater emergent wetlands also present (USFWS 2023). Threatened species identified that may be present within the site include Canada lynx, grizzly bear, North American wolverine, yellow-billed cuckoo, bull trout, Spalding's catchfly, and whitebark pine. Identified critical habitat includes lynx critical habitat and bull trout critical habitat (USFWS 2024). While the Kootenai River has not been designated as a National Wild and Scenic River by an act of Congress, it does hold one or more characteristics indicating it is eligible to be designated as a Wild and Scenic River and classified as recreational. Approximately 2% of NFS lands within the site are designated as eligible Wild and Scenic River Area, associated with areas adjacent to the Kootenai River.

2.10 Source, Nature, and Extent of Contamination

2.10.1 Overview of Sampling Activities

Much of what is now the site was part of the OU3 Study Area (Figure 2-5) that was evaluated in the OU3 Remedial Investigation (RI)(MWH 2016), the 2016 RI Addendum (Stantec 2018a), and the 2017 RI Addendum (Stantec 2018b) to determine the extent of LA around the former Libby Vermiculite Mine. As such, various media were sampled and analyzed for asbestos in the site, including soil, duff, ash, and tree bark and activity-based sampling (ABS) air samples. Sampling and analysis activities performed were conducted in accordance with EPA-approved investigation-specific sampling and analysis plans and quality assurance project plans. Following is an overview of the media and ABS programs in which samples were collected in the site. MWH's RI report provides detailed information for each sampling program, including analytical results and sampling activities in the former Libby Vermiculite Mine area (MWH 2016).

In EPA's final Human Health Risk Assessment (HHRA) (EPA 2015), exposure and risk estimates for OU3 were stratified into near, intermediate, and far concentric exposure areas based on the distance from the center of the former Libby Vermiculate Mine. The "near" area is within 2 miles of the mine center, the "intermediate" area is between 2 to 6 miles from the mine center, and the "far" area is greater than 6 miles from the mine center (Figure 2-5). The site is located primarily in the intermediate area. For the purposes of the nature and extent discussion for these constituents, the following primary media definitions (MWH 2016) are used:

- **Soils**: The unconsolidated mineral or organic matter on the surface of the Earth that has been subjected to, and shows effects of, environmental factors of climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief and acting on parent material over a period of time. Soil excludes materials defined as mine waste, bark, duff, or ash.
- **Bark**: The tough outer covering of the woody stems and roots of trees, shrubs, and other woody plants outside the vascular cambium.
- **Duff**: Partially to fully decomposed bark, twigs, needles, leaves, grasses, and other vegetation and the layer of litter that occurs on top of the mineral soil in forested areas.
- **Ash**: The solid residue left when combustible material is thoroughly burned.
- **Surface water**: Any waters on the earth's surface, including but not limited to streams, lakes, ponds, and reservoirs, and irrigation and drainage systems discharging directly into a stream, lake, pond, reservoir, or other surface water. Water bodies used solely for treating, transporting, or impounding pollutants will not be considered surface water.

The nature and extent of LA in soil and duff were assessed as separate source media in the RI, because each medium was analyzed using different analytical methods. Soil samples were analyzed using polarized light microscopy–visual area estimation (PLM-VE) and duff samples were analyzed using transmission electron microscopy (TEM). However, both media contribute to airborne LA releases and it is difficult to disaggregate the two media for understanding potential exposures because duff decomposes into soil and soil particles mixed with duff.

2.10.2 Soil and Mine Waste

As part of the OU3 RI, soil and mine waste samples were collected from various areas of the former Libby Vermiculite Mine (e.g., waste rock, coarse tailings, and bedrock outcrops). The samples most relevant to the site are the soil samples collected in forested areas that have potential susceptibility to release LA during wildland fires, as opposed to the samples collected in certain mine areas (e.g., from bedrock outcrops), which would have minimal susceptibility to a wildland fire. These relevant samples include soil samples collected along several forest soil transects that radiated out from the mine center up to 8 miles into the surrounding forest. Forest soil samples with detections (trace or higher) of LA assessed via PLM-VE were collected within approximately 2 miles from the center of the former Libby Vermiculite Mine (within the near area), which is within the OU3 boundary but not in the site. However, the lack of LA detection by PLM-VE does not mean LA is not present because this method cannot reliably detect low LA concentrations.

2.10.3 Tree Bark and Duff

LA levels on tree bark and in duff tend to decrease with increasing distance from the former Libby Vermiculite Mine (MWH 2016). The mean total LA levels for tree bark for the near, intermediate, and far areas were 3.7, 0.88, and 0.17 million structures per square centimeter, respectively (MWH 2016). The mean total LA levels for duff samples from the near, intermediate, and far areas were 733.7, 78.8, and 6.8 million structures per gram-dry weight, respectively (MWH 2016). LA has also been detected on tree bark and in duff in the surrounding forest outside the OU3 boundary as far as 17 miles from the mine (CDM Smith 2016).

2.10.4 Ash and Smoke

Burn chamber experiments were performed in 2011 at EPA's Open Burn Test Facility to provide data on LA concentrations in air to which wildland firefighters could potentially be exposed during burning of duff. Experiments were performed to simulate both rapid combustion during a wildfire (high temperature) and smoldering combustion after the initial fire subsides (low temperature). LA-impacted duff burned in the experiments was collected from within the current OU3 boundary, not within the site. Results indicated most of the LA fibers present in duff do not become entrained in smoke emissions when burned but are retained in the ash. LA-impacted ash has the potential to mobilize if the ash is disturbed, such as during dry mop-up activities, during precipitation or wind events, or via erosional processes (MWH 2016).

In 2015, two in situ burn studies were conducted within OU3. One study was conducted during a slash pile burn and the other study was conducted under a simulated prescribed understory burn. Both studies collected personal ABS air and perimeter air samples (placed at three distances surrounding the fire) during the burn to evaluate LA air concentrations in smoke emitted from the fires. Mean LA air concentrations at the perimeter monitors were generally lower than the personal air samples and tended to decrease with increasing distance from the burn area (MWH 2016). Personal ABS air samples were used to assess potential firefighter exposures in the HHRA (described below).

Several opportunistic sampling efforts have also been conducted during authentic wildfires that have occurred within the Libby Asbestos Superfund Site boundary to collect ambient air samples within the Libby community.

2.10.5 Surface Water

In investigations performed as part of the RI, LA concentrations in surface water were compared against the National Primary Drinking Water Regulation Maximum Contaminant Level (MCL) for asbestos of 7 million fibers per liter of water greater than 10 micrometers in length. No MCL exceedances occurred in surface water samples collected in what is now the site, such as in Upper Rainy Creek. Within OU3, LA concentrations increase with proximity to disturbed areas in the former Libby Vermiculite Mine area, such as downslope of tailings and waste rock piles in Fleetwood and Carney Creeks. Exceedances of the MCL occurred at various locations in Lower Rainy Creek, typically between April and May. No samples collected in the Kootenai River exceeded the MCL (MWH 2016).

2.10.6 Activity-Based Sampling – Air

ABS is a standard sampling technique used to measure air concentrations during disturbances of asbestos-contaminated materials. During ABS, personnel who are engaged in a variety of source disturbance activities, wear air monitors and the resulting air filters are analyzed for asbestos to determine the asbestos air concentration. These air concentrations can be used to estimate exposures for the purposes of evaluating potential human health risks.

Phase contrast microscopy-equivalent (PCME) LA air concentrations for personal air ABS samples span several orders of magnitude, depending on the scenario, the intensity of the disturbance scenario, the location of the disturbance, the level of LA in the disturbed media, and the meteorological conditions. Higher air concentrations tend to be associated with more vigorous

disturbance activities, higher LA levels in the disturbed media, and when environmental conditions are drier. The personal air ABS concentrations generally tend to decrease with distance from the former Libby Vermiculite Mine, which is consistent with the mean levels for both tree bark and duff that also tend to decrease as a function of distance from the former Libby Vermiculite Mine. These ABS air data were used in the Final HHRA and Addendum to evaluate potential exposures and risks from inhalation of LA (discussed in Section 2.11).

2.10.7 Firefighter Air Monitoring

Personal air sampling of USFS firefighters responding to the Highway 37 Fire was conducted from August 2 to August 13, 2018. The objective of this sampling investigation was to provide measured data to inform work practices in support of Occupational Safety and Health Administration (OSHA) compliance monitoring. A total of 424 field samples were collected from four workers over 9 days. A total of 14 firefighting tasks were performed that included driving, hiking, dry mop-up, wet mop-up, and digging fire lines (CDM Smith 2019).

The phase contrast microscopy (PCM) results showed that the calculated 8-hour time-weighted average (TWA) air concentrations frequently approached or slightly exceeded the OSHA TWA exposure limit of 0.1 fibers per cubic centimeter (f/cc) of air for most workers on most days. The four tasks with the highest PCM air concentrations were dry mop-up, digging fire lines, wet mop-up, and utility task vehicle (UTV) driving on gravel roads. Although air concentrations for several samples approached the OSHA short-term exposure limit (STEL) of 1 f/cc, there were no exceedances of the STEL (CDM Smith 2019).

The samples were also analyzed using TEM. The TEM results showed most of the "fibers" observed during the PCM analysis were not asbestos. On average, only about 6% of the structures recorded during the TEM analysis were LA structures. This means airborne dust particulates were mainly non-asbestos materials, but there were two samples with up to 20% LA structures. The estimated TEM PCME air concentrations were significantly lower than the PCM air concentrations. Based on TEM results, the 8-hour TWA air concentrations were well below the OSHA 8-hour TWA exposure limit (0.1 f/cc) (CDM Smith 2019).

While this investigation showed there is significant airborne dust generated during firefighting activities, most of the dust consists of non-asbestos particulates and the amount of LA in the dust was variable. The use of PCM tended to overestimate airborne asbestos concentrations by about an order of magnitude (CDM Smith 2019).

2.11 Human Health Risk Assessment

The Final HHRA (EPA 2015) and Addendum (EPA 2018) quantify potential human health risks from exposure to LA in the OU3 Study Area and within OU3, respectively, after the delineation of the current OU3 boundary in 2017. Results of the risk assessment are intended to help risk managers determine whether remedial actions are necessary to address risks, and if so, which exposure scenarios would need to be addressed in future remedial actions.

More than 150 different exposure scenarios were evaluated as part of the risk assessment. Risk estimates for these exposure scenarios were evaluated both individually and cumulatively in the risk assessment. Cumulative risk is expressed as the sum of cancer risks or non-cancer hazard quotients (HQs) (referred to as the hazard index [HI]) from various exposure scenarios. The

HHRA showed that non-cancer exposures were a more sensitive metric of potential concern than cancer risk (EPA 2015). For this reason, the discussion of risk in this EE/CA focuses on the protection of non-cancer effects. If the cumulative non-cancer HI is less than or equal to 1, then remedial action is generally not warranted unless there are adverse environmental impacts.

Cumulative risk calculations show that people who are predominantly exposed at locations with lower LA levels in source media are likely to have cumulative risks that are below a level of concern even when the cumulative scenario includes many different exposure activities across multiple OUs. Cumulative exposure and risk can be reduced by changing the locations where the activities are performed, such as collecting firewood from areas far from the former Libby Vermiculite Mine. Cumulative exposure has the potential to become significant if most of a person's lifetime is spent at properties and in locations where LA is present and where people are engaging in source disturbance activities that have a high potential for LA releases. When cumulative exposure includes scenarios where LA-contaminated source media are disturbed, such as trespassing on the disturbed area of or performing certain activities related to commercial logging operations near the former Libby Vermiculite Mine, these exposures may be important risk drivers for cumulative risk estimates. EPA defines a risk driver as an individual exposure scenario that contributes a substantial fraction of the cumulative risk. Addressing exposures for the risk drivers for each potential receptor will have the greatest impact in lowering cumulative exposures and risks (EPA 2015).

To ensure protectiveness in consideration of cumulative exposures, an exposure scenario HQ value of 0.6 was identified as the threshold for identifying individual exposure scenarios with the potential to contribute to unacceptable risks (MWH 2016). The current OU3 boundary was developed in consideration of the HQs for ABS areas throughout the forested area surrounding the mine. Outside OU3, the site for this EE/CA, LA contamination was not present at concentrations in site environmental media (e.g., soil, duff, and post-fire ash[9]) posing unacceptable human health risks to receptors when disturbed. However, within OU3, several LA exposure scenarios for forest workers, including wildland firefighters, estimated HQs greater than 0.6 for one or more ABS areas (EPA 2015):

- Outdoor worker exposures during commercial logging activities in OU3 near the former Libby Vermiculite Mine, especially those logging activities that disturb soil and duff (HQ = 2 for site restoration; HQ = 5 for skidding)
- Firefighter exposures during an understory burn near the former Libby Vermiculite Mine (HQ = 0.7) and while performing mop-up activities following the understory burn (HQ = 5 during dry mop-up and HQ = 1 during wet mop-up)
- Forest worker exposures while building slash piles near the former Libby Vermiculite Mine (HQ = 2)

The risk of LA exposure to wildland firefighters in OU3 justifies this NTCRA to reduce the likelihood of intense wildland fire spreading from the site into OU3. Figure 2-5 presents the HQ values for the hooking/skidding scenario, a surrogate exposure scenario for soil/duff disturbance

[9] Bark was investigated as part of the OU3 RI. However, it will not be discussed further in the EE/CA except as a contribution of LA to post-fire ash within OU3.

activities, such as understory mop-up and building slash piles which are associated with firefighting (EPA 2018).

2.12 Ecological Risk Assessment

An ecological risk assessment was conducted for the Libby Asbestos Superfund Site. Part 1 of this risk assessment focused on risks within the OU3 Study Area, much of which is now the site after the OU3 boundary was determined (EPA 2014). The risk assessment evaluated multiple lines of evidence to assess exposures of fish, aquatic invertebrates, amphibians, mammals, and birds to LA. The studies indicated that these ecological receptors are unlikely to be adversely impacted by LA released to the environment from previous mining activities (EPA 2014).

2.13 Current or Previous Response Actions

There have been no previous removal actions at the site. However, previous removal actions in the adjacent OU3 addressed wildland fire mitigation and preparedness for OU3. In addition, there is an ongoing feasibility study to support remedial action for the forested areas and the former Libby Vermiculite Mine in the adjacent OU3. The following summarizes current or previous CERCLA response actions in OU3 that are related to wildland fire mitigation or preparedness actions.

2.13.1 2016 Removal Action

USFS historically funded one helicopter to be stationed on the Kootenai National Forest. However, that helicopter was not dedicated to OU3 or the Kootenai National Forest and it was dispatched to wildland fires anywhere in the United States. Because of the priority and concern for wildland fires starting in or near OU3, EPA and USFS initiated a time-critical removal action (TCRA) in 2016 to authorize heightened wildland fire mitigation actions, including aggressive initial attack, to enhance wildland fire suppression effectiveness during the 2016 fire season (EPA 2016). As part of the 2016 TCRA, an additional helicopter was stationed in Libby during high fire preparedness levels or as determined by fire managers to provide an immediate response to and support aggressive initial attack on wildland fire starts in OU3. In addition to the helicopter, the TCRA included heavy equipment (dozer and lowboy) and a team of specially trained and equipped firefighters stationed in Libby to enhance wildland fire suppression effectiveness at OU3.

2.13.2 2017 NTCRA

In 2017, EPA and USFS initiated an NTCRA consistent with the 2016 TCRA to further enhance wildland fire preparedness through the stationing of a helicopter at the Libby Airport to respond to wildland fires within OU3 (EPA 2017). In addition, the NTCRA included a dedicated and specially trained ground-based crew to be stationed in Libby during the fire season. The actions associated with this NTCRA have continued since the initial implementation in 2017 through the most recent fire season and are anticipated to continue into future fire seasons.

2.13.3 OU3 Remedial Action

A remedial action for OU3 has not yet been initiated; however, the feasibility process for OU3 is currently underway and involves two phases. Phase 1 would address unacceptable risks from LA in the forested area of OU3, and Phase 2 would address unacceptable risks at the former Libby

Vermiculite Mine and along Rainy Creek and its tributaries. As part of the remedial process, EPA identified remedial action objectives for Phase 1 pertaining to unacceptable human health risks for outdoor workers (e.g., USFS workers, firefighters, and commercial loggers) from exposures to LA during disturbances of LA-contaminated soil, duff, or post-fire ash and LA migration from contaminated soil, duff, and post-fire ash resulting in ARAR exceedances in surface water within OU3.

Section 3

Removal Action Scope, Goals, and Objectives

3.1 Statutory Limits on Removal Actions

Section 104(c)(1) of CERCLA requires that Superfund-financed removal actions not continue after $2 million has been obligated for the response action or 12 months has elapsed from the date of the initial response to a release or threatened release of hazardous substances. This removal action is not a Superfund-financed removal action; therefore, the statutory limit of $2 million and 12-month duration does not apply.

3.2 Determination of Removal Action Scope

The general objective of a removal action, in accordance with CERCLA and the NCP, is to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release of hazardous substances or pollutants or contaminants to the environment.

The scope of the EE/CA is limited to wildland fire mitigation activities for USFS and contractor personnel at the site. The goal of the NTCRA is to modify the fuels condition to influence fire intensity across the landscape and reduce the potential for wildland fire to spread into OU3, thereby reducing exposure and migration risks in OU3 from LA released from contaminated source media (e.g., soil, duff, and post-fire ash). This NTCRA is considered an early response action because the remedial action being led by EPA is expected to reduce the remaining exposure and migration risks from LA contamination in OU3 to acceptable levels for adequate protection of human health and the environment.

3.2.1 Geographic Extent of the NTCRA

The site boundary shown on Figure 2-1 and described in Section 2.1 defines the geographic extent of the NTCRA for evaluation in this EE/CA. The locations of the site boundaries surrounding OU3 were chosen by an interdisciplinary USFS team based on topography, geographical features (ridges, water bodies, and roads), surveys of vegetation conditions, fire modeling efforts, and assessment of fuels conditions influencing the potential for fire start and movement into OU3.

3.2.2 Removal Action Objectives

The following RAOs were identified for this EE/CA:

1. Reduce fuels available at the site using vegetation management activities to lower wildland fire intensity and spread into the adjacent OU3, which could reduce exposure of wildland firefighters to LA released from contaminated soil, duff, or ash during and after a wildland fire.
    - *Rationale: There are identified unacceptable risks to wildland firefighters from exposure to LA within OU3 during understory burn dry mop-up as presented in the HHRA (EPA 2015).*

2. Reduce fuels available at the site using vegetation management activities to lower wildland fire intensity and spread into the adjacent OU3, which could reduce erosion and overland flow of LA-contaminated soil, duff, or ash to surface water during and after a wildland fire.

   — *Rationale: Following wildland fires in OU3, the post-fire ash containing LA (as well as contaminated soil and duff in the burned areas) is susceptible to redistribution and transport by erosion and runoff after precipitation events, thereby increasing the potential for migration of LA to nearby surface water bodies.*

3. Modify road networks in the site to limit human-caused fire starts and maintain or improve firefighter response to wildland fires to lower wildland fire intensity and spread into the adjacent OU3, which could reduce exposure of wildland firefighters to LA released from contaminated soil, duff, or ash during and after a wildland fire.

   — *Rationale: There are identified unacceptable risks to wildland firefighters from exposure to LA within OU3 during understory burn dry mop-up as presented in the HHRA (EPA 2015).*

4. Modify road networks in the site to limit human-caused fire starts and maintain or improve firefighter response to wildland fires to lower wildland fire intensity and spread into the adjacent OU3, which could reduce erosion and overland flow of LA-contaminated soil, duff, or ash to surface water during and after a wildland fire.

   — *Rationale: Following wildland fires in OU3, the post-fire ash containing LA (as well as contaminated soil and duff in the burned areas) is susceptible to redistribution and transport by erosion and runoff after precipitation events, thereby increasing the potential for migration of LA to nearby surface water bodies.*

3.2.3 Scope of Removal Action Activities

The scope of this EE/CA includes the following activities to achieve RAOs:

- Vegetation management activities in the site to lower wildland fire intensity and the potential for wildland fire spread into OU3.
- Modification and potential expansion of the road system in the site to allow for the implementation of vegetation management activities, to maintain or improve firefighter response to wildland fires, and to reduce human-caused fire starts.

The scope of this EE/CA does not include firefighting activities, including initial response to wildland fires and wildland fire suppression. However, the alternative analysis does evaluate the consequences of the vegetation and road management activities on achievement of the RAOs, which include reducing the likelihoods of exposure of firefighters to LA-contaminated soil, duff, and post-fire ash and the migration of LA-contaminated media to surface water potentially resulting from the spread of wildland fire from the site into OU3.

3.3 Determination of Tentative Removal Action Schedule

Elements of this NTCRA are targeted to start within federal fiscal year 2024, which ends in September 2024. The following is a tentative schedule of major removal action milestones:

Activity	Tentative Date
Draft final EE/CA for public review	May 2024
Public comment period	May through June 2024
NTCRA public meeting	May 2024
Response to significant public comments	June 2024
Action memorandum	September 2024
NTCRA implementation start	September 2024
NTCRA implementation completion	Approximately 15 years after NTCRA implementation start

The NTCRA would not involve post-removal site control (PRSC) activities that are typically performed after an NTCRA because this NTCRA only involves the initial establishment of wildland fire mitigation activities within the site. For the purposes of this EE/CA, it is assumed this NTCRA would be initiated in fiscal year 24 and completed in approximately 15 years.

3.4 Planned OU3 Remedial Activities

There are additional remedial activities currently being implemented for the adjacent OU3. An RI for OU3 has been completed, and the feasibility study for OU3 is currently in development. The feasibility study process for OU3 involves two phases. Phase 1 would address unacceptable risks from exposure to LA in forest media, and Phase 2 would address unacceptable risks from exposure to LA at the former Libby Vermiculite Mine and along Rainy Creek, the Kootenai River, and other tributaries. The Phase 1 part of the feasibility study is currently assessing unacceptable risks to human health from exposure to LA-contaminated soil, duff, and post-fire ash and migration of LA from contaminated soil, duff, and post-fire ash through erosion and overland flow that would result in exceedances of ARARs for LA in surface water.

Remedial alternatives are in development in the feasibility study to address unacceptable risks from those potential exposures and migration pathways. The completion of the Phase 1 and Phase 2 feasibility study will culminate in EPA's selection of a final remedial plan for OU3 in a record of decision and the implementation of the selected remedy. This NTCRA would cover the near-term activities at the site (the Mitchell Jackson Project area that surrounds OU3) before the selected remedy is implemented in the adjacent OU3. The timeline for remedial action in OU3 has not been determined but will occur subsequent to NTCRA implementation for the site.

This page intentionally left blank.

Section 4

Identification and Analysis of Removal Action Alternatives

4.1 Overview

This section describes and analyzes each removal action alternative identified and developed to address the RAOs identified in Section 3 for the NTCRA.

This EE/CA identified the following removal action alternatives for evaluation:

- Alternative 1[10]: Vegetation and Transportation Management Activities Using the Existing Road System
- Alternative 2[11]: Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System

These removal action alternatives are evaluated and compared using the criteria specified in EPA's *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA 1993). Evaluation criteria are used to compare removal action alternatives in the areas of effectiveness, implementability, and cost. Following are the evaluation criteria and subcriteria:

Effectiveness

- **Overall Protection of Human Health and the Environment –** This subcriterion evaluates how each alternative achieves adequate protection and describes how the alternative will reduce, control, or eliminate risks through treatment, engineering, or institutional controls. This evaluation should identify any unacceptable short-term impacts.
- **Compliance with ARARs and Other Criteria, Advisories, and Guidance –** This subcriterion evaluates how each alternative addresses and complies with ARARs of federal and state statutes as well as other criteria, advisories, and guidance that are typically identified as TBCs. Appendix B lists the ARARs and TBCs identified for this NTCRA.
- **Long-Term Effectiveness and Permanence –** This subcriterion evaluates the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes in the NTCRA area. Magnitude of risk as well as adequacy and reliability of controls are specific factors evaluated.

[10] Alternative 1 is referred to as Alternative 3 in USFS documents associated with this project, including the fire modeling analysis in Appendix A. However, it is herein referred to as Alternative 1.

[11] Alternative 2 is referred to as Alternative 4 in USFS documents related to this work, including the fire modeling analysis in Appendix A. However, it is herein referred to as Alternative 2.

- **Reduction in Toxicity, Mobility, or Volume through Treatment –** This subcriterion evaluates the CERCLA policy of preference for treatment (i.e., for technologies that will permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element).

- **Short-Term Effectiveness –** This subcriterion evaluates the effects of the alternative during implementation before the removal objectives have been met. Alternatives should also be evaluated with respect to their effects on human health and the environment following implementation. Protection of the community and workers, environmental impacts, and time until response objectives are achieved are specific factors evaluated.

Implementability

- **Technical Feasibility –** This subcriterion evaluates the ability of the technology to implement the removal action. The reliability of the technology is also of concern as technical problems associated with implementation may delay the schedule.

- **Administrative Feasibility –** This subcriterion evaluates those activities needed to coordinate with other offices and agencies. The administrative feasibility of each alternative should be evaluated, including the need for off-site permits, adherence to applicable non-environmental laws, and concerns of other regulatory agencies. Statutory limits, permits, and waivers are specific factors evaluated.

- **Availability of Services and Materials –** This subcriterion determines if off-site treatment, storage and disposal capacity, equipment, personnel, services and materials, and other resources necessary to implement an alternative will be available in time to maintain the removal schedule. Availability of funds to meet PRSC requirements is also generally a factor, though is not applicable for this specific NTCRA.

- **Support Agency Acceptance –** This subcriterion evaluates the support agency's anticipated response to and acceptance of a removal action alternative. As discussed in Section 1.1, there is no support agency for this NTCRA, so this criterion is not applicable to this NTCRA.

- **Community Acceptance –** This subcriterion evaluates the public's anticipated response to and acceptance of a removal action alternative.

Cost

- **Capital Costs and Annual Post-Removal Site Control Costs –** This subcriterion evaluates the capital for materials, equipment, and related items. While annual PRSC costs normally would be provided, this NTCRA does not involve any PRSC as discussed in Section 3.3. Cost estimates for each removal action alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000b). As stated in this guidance, it is also pertinent to develop cost estimates for an EE/CA and supersede prior feasibility study cost estimating guidance provided by EPA. The present value of each alternative provides the basis for the cost comparison. The present value cost represents the amount of money that, if invested in the initial year of the removal action at a given rate, would provide the funds required to make future payments to cover all costs

associated with the remedial action over its planned life. Future costs are included and discounted (reduced) by the appropriate present value discount rate over the period of analysis selected for each alternative. Appendix D presents the 7% real discount rate used to develop the present value costs for each alternative.

The last two subcriteria of implementability—Support Agency Acceptance and Community Acceptance—are not directly evaluated in this EE/CA. These two criteria are evaluated when the final decision on the proposed removal action is selected and in conjunction with the Action Memorandum preparation. These two subcriteria are important; careful planning and consideration are required to gain acceptance.

Sections 4.5.1 and 4.5.2 present the evaluation using the qualitative ratings system of each removal action alternative (1 and 2), respectively. Exhibit 5-1 provides definitions of the qualitative rating categories. Appendix C provides the detailed rationale for assigning the ratings.

The sections that follow provide detailed descriptions of the proposed removal action alternatives, including common components of the alternatives, and enough information to conduct the evaluations. Each alternative description includes a summary of the alternative with descriptions of individual components of the alternative. Appendix D presents the quantity estimates for components of each alternative for purposes of alternative cost estimation.

4.2 Common Components of Each Alternative

Both alternatives propose using many of the same vegetation and transportation management activities to lower wildland fire intensity and the potential for wildland fire spread into OU3, to limit human-caused fire starts, and to maintain or improve firefighter response to wildland fires.

This subsection provides a brief explanation of the management activities proposed for both alternatives. Additional details pertaining to the location, quantity, and other aspects of the application of these management activities are described for each alternative in its respective subsection (Sections 4.3.1 and 4.4.1).

4.2.1 Vegetation Management Activities

The identified vegetation management approach to mitigate wildland fire intensity and spread depends on numerous factors, including current and desired forest vegetation conditions at the stand and landscape scales, biophysical setting, accessibility, and management direction and emphasis for the area. Vegetation management activities are applied to develop desired conditions to increase resistance and resilience to disturbances and stressors, such as fire, which would reduce the likelihood of intense fire spreading into OU3 and corresponding unacceptable risks to wildland firefighters from LA exposure.

Vegetation management activities address fuels, species composition, and size class. As summarized in Stephens et al. 2012, wildland fuels are commonly classified as ground, surface, ladder, and crown. Ground fuels, including the duff on the soil surface, are not significant contributors to wildland fire spread and intensity. Fuels management approaches typically address surface and ladder fuels—the greatest contributors to wildland fire. Surface fuels include dead and down woody materials, litter, grasses, and short shrubs. Ladder fuels are small trees or

tall shrubs that provide vertical continuity from surface fuels to crown fuels (the overstory) (Stephens et al. 2012).

Of the tree species most common in the Kootenai National Forest, western larch and ponderosa pine are the most resistant species because of their thick bark, high canopy base height, low crown bulk density, and low foliage flammability. Douglas-fir is relatively resistant to fire when mature but more susceptible when young (Hood et al. 2018). The site is characterized by overstocked stands dominated by middle-aged (medium-size class) Douglas-fir, resulting in a uniform stand structure with low canopy base height, which can allow fire to transition from surface to crown fire. As such, vegetation management approaches typically aim to shift the species composition toward greater percentages of ponderosa and western larch and diversify the size class.

4.2.1.1 Harvest Vegetation Management Activities

Harvest vegetation management activities are various approaches to the felling and removal of trees from the forest to achieve the RAOs. The specific method depends on existing stand density, species composition, biophysical setting, and desired conditions. Harvest vegetation management activities would be carried out by both ground-based and cable yarding methods. Merchantable timber would be transported to mills via haul routes (discussed in Section 4.2.2.1). Harvest vegetation management activities have associated fuels management activities (burning and mastication) as described in Section 4.2.1.2.

The subsections that follow describe various harvest vegetative management activities pertinent to this NTCRA for the site.

4.2.1.1.1 Regeneration Harvest Activities

Regeneration harvests are applied to mature stands to establish new age class or species of trees.

Clearcut with Reserves

Clearcut with reserves is a regeneration harvest approach generally applied where desirable leave trees are not available. Most of the trees in a stand are removed (typically leaving 5 to 20 trees per acre), producing an open environment to be replanted with more fire-resilient species such as western larch and ponderosa pine.

Seed Tree Harvest

A seed tree harvest removes trees except those needed for the purposes of seed production of desirable species. Larger trees (typically, 8 to 20 trees per acre) are left as reserve trees to provide a natural seed source for regeneration of a new age class of trees and to serve other functions such as future wildlife snags, as coarse woody debris, and to provide structural diversity. Compared to shelterwood harvest, stands proposed for seed tree harvest typically do not occur on hot south, west, and southwest aspects where moderating the unit with shade is essential for reforestation.

Shelterwood Harvest

A shelterwood harvest removes most trees except those needed to provide shade to moderate the environment for regeneration. This approach cuts and removes about two-thirds of the existing canopy cover to create openings in the stand. After fuel management activities (discussed below) are completed, trees of the desirable species would be planted in the openings. Planted trees, in combination with other trees that naturally seed in and establish themselves, would regenerate the openings to establish a new age class of trees, thereby creating a two-aged stand.

Shelterwood harvests are typically prescribed for units with south, west, and southwest aspects that have long exposures to sun. The existing overstory canopies in stands proposed for shelterwood harvest tend to be moderate to very dense, and these areas tend to have a substantial number of understory trees that serve as ladder fuels. Compared to stands proposed for management by commercial thin harvests, the stands proposed for shelterwood harvest tend to have fewer trees of the more desirable species, tend to have more insect or disease agents affecting the trees, or do not contain enough good quality trees that would likely withstand wind if the stands were thinned. The leave trees (typically, 15 to 30 trees per acre) provide shade, seed, and structure for regenerating the unit.

Openings Greater than 40 Acres

Ponderosa pine and western larch are more resistant to fire and there is a desire to shift to a greater proportion of these species in the site. The creation of openings through regeneration harvest would promote the establishment of these species because they are intolerant to shade. Proposed clearcut with reserves, seed tree, and shelterwood harvest treatments would result in varying levels of openness, as the number of leave trees per acre depends on the regeneration harvest approach. Clearcut with reserves would be the most open, shelterwood harvest would be the least open, and seed tree harvest would fall in-between. Topography, irregular edges, riparian habitat conservation areas, and other exclusion areas identified during layout would help break up the visual continuity of these openings. Overall, increasing the diversity of patch sizes, stand structure, and tree species composition would make forest stands more resistant and resilient to insects, diseases, and other natural disturbances such as wildfire. Regeneration harvests proposed for alternatives would create variety of patch sizes, with openings ranging in size from 46 to 342 acres either as individual units or in combination with other regeneration harvest units.

Reforestation

As stated in Section 4.2.1, the proposed vegetation management approaches typically aim to shift the species composition toward greater percentages of ponderosa and western larch. Therefore, reforestation is part of the overall management activity in the regeneration harvest units (shelterwood, seed tree, and clearcut with reserves) to improve resilience. Reforestation can include natural regeneration, however, often involves planting seedling trees to meet desired species composition (fire-resistant species) in the treated areas.

4.2.1.1.2 Intermediate Harvest Activities

Intermediate harvests are designed to enhance growth, quality, and composition of the stand after establishment or regeneration.

Commercial Thinning

A commercial thin harvest is the mechanized thinning and removal of pole-sized trees. By reducing the density of trees in the stand, the overall fuel load is reduced, and remaining trees have more sunlight, soil nutrients, and water. In general, commercial thinning is proposed for stands containing enough healthy trees of a desirable species and condition that, after thinning, would not contain any sizable canopy openings. No trees would need to be planted in these areas because a manageable stand of trees would be retained.

Improvement Harvest

Improvement harvests are applied to stands of pole-sized or larger trees primarily to remove the small- and medium-sized Douglas-fir and grand fir trees and leave the large overstory ponderosa pine, western larch, as well as some larger Douglas-fir. Following harvest, the stand would remain fully stocked. No trees would be planted, and the residual stand may have some small openings and clumps of residual trees. Improvement harvests increase fire resiliency of the stand by shifting to more tolerant species, mainly western larch and ponderosa pine, of a larger size class and reducing ladder fuels.

4.2.1.2 Other Vegetation Management Activities

Other vegetation management activities include methods for units where no harvest or associated activities occurs to achieve the RAOs. The subsections that follow describe various other vegetation management activities pertinent to this NTCRA for the site.

4.2.1.2.1 Pre-Commercial Thinning

Pre-commercial thinning is the selective felling of young trees (typically 2 to 5 inches in diameter) that have not reached commercial size. The objectives of pre-commercial thinning are to reduce stocking levels (generally to 200 to 350 trees per acre) and thereby reduce fuels, maintain desired species composition, and improve health and growth of the stand in the long term. The best quality trees are retained and featured as future mature trees with a preference for fire-resilient species like ponderosa pine, western larch, western white pine, and some Douglas-fir. Thinning can be completed by hand or mechanically. During the hand thinning operations, pruning of lower live limbs would occur on western white pine to reduce the risk of white pine blister rust infection.

The fuels management approach paired with pre-commercial thinning depends on unit conditions. Cut trees are typically scattered on the forest floor and remain in place to contribute small-diameter woody debris and soil nutrients. Some units would have site-specific spot piling by hand, which would then be burned in the fall or spring during moist conditions. Prescribed fire (burning, described below) would also be used in some units to apply low-intensity underburn fire to consume surface fuels with very little impact on the retained trees.

4.2.1.2.2 Slashing

Slashing consists of cutting smaller-diameter trees, often using a chainsaw, but can also be accomplished using mechanical equipment. The objectives are to maintain the existing forest overstory structure and species composition while improving the understory conditions to reduce vertical and horizontal continuity of fuels. Slashing would primarily target Douglas-fir and grand fir trees that are 7 inches or less in diameter and all trees less than 4 inches in diameter at

breast height. As applicable, other less desirable species, such as lodgepole pine, or unhealthy ponderosa pine and western larch may also be cut, and healthy ponderosa pine, western larch, western white pine, and Douglas-fir that are 4 to 7 inches in diameter at breast height could be thinned.

The fuels management approach paired with slashing depends on unit conditions. Where fuels levels are low, cut trees would be scattered and left on the ground for coarse woody debris, soil nutrients, and natural decomposition. Some units would have site-specific spot piling, mostly by hand, which would then be burned in the fall or spring during moist conditions. Prescribed fire (burning, described below) also would be used in some units to apply low-intensity underburn fire to consume surface fuels with very little impact on the forest overstory canopy.

4.2.1.2.3 Burning

Prescribed fires are ignited by fire managers under planned and predetermined weather and fuel conditions to create desired fire behavior to achieve specific management objectives. For this project, the desired fire behavior objective is a low-intensity surface fire. Prescribed burns are applied by experienced fire personnel who are certified as prescribed fire burn bosses. Burning is both a primary vegetation management activity and a fuels management approach after vegetation management activities such as thinning and slashing. Burning also helps restore the natural function of fire to the landscape. Two approaches to burning, underburning and pile burning, are proposed for the alternatives.

Underburning applies fire across the entire unit and is controlled by using one or more ignition patterns to achieve desired fire effects. Ignition occurs progressively, allowing the fire to burn toward previously ignited areas. In regeneration harvest units (shelterwood, seed tree, and clearcut), underburning would reduce fuel loads and prepare the unit for reforestation. This process controls fire intensity and resulting fire effects, along with fire rate of spread. To help keep prescribed fire within the desired area, fire line is constructed with the use of an excavator or hand crew along the perimeter of the burn boundary to use as a control line. This is generally done at the completion of harvest activities and before ignition.

Pile burning, either hand or machine piled, would occur to reduce fuel loading and, in some units, as preparation for planting. Under appropriate conditions, some burning between piles would be allowed to continue to creep as described in a unit-specific prescribed fire burn plan. Natural features, changes in fuel types, and preexisting control lines would function to keep the creeping fire in predetermined areas. Additionally, pile burning typically occurs under wet or snowy conditions to limit fire spread.

4.2.1.2.4 Mastication

Mastication is a fuels management approach that involves the mechanical grinding, shredding, or chopping of trees or shrubs into small pieces. As such, mastication converts ladder fuels to surface fuels. Mastication also enhances decomposition of dead biomass and can be used to eliminate vegetation competition and pole-sized trees in the understory (Jain et al. 2018). Mastication is a fuels management approach to supplement both harvest and other vegetation management activities.

4.2.1.2.5 Weed Management

Noxious weeds impact species composition and act as surface fuels. Spraying for noxious weeds, including but not limited to knapweed, oxeye daisy, and cheatgrass, reduces the potential for encroachment into harvest management units. Depending on access for a given location, weed management activities can occur via backpack (off-road locations), truck (using roads), and UTV (along the power transmission line, Figure 2-2).

Each alternative proposes the use of drones to map the extent of cheatgrass growth in the site to better inform specialists on the susceptibility to fire of areas with access limitations because of rugged terrain: the northern boundary with OU3 and the Alexander Inventoried Roadless Area (discussed in Section 4.2.3). Drone mapping would occur between June 16 and September 1 to target the general cheatgrass curing timing, which occurs prior to curing other grasses. Approximately 150 to 200 acres can be mapped each flight, which generally occurs at an altitude greater than 300 feet above ground surface. Mapping is also beneficial for identifying potential future management activities.

4.2.2 Transportation Management Activities

Each alternative would use a variety of transportation management activities to achieve the RAOs. This subsection summarizes the existing road system improvements and access management approaches proposed in each alternative to facilitate the proposed vegetation management activities, manage public access to reduce the likelihood of human-caused fire starts, improve fire response, and maintain or improve road drainage.

4.2.2.1 Existing Road System Improvements

Each alternative proposes the use of several road system improvements to facilitate the proposed vegetation management activities and support response in the event of wildland fires within the site. Gravel for proposed road improvement activities would come from the Alexander gravel pit, located in the eastern part of the site, or from local sources as needed.

4.2.2.1.1 Upgrades for Use as Timber Haul Routes

Upgrades to existing NFS roads within the site are needed for use as haul routes for proposed timber harvests, many of which address surface water quality because there are numerous streams and associated riparian areas within the site (Figure 2-3). Upgrades may include but are not limited to:

- Blading and reshaping the road surface
- Uprooting small trees and uprooting or cutting back brush from the roadway, cut and fill slopes, or both
- Cleaning existing culverts and the inlets, outlets, and catch basins
- Adding or replacing existing culverts to better accommodate existing or future stream flows
- Placing gravel on road surfaces to reduce erosion
- Installing rolling dips and/or water bars to redirect and reduce road surface water and sediment entering streams

- Placing rock armoring in rolling dips and around culvert inlets
- Placing straw material such as bales, straw waddles, or silt fences around sensitive disturbed areas
- Conducting dust abatement while the roads are being used for timber hauling

Some currently undetermined roads (Section 4.2.2.1.4), county roads, and privately owned roads would also be used as haul routes. Private landowners would need to allow access for use of the privately owned roads. Based on previously existing relationships with private landowners and USFS, private road access is not anticipated to be an impediment.

4.2.2.1.2 Realignment

Realignment is new construction limited to rerouting an existing segment of an NFS road that is currently not in a condition suitable for vegetation management activities or fire access for large vehicles or other equipment. Both alternatives propose realignment of 0.5 mile of the existing Lower Rainy Road[12], located within OU3, to facilitate access for vegetation management activities and firefighting response within the site. Given the risks to human health from elevated LA concentrations within OU3, additional safety precautions would be required for this work. Examples of safety measures include personal protective equipment (PPE) for workers, dust suppression, establishment of work zones, air monitoring, and establishment of proper work procedures including LA-contaminated soil management procedures.

4.2.2.1.3 Temporary Road Construction

Temporary roads are used only to facilitate the proposed vegetation management activities and do not become part of the NFS. Locations proposed for temporary roads require access for timber haul or can be used to reduce harvest skid distances and associated resource impacts, but because of the habitat type and proposed treatments, these roads were not determined to be necessary for long-term access for wildland fire suppression or other USFS management objectives. Temporary roads would be returned to their preharvest condition following the completion of harvest activities.

4.2.2.1.4 Addition of Undetermined Roads to the National Forest System

Undetermined roads are existing road prisms that were illegally created by users or from unknown past actions, such as abandoned historical routes or from previous management activities. Undetermined roads are currently not part of the NFS but can be added for management purposes. Each alternative proposes the addition of undetermined roads to the NFS to provide access for proposed vegetation management activities and fire suppression as part of the NTCRA. The addition of undetermined roads does not involve new road construction; but improvements similar to those described in Section 4.2.2.1.1 for timber haul routes would be anticipated.

[12] Lower Rainy Road is USFS Road 4755, not to be confused with the paved road to the former Libby Vermiculite Mine area known as Rainy Creek Road.

4.2.2.2 Access Management

Access restrictions are common on NFS roads to achieve forest management objectives and would be implemented for the NTCRA to achieve RAOs and comply with ARARs (Appendix B). Many NFS roads within the site have existing public motorized access restrictions, including seasonal, yearlong, and for undetermined periods of time associated with potential closure orders. Intermittent closures may also be implemented, as needed, for public safety while vegetation management activities are being performed for the NTCRA.

4.2.2.2.1 Road Storage

Road storage is proposed for roads that, following the completion of vegetation management activities, are not expected to be needed in the near future but would be needed for the long-term management of NFS lands and the NTCRA, including access for fire response. Approaches to road storage vary depending on the needs of the road and watershed. At a minimum, an earthen berm would be installed at the beginning of all stored roads. Some roads may require other stabilization work that may include replacing undersized culverts, providing armored overflows, recontouring unstable sections of road, water barring, scarifying the road surface, and seeding. It is expected that all roads would be scarified and seeded to help establish native vegetation and deter the establishment of noxious weeds. Any best management practices (BMPs) implemented on roads for harvest use would be left in place, such as drainage structures. The level and type of road work would be identified for each road or road segment and would be at least the minimum needed to effectively stabilize the road.

4.2.2.2.2 Road Decommissioning

Decommissioning is the act of removing a road from the road system. Roads proposed for decommissioning to achieve RAOs for this NTCRA were identified through the travel analysis process as being not needed for long-term access for fire response or resource management. The Forest Plan requires that roads being decommissioned are to be left in a hydrologically stable condition (posing minimal risk of watershed impacts). Like road storage, activities for road decommissioning vary depending on the needs of the road and watershed. At a minimum, all roads proposed for decommissioning would have the entrance blocked to motorized use (both public and administrative access), which reduce the likelihood of human-caused fire starts, particularly from motorized vehicles.

4.2.2.2.3 Conversion from Road to Non-motorized Trail

For two road segments deemed not necessary for fire response within the site, conversion of the roads to nonmotorized trails allows public recreational access without the risk of fire start from motor vehicle use. Both alternatives propose the conversion of 0.9 miles of road to nonmotorized trail leading into the Alexander Inventoried Roadless Area. These segments connect to and extend existing nonmotorized trails in the area.

4.2.2.2.4 Access Travel Management Changes

Seasonal and yearlong access restrictions would be implemented for both alternatives to restrict motorized access to reduce the likelihood of human-caused fire starts, address resource concerns, and comply with ARARs. Access restrictions on NFS roads that are seasonally open to the public or allow for administrative use by USFS are typically implemented via gates.

4.2.3 Special Management Areas

4.2.3.1 Alexander Inventoried Roadless Area

Much of the southeastern part of the site is composed of the Alexander Inventoried Roadless Area, which is adjacent to and overlaps the OU3 boundary (Figure 2-2). As a designated roadless area, road construction and road reconstruction are typically prohibited based on the U.S. Department of Agriculture–promulgated Roadless Area Conservation Rule (herein referred to as the 2001 Roadless Rule). The inventoried roadless area encompasses 6,715 acres of forested lands so it was considered for vegetation management activities to meet the RAOs. Although motorized vehicle access is limited, vegetation and transportation management activities were proposed around the perimeter as part of each alternative.

4.2.3.2 Vegetation Management within Old Growth Forest

Vegetation management activities within old growth would maintain old growth characteristics but improve resistance and resiliency by reducing competition, improving species composition, and reducing fuel levels. These improvements in old growth increase resistance and resilience to insects, diseases, and fire.

In old growth areas within the warm/dry biophysical setting, wildland fire historically was an important agent in controlling density and species composition. Low to moderate intensity wildland fires on a frequency of 35 to 100 years played a major role in maintaining the early seral community of conifers, typically ponderosa pine with some western larch and lodgepole pine in moist areas, and would burn non-uniformly consuming the litter and undergrowth. Over the last century, wildland fire suppression has essentially replaced those frequent, low-intensity underburns, resulting in a higher stand density of middle-aged trees. A dense layer of Douglas-fir and other shade-tolerant species have developed in the understory stressing the stands and making them less resistant and resilient. This condition puts them at risk for stand-replacing fires and insect and disease mortality. Proposed vegetation management activities within old growth stands would increase the old growth characteristics by thinning from below around large-diameter ponderosa pine, western larch, and Douglas-fir, thereby reducing tree density and increasing resiliency to insect, disease, and fire.

4.3 Alternative 1: Vegetation and Transportation Management Activities Using the Existing Road System

4.3.1 Alternative 1 Component Descriptions

Alternative 1 would address the RAOs through a combination of vegetation and transportation management activities within the site. The vegetation management activities would modify fuels conditions to lower the wildland fire intensity in the site. Transportation management activities would limit human-caused fire starts, maintain or improve firefighter response to wildland fires within the site, and facilitate vegetation management activities. The proposed activities would reduce the likelihood of wildland fires starting and spreading into OU3, thereby reducing the potential for unacceptable human health risks of wildland firefighter exposure to LA and migration to surface water of LA-contaminated media (e.g., soil, duff, and post-fire ash).

Alternative 1 includes a variety of vegetation management activities described in Section 4.2.1 complemented by transportation management activities using the existing road system. Figures 4-1 and 4-2 provide detailed illustrations of the proposed vegetation and transportation management activities, respectively, included in Alternative 1. Figure 4-3 shows generalized illustrations of both vegetation and transportation management activities proposed for Alternative 1 relative to mapped streams and wetlands within the site. Table 4-1 provides estimated quantities of proposed vegetation management activities. Table 4-2 provides estimated quantities associated with the proposed transportation management activities.

4.3.1.1 Vegetation Management Activities

Alternative 1 proposes all harvest vegetation management methods described in Section 4.2.1.1. Harvest vegetation management activities are proposed on NFS lands throughout western, northern, and eastern parts of the site (Figure 4-1). Units were identified for clearcut with reserves, seed tree, shelterwood, commercial thinning, and improvement harvests based on existing and desired forest conditions identified during reconnaissance surveys performed in 2022. The harvest and fuels management methods chosen for each unit depend on existing species and size class, biophysical setting, and fuels condition. Regeneration harvest activities proposed for Alternative 1 would create 24 openings greater than 40 acres. Harvest-related fuels management activities include mastication, underburning, and piling combined with burning or mastication. Some units proposed for harvest vegetation management activities are near streams. Unit boundaries would be adjusted during layout to exclude riparian corridors based on ground conditions. Harvest would not occur in riparian habitat conservation areas.

Other vegetation management activities (Section 4.2.1.2) proposed for Alternative 1 include pre-commercial thinning, slashing, and underburning. Most pre-commercial thinning is proposed for northern and eastern areas of the site, the majority by hand. Proposed hand slashing primarily occurs in the eastern part of the site, with some mechanical slashing in the north near proposed harvest units. Fuels management in these units also includes mastication, underburning, and piling combined with burning.

A small amount of improvement harvest is proposed for locations in the southeast part of the site, which is primarily composed of the Alexander Inventoried Roadless Area. Harvest activities proposed in the Alexander Inventoried Roadless Area occur around the perimeter because of the lack of access to the interior. In addition, a small quantity of hand slashing is proposed in the Alexander Inventoried Roadless Area near its perimeter. These vegetation management activities are identified to improve the fuels condition but retain large trees based on conditions described in the 2001 Roadless Rule. Noxious weed management activities are proposed, primarily along roads but also in off-road locations and along the 115 kV power transmission line (Figure 2-2). In addition, Alternative 1 proposes the use of drones to map cheatgrass population, primarily in the Alexander Inventoried Roadless Area and along the northern boundary with OU3. Mapping is beneficial to identify potential future management activities.

4.3.1.2 Transportation Management Activities

Table 4-2 summarizes transportation management activities needed to facilitate the vegetation management activities proposed in Alternative 1. Access for proposed vegetation management activities would be facilitated by yearlong open, seasonally open, and yearlong gated roads. Temporary road construction would be used to access vegetation management units, as needed,

but there would be no construction of new NFS roads. Use of the existing road system would require the realignment of 0.5 miles of the existing Lower Rainy Road and 3.6 miles of temporary roads. In addition, 2.1 miles of undetermined roads, existing roads from an unknown past action or illegally created by users, would be added as NFS roads to support the proposed vegetation management and wildland fire response activities. Commercial removal of timber proposed in Alternative 1 would use a total of 98.4 miles of haul routes, 92 miles of which are NFS roads. Access for wildland fire response and limiting public access to reduce the likelihood of human-caused fire starts would be managed via road storage (4.8 miles), road decommissioning (3.4 miles), the conversion of road to trail (0.9 miles in the Alexander Inventoried Roadless Area), and other access travel management changes (9.7 miles). Some proposed transportation management activities would be conducted near streams and within riparian corridors. Road activities, such as those described in 4.2.2.1.1, would be implemented, as needed, for all road work in the site to reduce the potential for erosion and sediment movement into streams from road and vegetation management activities.

4.4 Alternative 2: Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System

4.4.1 Alternative 2 Component Descriptions

Similar to Alternative 1, Alternative 2 would address the RAOs through a combination of vegetation and transportation management activities within the site.

The vegetation management activities would modify fuels conditions to lower the wildland fire intensity in the site. Transportation management activities would limit human-caused fire starts, maintain or improve firefighter response to wildland fires within the site, and facilitate vegetation management activities. The proposed activities would reduce the likelihood of wildland fires starting and spreading into OU3, thereby reducing the potential for unacceptable human health risks of wildland firefighter exposure to LA and migration to surface water of LA-contaminated media (e.g., soil, duff, and post-fire ash).

Alternative 2 includes a variety of vegetation management activities described in Section 4.2.1 complemented by transportation management activities using the existing road system as well as construction of new NFS roads. Figures 4-4 and 4-5 provide detailed illustrations of the proposed vegetation and transportation management activities, respectively, included in Alternative 2. Figure 4-6 shows generalized illustrations of both vegetation and transportation management activities proposed for Alternative 2 relative to mapped streams and wetlands within the site. Table 4-1 provides estimated quantities of proposed vegetation management activities for both alternatives. Table 4-2 provides estimated quantities associated with the proposed transportation management activities for both alternatives.

4.4.1.1 Vegetation Management Activities

Just as for Alternative 1, all harvest vegetation management methods described in Section 4.2.1.1 are proposed in Alternative 2. Harvest activities are proposed on NFS lands throughout western, northern, and eastern parts of the site (Figure 4-3). Units were identified for clearcut with reserves, seed tree, shelterwood, commercial thinning, and improvement harvests based on existing and desired forest conditions identified during reconnaissance surveys performed in 2022. The harvest and fuels management methods identified for each unit depend on existing

species and size class, biophysical setting, and fuels condition. Regeneration harvest activities proposed for Alternative 1 would create 25 openings greater than 40 acres. Harvest-related fuels management activities include mastication, underburning, and piling combined with burning or mastication.

A greater area of vegetation management activities is proposed for Alternative 2 than Alternative 1. This is facilitated by the construction of new NFS roads (Section 4.4.1.2), particularly in the warm and dry areas in the western part of the site. Because of the high density of ladder fuels along the OU3 boundary in the direction of general prevailing winds (Appendix A), additional vegetation management activities in this area are considered beneficial to reduce the likelihood of intense wildland fire that has the potential to move into OU3. Some units proposed for harvest vegetation management activities are near streams. Unit boundaries would be adjusted during layout to exclude riparian corridors based on ground conditions. Harvest would not occur in riparian habitat conservation areas.

Other vegetation management activities (Section 4.2.1.2) proposed for Alternative 2 include pre-commercial thinning, slashing, and underburning. The same units proposed for pre-commercial thinning in Alternative 1 are also proposed for Alternative 2, with some mechanical thinning in the northern area of the site near proposed harvest units. Proposed hand slashing in the northern and eastern areas of the site are the same as those proposed for Alternative 1, with additional units in the western parts of the site. Some mechanical slashing is proposed in the north and east near proposed harvest units, and one unit is proposed near Blue Mountain.

In Alternative 2, hand slashing is also proposed along the northern boundary with OU3 (Figure 4-4). Slashing in this area would have a potential added benefit because it borders Area 1 within the Phase 1 ABS area of OU3. This area has the largest HQ value of any Phase 1 ABS area within OU3 (HQ = 5) (Section 2.11, Figure 2-5). Proposed slashing would result in a more open canopy along the ridgetop and would reduce ladder fuels through the closed canopy forest. This allows for a more effective aerial delivery of water and fire retardant to the forest floor where it is most effective. Fuels management in these units also includes mastication, underburning, and piling combined with burning.

Both alternatives propose the same locations and quantities of harvest activities in and around the Alexander Inventoried Roadless Area. Proposed harvest activities in this area occur around the perimeter because of the lack of access to the interior. These vegetation management activities are identified to improve the fuels condition and will retain large trees based on conditions described in the 2001 Roadless Rule. A small quantity of hand slashing is also proposed in this area near its perimeter. Noxious weed management activities are proposed, primarily along roads but also in off-road locations and along the 115 kV power transmission line (Figure 2-2). Alternative 2 also proposes the use of drones to map cheatgrass population, primarily in the Alexander Inventoried Roadless Area and along the northern boundary with OU3. Mapping is also beneficial for identifying potential future management activities.

4.4.1.2 Transportation Management Activities

Table 4-2 summarizes the transportation management activities needed to facilitate the vegetation management activities proposed in Alternative 2. Just as proposed for Alternative 1, access for vegetation management activities proposed for Alternative 2 would be facilitated by

yearlong open, seasonally open, and yearlong gated roads. Alternative 2 would similarly use temporary roads (4.3 miles), the realignment of 0.5 miles of the existing Lower Rainy Road, and 2.1 miles of undetermined roads added to the NFS to support the proposed vegetation management and wildland fire suppression activities. However, in addition to Alternative 1, Alterative 2 also proposes the construction of new roads for permanent inclusion in the NFS and the administrative use of 4.1 miles of barriered NFS roads (currently no wheeled motorized use). A total of 8.3 miles of new NFS roads are proposed, primarily in the western part of the site, areas critical to reducing the likelihood of wildland fire start and spread into OU3 because of their warm/dry biophysical setting, buildup of fuels, and location upwind of OU3 (Appendix A). New NFS roads would facilitate an increase in both vegetation management activities and wildland firefighter response in these areas. One segment of new NFS road is also proposed in the eastern part of the site.

Commercial removal of timber proposed in Alternative 2 would use a total of 117.6 miles of haul routes, 108.9 miles of which are NFS roads. Access for wildland fire response and limiting public access to reduce the likelihood of human-caused fire starts would be managed via road storage (12.2 miles), road decommissioning (3.8 miles), conversion of road to trail (0.9 miles leading into the Alexander Inventoried Roadless Area), and other access travel management changes (11.1 miles). Some proposed transportation management activities would be conducted near streams and within riparian corridors. Road activities, such as those described in 4.2.2.1.1, would be implemented, as needed, for all road work in the site to reduce the potential for erosion and sediment movement into streams from road and vegetation management activities.

4.5 Detailed Analysis of Alternatives

The subsections that follow summarize the evaluation of the removal action alternatives based on the evaluation of criteria described in Section 4.1.

4.5.1 Summary of Detailed Analysis for Alternative 1

Exhibit 4-1 provides evaluation of criteria for Alternative 1. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix C that provide justification for the rating. Evaluation of support agency acceptance and community acceptance for Alternative 1 is not directly evaluated in this EE/CA. Sections 4.6 and 4.7 provide detailed explanations of these two subcriteria and why they are excluded from the EE/CA.

Exhibit 4-1 Detailed Analysis Summary – Alternative 1

Evaluation Criterion	Evaluation Subcriterion	Qualitative Rating	Evaluation Table Reference (Appendix C)
Effectiveness	Overall Protection of Human Health and the Environment	Acceptable	C-1
	Compliance with ARARs	Will Comply	C-1
	Long-Term Effectiveness and Permanence	Moderate	C-1
	Reduction of Toxicity, Mobility, or Volume through Treatment	None	C-1
	Short-Term Effectiveness	Moderate to High	C-1
Implementability	Technical Feasibility	Moderate to High	C-2
	Administrative Feasibility	High	C-2
	Availability of Services and Materials	Moderate High	C-2
	Support Agency Acceptance	Not Evaluated	C-2
	Community Acceptance	Not Evaluated	C-2
Cost	Capital Costs and Annual PRSC Costs (Present Value)[1]	$34,721,000	-

[1] Costs presented in this exhibit are present value costs. Appendix D presents detailed costs (cost summaries and present value analyses) for each alternative. Alternative 1 does not have PRSC costs.

4.5.2 Summary of Detailed Analysis for Alternative 2

Exhibit 4-2 presents evaluation of criteria for Alternative 2. The exhibit includes the qualitative ratings for each criterion and reference to the evaluation tables in Appendix C that provide justification for the rating. Evaluation of support agencies acceptance and community acceptance for Alternative 2 is not directly evaluated in this EE/CA. Sections 4.6 and 4.7 provide detailed explanations of these two subcriteria and why they are excluded from the EE/CA.

Exhibit 4-2 Detailed Analysis Summary – Alternative 2

Evaluation Criterion	Evaluation Subcriterion	Qualitative Rating	Evaluation Table Reference (Appendix C)
Effectiveness	Overall Protection of Human Health and the Environment	Acceptable	C-1
	Compliance with ARARs	Will Comply	C-1
	Long-Term Effectiveness and Permanence	Moderate to High	C-1
	Reduction of Toxicity, Mobility, or Volume through Treatment	None	C-1
	Short-Term Effectiveness	Moderate to High	C-1
Implementability	Technical Feasibility	Moderate to High	C-2
	Administrative Feasibility	High	C-2
	Availability of Services and Materials	Moderate to High	C-2
	Support Agency Acceptance	Not Evaluated	C-2
	Community Acceptance	Not Evaluated	C-2
Cost	Capital Costs and Annual PRSC Costs (Present Value)[1]	$43,819,000	-

[1] Costs presented in this exhibit are present value costs. Appendix D presents detailed costs (cost summaries and present value analyses) for each alternative. Alternative 2 does not have PRSC costs.

4.6 Support Agency Acceptance

As discussed in Section 1.1 there is no support agency for this NTCRA, so this criterion was not evaluated.

4.7 Community Acceptance

Assessment of community acceptance will include responses to questions any interested person in the community may have regarding any component of the removal action alternatives presented in the EE/CA. A public meeting was held on September 18, 2023, to engage with some representatives of the community on preliminary NTCRA concepts, but detailed specifics of each of the alternatives were not presented. The September 18, 2023, public meeting was conducted before the formal public comment period began for the EE/CA. However, an additional public meeting will be held during the public comment period to allow the public an opportunity to provide oral comments on the EE/CA.

A full assessment will be completed after USFS receives public comments on the EE/CA during the public comment period. Thus, community acceptance is not considered in the detailed analysis of alternatives presented in the EE/CA.

This page intentionally left blank.

Section 5

Comparative Analysis of Removal Action Alternatives

This EE/CA evaluates the two alternatives in Section 4 against the short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost, as well their subcriteria. Exhibit 5-1 presents results of the detailed analysis for each removal action alternative to allow comparative analysis of the alternatives and identify the key trade-offs between them as presented in the EE/CA. Comparative analysis for the removal action alternatives using the evaluation criteria has been put into narrative form in the subsections that follow. Only significant comparative differences between alternatives are presented; the full set of rationale for assigning the qualitative ratings is provided in Appendix C.

5.1 Effectiveness

5.1.1 Overall Protection of Human Health and the Environment

Alternatives 1 and 2 were both rated as "acceptable" for the Overall Protection of Human Health and the Environment subcriterion. Both alternatives would achieve the RAOs through the proposed vegetation and transportation management activities. The vegetation management activities would modify fuels conditions to lower the wildland fire intensity in the site. Transportation management activities would limit human-caused fire starts via public access management, maintain or improve firefighter response to wildland fires within the site, and facilitate vegetation management activities. The proposed activities would reduce the likelihood of wildland fires starting and spreading into OU3, thereby reducing the potential for unacceptable human health risks of wildland firefighter exposure to LA and migration to surface water of LA-contaminated media (e.g., soil, duff, and post-fire ash).

In 2022, an interdisciplinary team chose locations for vegetation and transportation management activities based on assessments of current forest condition, site topography and features, and fire modeling. The current conditions in the site are susceptible to intense wildland fire with a potential to move into OU3. Proposed vegetation management activities, both harvest and other activities, would reduce fuels and the potential for intense wildland fire by reducing flame length, increasing canopy base heights, and decreasing canopy bulk densities, thereby reducing crown fire potential. BMPs would be implemented as part of proposed transportation management activities to address sedimentation concerns associated with hauling on existing and new roads, as pertinent. All vegetation and transportation management activities proposed for Alternative 1 are also proposed for Alternative 2. Alternative 2 proposes an additional 17% more harvest acreage and 7% more acreage for other vegetation management activities. Fire behavior modeling (Appendix A) indicates the proposed vegetation management activities would reduce total crown fire potential from 67% of the site total USFS-managed land to 48% in Alternative 1 and 46% in Alternative 2. Section 5.3 provides a more detailed comparison of the results of the fire modeling.

While the additional vegetation management acreages proposed in Alternative 2 reduce the total modeled acreage susceptible to crown fire by only an additional 2%, this additional reduction primarily occurs in the critical western part of the site affecting fire spread into OU3, including along the OU3 boundary. Because of the prevailing wind direction, warm/dry biophysical setting, and buildup of vegetative fuels in these units, there is a higher likelihood of the start and spread of intense wildland fire from this part of the site into OU3 (Appendix A). Access to perform the additional vegetation management activities proposed in Alternative 2 is facilitated by the construction of new NFS roads, which would also improve firefighter response in the event of a fire. Alternative 2 also proposes slashing (by hand) along the northern site boundary with OU3, which is adjacent to the ABS area within OU3 with the highest HQ value (HQ = 5, Figure 2-5).

Short-term impacts to the community, environment, and workers are generally the same for each alternative. Access for the implementation of proposed activities, including the use of log trucks, heavy machinery, and prescribed burning, would impact traffic and air quality. There are potential erosion and sedimentation impacts associated with harvest and road improvement activities. There are also safety risks associated with logging, heavy equipment operation, and hand tool use, particularly on steep terrain, at stream crossings, or around other water bodies (Figures 4-3 and 4-6). Each alternative would also include both temporary and long-term road and trail access changes. The greater quantities of activities proposed for Alternative 2 would increase the quantity of short-term effects to the community, workers, and the environment. Short-term impacts would be mitigated by the implementation of BMPs, including adherence to ARARs and TBCs (Section 5.2 and Appendix B) and communication with the community about vegetation and transportation management activities, as needed, such as when prescribed burns will occur.

Wildland fire behavior is a function of many factors beyond a forest manager's control, including temperature, humidity, and wind direction, meaning there is inherent uncertainty and randomness that influence fire intensity and spread. However, the greater area of vegetation management and transportation management activities proposed in Alternative 2, particularly in critical locations in the western portion of the site, would further mitigate the likelihood of wildland fire spread into OU3 and the associated unacceptable human health risks of wildland firefighter exposure to LA and migration to surface water of LA-contaminated media (e.g., soil, duff, and post-fire ash) within the forested portions of OU3.

5.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Alternatives 1 and 2 were both rated "will comply" under the assumption that the vegetation and transportation management activities proposed in the alternatives would comply with chemical-, location-, and action-specific ARARs during implementation of each alternative. Appendix B provides additional information concerning compliance with potential ARARs.

5.1.2.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements

Alternatives 1 and 2 are expected to meet the chemical-specific federal ARARs identified for this NTCRA. These ARARs address the following types of contaminants and media:

- Particulate matter released to the air during activities such as grading, clearing, and excavation during the construction of new or temporary roads, and maintenance of existing roads.

- Particulate matter released to the air during prescribed burns.

The primary approaches for compliance with air quality standards for particulate matter would be use of engineered controls and BMPs.

5.1.2.2 Location-Specific Applicable or Relevant and Appropriate Requirements

Alternatives 1 and 2 are expected to meet the location-specific federal ARARs identified for this NTCRA. These ARARs address the following types of locations or conditions associated with locations:

- USFS-managed lands
- Endangered or threatened species or their critical habitat (e.g., grizzly bear)
- Migratory birds and their habitat (e.g., harlequin duck)
- Bald or Golden eagles or their habitat
- Cultural and archaeological resources and artifacts
- Eligible wild and scenic river (Kootenai River)
- Streams (waters of the U.S.)
- Wetlands
- Floodplains

The primary approaches for compliance would be adjusting locations of staging areas for remediation work and adjusting work windows (timing of specific activities).

5.1.2.3 Action-Specific Applicable or Relevant and Appropriate Requirements

Alternatives 1 and 2 are expected to meet the action-specific federal ARARs identified for this NTCRA. These ARARs address the following types of actions:

- Site preparation activities (e.g., erosion and sedimentation control measures)
- Discharge requirements of fill materials to streams or modification of streams for transportation management activities
- Discharge requirements (point or nonpoint) to streams or wetlands from point or nonpoint sources during vegetation and transportation management activities

The primary approaches for compliance would be adjusting locations of discharges or fill placement and using BMPs to mitigate effects.

5.1.3 Long-Term Effectiveness and Permanence

Alternative 1 was rated “moderate” and Alterative 2 was rated “moderate to high” for the Long-Term Effectiveness and Permanence subcriterion. Proposed vegetation management activities, both harvest and other activities, would reduce fuels and the potential for intense wildland fire by changing flame length, canopy base heights, canopy bulk densities, and crown fire potential. All vegetation and transportation management activities proposed for Alternative 1 are also proposed for Alternative 2. Each alternative proposes most of the same vegetation and transportation management activities to achieve the RAOs, but greater quantities of each are

proposed in Alternative 2. Alternative 2 proposes 6,301 acres of harvest activities and 3,786 acres of other vegetation management activities, which is approximately 17% and 7%, respectively, more than Alternative 1. Alternative 2 also proposes the construction of 8.3 miles of new NFS roads to facilitate access to perform the additional vegetation management activities, which would also improve firefighter response in the event of a wildland fire. Most of the additional activities proposed in Alternative 2 occur in the critical western part of the site. Because of the prevailing wind direction, warm/dry biophysical setting, and buildup of fuels in these units—many along the OU3 boundary—there is a higher likelihood of the start and spread of intense wildland fire from this part of the site into OU3. Alternative 2 also proposes slashing (by hand) along the northern site boundary with OU3, which is adjacent to the ABS area within OU3 with the highest HQ value (HQ = 5, Figure 2-5).

IFTDSS fire modeling of USFS-managed land (Appendix A-2) indicates that under current vegetation conditions, 67% of the site has crown fire potential with 73% of the site likely to experience surface fire flame lengths over 4 feet during a wildland fire under extreme burning conditions. This is because of an overabundance of surface and ladder fuels, including canopy base heights of less than 3 feet in 82% of the USFS-managed land in the site as well as high canopy bulk densities. The current conditions mean direct attack by firefighters likely would not be possible. Modeling suggests the fuels management activities proposed in Alternatives 1 and 2, including harvest activities, would increase the canopy base height and reduce surface and ladder fuels in treated stands, thereby removing contiguous fuels from the surface to the canopy and reducing surface fire flame lengths. The proposed alternatives would reduce the occurrence of canopy base heights less than 3 feet to 53% and 49% of the site, respectively. This means a greater opportunity to respond to fires in the site through direct attack methods. Canopy bulk densities would also decrease, requiring more wind to spread crown fires. Modeling results show the reduction of canopy bulk densities greater than 0.05 kg/m^3, the threshold above which crown fire is possible or likely (Powell 2017), from 93% of the site under existing conditions to 70% and 69% after proposed vegetation management activities in Alternatives 1 and 2, respectively. These changes in canopy base height, canopy bulk densities, and surface flame length all contribute to a reduction in the potential for crown fire. The percent of the site with total crown fire potential would be reduced from 67% to 48% and 46%, respectively, in Alternatives 1 and 2. The difference in the fire modeling percentages between Alternatives 1 and 2 are relatively small because they are calculated based on the total USFS-managed acreage of the site. However, as discussed, these differences primarily pertain to the southwest portion of the site that is the driest, has the greatest quantity of ladder fuels, and is located upwind from OU3 in the prevailing wind direction (Appendix A-1). Given that fires typically spread from a southwest to northeast direction in the Kootenai National Forest, reducing crown fire potential in these areas is critical to mitigate the likelihood of wildland fire spread into OU3 and thereby reducing the potential for unacceptable human health risks of wildland firefighter exposure to LA and migration to surface water of LA-contaminated media within the forested portions of OU3.

Wildland fire behavior has inherent uncertainty and randomness, so the possibility of a wildland fire starting and spreading from the site into OU3 is not eliminated by either alternative. However, the greater area of vegetation management proposed in Alternative 2, particularly in critical locations, would further mitigate the likelihood of wildland fire spreading into OU3 and the associated unacceptable exposure and migration to surface water of LA-contaminated media

within the forested portions of OU3. The additional vegetation and transportation management activities enhance the adequacy and reliability of these controls given the uncertainties of the wildland fire behavior, especially when considering climate change. The proposed additional vegetation management activities have ecosystem benefits in addition to fire intensity reduction benefits, including reducing stresses from disease and invasive insects. There remains a potential for the landscape to burn; however, these ecosystem benefits further provide effectiveness because the healthier ecosystem would have reduced the potential for burn intensity and severity and increased firefighting effectiveness. In addition, the greater amount of transportation management activities in Alternative 2, including new roads, provides greater improvement of access for firefighter response and provides greater reliability for uncertainties that roads could become temporarily unusable because of fire, flood, or other reasons.

5.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Neither alterative would treat LA-contaminated media. Thus, each alternative was given a rating of "none" because it fails to provide a reduction of toxicity, mobility, or volume through treatment as defined by CERCLA and the NCP.

5.1.5 Short-Term Effectiveness

Both alternatives were rated "moderate to high" for the Short-Term Effectiveness subcriterion. The types of adverse impacts to the community, workers implementing the activities, and environment are the same. While Alternative 2 proposes a greater quantity of vegetation and transportation management activities and therefore a greater quantity of some risks (as discussed below), the types of adverse impacts and mitigation approaches are the same. The most challenging risks, which are also the most unique to the site, come from the small segment of road improvements in OU3 (discussed below) and are the same in type and quantity for each alternative.

There are a variety of short-term risks to the community associated with the vegetation and transportation management activities proposed for both alternatives. Smoke from prescribed burning, as part of vegetation management activities, could impact air quality in nearby communities, though burns are planned in coordination with air quality agencies for days with good smoke dispersal. There would be public notifications of planned burning activities. Potential impacts to the community from the transport of timber removed from harvest units include an increase in log truck traffic, noise, potential safety risks from local traffic congestion, and vehicular pollution on public roads and through the community. Impacts are anticipated to be greater for Alternative 2 because 17% more acreage is proposed for harvest activities. For either alternative, community impacts could be reduced through measures such as BMPs to minimize traffic safety hazards, such as traffic control signs. In addition, to the extent practicable, the USFS will carefully select haul routes and implement work hour restrictions to minimize public safety hazards. Access to certain trails, roads, or other recreational areas within the site may be reduced during implementation of both alternatives. Signage could be used to alert the community of ongoing work activities to reduce safety risks for community members recreating in the Kootenai National Forest within the site during the implementation of the NTCRA.

There are elevated physical health and safety risks in the logging industry as a whole. Vegetation management activities proposed in both alternatives present potential safety risks to workers, especially when implemented on steep and difficult terrain, and when performing hand work (chain sawing, slashing, piling). In addition, prescribed burning has potential safety risks to workers through inhalation of smoke and exposure to fires. There are also potential safety risks to workers related to increased traffic associated with log trucks, noise, falls, and mechanical hazards, all of which would be greater in Alternative 2 because of the greater acreages proposed for management. Worker risks can be reduced through training, planning, and the use of standard operating procedures and BMPs.

For the small segments of road construction and improvements conducted within the OU3 boundary proposed in both alternatives, surface disturbance of LA-contaminated forest media such as contaminated soil or duff could pose short-term risks to workers from exposures to LA. Dust suppression, use of PPE, establishment of work zones, air monitoring, and establishment of proper work procedures are examples of safety measures that could be implemented to protect workers. Surface disturbance of LA-contaminated forest media could pose potential adverse environmental impacts through dispersion of dust. Water- or chemical-based suppression is an example of a measure that could be used for controlling LA-contaminated forest media and dust during construction. Alternative 2 proposes the construction of approximately 0.25 miles of new NFS road in OU3 in addition to the 0.5 miles of realignment also proposed in Alternative 1, as well as access through OU3 for construction of new and temporary roads west of the OU3 boundary in the western portion of the site. The increased work and time spent in OU3 increases the potential for short-term risks to workers. However, the increase is minor relative to the total amount of work proposed for each alternative, and the risk mitigation strategies are the same.

There are a variety of potential environmental impacts associated with the implementation of each alternative. The removal of vegetation and alteration of soil properties from harvest and fuels management activities could adversely impact slope stability and water quality through erosion. However, measures such as erosion control procedures and BMPs could be used to minimize impacts to soils, streams, and other water bodies. Log haul and use of other heavy construction equipment has potential impacts to local air quality because of emissions from increased truck traffic, as does prescribed burning. Use of fuel-efficient and low-emissions equipment vehicles when possible and coordination with air quality agencies for prescribed burning could reduce environmental impacts. Development of on-site gravel pits for transportation management activities could adversely impact the environment. Mitigation measures would include reclamation of the Alexander gravel pit after use. Vegetation management activities may impact wildlife, such as grizzly bears, Canada lynx, and migratory birds, and their habitat. Alternative 2 would impact greater quantities of habit because of the greater quantities of proposed activities. There are potential additional environmental impacts to streams and other water bodies from crossing streams with new roads or other actions in the direct vicinity of water bodies, such as impacts to aquatic wildlife and water quality. All vegetation management activities would be performed in compliance with ARARs and TBCs, to the greatest extent practicable, including to the standards and guidelines outlined in the Forest Plan.

Some of the proposed vegetation and transportation management activities could begin within this calendar year for each alternative (assumed to be 2024). While Alternative 2 proposes greater quantities of activities, the anticipated completion time for each alternative is the same because of the contracting mechanisms for implementation. The selected remedy for OU3 will be responsible for providing overall protection from risks posed by unaddressed LA in forest media within OU3. However, each alternative would contribute to protectiveness of human health in OU3 until a final remedy for OU3 is selected.

5.2 Feasibility

5.2.1 Technical Feasibility

Both alternatives were rated "moderate to high" for the Technical Feasibility subcriterion. There are challenges associated with performing vegetation management activities on steep terrain or crossing streams and other water bodies, including the need for potentially limited specialized equipment. In addition, timber management activities may be performed in winter conditions to minimize impacts from erosion, which can be prone to short-term delays if roads are closed because of winter safety and accessibility concerns such as heavy snow or ice. However, USFS is familiar with these challenges as this characterizes the terrain and climate of the Kootenai National Forest.

The small segments of road work proposed in OU3 to access units for vegetation management activities located near the OU3 boundary would add additional complexity because they are located within OU3 and therefore could pose elevated exposure risks to workers from LA in contaminated forest media (e.g., soil and duff). Alternative 2 proposes more road work in and transportation through OU3 than Alternative 1. However, the increased quantity is minimal and USFS is familiar with the health and safety requirements for performing work in OU3.

Alternative 2 proposes a larger volume of the same harvest and other vegetation management activities as Alternative 1. As such, differences in technical feasibility considerations regarding vegetation management activities are negligible. While the construction of new NFS roads proposed in Alternative 2 results in additional road construction activities compared to Alternative 1, NFS road construction in these settings is standard for USFS and is not a significant technical feasibility challenge.

The proposed vegetation and transportation management activities proposed for either alternative do not preclude further response actions with the site. They also do not preclude future remedial actions in OU3, which will address LA-contaminated forest media posing unacceptable exposure risks. Implementation of the vegetation and transportation management activities within the site proposed in both alternatives would reduce the likelihood of intense wildland fire spreading into OU3 from the site in the interim before the OU3 remedy is implemented. Visual inspections for vegetation and transportation management activities and monitoring of fuels conditions would be performed, as needed, to monitor effectiveness of the alternative in achieving the RAOs.

5.2.2 Administrative Feasibility

Both alternatives were rated "high" for the Administrative Feasibility subcriterion. Both alternatives involve vegetation and transportation management activities to reduce the likelihood of intense wildland fire spread from the site into the adjacent OU3. This removal action is not a Superfund-financed removal action, therefore the statutory limit of $2 million and a 12-month duration does not apply.

Off-site removal activities would be required for both alternatives for the small segments of road improvements conducted within the OU3 boundary (Tubb Gulch Doak Creek, and Lower Rainy Roads). Alternative 2 would additionally require off-site removal activities for road construction and improvement on Lower Rainy North Face 3 Road and proposed new system road NS-10. These activities may require additional coordination with EPA, Lincoln County, or other entities, especially if off-site disposal of LA-contaminated wastes such as PPE is required.

Alternative 2 would use 2.3 miles more non-NFS roads than Alternative 1; however, preliminary agreements are already in place between USFS, Lincoln County, and Stimson Lumber Company for the use of private roads as haul routes. Periodic road closures to reduce human-caused fire starts would be feasible to implement on USFS property. Road closures during periods of elevated fire danger are routinely implemented by USFS to reduce human-caused fires. Both alternatives would require coordination with other government agencies, including, EPA and state of Montana and county agencies as needed pertaining to roads, highways, and other public infrastructure within and adjacent to the site, especially if off-site disposal of remediation wastes from work within OU3, such as PPE, are required.

While there is a 17% increase in harvest activities and a 7% increase in other vegetation management activities in Alternative 2 over Alternative 1, and Alternative 2 proposes the construction of new NFS roads, the contracting mechanisms and estimated time to completion are the same for each alternative and there are negligible additional administrative challenges.

5.2.3 Availability of Services and Materials

Both alternatives were given a rating of "moderate to high" for the Availability of Services and Materials subcriterion. Both alternatives would require off-site disposition of timber, but it is anticipated that local sawmills have the capacity to accept the volume of timber generated from the implementation of either alternative. Wastes associated with the proposed realignment of Lower Rainy Road and other roadwork within OU3 may require off-site disposal of LA-contaminated wastes such as PPE, which Lincoln County Landfill received during previous work in the area.

The technology, equipment, subcontractors, personnel, and facilities required to successfully complete both alternatives are available in the marketplace but could be affected by comfortability working in this area and competing activities during the construction season such as fire response. All vegetation and transportation management activities proposed for each alternative are standard practice and USFS has equipment and personnel to support implementation. Suitable road materials (gravel) for implementation of the transportation management activities proposed for each alternative, including new NFS road construction in

Alternative 2, are available from the on-site gravel pit or other local sources. Other materials (culverts and gates) are readily available from off-site vendors.

The greater quantity of vegetation and transportation management activities proposed for Alternative 2 would pose negligible additional challenges regarding the availability of services and materials.

5.2.4 Support Agency Acceptance

As discussed in Section 1.1, there is no support agency for this NTCRA, so this criterion was not evaluated.

5.2.5 Community Acceptance

As discussed in Section 4.7, a full assessment will be completed after USFS receives public comments on the draft final EE/CA during the public comment period. An additional public meeting will be held during the public comment period to allow the public the opportunity to provide oral comments on the EE/CA. Thus, community acceptance is not considered in the detailed analysis of alternatives presented in the EE/CA.

5.3 Cost

Present value costs for all removal action alternatives were analyzed over a 15-year period of analysis. As described in Section 4.1, costs that are incurred after the initial year of the removal action are included and discounted (reduced) by a 7% real discount rate to develop present value costs for each alternative. The following costs correspond to total costs incurred throughout a 15-year period.

The present value cost for Alternative 1 is approximately $34,721,000.

The present value cost for Alternative 2 is approximately $43,819,000.

This page intentionally left blank.

Exhibit 5-1 Summary of Comparative Analysis for Removal Action Alternatives

Removal Action Alternative	Description	Effectiveness					Implementability					Cost
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume Through Treatment	Short-Term Effectiveness	Technical Feasibility	Administrative Feasibility	Availability of Services and Materials	Support Agency Acceptance	Community Acceptance	Present Value Cost (Dollars)
1	Vegetation and Transportation Management Activities Using the Existing Road System	Acceptable	Will Comply	Moderate	None	Moderate to High	Moderate to High	High	Moderate to High	**NE**	**NE**	$34,721,000
2	Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System	Acceptable	Will Comply	Moderate to High	None	Moderate to High	Moderate to High	High	Moderate to High	**NE**	**NE**	$43,819,000

Notes

1. Appendix D presents the detailed cost spreadsheets (cost summaries, present value analyses, and cost worksheets) for each alternative, used to arrive at the present value cost identified in the exhibit.
2. Costs are based on a 15-year period of analysis.

Legend for Qualitative Ratings System:

Effectiveness and Implementability			Cost
Overall Protection of Human Health and the Environment	**Compliance with ARARs**	**For Remaining Criteria**	**Present Value Cost in Dollars**
Unacceptable	None	None	
Acceptable	Will Comply	Low	
		Low to Moderate	
		Moderate	
		Moderate to High	
		High	
		NE (Not Evaluated)	

This page intentionally left blank.

Section 6

Recommended Removal Action Alternative

Taking into consideration the evaluation criteria presented in this EE/CA, the recommended removal action alternative for the site is Alternative 2: Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System. Both alternatives propose many of the same vegetation and transportation management activities, but the greater quantity of vegetation management activities and the construction of new NFS roads proposed in Alternative 2 more comprehensively address uncertainties related to environmental conditions at the site with respect to achieving the RAOs. The greater quantity of acres proposed for vegetation management activities in Alternative 2 would further modify fuels levels to lower the potential for the start and spread of intense wildland fires in the site. The transportation management activities proposed in Alternative 2, particularly the construction of new NFS roads, would maintain and improve wildland firefighter response within the site and facilitate the implementation of vegetation management activities, as well as limit human-caused fire starts through access controls. As such, increased quantities of activities proposed in Alternative 2 would further reduce the potential for the start and spread of wildland fires from the site into OU3, thereby further reducing the potential for unacceptable human health risks of wildland firefighter exposure to LA and migration of LA-contaminated media (e.g., soil, duff, and post-fire ash) to surface water.

Alternative 2 has higher long-term effectiveness and permanence than Alternative 1 because of the greater quantity of proposed vegetation and transportation management activities, most of which would occur in the critical western part of the site. Because of the prevailing wind direction, warm/dry biophysical setting, and buildup of fuels in these units—including locations along the OU3 boundary—there is greater likelihood of the start and spread of intense wildland fire from this part of the site into OU3 and therefore greater need for vegetation management activities in this area (Appendix A). Alternative 2 also proposes slashing (by hand) along the northern OU3 boundary, which is adjacent to the ABS area within OU3 with the highest HQ value (HQ = 5, Figure 2-5). The greater extent of transportation management activities proposed in Alternative 2, including new roads, would not only facilitate access for proposed vegetation management activities, but also improves access for wildland fire response. The new roads will also provide greater reliability for uncertainties if some roads become temporarily unusable because of fire, flood, or other factors.

Wildland fire behavior is a function of many factors beyond a forest manager's control, including temperature, humidity, and wind direction, meaning there is inherent uncertainty and randomness that influence fire intensity and spread. However, the greater extent of vegetation management and transportation management activities proposed in Alternative 2, particularly in critical locations in the western portion of the site, would further mitigate the likelihood of wildland fire spread into OU3 and the associated unacceptable exposure and migration risks from LA within the forested portions of OU3.

The subcriteria of Short-Term Effectiveness, Technical Feasibility, Administrative Feasibility, and Availability of Services are not substantially different between Alternatives 1 and 2. The most challenging risks come from the small segments of road construction and improvements in OU3; Alternative 2 proposes a small quantity of additional road work in OU3 requiring a corresponding increase in the quantity of mitigation activities to minimize worker exposure to LA. However, the types of mitigation activities, with which USFS is already familiar, are the same for each alternative. Both removal action alternatives would comply with federal and state ARARs. While the cost of Alternative 2 is higher than Alternative 1, the increase in cost is considered proportional to the higher effectiveness for Alternative 2.

The added level of overall effectiveness based on the Long-Term Effectiveness and Permanence subcriterion for Alternative 2 over Alternative 1 (Exhibit 5-1), given the similar outcomes for the other evaluation criteria, justifies identifying Alternative 2 as the recommended removal action alternative for this NTCRA.

Section 7
References

CDM Smith. 2016. *Data Summary Report: 2007 to 2015*. Revision 5. Prepared for EPA Region 8, Denver, Colorado.

CDM Smith. 2019. *Data Summary Report, USFS Highway 37 Fire Monitoring, Modified Fire Response Zone, Libby, Montana*. Prepared for USFS.

EPA. 1991. *Guidance for Performing Preliminary Assessments Under CERCLA*. EPA/540/G-91/013. Washington, DC.

EPA. 1992. *Hazard Ranking System Guidance Manua*l. EPA 540-R-92-026. Washington, DC.

EPA. 1993. *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*. EPA 540-R-057. Washington, DC.

EPA. 2000a. Unilateral Administrative Order for Removal Response Activities, Libby Asbestos Site, Export Plant, Libby, Montana. EPA Region 8, Denver, Colorado.

EPA. 2000b. *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study*. EPA 540-R-00-002. Washington, DC.

EPA. 2002. *Action Memorandum Amendment for the Time-Critical Removal Action at the Libby Asbestos Site, Libby, Lincoln County, Montana*. EPA Region 8, Denver, Colorado.

EPA. 2014. *Baseline Ecological Risk Assessment for Exposure to Asbestos, Libby Asbestos Superfund Site, Part 1, Operable Unit 3*. EPA Region 8, Denver, Colorado.

EPA. 2015. *Final Site-Wide Human Health Risk Assessment Libby Asbestos Superfund Site, Libby, Montana*. EPA Region 8, Denver, Colorado.

EPA. 2016. *Action Memorandum Requesting Approval for Time-Critical Removal Action to Address Libby Amphibole Asbestos Contamination in Operable Unit 3 of the Libby Asbestos National Priorities List Site in Libby, Montana*. EPA 1775768. EPA Region 8, Denver, Colorado.

EPA. 2017. *Action Memorandum Requesting Approval for Non Time-Critical Removal Action to Address Libby Amphibole Asbestos Contamination in Operable Unit 3 of the Libby Asbestos National Priorities List Site in Libby, Montana and a Request for Ceiling Increase and Exemption from the 12-Month Statutory Limit on Removal Actions*. EPA 1883672. EPA Region 8, Denver, Colorado.

EPA. 2018. *Final Addendum: Site-Wide Human Health Risk Assessment Libby Asbestos Superfund Site, Libby, Montana*. EPA Region 8, Denver, Colorado.

EPA. 2024. EJScreen. Retrieved: May 16, 2024. epa.gov/ejscreen

Hood, S., I. Abrahamson, and C.A. Cansler. 2018. "Fire Resistance and Regeneration Characteristics of Northern Rockies Tree Species." In: Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory. Available at https://www.fs.fed.us/database/feis/pdfs/other/FireResistRegen.html

Jain, T., P. Sikkink, R. Keefe, and J. Byrne. 2018. *To Masticate or Not: Useful Tips for Treating Forest, Woodland, and Shrubland Vegetation*. Rocky Mountain Research Station. General Technical Report RMRS-GTR-381.

Meeker, G.P., A.M. Bern, I.K. Brownfield, H.A. Lowers, S.J. Sutley, T.M. Hoeffen, and J.S. Vance. 2003. "The Composition and Morphology of Amphiboles from the Rainy Creek Complex, Near Libby, Montana." *American Mineralogist* 88:1955–1969.

MWH. 2016. *Final Remedial Investigation Report, Operable Unit 3 Study Area, Libby Asbestos Superfund Site, Libby, Montana. Revision 1*.

MWH/Stantec. 2017. *Final Kootenai Development and Impoundment Dam (KDID) Hydrology Report, Operable Unit 3 Study Area, Libby Asbestos Superfund Site, Libby, Montana*. Prepared for W.R. Grace and Co, CT and Montana Departments of Environmental Quality and Natural Resources and Conservation, Dam Safety Section. MWH/Stantec, Denver CO.

NOAA. 2023. "Past Weather, Libby Montana, MT US." Accessed December 1, 2023, https://www.ncei.noaa.gov/access/past-weather/48.44420775335678,-115.7105286957543,48.332207609280005,-115.40132847873804.

NOAA. 2024. "NOAA NCEI U.S. Climate Normals Quick Access Banfield Mountain, MT." Accessed January 5, 2024, https://www.ncei.noaa.gov/access/us-climate-normals/#dataset=normals-monthly&timeframe=30&location=MT&station=USS0015A08S.

National Wildfire Coordinating Group. 2022. *Incident Report Pocket Guide*. PMS 461.

Nelson, J. *Draft 2023 Lincoln County Community Wildfire Protection Plan*.

Natural Resources Conservation Service. 2024. "Banfield Mountain (311) Site Information and Reports." Accessed January 5, 2024, https://wcc.sc.egov.usda.gov/nwcc/site?sitenum=311.

Powell, D.C. 2017. *Stand Density Thresholds Related to Crown Fire Susceptibility*. White Paper F14-SO-WP-SILV-37. USFS Pacific Northwest Region. Umatilla National Forest.

Stantec. 2018a. *Final 2016 Remedial Investigation Report Addendum, Operable Unit 3, Libby Asbestos Superfund Site, Libby, Montana*. Prepared for and with oversight by W.R. Grace & Co. – Conn and EPA Region 8, Denver, Colorado.

Stantec. 2018b. *Final 2017 Remedial Investigation Report Addendum, Operable Unit 3, Libby Asbestos Superfund Site, Libby, Montana*. Prepared for and with oversight by W.R. Grace & Co. – Conn and EPA Region 8, Denver, Colorado.

U.S. Census Bureau. 2020. "Libby CCD, Lincoln County, Montana." Accessed January 12, 2024. https://data.census.gov/profile/Libby_CCD,_Lincoln_County,_Montana?g=060XX00US3005392058#populations-and-people

U.S. Census Bureau. 2023. American Community Survey Data. https://www.census.gov/programs-surveys/acs/data.html

U.S. Federal Government. 2024. U.S. Climate Resilience Toolkit. [Online] http://toolkit.climate.gov. Accessed May 16, 2024.

USFWS. 2023. "National Wetlands Inventory." Last modified October 23, 2023. Accessed January 8, 2024, https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/.

USFWS. 2024. List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project. Mitchell Jackson Project, Project Code: 2023-0126514.

USFS. 2015. *Land Management Plan, 2015 Revision, Kootenai National Forest*. USFS Northern Region.

USFS. 2016. *Libby Asbestos Superfund OU3, Draft Fire Behavior/Fuels Report*.

USFS. 2024. Approval Memorandum: Request to Conduct an EE/CA for the Proposed NTCRA at the Mitchell Jackson Project Area, Lincoln County, Montana.

Whitlock C., W. Cross, B. Maxwell, N. Silverman, and A.A. Wade. 2017. *2017 Montana Climate Assessment*. Bozeman and Missoula, Montana: Montana Institute on Ecosystems, Montana State University and University of Montana. 318 p. doi:10.15788/m2ww8w.

This page intentionally left blank.

Figures

This page intentionally left blank.

Figure 2-1
Site Location Map
Mitchell Jackson Project Area

Legend

- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Alexander Inventoried Roadless Area
- Highway
- Creek or Stream

N

0 1.5 3 Mi

0 2.5 5 Km

NORTHWIND CDM ADVANTAGE an 8(a) JV

Lake Kookanusa
MT Highway 37
Jackson Creek
South Fork Jackson Creek
Upper Rainy Creek
Doak Creek
Little Jackson Creek
Fleetwood Creek
Mitchell Creek
Carney Creek
Lower Rainy Creek
Peace Creek
Souse Creek
Alexander Creek
MT Highway 37
US Highway 2
Libby
US Highway 2

Figure 2-2
Site Features
Mitchell Jackson Project Area

Legend

- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Alexander Inventoried Roadless Area - Managed by United States Forest Service
- Highway
- Existing Roads
- Trails
- 115 Kilovolt Power Transmission Line

Management/ Ownership

- United States Army Corps of Engineers
- United States Forest Service
- Private

N

0 1 2 Mi

0 1.5 3 Km

NORTHWINDCDM ADVANTAGE an 8(a) JV

Lake Kookanusa

MT Highway 37

Libby

Figure 2-3
Surface Water Features
Mitchell Jackson Project Area

Legend

- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Freshwater Emergent Wetland
- Freshwater Forested/ Shrub Wetland
- Pond or Lake
- Creek or Stream

Watersheds

- Cedar Creek-Kootenai River
- Jackson Creek
- Little Jackson Creek-Lake Koocanusa
- Doak Creek
- Rainy Creek
- Mitchell Creek
- Alexander Creek
- Other Watersheds

** Colors may appear different due to overlay on basemap

N

0 1 2 Mi

0 1.5 3 Km

NORTHWIND CDM
ADVANTAGE an 8(a) JV

North Fork Jackson Creek
South Fork Jackson Creek
Jackson Creek
Lake Kookanusa
Upper Rainy Creek
Doak Creek
Little Jackson Creek
Fleetwood Creek
Cedar Creek
Mitchell Creek
Carney Creek
Lower Rainy Creek
Peace Creek
Souse Creek
Alexander Creek
Kootenai River
Libby

Figure 2-4
Historical Fire Occurrence (1986-2021) Mitchell Jackson Project Area

Legend

- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Alexander Inventoried Roadless Area
- Historical Fire Occurrence
- Highway
- Existing Roads
- Existing Trails

N

0 1 2 Mi
0 1.5 3 Km

NORTHWINDCDM ADVANTAGE an 8(a) JV

Lake Kookanusa

MT Highway 37

Libby

Figure 2-5

Summary of Exposure Areas and Activity-Based Sampling Areas Assessing Human Health Risk
Mitchell Jackson Project Area

Legend

- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Operable Unit 3 Study Area (2016 Remedial Investigation)
- Former Libby Vermiculite Mine
- Radial Distance from Center of Former Libby Vermiculite Mine
- Activity Based Sampling (ABS) Location
- ABS Location and Hazard Quotient (HQ) Value for Hooking/ Skidding[1]
- 2012 Near Logging Area & 2012 Near Woodstove Ash Timber

[1] The hooking/skidding scenario is a surrogate exposure scenario for activities that disturb soil/ duff, including understory mop-up and building slash piles. The HQ for dry mop-up in Area 1 is also equal to 5 (HHRA, EPA 2015).

N

0 1.5 3 Mi

0 2 4 Km

NORTHWIND CDM ADVANTAGE an 8(a) JV

6 Miles

2 Miles

Area G

Area B

Area A
HQ Value: 0.04

Area 1
HQ Value: 5

Area C
HQ Value: 2

Area E
HQ Value: 2

Area D
HQ Value: 0.8

Area F
HQ Value: 0.06

Area I

Area H
HQ Value: 1

Libby

Figure 4-1

Alternative 1: Vegetation Management Activities Mitchell Jackson Project Area

Legend

- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Alexander Inventoried Roadless Area
- Highway
- Existing Roads
- Trails

Harvest Activities

Regeneration Harvest Activities

- Clearcut with Reserves
- Seed Tree
- Shelterwood

Intermediate Harvest Activities

- Commercial Thinning
- Improvement

Other Activities

- Pre-Commercial Thinning (Hand)
- Pre-Commercial Thinning (Mechanical)
- Slashing (Hand)
- Slashing (Mechanical)
- Underburning

N

0 1 2 Mi

0 1.5 3 Km

NORTHWINDCDM ADVANTAGE an 8(a) JV

Lake Kookanusa

MT Highway 37

Libby

Figure 4-2
Alternative 1: Transportation Management Activities Mitchell Jackson Project Area

Legend

- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Alexander Inventoried Roadless Area
- Highway
- Existing Roads
- Trails

Proposed Roads

- Realignment
- Temporary
- Existing Undetermined

Access Management

- Store
- Gate Seasonally
- Gate Yearlong
- Convert to Non-Motorized Trails
- Decommission

N

0 1 2 Mi

0 1.5 3 Km

Lake Kookanusa

MT Highway 37

Libby

NORTHWINDCDM
ADVANTAGE an 8(a) JV

Figure 4-3

Alternative 1: Streams and Wetlands Near Proposed Alternative Components Mitchell Jackson Project Area

Legend

- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Alexander Inventoried Roadless Area
- Wetland
- Creek or Stream
- Highway
- Existing Roads

Proposed Vegetation Management Activities

- Harvest Activities
- Other Activities

Proposed Transportation Management Activities

- Changes to Existing Road System

N

0 1 2 Mi

0 1.5 3 Km

NORTHWINDCDM ADVANTAGE an 8(a) JV

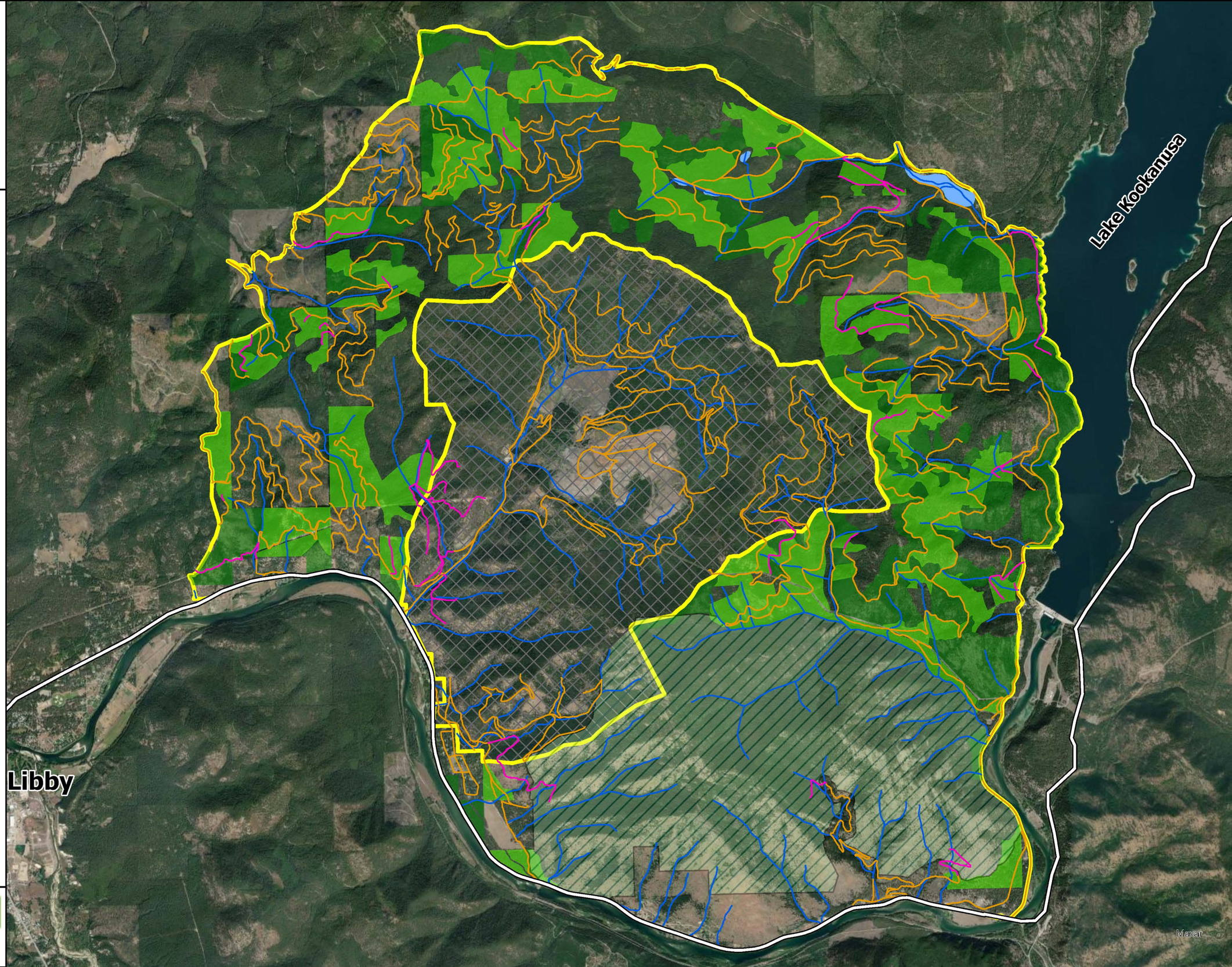


Figure 4-4

Alternative 2: Vegetation Management Activities Mitchell Jackson Project Area

Legend

- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Alexander Inventoried Roadless Area
- Highway
- Existing Roads
- Trails

Harvest Activities

Regeneration Harvest Activities

- Clearcut with Reserves
- Seed Tree
- Shelterwood

Intermediate Harvest Activities

- Commercial Thinning
- Improvement

Other Activities

- Pre-Commercial Thinning (Hand)
- Pre-Commercial Thinning (Mechanical)
- Slash (Hand)
- Slash (Mechanical)
- Underburning

N

0 1 2 Mi

0 1.5 3 Km

NORTHWIND CDM ADVANTAGE an 8(a) JV

Lake Kookanusa

MT Highway 37

Libby

Figure 4-5
Alternative 2: Transportation Management Activities Mitchell Jackson Project Area

Legend

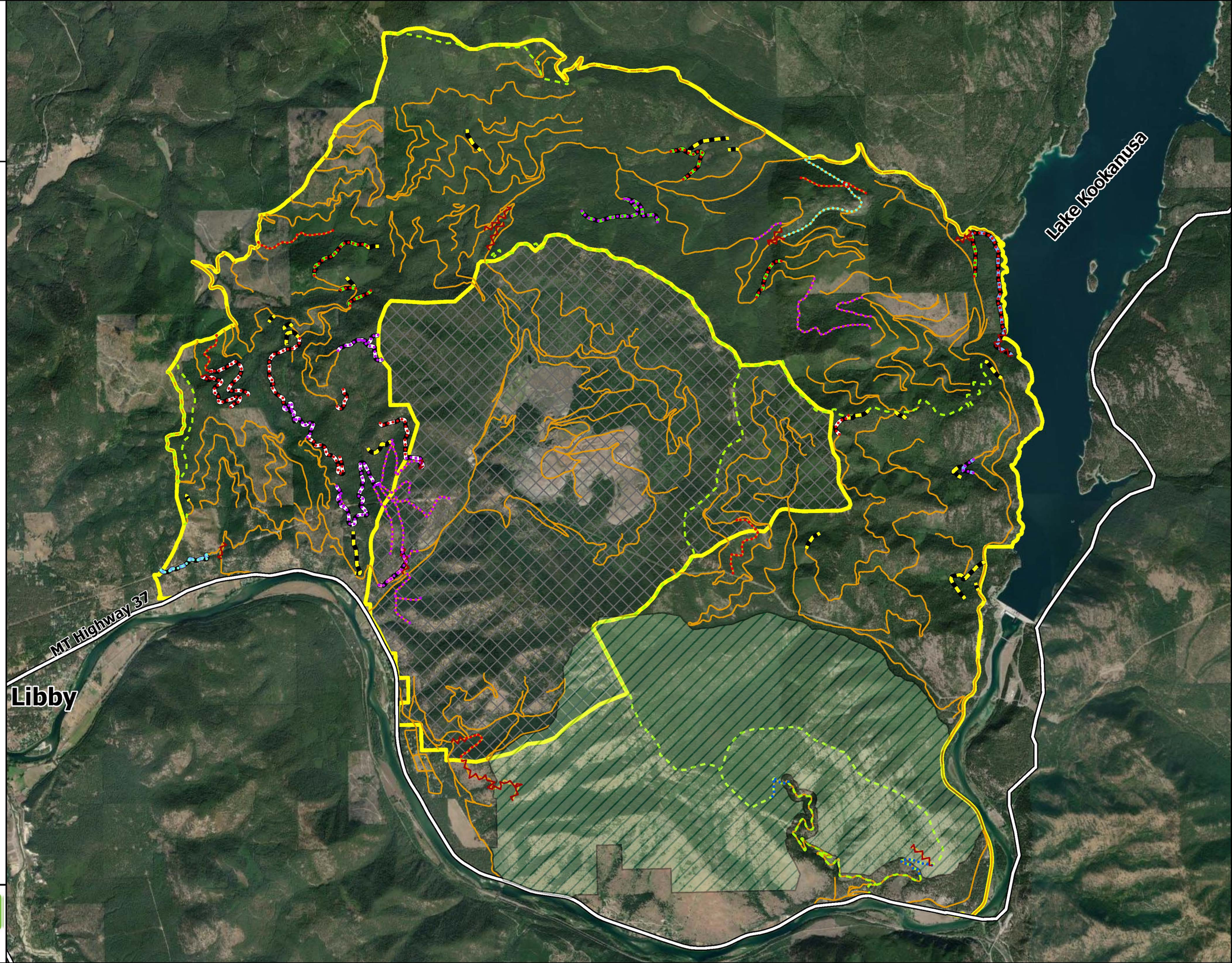
- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Alexander Inventoried Roadless Area
- Highway
- Existing Roads
- Trails

Proposed Roads

- New System
- Realignment
- Temporary
- Existing Undetermined
- Existing System Barriered

Access Management

- Store
- Gate Seasonally
- Gate Yearlong
- Convert to Non-Motorized Trail
- Decommission



N

0 1 2 Mi

0 1.5 3 Km

NORTHWINDCDM ADVANTAGE an 8(a) JV

Figure 4-6

Alternative 2: Streams and Wetlands Near Proposed Alternative Components Mitchell Jackson Project Area

Legend

- Mitchell Jackson Project Area
- Operable Unit 3, Libby Asbestos Superfund Site
- Alexander Inventoried Roadless Area
- Wetland
- Creek or Stream
- Highway
- Existing Roads

Proposed Vegetation Management Activities

- Harvest Activities
- Other Activities

Proposed Transportation Management Activities

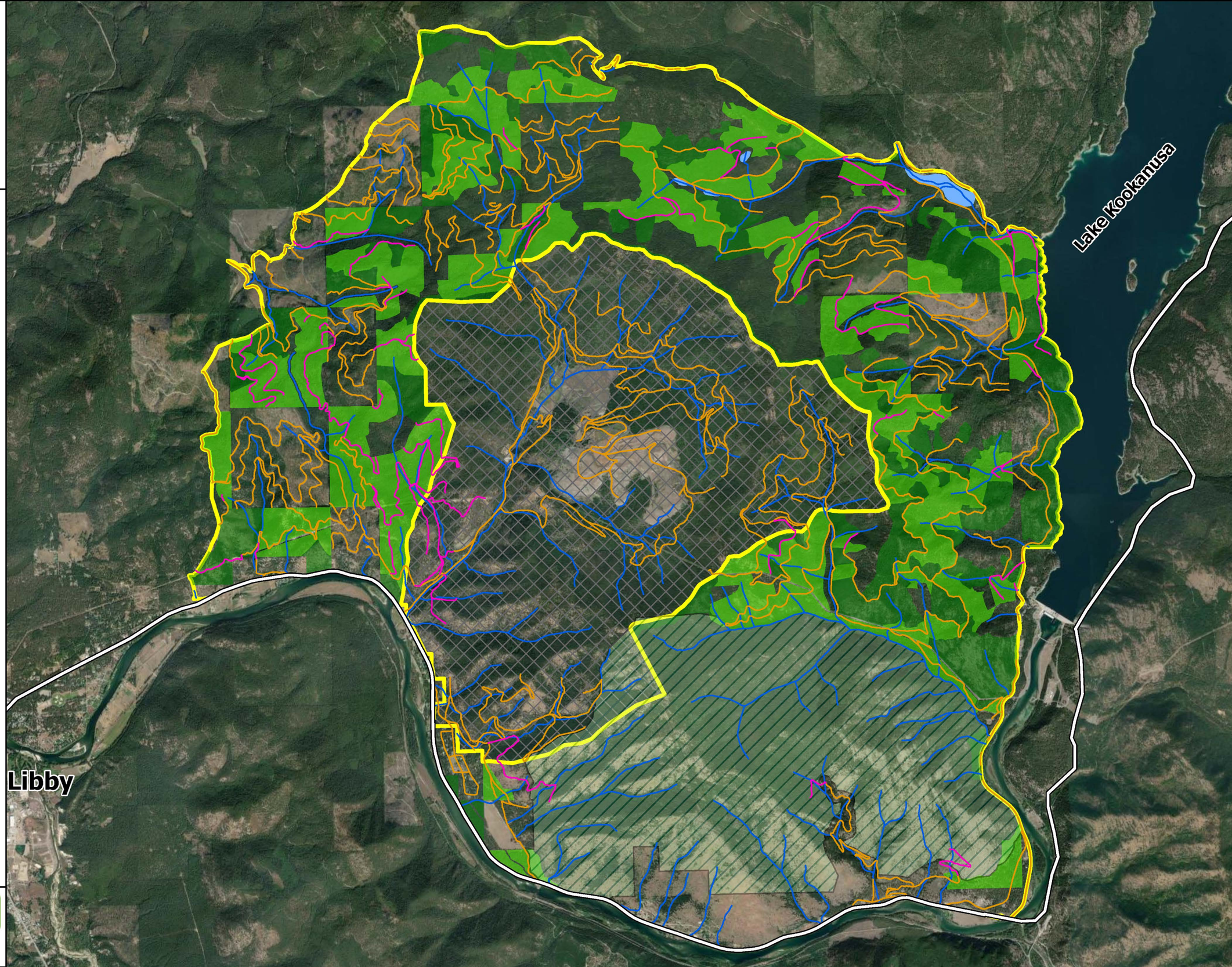
- Changes to Existing Road System

N

0 1 2 Mi

0 1.5 3 Km

NORTHWIND CDM ADVANTAGE an 8(a) JV



Tables

This page intentionally left blank.

Table 4-1. Proposed Vegetation Management Activities, Alternatives 1 and 2
Mitchell Jackson Project Area
Lincoln County, MT

Action	Alternative 1 (Acres)	Alternative 2 (Acres)
Harvest Activities		
Regeneration Harvest Activities		
Clearcut with Reserves	1,555	1,917
Seed Tree	1,205	1,306
Shelterwood	399	553
Intermediate Harvest Activities		
Commercial Thinning	678	677
Improvement	1,569	1,848
Total Harvest Activities	**5,406**	**6,301**
Harvest Activities by Method (Percentage)		
Ground-based	76%	70%
Cable Yarding	24%	30%
Regeneration Harvest Units Creating Openings Over 40 Acres[1]	2,828	3,404
Fuels Management and Site Preparation, Harvest Activities		
Pile (Excavator), Burn Piles	3,783	4,335
Pile (Excavator), Masticate	87	87
Masticate	92	92
Underburning	1,401	1,744
Total	**5,363**	**6,258**
Other Vegetation Management Activities		
Precommercial Thinning (Hand)	1,343	1,343
Precommercial Thinning (Mechanical)	175	175
Slashing (Hand)	1,768	1,981
Slashing (Mechanical)	255	278
Underburning	9	9
Total	**3,550**	**3,786**
Fuels Management, Other Vegetation Management Activities		
Pile (Hand), Burn Piles	652	879
Pile (Mechanical), Burn Piles	0	23
Masticate	430	430
Underburning	1,298	1,309
Total	**2,380**	**2,641**
Noxious Weed Management		
Backpack (Off-road)	228	210
Truck (Using Roads)	605	692
UTV (Along Powerline)	42	42
Total	**875**	**944**
Vegetation Management in Old Growth		
Harvest	949	1225
Slashing (Hand)	347	447
Slashing (Mechanical)	83	82
Total	**1,379**	**1,754**
Vegetation Management in the Alexander Inventoried Roadless Area		
Harvest	51	51
Slashing (Hand)	63	63
Total	**114**	**114**
Cheatgrass Population Mapping (Drones)		
Northern OU3 Boundary	113	113
Alexander Inventoried Roadless Area with <60% Cover	2,672	2,672
Total	**2785**	**2785**

Notes:
[1] 24 and 25 openings over 40 acres, in Alternative 1 and 2, respectively, either as individual units or in combination ranging in size from 46 to 342 acres.

Table 4-2. Proposed Transportation Management Activities, Alternatives 1 and 2
Mitchell Jackson Project Area
Lincoln County, MT

Action	Alternative 1	Alternative 2
Transportation Management	**(Miles)**	**(Miles)**
New National Forest System Road Construction	0	8.3
Realignment	0.5	0.5
Temporary Road Construction	3.6	4.3
Haul Routes (National Forest System Roads)[1]	92	108.9
Haul Routes (Other System Roads)[2]	6.4	8.7
Undetermined Roads Added to the System	2.1	2.1
Barriered Roads Used for Administrative Access	0	4.1
Road Storage	4.8	12.2
Road Decommissioning	3.4	3.8
Road Conversion to Non-motorized Trail	0.9	0.9
Travel Access Management Changes[3]	9.7	11.1
Gravel Pit Expansion	**(Acres)**	**(Acres)**
Existing Pit – Reclaim in Current Condition	2	2
Existing Stockpile – Continue Existing Use	< 1	< 1
Expansion Area	5	5

Notes:

[1] Includes undetermined roads proposed for addition to the National Forest System and Other Federal System roads with Forest Service jurisdiction.

[2] Other System roads include County and private roads.

[3]Access management changes, such as seasonal closures, in addition to other transportation management activities. Access travel management will be assigned to new system roads, realigned roads, and undetermined roads as applicable and needed.

Appendix A

Fire History, Fuels Condition, and Modeling Reports

Appendix A contains two parts:

- Appendix A-1 Historical Fire Behavior near the Mitchell Jackson Project Area
- Appendix A-2 Fire and Fuels Report

The contents of this appendix are the most recent versions provided by USFS on March 11, 2024 (Appendix A-1) and May 17, 2024 (Appendix A-2). The contents have not been modified. As such, there are some differences in terminology from the main body of the text, including:

- Alternatives 1 and 2 are referred to as Alternatives 3 and 4, respectively, in USFS documents in this Appendix (as well as in other USFS documents associated with this project).
- Given this is a USFS document related to forest management, some terms may not be reflective of CERCLA or NCP definitions. For example, “treatment” is used to describe vegetation management activities in this appendix. However, this does not imply the reduction of toxicity, mobility, or volume of a contaminant.

This page intentionally left blank.

Appendix A-1

Historical Fire Behavior near the Mitchell Jackson Project Area

This page intentionally left blank.

Mitchell Jackson Alternative 1 and 2 Summary – Fire and Fuels

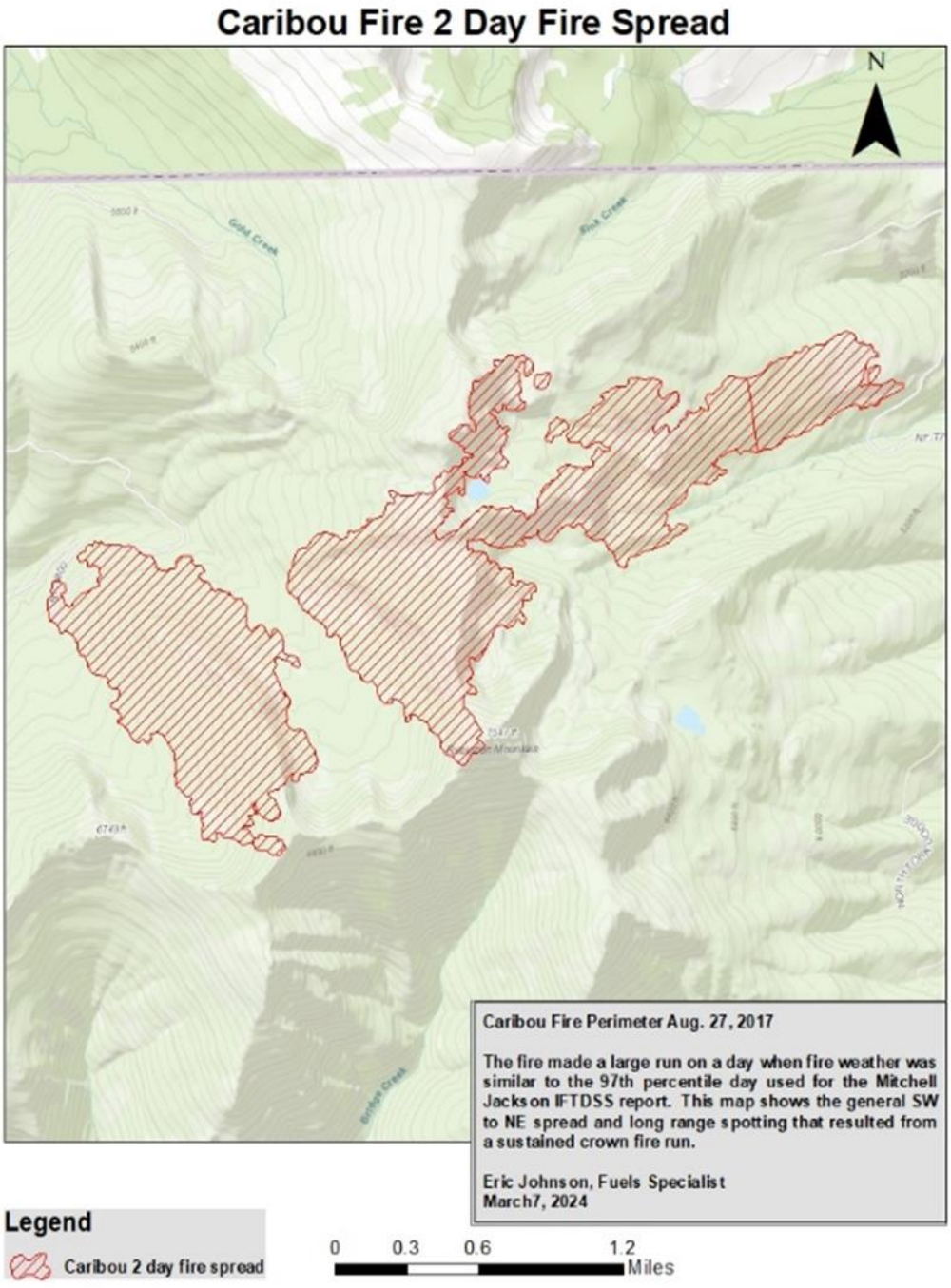
Wildfire spread is determined by several factors including slope, wind direction, and fuels. At any given time fire will be generally spreading upslope, with the wind, and in a direction that fuels are continuous enough to sustain fire. As fire continues to move across the landscape it follows the same upslope and with the wind pattern.

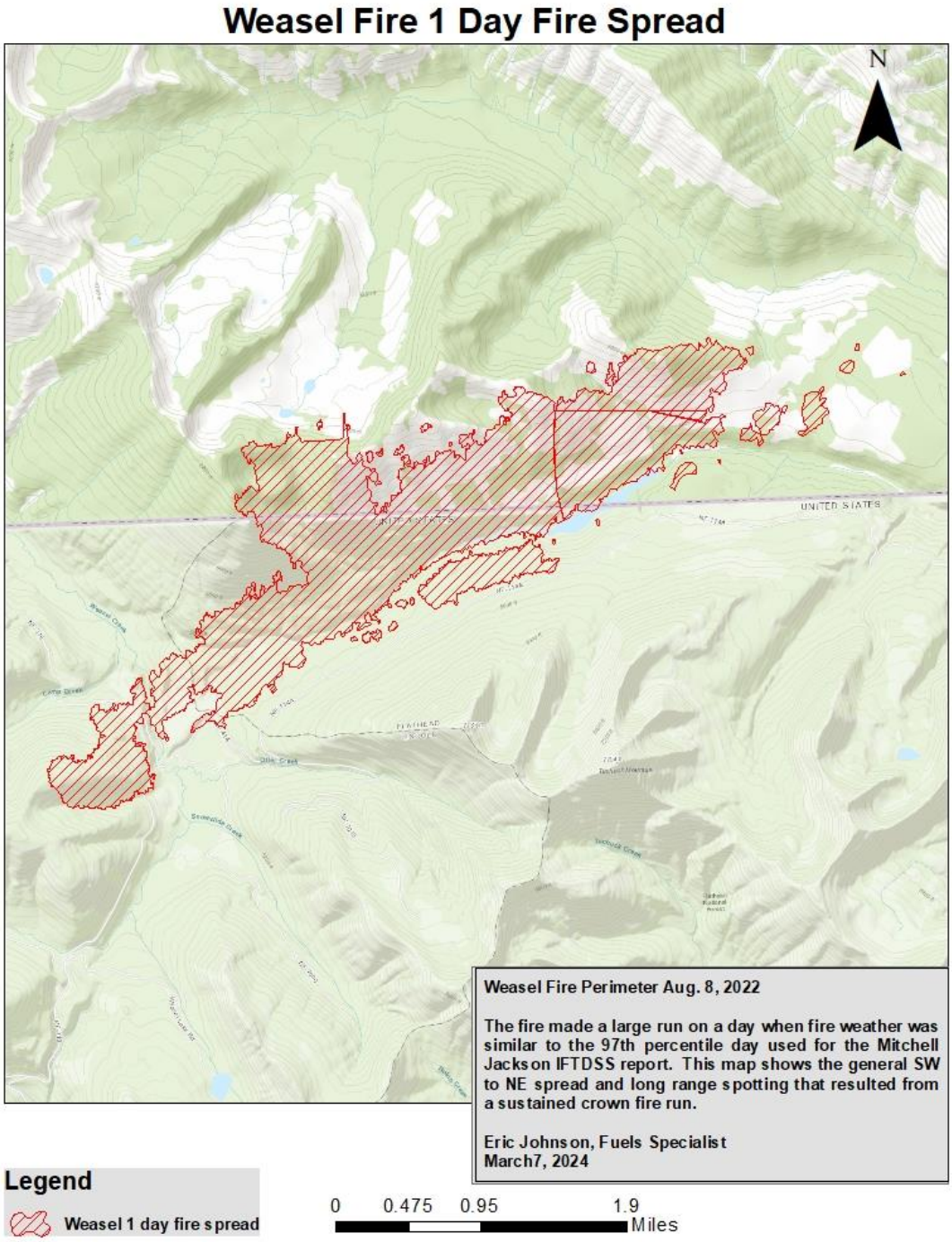
The general weather patterns for the western United States during the summer months have a southwest flow to them. It is because of this that fire generally spreads over the course of several days in a southwest to northeast pattern.

Typically, in the mountainous terrain of the northern Rockies during the summer months a strong ridge of high pressure develops over the region which causes relatively stable atmosphere and inversions to develop. During these times is when fires mostly follow the upslope/up valley spread direction while the general weather continues with a southwest flow.

As the ridge of high pressure begins to breakdown the southwest flow amplifies and causes an increase in wind speed and begins to cause the atmosphere to become more unstable, these are the days that create enough vertical movement in the atmosphere to allow for fire to transition from surface fire to crown fire and cause extreme fire behavior such as sustained crown fire runs and long-range spotting, almost always in a southwest to northeast direction. The fuel and weather conditions of these severe fire weather days are the same that are represented in the Mitchell Jackson IFTDSS fire modeling as the 97th percentile day.

The following two maps are from fires that occurred on the Kootenai National Forest in 2017 and 2022, respectively. These fires started and were burning under the ridge of high pressure and strong inversions that allowed fire to burn throughout the night. As the ridge of high pressure broke down, surface wind speeds increased, the inversions lifted essentially “taking the top off the atmosphere” and allowed for the fire to transition from surface to crown fire. The Caribou Fire map shows two days of burning under these conditions, while the Weasel Fire run occurred over a few hour window in one afternoon.


Caribou Fire 2 Day Fire Spread
N
Caribou Fire Perimeter Aug. 27, 2017
The fire made a large run on a day when fire weather was similar to the 97th percentile day used for the Mitchell Jackson IFTDSS report. This map shows the general SW to NE spread and long range spotting that resulted from a sustained crown fire run.
Eric Johnson, Fuels Specialist
March7, 2024
Legend
Caribou 2 day fire spread
0 0.3 0.6 1.2
Miles

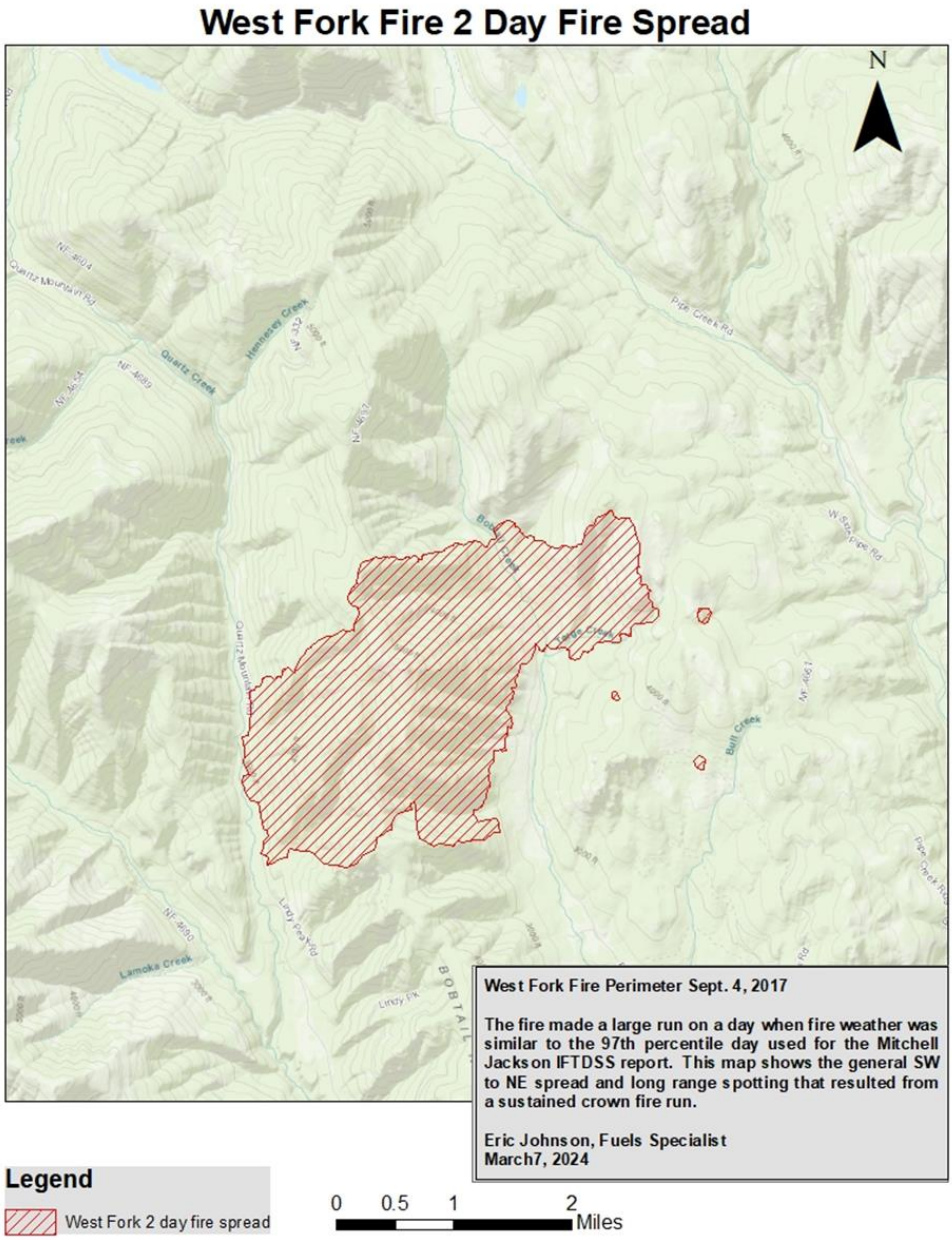


Both of these maps capture the spread direction and long-range spotting that can occur during extreme burning conditions.

Mitchell Jackson Alternative 1 and 2 Summary – Fire and Fuels

The West Fork Fire occurred in 2017 in close proximity to the Mitchell Jackson project area. This fire started by a lightning strike on the far western side of the fire in the below map. The fire started mid slope on a west aspect and burned for two days with aggressive aerial attack on the fire before the same weather events that caused the Caribou and Weasel fires to "blowup" occurred with this fire.

This fire is of particular interest in relation to the Mitchell Jackson project because the terrain and fuel conditions that were present during the West Fork fire are similar to the conditions located within the southwestern portions of the Mitchell Jackson project area. The terrain is steep and has several south and west facing slopes that are dry sites and overstocked with Douglas-fir. These overstocked dry sites exhibit the most drought stress and lowest fuel moistures during the peak of the fire season. This map also shows the prevailing southwest to northeast spread and long-range spotting that occurs during extreme burning conditions.



Several fire behavior metrics were used to assess the fire potential and show the need for fuels treatments within the Mitchell Jackson project area and to compare the treatment alternatives for the project. Although the models do not show a large difference between the two alternatives in terms of flame lengths, canopy base height, crown bulk density, and crown fire type, Alternative 4 is the preferred alternative for fuels treatments because of the increased treatment acres in the southwest portion of the project area. A fire start within the Tubb Gulch area of the Mitchell Jackson fire would likely burn in a similar manner to the West Fork fire and spread into the OU3 site.

The above examples are three large fires that have occurred on the Kootenai National Forest since 2017 and demonstrates fire spread from the southwest and long-range spotting that occurs during large fire growth.

Alternative 4 also has increased treatment acres along the boundary of OU3. Some of these treatment units are not located in areas that maybe impacted by fires moving in a southwest to northeast pattern, but they are located along ridgetops where fire will burn into as it moves upslope and updrainage.

Eric Johnson Fuels Specialist March 7, 2024

Appendix A-2

Fire and Fuels Report

This page intentionally left blank.

Mitchell-Jackson Project

Fire and Fuels Report

Prepared by:

Eric Johnson

Fuels Specialist

For:

Libby Ranger District

Kootenai National Forest

Date:

May 17, 2024

Table of Contents

Introduction

The Mitchell-Jackson project area surrounds the EPA Identified Superfund site known as Operable Unit 3 (OU3) in rural Lincoln County, Montana near the city of Libby, MT. This superfund site was identified in 1999 to aid in the cleanup of Libby Amphibole Asbestos – a known carcinogen that resulted from the open pit Vermiculite mine that operated between 1920 and 1990. While most of the Libby area has been cleaned up from any asbestos contamination the lands within the designated OU3 boundary still support high levels of asbestos. This asbestos is located within the soil, duff, and bark of trees.

The Mitchell-Jackson project is intended to provide wildland fire fuels reduction treatments to the Forest Service lands located within the project area to reduce fire severity and fire spread into the OU3 project area. There is concern that fire starting within or moving into OU3 would release asbestos fibers from the soil, duff, and vegetation into the smoke and redistribute the fibers downwind from the fire. Also, any ground disturbing activities could release the fibers into the air and be breathed in my responding firefighters and any public within the area. Currently, Forest Service firefighters from the Kootenai National Forest are trained in the use of specialized respirators that must be worn when fighting fires within the OU3 boundary. The use of these respirators is extremely taxing on the firefighters and limits their ability to engage in firefighting activities safely and effectively.

The fuels within the Mitchell-Jackson project area, like any natural environment are dynamic and change over time. These changes occur slowly over the course of many years unless a major disturbance event occurs. Expected fire behavior varies as changes in stand age and succession leads to changes in structure, function, species composition and fuel loading. Tree mortality caused by natural and human caused events can lead to increases in standing and down woody debris; thereby, increasing surface fuel loads. The growth of new trees and vegetation can affect the abundance of ladder and crown fuels over time, which would increase the probability of crown fire.

The Mitchell-Jackson project is a critical area that needs a landscape level fuels treatment to help protect the OU3 site from wildfire starting outside and moving into any asbestos contaminated areas and to provide for the safety of firefighters and increase their effectiveness in firefighting; in turn, keeping fires smaller and lasting for shorter durations; thus limiting exposure to the hazards and reducing smoke production.

Wildfires on the Kootenai National Forest generally have right rates of spread across the landscape from a southwest to northeast direction, as that is the general wind pattern. However, fires can spread in any direction but generally follow an upslope/up drainage path, or the southwest to northeast direction. The OU3 superfund sites lies nearly in the center of the project area but the lands to the southwest of the site are some of the warmest and driest forest types within the project area. Fire starts in the area will likely burn with the most intensity and highest rates of spread and the topography aligns with the general southwest flow of weather patterns making this area the highest concern in terms of fire hazards and fuel mitigation.

The proposed treatments within the Mitchell-Jackson project along with wildland fire fuels treatments on adjacent private property, will help create the landscape level fuels treatments needed to enhance protection for the OU3 superfund site. Landscape level treatments that are spatially connected are needed to provide firefighters a continuous area that will modify fire behavior and increase chances of success for suppressing a wildfire. Treating areas within Lynx habitat and creating openings greater that 40 acres will be needed to achieve the desired connectivity of units and have landscape level success in moderating fire behavior.

This project area has also been identified as a high priority area in need of fuels treatments by the Montana Forest Action Plan (Montana Department of Natural Resources and Conservation 2020), the Lincoln County Community Wildfire Protection Plan (Lincoln County 2023), local/state government officials, and district/forest level fire management.

Regulatory Framework and Consistency

Forest Service Manual

The Forest Service Manual Forest Service Manual (FSM) - All Issuances (usda.gov), provides direction and legal authorities.

Land and Resource Management Plan

The Kootenai National Forest Land Management Plan (U.S. Department of Agriculture 2015) provides guidelines, objectives and desired conditions forest-wide, as well as by management and geographic area the following are applicable: FW-DC-AQ-01, FW-DC-FIRE-01, FW-DC-FIRE-02, FW-DC-FIRE-03, FW-DC-VEG-10, FW-OBJ-FIRE-01, FW-OBJ-FIRE-02, GA-DC-FIRE-KOO-01, GA-DC-FIRE-LIB-01, GA-DC-FIRE-LIB-02, MA2-DC-FIRE-01, MA5a-DC-FIRE-01, FW-GDL-AQ-01, MA2-GDL-FIRE-03, MA6-GDL-FIRE-01.

Federal Policy

Fire Management Guidance

Federal fire policy is outlined in the Guidance for Implementation of Federal Wildland Fire Management Policy (U.S. Department of Agriculture and U.S. Department of the Interior 2009).

The Federal Wildland Fire Management Policy clearly states that wildland fire analysis will carefully consider the long-term benefits in relation to risks both in the short- and long-term: “Fire, as a critical natural process, will be integrated into land and resource management plans and activities on a landscape scale, and across agency boundaries. Response to wildland fire is based on ecological, social, and legal consequences of fire. The circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and values to be protected dictate the appropriate management response to fire.”

Air Quality

The Clean Air Act (Section 110) requires states to develop State Implementation Plans (SIPS) which identifies how the State will attain and maintain national air quality standards. Three elements of the Clean Air Act generally apply to management activities that produce emissions (1) protection of ambient air quality standards, (2) conformity with state implementation plans, and (3) protection of visibility in class 1 areas. The Clean Air Act of 1977 (as revised 1991) requires the Environmental Protection Agency (EPA) to identify pollutants that have adverse effects on public health and welfare and to establish air quality standards for each pollutant. Each state is also required to develop an implementation plan to maintain air quality.

As designated by law and state air quality rules, the Kootenai National Forest cooperates with the State

Air Quality Bureau and Lincoln County Environmental Health Division, Air Quality Program. The Forest Service is a member of the Montana/Idaho State Airshed Group. By participating in the Montana/Idaho State Airshed Group, complying with the Memorandum of Understanding with the Montana Air Quality Bureau and meeting the requirements of the State Implementation Plan and the Smoke Management Plan, the proposed activities would comply with the Forest Plan and the 1977 Clean Air Act. Prescribed burning will comply with the current federal and state management plans. If the monitoring unit forecasts ventilation problems, prescribed burning is either restricted by elevation or curtailed until good ventilation exists.

Wildland Fuels Reduction Guidance

The Forest Service has proposed treatments within the wildland urban interface (WUI) of the Mitchell-Jackson project area designed to help reduce wildland fuels. The National Cohesive Wildland Fire Management Strategy provides guidance for prioritizing wildland fuels reduction (U.S. Department of Agriculture and U.S. Department of the Interior 2014):

- Where wildfires are unwanted or threaten communities and homes, design and prioritize fuel treatments (prescribed fire, and mechanical, biological and chemical treatments) to reduce fire intensity, structure ignition, and wildfire extent.
- Where feasible, implement strategically placed fuel treatments to interrupt fire spread across landscapes.
- Continue and expand the use of prescribed fire to meet landscape objectives, improve ecological conditions, and reduce the potential for high-intensity wildfires.
- Where allowed and feasible, manage wildfire for resource objectives and ecological purposes to restore and maintain fire-adapted ecosystems and achieve fire-resilient landscapes.
- Use and expand fuel treatments involving mechanical, biological, or chemical methods where economically feasible and sustainable, and where they align with landowner objectives.

Community Wildfire Protection Plan

The Lincoln County Community Wildfire Protection Plan (Lincoln County 2023) was developed to position fire protection agencies, county leaders, rural communities, county residents, forestland owners and managers to be better prepared to protect Lincoln County residents and its natural resources from the potentially devastating impacts of wildfire.

Wildland Urban Interface (WUI)

Within the WUI, there is a high level of risk associated with fire. The primary risks are to public and firefighter safety, capital investments and natural resource values. It is not a question of, if unwanted fire will occur within the WUI, but when.
WUI is defined (and mapped) in the Lincoln County Community Wildfire Protection Plan as the zone where structures and other human development meet and intermingle with undeveloped wildland and vegetative fuels (Lincoln County 2023).

Private organizations and governmental agencies provide information, resources, and incentives to encourage the reduction of wildland fuel loads around individual homes and around communities as a whole. (Nowicki 2002) states, "Additional thinning beyond the home ignition zone may enhance the ability of firefighters to safely defend community space."

Topics and Issues Addressed by this Analysis

Resource Indicators

To meet the project's purpose and need the following resource indicators were used to evaluate each alternative's ability to reduce the potential for high intensity wildfire while promoting desirable fire behavior characteristics and fuel conditions.

The Resource indicators include:

- Surface fire flame lengths
- Canopy base height
- Canopy bulk density
- Crown fire potential

Resource Element	Resource Indicator	Measure	Used to address P/N or key issue?
Fire Behavior	Surface Fire Flame Lengths; 97th percentile (worst-case scenario)	Percent of Proposed Treatment Acres and Associated Fire Behavior Under Modeled Fire Scenario. Feet	Purpose and need
Fire Behavior	Canopy Base Height	Percent of Proposed Treatment Acres and Associated Fire Behavior Under Modeled Fire Scenario. Feet	Purpose and need
Fire Behavior	Canopy Bulk Density	Percent of Proposed Treatment Acres and Associated Fire Behavior Under Modeled Fire Scenario. Kg/M^3	Purpose and need
Fire Behavior	Crown Fire Potential; 97th percentile (worst-case scenario)	Percent of Proposed Treatment Acres and Associated Fire Behavior Under Modeled Fire Scenario. Active Crown Fire, Passive Crown Fire, or No Crown Fire- (Surface Fire) *	Purpose and need

* Passive Crown Fire is a fire in which trees or groups of trees torch, ignited by the passing front of the fire (Passive Crown Fire | NWCG). Active Crown Fire occurs where surface and crown fire energy are linked. Surface intensity is sufficient to ignite tree crowns, and fire spread and intensity in the tree crowns encourages surface fire spread and intensity (Passive Crown Fire | NWCG)

Methodology

Fire history for the Mitchell-Jackson analysis area was derived from records maintained in the GIS library for the Kootenai National Forest. Records in the GIS library were derived from the Forest Fire History Atlas records and fire records maintained at the national database in Kansas City.

Fire Behavior Modeling

The Interagency Fuels Treatment Decision Support System (IFTDSS) located at https://iftdss.firenet.gov/landing_page/index.html, was used to model predicted fire behavior pre-treatment and 8 years post-treatment under the No Action and Proposed Action alternatives.

As stated at https://iftdss.firenet.gov/landing_page/about.html, "is a web-based application designed to make fuels treatment planning and analysis more efficient and effective. IFTDSS provides access to data and models through one simple user interface. It is available to all interested users, regardless of agency or organizational affiliation.

IFTDSS is designed to address the planning needs of users with a variety of skills, backgrounds, and needs. A simple and intuitive interface provides the ability to model fire behavior across an area of interest under a variety of weather conditions and easily generate downloadable maps, graphs, and tables of model results. Additionally, the application provides a step-by-step process for testing a variety of fuels treatment impacts (thin, clear cut, prescribed burn) on fire behavior and comparing results to determine which modeled treatment best achieves desired results in terms of reduced fire behavior potential. It can be used at a variety of scales from local to landscape level.

IFTDSS hosts a complete set of reference data available for the entire US including LANDFIRE fuels information, SILVIS Wildland Urban Interface, Agency Ownership, as well as a modern map interface allowing users to create or upload their own data."

IFTDSS was used to model changes to the proposed alternative areas by modeling fire behavior under a worst-case weather and fuels scenario (97th percentile) 8 years post-treatment harvest followed by piling and pile burning action compared to a no treatment (existing condition). These model runs are located in the project file.

Pre-treatment and post-treatment modeling for flame lengths, crown fire potential, canopy base heights, and canopy bulk densities were obtained from the Interagency Fuels Treatment Decision Support System (https://iftdss.firenet.gov/#/home). The reports from the IFTDSS model runs are located in the project file.

For more information about the Interagency Fuel Treatment Decision Support System please see About (firenet.gov).

Weather data statistics utilized for this analysis was for the years of 1985 to 2016 and utilized data from the Big Creek Baldy Remote Automated Weather Stations (RAWS). Data values were obtained that represent the 97th percentile, which means that roughly three percent of the time, fuel and weather conditions meet these criteria and represents a potential worst-case scenario.

Anything that burns could be a fuel source. However, this analysis focuses on vegetation as the fuel source, whether live or dead, standing or fallen.

Dead fuel moisture responds solely to ambient environmental conditions and is critical in determining fire potential. Dead fuel moistures are classed by timelag. A fuel's timelag is proportional to its diameter and is loosely defined as the time it takes a fuel particle to reach 2/3's of its way to equilibrium with its local environment. Dead fuels in fall into four classes and are described in Table 1.

Table 1. Fuel Timelag size classes

Dead Fuel Timelag Class	Dead Fuel Diameter Range
1-Hour Fuels	0 – ¼ inch
10-Hour Fuels	¼ - 1 inch
100-Hour Fuels	1 – 3 inches
1,000-Hour Fuels	3 – 8 inches

The 1-hour and 10-hour fuels are the primary carriers of most fires and change throughout the day in response to temperature and humidity. The 100-hour and 1,000-hour fuels change over the course of a season and add significantly to fire intensity, severity, and resistance to control. 1,000hr fuels are a good representation of prolonged moisture patterns including drought. Fuel Moistures utilized for this analysis are displayed in Table 2.

Table 2. Fuel Moistures utilized for this analysis (97th Percentile).

Fuel Moisture Class	Fuel Moisture Percentage
1-Hour	3 percent
10-Hour	4 percent
100-Hour	9 percent
Live Herbaceous	34 percent
Live Woody	63 percent

While the fire behavior model can be helpful as a decision support tool, it is not a prediction of what may actually occur. While fire behavior models can help to approximate fire behavior outcomes, it cannot predict the actual fire behavior in a wildfire event. For example, an actual fire would have varying flame lengths, rates of spread, and crown fire potential. The modeling is useful for comparing the effects of the alternatives and estimating the indicators.

There are several factors that go into calculating fire behavior, fire danger, and estimating fire intensity across a landscape. In relation to firefighting safety and effectiveness surface fire flame lengths and crown fire potential are good metrics used to quantify fire suppression difficulty.

Surface Fire Flame Lengths

In terms of wildland fire, surface fire is fire that burns the vegetation that is on or directly above the surface of the forest floor (within three feet of the ground). This fire consumes both live and dead vegetation including grass, brush, leaves, and needles. This fire is mostly driven by fuels within the 1-hr and 10-hr timelag category and rates of spread vary greatly based on the fuel models and weather conditions.

Also associated with surface fire (though different) is ground fire. Ground fire consumes fuels that are below ground such as deep root, deep duff, or peat. These fires are not very common or routinely modeled and do not significantly contribute to fire suppression difficulty.

Under existing fuel conditions, in the event of a summer wildfire, with extreme weather conditions, surface fires could exhibit behavior that limits direct attack to ground machinery and aerial resources. Expected flame lengths could be greater than the limit that can be safely attacked by hand crews. Predicted flame lengths could exceed 4 feet, which is the limit for safe direct attack by firefighters. There

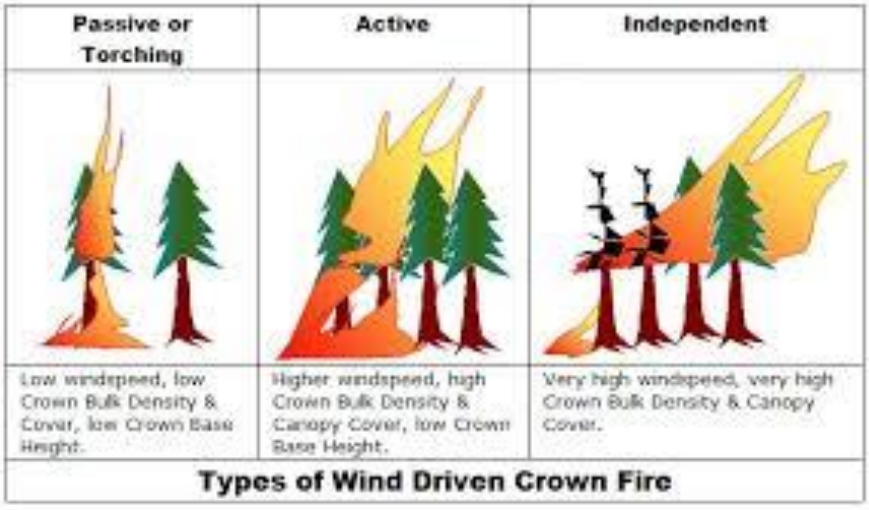
is an even greater concern in the Wildland Urban Interface as these intense fires may threaten values at risk as well as compromise egress routes.

Crown Fire Potential

Crown fires are considered the main threat to ecological and human environment values, and they are one of the biggest challenges of fire management today (Graham, McCaffrey, & Jain, 2004). Crown fire is described in three different ways; passive, active, and independent.

Passive crown fires involve the burning of individual trees (often called torching), while active crown fires (also referred to as running crown fires) present a solid wall of flame from the surface through the canopy fuel layers. Active crown fires spread from one tree crown to the next through the canopy. Independent crown fires act similarly to active crown fires, however they spread without the aid of the heat from the surface fire. Independent crown fires are rare and occurring during only the most extreme conditions. Independent crown fires have not been modeled by fire managers. Figure 1 illustrates the three types of crown fires.

Figure 1. Types of crown fire.



Crown fire potential is generally based on the amount of surface fuels, the amount of ladder fuels, and the density and spacing of the canopy. Heavy surface fuels generally contribute to higher flame lengths. Low canopy base heights can carry surface fires into the crowns. Once established in the crowns, a crown fire may continue. The three key fuels factors contributing to crown fires are canopy base height, canopy bulk density, and surface fire flame lengths.

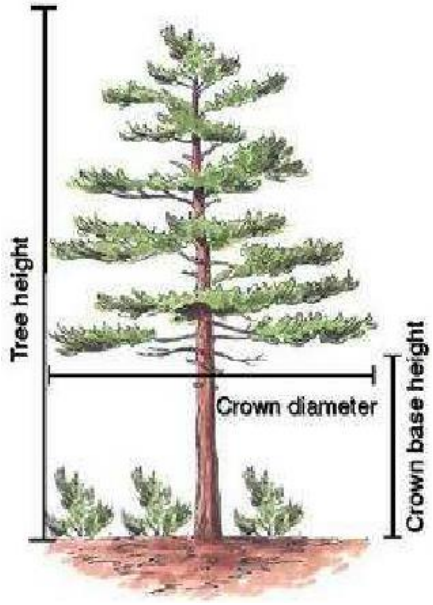
For a crown fire to start, a surface fire of sufficient intensity is first necessary. The distance between the heat source at the ground surface and the canopy-fuel layer will determine how much of the surface fire's energy is dissipated before reaching the fuels at the base of the canopy. The higher the canopy base, the lower the chances of crowning (Cruz, Alexander, 2014). Assuming that a surface fire has enough intensity to transition to crown fire, the next thing to be taken into consideration is whether the canopy of the forest has enough fuel to sustain the crown fire, this is known as canopy bulk density and is often expressed in kilograms of fuel per cubic meter (kg/m^3).

Canopy Base Height

Canopy base height (CBH) is the lowest height above the ground where there is a sufficient amount of

canopy fuel to transition a fire from the surface fuels into the tree crowns (Scott and Reinhardt 2001). Canopy Base Height includes ladder fuels such as understory trees and shrubs. Therefore, low canopy base heights are a critical factor in determining crown fire potential. Fuel treatments should focus on removing some or all the ladder fuels and other vegetation that contributes to a low canopy base height, especially where reducing crown fire initiation is a priority. The structure and species composition of the stands with low growing crowns, as well as dense understory trees are contributing to the low canopy base heights observed. Figure 2 illustrates the crown base height for a singular tree, the canopy base height would be across the entire forest stand.

Figure 2. Crown (or canopy) Base Height



Canopy Bulk Density

Canopy bulk density (CBD) is the mass of available fuel per unit of canopy volume (kg/m³). It is a bulk property of a stand, not an individual tree. Canopy bulk density is an important crown characteristic needed to predict crown fire spread. The more space in the canopy, the greater the wind necessary to move fire from one crown to the next. Dense canopies would require much less wind speed to support crown fire.

In order for a surface fire to transition and/or sustain a crown fire, the right combination of surface fuels, canopy base height and canopy bulk density are needed. These fuel characteristics can be altered by forest managers to reduce the potential for crown fire activity. Therefore, the potential for crown fire activity within the vegetation management and fuel reduction units is an appropriate indicator to measure how the alternatives meet the purpose and need for the project, Forest Plan direction, and national laws and regulations. (Scott and Reinhardt 2001) describe the criteria necessary for active crown fire: <ass-flow rate is defined by (Van Wagner 1977) as the rate of fuel consumption through a vertical plane within the fuel bed and it is product of canopy bulk density and spread rate. Canopy bulk density affects the critical spread rate needed to sustain active crown fire. If the mass-flow rate falls below a certain threshold, active crowning in not possible. Therefore, the lower the canopy bulk-density, the lower the potential for active crown fire. Figure 3 demonstrates the relationship between windspeed and canopy bulk density in respect to crown fire initiation.

Figure 3. Effects of windspeed and canopy bulk density to crown fire

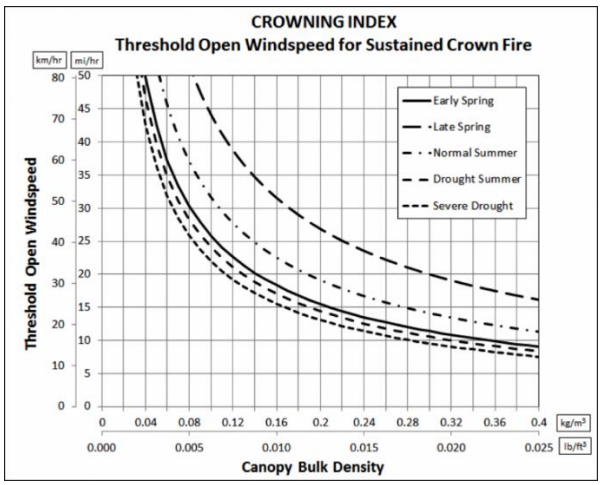


Figure 4 shows how canopy base height and canopy bulk density work in a stand of trees.

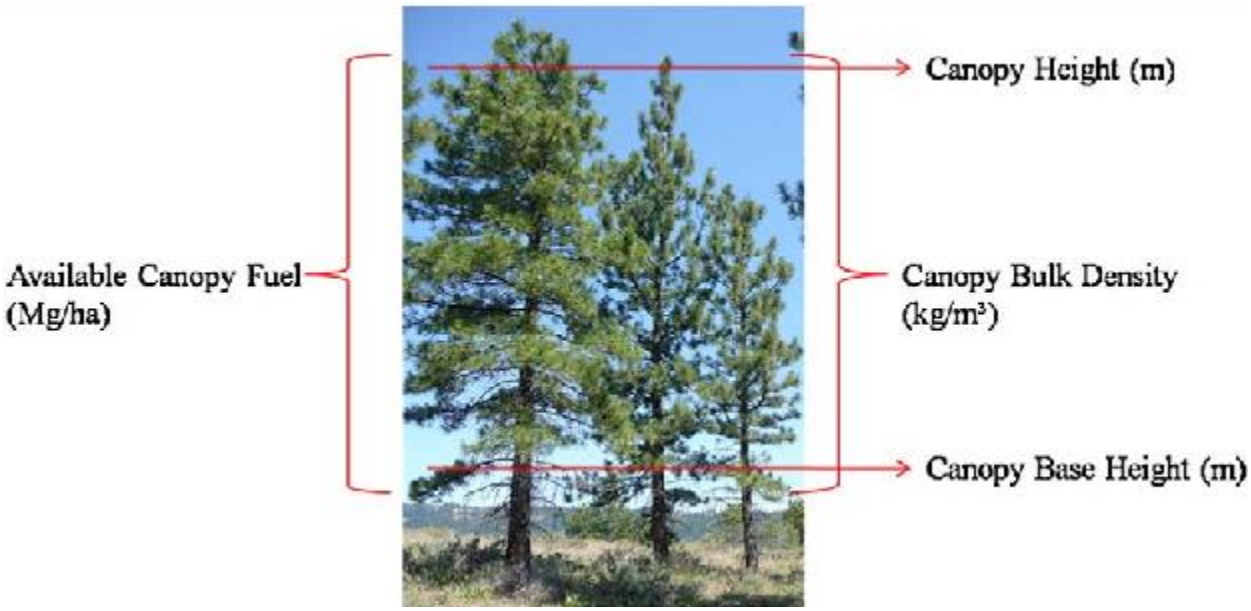


Figure 4. Canopy base height and canopy bulk density.

Assumptions and Limitations

As with any model, IFTDSS has limitations. IFTDSS will only run model scenarios out to eight years post-treatment. However, research such as (Parks et al. 2018) and empirical evidence, show effects of harvest treatments with burning having an effect on fire behavior out to 33 years in these vegetation and habitat types that are in the OU3 Jackson project.

IFTDSS utilizes fuel models to project fire behavior. Fuel models are tools used by fire specialists to estimate fire behavior and characterize the amount of fuels available to burn during a surface fire. A fuel model is chosen by the primary carrier of the fire (i.e. grass, brush, timber litter, slash) and its fuel

characteristics (i.e. amount of fuel, fuel depth, etc.). Rothermel has a detailed discussion of fuel models and how they are used to predict the spread and intensity of forest and range fires. (Rothermel 1983)

Spatial and Temporal Context for Effects Analysis

Analysis Area

The fire and fuels analysis area is the Mitchell-Jackson project area. Past activities associated with timber harvest with regards to fire and fuels were analyzed for the project area. A fire history analysis was also conducted for the entire project area. The analysis area boundary is the project area boundary which utilizes hydrological breaks and topographic features to display the effects for past fuel treatment activities and the effects of wildfire frequencies and wildfire suppression over time. Fire behavior modeling was conducted for the proposed treatments with regards to the objective of reducing flame lengths and crown fire potential. In addition to modeling crown fire potential, the analysis also affirms that if a crown fire enters from outside the project area into a proposed treatment area it would likely transition to a surface fire, enabling a safer fire suppression environment.

Temporal

Time period covered by the effects analysis includes:

- All recordable fires from 1986 to present.
- Historical fire data from 1860 to 1930's.
- Pre-treatment and post treatment fire behavior with research showing treatment effects on fire behavior lasting out to 33 years (Parks et al. 2017).

Affected Environment

Existing Condition

The Mitchell-Jackson analysis area would have historically had frequent low, mixed, and stand-replacing fire severities across the landscape. Missed fire cycles over the past century are largely attributed to fire suppression activities. Other causes include logging and land use conversion such as mining, recreation, and housing development. Past regeneration harvesting has created smaller and more uniform blocks of regeneration than occurred under natural fire regimes, which occurred over larger areas and left residual live tree patches and scattered fire-tolerant large live trees. More recent regeneration harvests have less uniform leaving snags, live trees, and some reproduction. However, the size to these harvest have been generally limited to 20-40 acres, which contributes to fragmentation of larger blocks of mid-late seral forest.

Climate Change

Fire exclusion since the 1920s has increased surface fuel loads, tree densities, and ladder fuels, especially in low-elevation dry conifer forests (Schoennagel et al. 2004). As a result, fires at the lowest and driest

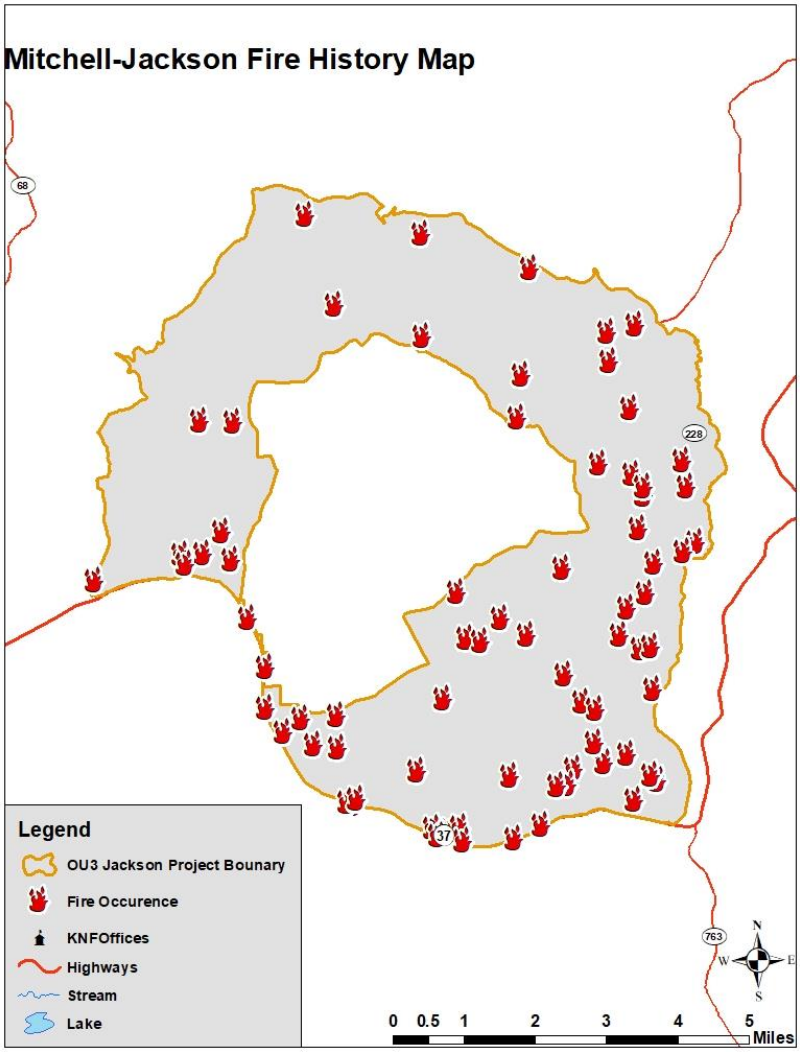
elevations may be larger and more intense, and may cause higher rates of tree mortality, than historical fire. But in mid- and higher elevation forests, where fires were historically infrequent because of relatively cold, wet conditions, fire exclusion has not affected the fire regimes (Romme and Despain 1989); (Schoennagel et al. 2004). However, earlier onset of snowmelt, predicted to occur with changing regional climate, will reduce fuel moisture during fire season, making mid- to high-elevation forested systems flammable for longer periods of time (Miller et al. 2008). According to (Westerling et al. 2006), "The average season length (the time between the reported first wildfire discovery date and the last wildfire control date) increased by 78 days (64%), comparing 1970 to 1986 with 1987 to 2003." "The greatest absolute increase in large wildfires occurred in Northern Rockies forests. This sub-region harbors a relatively large area of mesic, middle and high elevation forest types (such as lodgepole pine and spruce-fir) where fire exclusion has had little impact on natural fire regimes, but where we found that an advance in spring produces a relatively large percentage increase in cumulative moisture deficit by midsummer." Longer fire seasons will allow for more ignitions, greater likelihood of fire spread, and a longer burning duration.

Fire History

The Mitchell-Jackson analysis area has had a minimum of 6 fires greater than 5 acres in size since 1986. Since 1986 there has been a total of 76 wildfires for a total of 161 acres burned with an average fire size of 2 acres. Of the fires in the planning area, 72% are caused by lightning and 28% being started by anthropogenic sources. Table 3 synthesizes the data and Map 1 provides the graphical representation of it.

Table 3. Fire History and Occurrence

Decade	Number of Fires	Acres Burned	Average Size
1980's (1986-1989)	8	1	.1
1990's (1990-1999)	25	55	2
2000's (2000-2009)	31	17	.9
2010's (2010-2019)	10	78	8
2020's (2020-2021)	2	.2	.2



Map 1. Fire History and occurrence.

Fire Regime Groups

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 aboriginal burning (Agee 1993). The historical fire regimes are classified by number of years between fires (frequency or fire return interval) and the severity of the fires effects on the dominant overstory vegetation.

A low severity fire would consist mostly of light intensity surface fire where less than 25 percent of the dominant overstory vegetation would be killed. A mixed severity fire is mostly surface fires with flare-ups of passive crown fires and could result in up to 75 percent mortality of the dominant overstory vegetation. A high severity fire is either a crown fire or a high-intensity surface fire that would result in greater that 75 percent of the dominant overstory vegetation being killed.

According to Data obtained from and https://iftdss.firenet.gov/#/home, (see project file) the OU3 Jackson project area contains the fire regime groups I, III, and IV. The descriptions below detail fire characteristics of fire regimes and the associated Vegetation Response Unit (VRU, a vegetation classification described in the Forest Vegetation section).

Fire Regime Group I- Fire return interval of 0-35 years of low to mixed severity fires with rare stand replacing fires.

In the project area, Fire Regime Group I is represented by Vegetation Response Units (VRU) 2 and 3. VRU 2 is moderately warm and dry with a fire return interval (FRI) of 15-45 years. VRU 3 is moderately warm and moderately dry with an FRI of 25-50 years. Forest stands on these sites are dominated by ponderosa pine, Douglas-fir and western larch.

Fire Regime Group III- Fire frequency of 35-100+ years of low and mixed severity. These sites are moister than fire regime group I. Stands on these sites are dominated by western larch, Douglas-fir, western white pine, and some lodgepole pine on the drier portions and cedar, hemlock and grand fir on the moister sites.

Fire Regime Group III is well represented by VRU 5 which is moderately cool and moist with FRI on south aspects from 17-113 years and 110-340 on north aspects.

Fire Regime Group IV- Fire frequency of 35-100+ years of high severity stand replacing fires. These sites consist of mixed conifer species with a heavier component of shade-tolerant species like grand fir, lodgepole pine, Engelmann spruce, and subalpine fire. Other sites are cooler and dryer than Fire Regime Group III with western larch, Engelmann spruce, and Douglas-fir common.

Fire regime group IV is represented by VRUs 7, 8, 9 10. FRI in these groups cover a wide range 35 year at low severity to 200 years high severity.

Table 3 displays the percentage of each fire regime in the project area.

Table 3. Fire Regime Groups Represented in the Project Area.

Fire Regime Group	Description	Existing Conditions (Percent of Project Area)
I	0-35 year frequency at low to mixed severity	76%
III	35-100+ year frequency at low to mixed severity	20%
IV	35-100+ year frequency at high severity	3%

The Mitchell-Jackson analysis area would have historically exhibited frequent low, mixed, and stand-replacing fire severities across the landscape. Vegetation Response Units, as a subset of the Forest's biophysical settings, can be used to classify historic fire regimes and the potential number of fire cycles missed. (See the Forest Vegetation Section for more discussion of forest stand conditions, VRU's, and departure from desired conditions). Missed fire cycles are largely attributed to fire suppression. Other causes include logging, grazing and land conversion to agriculture or housing developments.

Cheatgrass

Cheatgrass (*Bromus tectorum*) is a non-native annual grass that is found throughout the western United States (Mosley et. al 1999) and is located on the warm and dry Vegetative Response Units (VRU) within the Mitchell-Jackson project area. Cheatgrass grows rapidly and can create monocultures with high densities. Plants can range between 1 and 1,400 stems per square foot, averaging around 600 stems per square foot. (Stewart, 1949).

Cheatgrass has a fine structure and dries and cures completely early in the summer which makes it extremely flammable. Due to the tendency to form continuous monocultures and curing early in the summer, cheatgrass creates an environment where fire seasons are extended and fire start easily, have high rates of spread, and can move faster than fire fighting resources can respond. (Young et. al 1978)

Resource Indicators for Existing Condition

Table 4 depicts the percent of the project area (existing conditions) with the associated fire behavior resource indicators.

Table 4. Percent of Project Area with associated Fire Behavior Indicators and Measures for the Existing Condition.

Resource Element	Resource Indicator	Measure	Existing Condition: Percent of Project Area and Associated Fire Behavior Under Modeled Fire Scenario
Fire Behavior	Surface Fire Flame Lengths; 97th percentile (worst-case scenario)	Percent of Project Area within each Flame Length Category	>25 Feet: 29% >11 – 25 Feet: 19% >8 – 11 Feet: 10% >4 – 8 Feet: 15% >1 – 4 Feet: 24% >0 – 1 Feet: 1%
Fire Behavior	Crown Fire Potential; 97th percentile (worst-case scenario)	Percent of Project Area with Associated Crown Fire Potential	Active Crown Fire*: 8% Passive Crown Fire*: 59% No Crown Fire (Surface Fire): 32%
Fire Behavior	Canopy Base Height	Percent of Project Area within each Canopy Base Height Category	>0 – 3 Feet: 82% > 3 – 5 Feet: 3% >5 Feet: 2% No Canopy: 12%
Fire Behavior	Canopy Bulk Density	Percent of Project Area within each Canopy Bulk Density Category	>.20 - .25 Kg/m^3: 4% >.15 - .20 Kg/m^3: 10% >.10 - .15 Kg/m^3: 14% >.05 - .10 Kg/m^3: 52% >0 - .05 Kg/m^3: 7%

* Passive Crown Fire is a fire in which trees or groups of trees torch, ignited by the passing front of the fire (Passive Crown Fire | NWCG). Active Crown Fire occurs where surface and crown fire energy are linked. Surface intensity is sufficient to ignite tree crowns, and fire spread and intensity in the tree crowns encourages surface fire spread and intensity (Passive Crown Fire | NWCG).

Environmental Consequences

No Action Alternative

Effects

Implementing the No Action Alternative does not meet the purpose and need of the project. This alternative would not address the human-induced changes resulting from years of fire suppression activities and the continuing buildup of wildland fire fuels. Natural processes would continue, and the accumulation of forest debris would increase fuel loadings, which would contribute to higher severity and intensity wildfires. Many of the forested stands in the analysis area would remain overstocked and ladder fuels would continue to fill-in and crowd the understory. The drier forest stands would continue to lose vigor due to competition from a dense understory of shade tolerant species. This understory would serve as ladder fuels that would permit a surface fire to expand into the canopy of overstory trees. This could result in the mortality of many of the existing overstory trees that would have otherwise survived a surface fire of lower intensity. Because there would be no new fuel treatments to reduce the fire hazard in the analysis area and no regeneration of more fire-tolerant species, the potential for high severity wildland fires would continue and be more likely than under the action alternative.

The project area would continue to have an increase in wildland fire fuel loadings. Timber harvest, prescribed burning, hand slashing and piling, and precommercial thinning would not be used to reduce crown densities and ladder fuels. Existing surface fuels would not be treated and would remain a hazard. Although the 2015 Forest Plan does allow the use of unplanned ignitions in certain areas, it can be expected that full suppression activities would continue to occur in the WUI to protect life, property, and key resources (FW-DC-FIRE-03).

Because there would be no new fuel treatments to reduce the fire hazard in the analysis area, the potential for high-severity wildland fires would continue and be more likely than under the action alternative. Also, private landowners adjacent to the project area may not be eligible for grants to complete fuels reduction activities on their own land because no fuels reduction activities would be occurring on adjacent Forest Service lands. Any fire that starts inside the analysis area or starts outside and moves into the analysis area that threatens values would likely be more expensive, difficult and dangerous to suppress. Development of private lands is likely to continue, increasing the complexity and expense of fire suppression.

Fire modeling indicates there is a risk of crown fire under existing conditions. These areas would also exhibit flame lengths and rates of spread that would require indirect suppression tactics utilizing mechanized equipment and aviation resources. Fire hazard would increase over time, as stand conditions continue to deteriorate in the analysis area due to insects, disease, wind and snow. Eventually, wildland fires have a greater chance to burn in large continuous patch sizes due to the lack of breaks in the forest canopy and heavy fuel loading, putting homes and private property at risk.

Effects to Air Quality

The potential for a high-intensity wildfire occurring in the project area is greatest with the no action alternative. This would have greater impacts on air quality than the proposed action alternative.

The direct effects of a wildfire from choosing the no-action alternative are that fire occurrence, intensity, size, duration would be greater than what would be produced from implementation of the proposed action, because wildfires are largely unmanageable in terms of the timing and duration of the event. Smoke from wildfires is unmanageable and would likely produce greater quantities of particulates, last longer in duration, and likely impact a larger area than planned ignitions from prescribed fire. These

impacts were all demonstrated from fires occurring in the Northern Rockies during 1988, 1994, 2000, 2001, 2003, 2012, 2015 and 2017. (Ward et al. 1976) estimated that smoke emissions caused by wildfires are approximately three times greater than that produced by prescribed burning. However, in the absence of wildfires, there would be no cumulative effects to air quality caused by the no action alternative since no new management activities would be implemented.

Proposed Action Alternative
Action Alternatives 3 and 4

Effects

Implementing the proposed action alternatives provides access and opportunities for firefighters to engage on wildfires safely and successfully. The larger openings (over 40 acres) proposed would provide more effective areas for suppression resources to engage wildfires safely under more severe conditions. The interdisciplinary team designed these large, irregularly shaped openings to adhere to several of the forest plan's desired conditions which includes providing a landscape-scale fuels management strategy with barriers to interrupt crown fire spread across the landscape and provide opportunities for control and anchor points as well as potential safety zones for firefighters.

The proposed actions would treat wildland fire fuels in order to reduce crown fire potential adjacent to the OU3 site. These treatments would also contribute to safe and effective fire management. Reintroduction of fire to the ecosystem would be accomplished using planned and unplanned ignitions.

The effects of the proposed fuel reduction treatments through harvest activities and excavator piling or prescribed burning include the modification of potential fire behavior within the treated areas. A reduction in surface and ladder fuel loadings creates shorter flame lengths, lower fire intensities, and a surface fire that burns on the ground and not in the tree crowns. Reduced flame lengths and lower fire intensity produces the type of fire behavior that can more easily be controlled or extinguished. Fire behavior within the treated areas would be reduced, resulting in safer conditions for firefighters and/or the public. As stated in (Hudak et al. 2011), "From our own case study, we found that the most effective treatments combined forest thinning and reduction of surface fuels."

The most effective treatments with the greatest longevity for reducing fire behavior are regeneration harvest followed by prescribed burning. Omi found treatments that include thinning followed by slash treatment were the most impressive in reducing fire intensity and severity and can last up to a decade while Parks saw results of previous burned areas in northwestern Montana having effects out to 33 years. (Omi et al. 2007), (Parks et al. 2018).

One possible effect of the removal of trees in the overstory, as proposed with this project, is that this could increase surface winds depending on topography and surrounding trees (Albini and Baughman 1979). The decrease in shading could also cause drying of both live and dead surface fuels (Pollet and Omi 2002b). The effect on fire behavior could be an increase in rates of spread of a surface fire, depending on vegetative characteristics, terrain influences, position on slope, and time of day. However, the possible benefits associated with reducing crown fire potential, outweighs the increased winds and drying of surface fuels because the primary concerns are flame lengths and intensity, thereby increasing opportunities for safe suppression activities (Estes et al. 2012); (Graham et al. 2004). It is also important to recognize that until treatment of the slash created during harvest operations occurs, it is possible that wildfire severity would be temporarily increased until the hazard has been abated (Omi et al. 2007).

Many researchers suggest strong support in the current scientific literature and multiple case studies

demonstrating fuel treatment effectiveness in reducing fire behavior, the probability of crown fire, and fire severity (Stephens et al. 2012), (Hudak et al. 2011), (Safford et al. 2009), (Graham et al. 2009), (Pollet and Omi 2002a), (Graham et al. 1999), (van Wagtendonk 1996), (Weatherspoon and Skinner 1996), (Mooney 2010), (Omi et al. 2007). Based on current research, the treatments would be effective for 7-33 years or more depending on treatment type and the relative intensity and severity of that treatment.

The proposed action is designed to apply the principles of a fire-resilient forest as defined in Table 5.

Table 5: Principles of Fire-Resilient Forests (Agee and Skinner 2005)

Objective	Effect	Advantage	Concerns
Reduce surface and ladder fuels	Reduces potential flame length	Fire control easier, less torching	Surface disturbances less with fire than other techniques
Increase canopy base height	Requires longer flame length to ignite tree crowns	Less torching	Opens understory, may allow surface wind to increase
Decrease crown density	Makes independent crown fire less probable	Reduces crown fire propagation	Surface wind may increase, surface fuels may be drier
Increase proportion of mature fire-resilient tree species	Thicker bark, taller crowns, higher canopy base height	Increases survivability of trees	Removing smaller trees is sometimes problematic

Effects to Old Growth from Proposed Activities

Fuel treatments in the proposed action for areas designated as old growth and recruitment potential old growth are designed to reduce surface and ladder fuels via a combination of intermediate harvest, slashing understory, and prescribed burning. By reducing ladder fuels and surface fuels, the treatments are expected to maintain or enhance the old growth attributes and help ensure the survivability of the old, large diameter trees in these individual stands. The overall goal is to work towards returning these stands to their appropriate fire regime and increase fire resiliency.

Effects to Air Quality

Air quality is an important resource to consider; however, there are generally few issues or concerns in regard to air quality from project activities because the Forest complies with all laws, regulations and policies regarding smoke management. The Forest cooperates with the regulating agency's recommendations for when and how much burning occurs at any one time so that standards are met. There would be public notifications of the planned burning activities. Prescribed burns are planned for days with good smoke dispersal and in coordination with air quality agencies.

Effects of Treatments on Fire Behavior

Expected flame lengths from a wildfire under high to extreme conditions would be reduced to less than 4 feet on about 34% of the treated acres, and flame lengths kept under 8 feet on 59% of the treated acres. Generally, a fire with flame lengths under 4 feet can be attacked with hand resources, while flame lengths between 4-8 feet will need heavy equipment to suppress, and flame lengths above 8 feet are extremely difficult to control, and direct attack tactics will not be effective.

By increasing canopy base heights (preferred threshold >7 feet), decreasing canopy bulk densities

(preferred threshold $\leq$ .10 Kg/M^3), and decreasing flame lengths (preferred threshold $\leq$ 4 feet), a wildfire in the treatment areas would be a surface fire, which would be more conducive to fire suppression activities. The two criteria of lower flame lengths and no crown fires are the primary fire behavior characteristics to allow fire control for ground-based suppression personnel directly attacking the fire. Also, these conditions would substantially reduce the potential for long range and short-range spotting from firebrands, which are associated with high fire intensities, torching, crowning and fire whirls (Rothermel 1983). Fires exhibiting long range spotting pose some of the greatest threats to firefighter and public safety because they are extremely difficult to control.

Tables 7 through 10 compare the fire behavior expected between the existing conditions and Alternatives 3 and 4 for the metrics of *Flame Length*, *Canopy Base Height*, *Canopy Bulk Densities*, *and Crown Fire Potential*.

Table 7: Percent of Proposed Treatment areas Pre-Treatment compared to 8 Years Post-Treatment for Flame lengths in Alternatives 3 and 4

Flame Length	Existing Conditions	ALT 3	ALT 4
>25 feet	29%	21%	20%
>11 - 25 feet	19%	14%	13%
>8 - 11 feet	10%	11%	12%
>4 - 8 feet	15%	25%	25%
>1 - 4 feet	24%	27%	29%
>0 -1 feet	1%	1%	1%

Table 8: Percent of Proposed Treatment areas Pre-Treatment compared to 8 Years Post-Treatment for Canopy Base Heights in Alternatives 3 and 4

Canopy Base Height	Existing Conditions	ALT 3	ALT 4
>0-3 feet	82%	53%	49%
>3 – 5 feet	3%	3%	3%
>5 feet	2%	33%	35%
No Canopy	12%	12%	12%

* Canopy Base Height is the lowest height above the ground at which there is enough canopy fuel to propagate fire vertically into the canopy. It is an effective value that incorporates ladder fuels such as shrubs and understory trees (Scott and Reinhardt 2001).

Table 9: Percent of Proposed Treatment areas Pre-Treatment compared to 8 Years Post-Treatment for Canopy Bulk Densities in Alternatives 3 and 4

Canopy Bulk Density	Existing Conditions	ALT 3	ALT 4
>.20 - .25 Kg/m^3	4%	3%	2%
>.15 - .20 Kg/m^3	10%	7%	7%
>.10 - .15 Kg/m^3	14%	10%	10%
>.05 - .10 Kg/m^3	52%	37%	39%

>0 - .05 Kg/m^3	7%	30%	29%

Table 10: Percent of Proposed Treatment areas Pre-Treatment compared to 8 Years Post-Treatment for Crown Fire Potential in Alternatives 3 and 4

Crown Fire Type	Existing Condition	ALT 3	ALT 4
Active Crown Fire	8%	6%	6%
Passive Crown Fire	59%	42%	40%
No Crown Fire (Surface Fire)	32%	51%	54%

* Passive Crown Fire is a fire in which trees or groups of trees torch, ignited by the passing front of the fire (Passive Crown Fire | NWCG). Active Crown Fire occurs where surface and crown fire energy are linked. Surface intensity is sufficient to ignite tree crowns, and fire spread and intensity in the tree crowns encourages surface fire spread and intensity (Passive Crown Fire | NWCG).

**IFTDSS model reports are stored in the project file under the name "OU3Jackson." The project name changed after the reports were generated.

Effects of Roads

Road maintenance, reconstruction, and new road construction proposed for timber harvest would improve access and egress for public and firefighters and contribute to safer conditions. New road construction proposed under the proposed action alternative is beneficial for firefighters from a safety aspect while also providing for a more efficient response time to an incident. These roads would help provide for more rapid ingress and egress to a wildfire in the area, allow for more tactical options, and provides more escape routes and possible evacuation routes in the case of an emergency.

Effects of Precommercial Thinning

Precommercial thinning can produce increased fuel loading and expected fire behavior following the first 1-10 years post-cutting. In areas of precommercial thinning units that are adjacent to main roadways and private property, if enough slash debris is created that could increase fire behavior and crown fire potential, the fuels will be treated via piling and burning, or chipping. The slash debris in the rest of the areas will be expected to decrease significantly (especially 0-1 inch fuels) within 5-10 years, and thereby reducing the risk of increased fire behavior.

As stated in (Graham et al. 1999), "Cleanings and weedings (precommercial thinning) in sapling-sized stands can influence fire behavior by favoring species with light crowns (western larch and western white pine). These treatments can space trees, allowing stands with low crown bulk densities to develop." Creating stands with lower crown bulk densities will then decrease the chances of a crown fire. Therefore, the treatment of these stands contributes toward the purpose and need statement of promoting desirable fuel conditions while also trending the forest vegetation towards the principals of fire-resilient forests outlined in Agee and Skinner (2005), especially in the WUI.

Cumulative Effects

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis

Fire suppression, past wildfires, and timber management have, and will continue to have, the most effect on fuels in the analysis area. Past harvest activities on NFS land that were followed up with fuel reduction activities, such as piling and burning or underburning, still provide some benefit to reduce the spread of a wildfire.

Fire suppression activities will follow Forest Plan Desired Conditions. FW-DC-FIRE-03 states that the use of wildland fire (both planned and unplanned ignitions) increases in many areas across the Forest. Fire plays an increased role in helping to trend the vegetation towards the desired conditions while serving other important ecosystem functions. However, when necessary to protect life, property and key resources, many wildfires are still suppressed. Many areas within the OU3 Jackson project area would still dictate the suppression of unplanned ignitions due to the proximity to the wildland urban interface and the EPA defined OU3 boundary. The exclusion of wildfires from stands that are historically dependent upon wildfire would contribute to an increase in fuel loading. Dead and down fuels would continue to accumulate and allow vigorous undergrowth of small tree thicket, providing ladder fuels that could accelerate initiation of crown fires in forest stands. Fire suppression activities have the cumulative effect of increasing fuel loadings within the project area.

Future projects that are adjacent to the Mitchell-Jackson project will cumulatively add to more fuels treatments across the landscape. The adjacent treatments will provide a broader scale of treatments to provide more areas to modify fire behavior and allow more options for fire management teams to suppress wildfires effectively and safely.

Previous large wildfires occurring from 1986 to present are also providing a reduced fire severity benefit in the burn areas. Although previous regeneration harvest in the Project Area followed by broadcast burning did not mimic all of the ecological processes that occur during a mixed or stand replacing wildfire, it was effective at reducing fuels and maintaining an individual stand in a mixed or stand-replacing fire regime. Underburning associated with harvest or ecosystem burning and typically occurred within the Project Area within Fire Regimes I or III. In most cases, timber harvest or noncommercial slashing of ladder fuels eliminated the ladder fuels and burning was done to reduce fuels and improve wildlife habitat and/or browse. This type of treatment was effective at maintaining or returning individual or multiple stands to a low or mixed severity fire regime.

There are generally few issues or concerns in regard to air quality from project activities because the Forest complies with all laws, regulations, and policies regarding smoke management. The public also needs to check on daily air quality restrictions before burning because burning could be restricted by the county or state due to poor air quality.

Timber harvest activities occurring on private land are providing protection against active crown fires. However, unless the slash created was treated, fire spread and intensities of a fire experienced on these lands could increase or not be reduced to the same level as it would with post-harvest fuels treatment.

Firewood cutting is also expected to continue in the analysis area. Cumulatively, this has been effective at decreasing wildland fire fuel loads within 100 feet of many of the open roads.

Summary

Fire and fuels management for the Mitchell-Jackson project, through the use of planned prescribed fire, management of unplanned ignitions, and the use of non-ignition fuels reduction, helps meet forest wide desired conditions, objectives, goals, standards and guidelines. The harvest and non-harvest related fuels treatments proposed in the action alternatives help benefit fire management; silvicultural practices; wildlife forage and habitat, and natural ecological processes. Fuel treatments also help to reduce the impacts from climate change to this project area. Alternative 4 (Preferred Alternative) helps reduce wildland fire fuels across the most acres on the landscape.

Within the WUI, there is a high level of risk associated with fire. The primary risks are too public and firefighter safety, capital investments and natural resource values. It is not a question of, if unwanted fire would occur within the WUI, but when.

Implementing *Alternative 1* (No Action) does not meet the purpose and need of the project. Some natural processes would continue; however, fire will continue to be suppressed and accumulation of forest debris would increase fuel loadings. Many of the forested stands in the analysis area would remain overstocked and ladder fuels would continue to fill-in and crowd the understory. The drier forest stands would continue to lose vigor due to competition from a dense understory of shade tolerant species. This understory would serve as ladder fuels that would permit a surface fire to expand into the canopy of overstory trees. This could result in the mortality of many of the existing overstory trees that would have otherwise survived a surface fire of lower intensity. Because there would be no new fuel treatments to reduce the fire hazard in the analysis area, the potential for high-severity wildland fires would continue and be more likely than under the action alternative.

Implementing *Alternative 3* provides for fuels treatments throughout much of the project area and does address some treatments in the driest, most vulnerable stands as well as cheat grass control. The larger openings (over 40 acres) proposed in alternative 3 would provide more effective areas for suppression resources to engage wildfires safely under more severe conditions. Alternative 3 falls short of creating and improving roads that, even if just temporary roads will provide for safer and more efficient response for firefighters. Alternative 3 also does not have proposed fuels treatments in certain critical areas such as Tub Gulch and along the northern boundary of the OU3 site.

Implementing *Alternative 4* provides the most access and opportunities for firefighters. The larger openings (over 40 acres) proposed in alternative 4 would provide more effective areas for suppression resources to engage wildfires safely under more severe conditions. The improvements to the road infrastructure and creation of new roads will aid in fire response, both in terms of safety and efficiency. Though the tables comparing Alternatives 3 and 4 do not show a large difference in fire behavior during a 97^{th} percentile day, Alternative 4 has more treatment unit in the areas of greatest concern. These units are in the driest, most overstocked areas in the southwest portion of the project area, and there are also several non-commercial units located along the OU3 boundary that are not in Alternative 3. Fuels reduction treatments in these locations will be critical for firefighting safety and effectiveness and increases the effectiveness of aerial firefighting with helicopter bucket drops and retardant. This critical piece is not able to be modeled but is obvious to firefighting resources. Alternative 4 also has the most reintroduction of fire to the ecosystem which would be accomplished using planned ignitions.

Alternative 4 is the preferred alternative for fuels management and fire fighter safety and effectiveness.

Compliance with the Land Management Plan

2015 Forest Plan

Forest Plan compliance occurs through the treatment of fuels across the forest and adjacent to values-at-risk, as well as ensuring firefighter and public safety during fire management activities. In addition, this project complies with all applicable federal, state or tribal air quality standards.

Forest Wide Desired Conditions:

FW-DC-AQ-01. The Forest meets applicable federal, state, or tribal air quality standards. Prescribed burning is planned to meet those standards, including areas classified as Class 1 areas (i.e., Cabinet Mountains Wilderness) and nonattainment areas (i.e., presently Libby Montana).

- Alternative 1 is not applicable under this desired condition, as no prescribed burning would take place.

- Alternatives 3&4 complies with the Montana/Idaho State Airshed Group that regulates smoke management for air quality. The Kootenai National Forest coordinates and schedules burning activities to maintain air quality. Prescribed burn plans describing how and under what conditions the burning would take place are prepared by qualified personnel for all burning activities. All activities under the proposed action would be consistent with the Forest Plan

FW-DC-FIRE-01: Public and firefighter safety is always recognized as the first priority for all fire management activities.

- Alternative 1: This desired condition will be adhered to by Fire Management under any alternative.
- Alternative 3 contributes progress toward this desired condition to a varying degree by providing areas of fuel treatment that will help modify fire behavior; therefore, making safer conditions for the public and firefighters.
- Alternative 4 has a greater effect on this desired condition by treating more acres for the reduction of wildland fire fuels will increases the amount of the project area that will exhibit moderate fire behavior which in tern creates a safer environment for the public and fire fighters.

FW-DC-FIRE-02: Hazardous fuels are reduced within the Wildland Urban Interface (WUI) and other areas where values are at risk. Fire behavior characteristics and fuel conditions exist in these areas that allow for safe and effective fire management. Fire behavior is characterized by low-intensity surface fires with limited crown fire potential. Forest conditions, and the pattern of conditions across the landscape, exist in these areas such that the risk is low for epidemic levels of bark beetles, high levels of root disease, and large scale stand-replacement wildfires.

- Alternative 1 does not contribute to this desired condition.
- Alternative 3 contributes toward this desired condition by treating wildlan fuels within and adjacent to the WUI.
- Alternative 4 contributes more towards this desired condition by treating more acres within and adjacent to the WUI, and has more strategic locations of treatment areas.

FW-DC-FIRE-03: The use of wildland fire (both planned and natural, unplanned ignitions), increases in many areas across the Forest. Fire plays an increased role in helping to trend the vegetation toward the desired conditions while serving other important ecosystem functions. However, when necessary to protect life, property, and key resources many wildfires are still suppressed.

- Alternative 1 does not contribute towards this desired condition.
- Alternatives 3&4 contributes toward this desired condition by treating wildland fire fuels with prescribed fire across the project area.

FW-DC-VEG-10: Newly invading, non-native invasive plant species are treated and populations are contained or eradicated. The weed program on the Forest uses integrated pest management approaches, including prevention and control measures that limit introduction, intensification, and spread due to management activities. Agreements with cooperative weed management areas assist control efforts across jurisdictional boundaries.

- Alternative 1 does not contribute to this objective.
- Alternatives 3&4 contributes to this objective by mapping locations of cheatgrass and by using herbicides and or biological controls to limit the spread or attempt to eradicate the species from the project area.

Forest Wide Objectives:

FW-OBJ-FIRE-01: The outcome is the treatment of fuels on approximately 5,000 to 15,000 acres annually on NFS lands, primarily through planned ignitions, mechanical vegetation treatments, and unplanned ignitions. NFS lands within the WUI are the highest priority for fuel treatment activities.

- Alternative 1 does not contribute towards this objective.
- Alternative 3 contributes to this objective by treating fuels across the project area.
- Alternative 4 contributes to this objective by treating more acres across the project area.

FW-OBJ-FIRE-02: Over the life of the Plan, manage natural, unplanned ignitions to meet resource objectives on at least 10 percent of the ignitions.

- Fire Management takes into consideration location, management area direction, and other factors, where the use of natural, unplanned ignitions may be utilized.

Geographic Area Desired Conditions:

GA-DC-FIRE-KOO-01. Threats from unplanned ignitions are reduced for the towns of Rexford, West Kootenai, the Pinkham area, and outlying communities and structures.

- Alternative 1 does not contribute to these desired conditions.
- Alternatives 3&4 contributes to this desired condition by proposing treatments across the project area that will modify fire behavior.

GA-DC-FIRE-LIB-01: Threats of wildfire are reduced for the city of Libby and outlying communities and structures.

- Alternative 1 does not contribute to these desired conditions.
- Alternative 3 contributes to this desired condition by proposing treatments across the project area that will modify fire behavior.
- Alternative 4 contributes at a greater level to this desired conditions by proposing more acres of treatment across the project area that will modify fire behavoir.

GA-DC-FIRE-LIB-02. Wildfire within the National Priorities List boundary will be managed to limit firefighter and public exposure to Libby amphibole. The initial response to wildfires will be suppression.

- Alternative 1 does not contribute to these desired conditions.
- Alternative 3 contributes to this desired condition by proposing treatments across the project area that will modify fire behavior.
- Alternative 4 contributes more to this desired condition by proposing more acres of treatments across the project area that will modify fire behavoir.

Management Areas:

Desired Conditions

MA2-DC-FIRE-01: **Wild and Scenic Rivers.** Fire plays an increased role as a natural disturbance agent.

- Alternative 1 does not contribute to this desired condition.
- Alternatives 3&4 contributes to this desired condition by piling and burning roughly 213 acres through slashing and hand piling or grapple piling post-harvest.

MA5a-DC-FIRE-01: Backcountry. The use of fire serves as the primary tool for trending the vegetation towards the desired conditions as well as serving other important ecosystem functions.

- Alternative 1 does not contribute to this desired condition.
- Alternatives 3&4 contributes to this desired condition by piling and burning roughly 88 acres through slashing and hand piling or grapple piling post-harvest.

Guidelines

FW-GDL-AQ-01. The Forest should cooperate with federal, state, tribal, and local air quality agencies as appropriate in meeting applicable air quality requirements.

- The Montana/Idaho State Airshed Group regulates smoke management for air quality. The Kootenai National Forest coordinates and schedules burning activities to maintain air quality. Prescribed burn plans describing how and under what conditions the burning would take place are prepared by qualified personnel for all burning activities. All activities under the proposed action would be consistent with the Forest Plan.

MA2-GDL-FIRE-03. Scenic/Recreational: Natural, unplanned ignitions, as well as planned ignitions, may be managed to meet resource objectives in eligible scenic and recreational river segments.

- Alternative 1 does not contribute to this guideline.
- Alternatives 3&4 contributes to this desired condition by piling and burning roughly 213 acres through slashing and hand piling or grapple piling post-harvest.

MA6-GDL-FIRE-01: Fuels are reduced, particularly within the wildland urban interface, to reduce the threat of wildland fire.

- Alternative 1 does not contribute to this guideline.
- Alternative 3 contributes toward this desired condition by treating wildland fire fuels with prescribed fire across the project area.
- Alternative 4 contributes greater to this desired condition be treating more acres and reducing more wildland fire fuels across the project area.

Literature Referenced

Agee, J. K. 1993. Fire ecology of Pacific northwest forests. Island Press, Island Press Suite 300, 1718 Connecticut Avenue, NW, Washington, DC, 20009.

_____. The influence of forest structure on fire behavior, Pages 17 *in* Conference The influence of forest structure on fire behavior. January 16-18, Seattle, WA.

Agee, J. K., and C. N. Skinner. 2005. Basic principles of forest fuel reduction treatments. Forest Ecology and Management 211:83-96.

Albini, F. A., and R. G. Baughman. 1979. Estimating windspeeds for predicting wildland fire behavior. U.S. Department of Agricultre Forest Service Research Paper INT-221, U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.

Cruz, M. G., and Alexander, M.E. 2014.Canopy Characterists of Conifer Forests. Fire Management Today. United States Department of Agriculture, Forest Service 73:12-16

Estes, B. L., E. E. Knapp, C. N. Skinner, and F. C. C. Uzoh. 2012. Seasonal variation in surface fuel moisture between unthinned and thinned mixed conifer forest, northern California, USA. International Journal of Wildland Fire 21.

Graham, R. T., A. E. Harvey, T. B. Jain, and J. R. Tonn. 1999. The effects of thinning and similar stand treatments on fire behavior in Western forests. Gen. Tech. Rep. PNW-GTR-463, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Graham, R. T., T. B. Jain, and M. Loseke. 2009. Fuel treatments, fire suppression, and their interaction with wildfire and its impacts: The Warm Lake experience during the Cascade Complex of wildfires in central Idaho, 2007. Gen. Tech. Rep. RMRS-GTR-229, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Graham, R. T., S. McCaffrey, and T. B. Jain, (tech. eds.). 2004. Science basis for changing forest structure to modify wildfire behavior and severity. Gen. Tech. Rep. RMRS-GTR-120, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Hudak, A. T., I. Rickert, P. Morgan, E. Strand, S. A. Lewis, P. R. Robichaud, C. Hoffman, and Z. A. Holden. 2011. Review of fuel treatment effectiveness in forests and rangelands and a case study from the 2007 megafires in central, Idaho, USA. Gen. Tech. Rep. RMRS-GTR-252, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Lincoln County. 2023. Lincoln County community wildfire prevention plan (CWPPP).

Miller, J. D., H. D. Safford, M. Crimmins, and A. E. Thode. 2008. Quantitative evidence for increasing forest fire severity in the Sierra Nevada and Southern Cascade Mountains, California and Nevada,

USA. Ecosystems 12:16-32.
Montana Department of Natural Resources and Conservation. 2020. Montana forest action plan. Montana Forest Action Advisory Council, Helena, MT.
Mooney, C. 2010. Fuelbreak effectiveness in Canada's boreal forests: A synthesis of current knowledge. FPInnovations FERIC, Vancouver, BC.
Mosely, J. C., S. C. Bunting, and M. E. Monoukian. 1999. Cheatgrass. In R. L. Sheley and J. K. Petroff, eds. Biology and Management of Noxious Rangeland Weeds. Corvallis: Oregon State University Press.
Nowicki, B. 2002. The community protection zone: Defending houses and communities from the threat of forest fire.
Omi, P. N., E. J. Martinson, and G. W. Chong. 2007. Effectiveness of pre-fire fuel treatments. Final report submitted to the joint fire science program governing board. Report Final Report JFSP Project 03-2-1-07.
Parks, S. A., L. M. Holsinger, C. Miller, and M.-A. Parisien. 2017. Analog-based fire regime and vegetation shifts in mountainous regions of the western US. Ecography.
Parks, S. A., M.-A. Parisien, C. Miller, L. M. Holsinger, and L. S. Baggett. 2018. Fine-scale spatial climate variation and drought mediate the likelihood of reburning. Ecological Applications 0:14.
Pollet, J., and P. N. Omi. 2002a. Effect of thinning and prescribed burning on crown fire severity in ponderosa pine forests. International Journal of Wildland Fire 11:1-10.
_____. 2002b. Effect of thinning and prescribed burning on crown fire severity in ponderosa pine forests. International Journal of Wildland Fire 11:1-10.
Romme, W. H., and D. G. Despain. 1989. Historical perspective on the Yellowstone fires of 1988. BioScience 39:695-699.
Rothermel, R. C. 1983. How to predict the spread and intensity of forest and range fires. Gen.Tech. Rep. INT-143, U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.
Safford, H. D., D. A. Schmidt, and C. H. Carlson. 2009. Effects of fuel treatments on fire severity in an area of wildland–urban interface, Angora Fire, Lake Tahoe Basin, California. Forest Ecology and Management 258:773-787.
Schoennagel, T., T. T. Veblen, and W. H. Romme. 2004. The interaction of fire, fuels, and climate across Rocky Mountain forests. BioScience 54:661-676.
Scott, J. H., and E. D. Reinhardt. 2001. Assessing crown fire potential by linking models of surface and crown fire behavior. Research Paper RMRS-RP-29, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.
Stephens, S. L., J. D. Mciver, R. E. Boerner, J., C. J. Fettig, J. B. Fontaine, B. R. Hartsough, P. L. Kennedy, and D. W. Schwilk. 2012. The effects of forest fuel-reduction treatments in the United States. BioScience 62:549-560.
Stewart, George; Hull, A. C. 1949. Cheatgrass (Bromus tectorum L.)--an ecologic intruder in southern Idaho. Ecology. 30(1): 58-74.
U.S. Department of Agriculture, Forest Service, and U.S. Department of the Interior, Bureau of Indian Affairs, Fish and Wildlife Service, and National Park Service. 2009. Guidance for implementation of federal wildland fire management policy.
U.S. Department of Agriculture, Forest Service, Northern Region. 2015. Final record of decision for the final environmental impact statement and Kootenai National Forest land management plan, Lincoln, Sanders, and Flathead Counties, Montana and Bonner and Boundary Counties, Idaho. Missoula, MT.
U.S. Department of Agriculture, and U.S. Department of the Interior. 2014. The national strategy: The final phase in the development of the national cohesive wildland fire management strategy.
Van Wagner, C. E. 1977. Conditions for the start and spread of crown fire. Canadian Journal of Forest Research 7:23-24.
van Wagtendonk, J. W. 1996. Chapter 43: Use of a deterministic fire growth model to test fuel treatments.

Pages 1155-1165 *in* Sierra Nevada Ecosystem Project: Final Report to Congress. University of California, Centers for Water and Wildland Resources, Davis.
Ward, D. E., C. K. McMahon, and R. Johansen. 1976. An update on particulate emissions from forest fires. U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station, Southern Forest Fire Laboratory, Macon, GA.
Weatherspoon, C. P., and C. N. Skinner. 1996. Chapter 56: Landscape-level strategies for forest fuel management. Pages 1471-1492 *in* Sierra Nevada Ecosystem Project: Final Report to Congress. University of California, Centers for Water and Wildland Resources, Davis.
Westerling, A. L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam. 2006. Warming and earlier spring increase western U.S. forest wildfire activity. Science 313:940-943.
Young, J. A.; Evans, R. A. 1978. Population dynamics after wildfires in sagebrush grasslands. Journal of Range Management. 31:283-289

Appendix B

Identification of Potential Applicable or Relevant and Appropriate Requirements and To Be Considered Information

This page intentionally left blank.

Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs)
Mitchell Jackson Project Area
Lincoln County, Montana

Media/Location/ Action	Requirements	Prerequisite	Citation(s)
Potential Federal Chemical-Specific ARARs			
Contaminants released to air	This statute and implementing regulations establish primary and secondary National Ambient Air Quality Standards (NAAQS) for particulate matter (PM) 10 and PM 2.5. NAAQS are implemented through the New Source Review program and state implementation plans.	Air emissions related to dust generated during the construction of new roads and smoke generated from vegetation management in the removal action area – **potentially relevant and appropriate** While not applicable since the federal New Source Review program addresses only major sources, NAAQS may be relevant and appropriate to this removal action because excavation and grading from new road construction and prescribed fires could generate PM 10 and PM 2.5.	Clean Air Act, 42 U.S.C §7401 et seq. and implementing regulations for NAAQS at 40 Code of Federal Regulations (CFR), 50.14(b)(3) and (b)(4) (prescribed fires), 50.6 (PM 10), 40 CFR 50.7 (PM 2.5)

Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs)
Mitchell Jackson Project Area
Lincoln County, Montana

Media/Location/ Action	Requirements	Prerequisite	Citation(s)
Potential Federal Location-Specific ARARs			
Prescence of floodplains within removal action work areas	This regulation requires measures to reduce the risk of flood loss, minimize impact of floods, and restore and preserve the natural and beneficial values of floodplains.	Identification of floodplains within the removal action area – **potentially applicable**	Flood Plain Management and Protection of Wetlands 44 CFR 9.11(b)(2), (b)(4), (c)(3)
Presence of cultural resources within removal action work areas	This statute and implementing regulations require federal agencies to take into account the effect of the response action upon any district, site, building, structure, or object that is included in or eligible for the National Register of Historic Places (generally, 50 years old or older). Federal agencies are required to take into account their undertakings on historic properties and must determine whether there will be an adverse effect, and if so, how the effect may be minimized or mitigated, in consultation with the appropriate state or tribal historic preservation office.	Identification of cultural resources on or eligible for the National Register by surveys – **potentially applicable**	National Historic Preservation Act at 16 U.S.C. § 470 and implementing regulations at 36 CFR 60, 63, and 800
Removal action activities within a national forest	The National Forest Management Act (NFMA) is the primary statute governing the administration of National Forest System (NFS) land. This statute requires the Secretary of Agriculture to assess forest lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the NFS.	Identification of USFS managed land for removal action activities – **potentially applicable**	National Forest Management Act of 1976 16 USC §§ 1601-1614

Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs)
Mitchell Jackson Project Area
Lincoln County, Montana

Media/Location/ Action	Requirements	Prerequisite	Citation(s)
Potential for removal action activities in habitat for federally endangered or threatened species	This statute and implementing regulations provide that federal activities not jeopardize the continued existence of any threatened or endangered species. 16 U.S.C. § 1536(a) of the Endangered Species Act requires consultation with the U.S. Fish and Wildlife Service (USFWS) to identify the possible presence of protected species and mitigate potential impacts on such species. Substantive compliance with the Endangered Species Act means that the lead agency must identify whether a threatened or endangered species, or its critical habitat, will be affected by a proposed response action. If so, the agency must avoid the action or take appropriate mitigation measures so that the action does not affect or minimizes the effects of the actions to the species or its critical habitat. If at any point the conclusion is reached that endangered species are not present or will not be affected, no further action is required. If any of the threatened or endangered species are identified during removal design and removal action, activities must be modified and conducted to conserve the species and their habitat. Consultation with the federal agencies will be conducted to identify substantive requirements for protection of threatened and endangered species.	Identification of endangered or threatened species and their habitat that may be impacted by a removal action – **potentially applicable** Species and their habitat that may be encountered in removal work areas are the: Canada lynx, lynx critical habitat, grizzly bear, wolverine, yellow-billed cuckoo, bull trout, bull trout critical habitat, Spalding's catchfly, and whitebark pine.	Endangered Species Act 16 U.S.C. § 1536(a)(2) and Implementing Regulations with listings of threatened species and endangered species at 50 CFR 17.11 and 17.12, or designation of critical habitat at 50 CFR 17.95 and 50 CFR 402.

Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs)
Mitchell Jackson Project Area
Lincoln County, Montana

Media/Location/ Action	Requirements	Prerequisite	Citation(s)
Potential for removal action activities in habitat for bald and/or golden eagles	This statute and implementing regulations make it unlawful for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any bald or golden eagle, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to federal regulations. In addition to immediate impacts, this requirement also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death, or nest abandonment. If bald or golden eagles are identified during removal design and removal action, activities must be modified and conducted to conserve the species and their habitat.	Identification of bald or golden eagles and actions that could impair the species and their habitat – **potentially applicable** The USFS has observed active eagle nests in the Mitchell Jackson project area.	Bald and Golden Eagle Protection Act 16 U.S.C. § 668(a) and 50 CFR 22.6.
Potential for removal action activities in habitat for migratory birds	This statute and implementing regulations make it unlawful for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird. If migratory birds, listed in 50 CFR 10.13, are identified during removal design and removal action, activities must consider effects on those species and conducted overall to conserve the species and their habitat.	Actions that may negatively impact the migratory birds and their habitat – **potentially applicable**	Migratory Bird Treaty Act 16 U.S.C. § 703(a) and Implementing Regulations 50 CFR 10.13 (List of Migratory Birds).

Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs)
Mitchell Jackson Project Area
Lincoln County, Montana

Media/Location/ Action	Requirements	Prerequisite	Citation(s)
Potential for removal action activities in areas containing Native American remains or artifacts	This statute and implementing regulations provide for the disposition of Native American remains and objects inadvertently discovered on federal or tribal lands after November 1990. If the response activities result in the discovery of Native American human remains or related objects, the activity must stop while the head of the federal land management agency (in this case, USFS) and appropriate Indian tribes are notified of the discovery. After the discovery, the response activity must cease and a reasonable effort must be made to protect the Native American human remains or related objects. The response activity may later resume (43 CFR Section 10.4).	Identification of Native American remains and objects – **potentially applicable** The USFS has information that Native American remains or objects may be present in the Mitchell Jackson project area.	Native American Graves Protection and Repatriation Act (NAGPRA) 25 U.S.C. § 3001, 25 U.S.C. § 3002(d), and Implementing Regulations 43 CFR §§ 10.1 – 10.17
Potential for removal action activities in areas containing archeological resources	This statute and implementing regulations provide for the protection of archeological resources located on public and tribal lands. Establishes criteria that must be met for the land manager's approval of any excavation or removal of archaeological resources if a proposed activity involves soil disturbances.	Discovery of archeological resources – **potentially applicable** The USFS has information that archeological resources may be present in the Mitchell Jackson project area.	Archaeological Resources Protection Act 16 U.S.C. §§ 470aa-ii et seq and Implementing Regulations 43 CFR §§ 7.1 et seq.
Potential to discover archaeological or historic resources within removal action work areas	This statute and implementing regulations establish requirements for the evaluation and preservation of historical and archaeological data, which may be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program. The unauthorized removal of archaeological resources from public or Indian lands is prohibited without a permit, and any not archaeological investigations at a site must be conducted by a professional archaeologist.	Identification of archeological or historical resources – **potentially applicable** The USFS has information that archeological resources may be present in the Mitchell Jackson project area.	Archaeological and Historic Preservation Act 16 U.S.C. 469 and Implementing Regulations 43 CFR 7

Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs)
Mitchell Jackson Project Area
Lincoln County, Montana

Media/Location/ Action	Requirements	Prerequisite	Citation(s)
Potential for removal action activities in wetlands	This regulation requires federal agencies take measures to incorporate wetlands protection considerations into planning, regulatory, and decision-making processes. It also requires the agency minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands. The agency shall avoid direct and indirect support of wetlands development wherever there is a practicable alternative.	Actions taken on jurisdictional wetlands – **potentially applicable** National Wetlands Inventory features indicate delineated wetlands within the Mitchell Jackson project area. Action will be taken to avoid adversely affecting them.	Protection of Wetlands Regulations 40 CFR Part 6 Appendix A.
Potential for removal action activities to affect streams or rivers	This statute and implementing regulations require coordination with federal and state agencies for federally funded projects to ensure that any modification of any stream or other water body affected by any action authorized or funded by the federal agency provides for adequate protection of fish and wildlife resources. Federal agencies must comply with substantive requirements identified by the U.S. Fish and Wildlife Service and the relevant state agency with jurisdiction over wildlife resources.	Modification of any stream or water bodies that affect non-game fish and wildlife resources – **potentially applicable**. Streams that could be affected by the removal action have been identified within the Mitchell Jackson project area.	Fish and Wildlife Coordination Act 16 U.S.C. §662 and 663, and Implementing Regulations 50 CFR 83; 33 CFR 320-330
Potential for removal activities within areas affecting national wild, scenic, or recreational rivers	This act and implementing regulations require action to avoid adverse effects on designated wild, scenic, or recreational rivers.	Removal actions such as vegetation management that affect or may affect any of the rivers specified in section 1276(a) – **potentially relevant and appropriate.** The Kootenai River is not authorized by Congress for inclusion or designated by the State of Montana to be classified as a wild or scenic river. However, it does meet the requirements to be designated as a recreational river area and therefore actions should preserve its current state.	Wild and Scenic Rivers Act 16 U.S.C. 1271 et seq. section 7 (a) and Implementing Regulations 40 CFR 6.302(e)

Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs)
Mitchell Jackson Project Area
Lincoln County, Montana

Media/Location/ Action	Requirements	Prerequisite	Citation(s)
Potential Federal Action-Specific ARARs			
Nonpoint source discharge of stormwater to streams from removal action activities	This act through Section 402 of the Clean Water Act, 33 USC §§ 1342, et seq., authorizes the issuance of permits for the discharge of any pollutant. This includes storm water discharges associated with industrial activity. See, 40 CFR 122.1(b)(2)(iv). Industrial activity includes inactive mining operations that discharge storm water contaminated by contact with or that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations. 40 CFR 122.26(b)(14)(iii); landfills, land application sites, and open dumps that receive or have received any industrial wastes including those subject to regulation under RCRA subtitle D. 40 CFR 122.26(b)(14)(v); and construction activity including clearing, grading, and excavation activities, see, 40 CFR 122.26(b)(14)(x).	Non-point stormwater discharges associated with removal activities resulting in disturbance of greater than 5 acres of total land area, or disturbance of less than 5 acres of total land area that is part of a larger common plan, if the larger common plan will ultimately disturb five acres or more – **potentially applicable**	Clean Water Act 33 U.S.C. §§ 1342, et seq., Point Source Discharges Requirements, Section 402

Potential Federal and State Applicable or Relevant and Appropriate Requirements (ARARs)
Mitchell Jackson Project Area
Lincoln County, Montana

Media/Location/ Action	Requirements	Prerequisite	Citation(s)
Discharge of dredged or fill material into waters of the United States during removal action activities	Section 404 regulates the discharge of dredged or fill materials into waters of the United States including return flow from such activity. This program is implemented through regulations set forth in the 404 (b)(1) guidelines, 40 CFR 230. The guidelines specify: the restriction on discharge (40 CFR 230.10); the factual determinations that need to be made on short- and long-term effects of proposed discharge of dredge or fill material on the physical, chemical, and biological components of the aquatic environment (40 CFR 230.11) in light of Subpart C through F of the guidelines; and the findings of compliance on the restrictions (40 CFR 230.12). Subpart J of the guidelines provide the standards and criteria for the use of all types of compensatory mitigation when the response action will result in unavoidable impacts to the aquatic environment.	Presence of waters of the U.S. in removal action areas – **potentially applicable**	Clean Water Act 404, 33 U.S.C. § 1344, et. seq., Dredge and Fill Provisions Section 404 (b)(1) and Implementing Regulations 40 CFR 230

Potential Federal and State To Be Considered Information (TBCs)
Mitchell Jackson Project Area
Lincoln County, Montana

Management Areas: Media/Location/Action	Requirements	Prerequisite	Citation(s)
Potential Federal Location-Specific TBCs			
Prescence of an eligible wild or scenic river	Non-native invasive plant species may be treated, and other vegetation restoration projects may occur if the need is linked to human-induced changes and is necessary for the recovery of threatened, endangered, and sensitive species or native ecological communities in eligible wild river segments.	Removal action activities in eligible wild or scenic rivers – **potential TBC**	Kootenai National Forest Land Management Plan KNFLMP (2015) MA2-GDL-VEG-01
Presence of old growth stands	Timber harvest or other vegetation management activities may be authorized in old growth stands if the activities are designed to increase the resistance and resiliency of the stand to disturbances or stressors, and if the activities are not likely to modify stand characteristics to the extent that the stand would no longer meet the definition of old growth.	Removal action activities that involve vegetation management in old growth stands - **potential TBC**	(KNFLMP) (2015) FW-GDL-VEG-01
Presence of old growth stands	Road construction (permanent or temporary) or other developments should generally be avoided in old growth stands unless access is needed to implement vegetation management activities for the purpose of increasing the resistance and resilience of the stands to disturbances.	Removal action activities that involve road construction in old growth stands – **potential TBC**	KNFLMP (2015) FW-GDL-VEG-02
Presence of occupied or suitable habitat for sensitive or endangered plants	Evaluate proposed management activities and project areas for the presence of occupied or suitable habitat for any plant species listed under the Endangered Species Act or on the regional sensitive species list. If needed, based on pre-field review, conduct field surveys and provide mitigation or protection to maintain occurrences or habitats that are important for species sustainability.	Removal action activities that involve occupied or suitable habitat for sensitive or endangered plant species – **potential TBC**	KNFLMP (2015) FW-GDL-VEG-07
Presence of peatlands or bogs	Peatlands/bogs should be buffered by at least 660 feet from management activities that may degrade this habitat.	Removal action activities near peatlands or bogs – **potential TBC**	KNFLMP (2015) FW-GDL-VEG-09
Presence of northern Rockies lynx habitat	The Northern Rockies Lynx Management Direction (2007) and ROD is included in Appendix B of the KNFLMP and shall be applied. For example, new or expanded permanent development and vegetation management projects must maintain habitat connectivity in a Lynx analysis unit (LAU) and/or linkage area.	Removal action activities occurring within northern Rockies lynx habitat – **potential TBC**	KNFLMP (2015) FW-STD-WL-01

Potential Federal and State To Be Considered Information (TBCs)
Mitchell Jackson Project Area
Lincoln County, Montana

Management Areas: Media/Location/Action	Requirements	Prerequisite	Citation(s)
Presence of grizzly bear analysis areas	The Motorized Access Management within the Selkirk and Cabinet Yaak Grizzly Bear Recovery Zone Management Direction and ROD is included in appendix B of the KNFLMP and shall be applied. For example, transportation management must road activities within individual bear management units (BMUs) or grizzly bear recurring use areas (BORZs) located outside of the Cabinet-Yaak Grizzly Bear Recovery Zone.	Removal action activities occurring within grizzly bear BMUs or BORZ areas – **potential TBC**	KNFLMP (2015) FW-STD-WL-02
Presence of impaired watersheds	Management activities in impaired watersheds (listed by the state under section 5 of the Integrated 303(d)/305(b) Report) with approved TMDLs are designed to comply with the TMDL. Management activities in watersheds with streams on the 303(d) list are designed to maintain or improve conditions relative to the cause for impairment and will not cause a decline in water quality or further impair beneficial uses. A short-term or incidental departure from state water quality standards may occur where there is no long-term threat or impairment to the beneficial uses.	Removal action activities near section 303(d) impaired watersheds – **potential TBC**	KNFLMP (2015) FW-GDL-WTR-01
Presence of public source water areas	Management activities shall maintain or improve water quality in public source water areas and be consistent with applicable state source water protection requirements. Short-term effects from activities in source water areas may be acceptable when those activities support long-term benefits to aquatic resources.	Removal action activities in areas near public source waters – **potential TBC**	KNFLMP (2015) FW-STD-WTR-01
Presence of landslide prone areas	Ground-disturbing management activities on landslide prone areas should be avoided. If activities cannot be avoided, they should be designed to maintain soil and slope stability.	Removal action activities in landslide prone areas – **potential TBC**	KNFLMP (2015) FW-GDL-SOIL-04
Presence of inventoried roadless area	If within an inventoried roadless area outside of Idaho, road construction and reconstruction shall follow direction found in the 2001 Roadless Rule. Establishes prohibitions on road construction, road reconstruction, and timber harvesting.	Removal action activities involving road construction/reconstruction within an inventoried roadless area outside of Idaho – **potential TBC**	KNFLMP (2015) MA5a,b,c-STD-AR-01 pursuant to 36 CFR 294.12

Potential Federal and State To Be Considered Information (TBCs)
Mitchell Jackson Project Area
Lincoln County, Montana

Management Areas: Media/Location/Action	Requirements	Prerequisite	Citation(s)
Presence of inventoried roadless area	If within an inventoried roadless area outside of Idaho, timber harvest activities shall follow direction found in the 2001 Roadless Rule. Establishes prohibitions on road construction, road reconstruction, and timber harvesting.	Removal action activities involving timber harvest activities within an inventoried roadless area outside of Idaho– **potential TBC**	KNFLMP (2015) MA5a,b,c-STD-TBR-02 pursuant to 36 CFR 294.13
Prescence of nests, den sites, and other birthing areas for threatened, endangered, proposed, or sensitive species	Nests and den sites and other birthing and rearing areas for terrestrial threatened, endangered, proposed, or sensitive species are relatively free of human disturbance during the period they are active at these sites. Individual animals that establish nests and den sites near areas of pre-existing human use are assumed to be accepting of that existing level of human use at the time the animals establish occupancy.	Removal action activities near nests, dens, or birthing areas for terrestrial threatened, endangered, proposed, or sensitive species- **potential TBC**	KNFLMP (2015) FW-DC-WL-01
Prescence of bald eagle nesting habitat	Large-diameter trees are available within potential bald eagle nesting habitat adjacent to large lakes and major rivers. Forested stands are managed to promote large diameter trees within eagle nesting territories, especially in the area between the nest site and the adjacent water body.	Removal action activities within bald eagle nesting habitat - **potential TBC**	KNFLMP (2015) FW-DC-WL-06
Prescence of an eligible wild or scenic river	Timber harvest is not allowed in eligible wild river segments.	Removal action activities in wild or scenic river segments – **potential TBC**	KNFLMP (2015) MA2-STD-TBR-01
Presence of a recreational river	Timber harvest is allowed to maintain or restore the values for which the eligible scenic or recreational river was identified. Timber harvest is not scheduled and does not contribute towards the allowable sale quantity.	Removal action activities in recreational river segments – **potential TBC**	KNFLMP (2015) MA2-GDL-TBR-02
Presence of a recreational river	Management activities should be consistent with the Scenic Integrity Objective of moderate to high in eligible recreational river segments.	Removal action activities in recreational river segments – **potential TBC**	KNFLMP (2015) MA2-GDL-AR-09
Prescence of RHCA	If necessary for the attainment of RHCA desired conditions, ground-based logging equipment should only enter an RHCA at designated locations.	Removal action activities=s involving transportation management activities (i.e., roadway stream crossings) in RHCAs – **potential TBC**	KNFLMP (2015) FW-GDL-RIP-05

Potential Federal and State To Be Considered Information (TBCs)
Mitchell Jackson Project Area
Lincoln County, Montana

Management Areas: Media/Location/Action	Requirements	Prerequisite	Citation(s)
Potential Federal Action-Specific TBCs			
Actions involving vegetation management	Timber harvest activities shall only be used when there is reasonable assurance of restocking within 5 years after final regeneration harvest. Restocking level is prescribed in a site-specific silviculture prescription for a project treatment unit and is determined to be adequate depending on the objectives and desired conditions for the Plan area. In some instances, such as when lands are harvested to create openings for fuel breaks, wildlife habitat, and vistas or to prevent encroaching trees, it is adequate not to restock.	Removal actions involving restocking after regeneration harvest with desired fire resistant species – **potential TBC**	KNFLMP (2015) FW-STD-TBR-03
Actions involving substantive requirements of permits and operating plans	Permits and operating plans (e.g., special use, grazing, and mining) shall specify sanitation measures and adhere to the forestwide food/attractant storage order in order to reduce human/wildlife conflicts and mortality by making wildlife attractants (e.g., garbage, food, livestock carcasses) inaccessible through proper storage or dispersal.	Removal action activities involving substantive requirements of permits and operating plans – **potential TBC**	KNFLMP (2015) FW-STD-WL-04
Actions that could spread noxious weeds	Populations of new noxious weed species are treated promptly and eradicated. Established noxious weed infestations are reduced and habitat conditions are improved for native grasses, forbs, and shrubs	Removal action activities involving noxious weeds – **potential TBC**	KNFLMP (2015) GA-DC-VEG-LIB-03
Actions involving vegetation management	Vegetation management activities should retain the amounts of coarse woody debris (including logs) that are displayed in Table 3 of the KNFLMP. A variety of species, sizes, and decay stages should be retained. Exceptions may occur in areas where a site-specific analysis indicates that leaving the quantities listed in the table would create an unacceptable fire hazard to private property, people, or sensitive natural or historical resources. In addition, exceptions may occur where the minimum quantities listed in the table are not available for retention.	Removal action activities involving vegetation management – **potential TBC**	KNFLMP (2015) FW-GDL-VEG-03

Potential Federal and State To Be Considered Information (TBCs)
Mitchell Jackson Project Area
Lincoln County, Montana

Management Areas: Media/Location/Action	Requirements	Prerequisite	Citation(s)
Actions involving removal of snags	Vegetation management activities should retain snags greater than 20 inches DBH and at least the minimum number of snags and live trees (for future snags) that are displayed in Table 4 of the KNFLMP. Where snag numbers do not exist to meet the recommended ranges, the difference would be made up with live replacement trees. Exceptions occur for issues such as human safety and instances where the minimum numbers are not present prior to the management activities.	Removal action activities involving removal of snags (dead or dying trees) – potential **TBC**	KNFLMP (2015) FW-GDL-VEG-04 FW-GDL-VEG-05 FW-GDL-VEG-06
Actions involving silvercultre practices to manage forest vegetation	Silvicultural systems (e.g., even-aged, two-aged or uneven-aged), regeneration methods (e.g., clearcutting, seed-tree, shelterwood, and group or single-tree selection), as well as other practices such as improvement cutting, commercial or pre-commercial thinning, use of planned or unplanned ignitions, planting, pruning, invasive terrestrial plant species control, cone collection, tree improvement, insect or disease control, site-preparation, and fuel reduction. Appropriate practices for a given situation depend on numerous factors, including the current and desired forest vegetation conditions at the stand and landscape scales, the biophysical setting, and the management direction and emphasis for the area. Silvicultural practices should generally trend the forest vegetation towards conditions that are more resistant and resilient to disturbances and stressors, including climate change.	Removal action activities that involve silvicultural systems, regeneration methods and other practices - **potential TBC**	KNFLMP (2015) FW-GDL-VEG-08
Actions involving vegetation management	Meet applicable state water quality standards and flow conditions to support beneficial use and meet the ecological needs of native and desirable non-native species in watersheds, streams, lakes, springs, wetlands, and groundwater.	Removal action activities involving vegetation management near water bodies – **potential TBC**	KNFLMP (2015) FW-DC-WTR-02
Actions involving decommissioning or storing of roads	In order to avoid future risks to watershed condition, ensure hydrologic stability when decommissioning or storing roads or trails	Removal action activities involving decommissioning or storing of roads or trails – **potential TBC**	KNFLMP (2015) FW-GDL-WTR-02

Potential Federal and State To Be Considered Information (TBCs)
Mitchell Jackson Project Area
Lincoln County, Montana

Management Areas: Media/Location/Action	Requirements	Prerequisite	Citation(s)
Actions involving discharges from land disturbances	Project-specific best management practices (BMPs) will be incorporated in all land use and project plans as a principal mechanism for controlling non-point pollution sources, meet soil and water goals, and protect beneficial uses. To the extent practicable, ditch and road surface runoff should be disconnected from streams and other water bodies.	Removal action activities involving discharges from land disturbances – **potential TBC**	KNFLMP (2015) FW-GDL-WTR-03
Actions involving use of ground based equipment on slopes	Ground-based equipment should only operate on slopes less than 40 percent, in order to avoid detrimental soil disturbance. Where slopes within an activity area contain short pitches greater than 40 percent, but less than 150 feet in length, ground-based equipment may be allowed, as designated by the timber sale administrator.	Removal action activities involving use of ground-based equipment on slopes – **potential TBC**	KNFLMP (2015) FW-GDL-SOIL-01
Actions involving vegetation management	Coarse woody debris is retained following vegetation management activities.	Removal action activties involving the management of vegetation – **potential TBC**	KNFLMP (2015) FW-GDL-SOIL-02
Actions involving harvesting organics	On nutrient- limited landtypes, harvested organics should remain on site for at least 6 months or over a winter season to allow foliage nutrients to leach into the soil, except where site-specific analysis indicates the fuels would present an unacceptable hazard.	Removal action activities involving organic harvesting in nutrient limited remedial action areas – **potential TBC**	KNFLMP (2015) FW-GDL-SOIL-03
Actions involving project specific BMP's	Project specific best management practices (BMPs) should be incorporated into all land management activities as a principle mechanism for protecting soil resources.	Removal action activities incorporating BMPs to protect soil – **potential TBC**	KNFLMP (2015) FW-GDL-SOIL-05
Actions involving scenic integrity for scenic travel routes	Management activities should be consistent with the mapped scenic integrity objective, see [Forest] plan set of documents. The scenic integrity objective is High to Very High for scenic travel routes.	Removal action activities involving scenic integrity for scenic travel routes – **potential TBC**	KNFLMP (2015) FW-GDL-AR-01

Potential Federal and State To Be Considered Information (TBCs)
Mitchell Jackson Project Area
Lincoln County, Montana

Management Areas: Media/Location/Action	Requirements	Prerequisite	Citation(s)
Actions involving road transportation systems	A transportation system is in place that provides safe and efficient public and administrative access to the Forest for recreation, special uses, forest resource management, and fire management activities. It is efficiently maintained, environmentally compatible, and responsive to public needs and desires. The transportation system and its use have minimal impacts on resources including threatened and endangered species, sensitive species, heritage and cultural sites, watersheds, and aquatic species. Newly constructed or reconstructed roads do not encroach into streams and riparian areas in ways that impact channel function, geometry, or sediment delivery. Roads in intermittent stored service pose minimal risks to water quality and aquatic ecosystems. Drainage structures have a minimal risk of failure, and provide adequate drainage that prevents accelerated runoff, erosion, and sediment delivery to streams. In addition, stream crossings provide for passage of aquatic organisms.	Removal action activities involving road construction/reconstruction/improvement – **Potential TBC**	KNFLMP (2015) FW-DC-AR-07
Actions involving air quality requirements	The Forest should cooperate with federal, state, tribal, and local air quality agencies as appropriate in meeting applicable air quality requirements.	Removal action activities involving air quality requirements – **potential TBC**	KNFLMP (2015) FW-GDL-AQ-01
Actions involving road maintenance operations	Soil and snow should not be side-cast into surface water during road maintenance operations.	Removal action activities involving road maintenance operations – **potential TBC**	KNFLMP (2015) FW-GDL-RIP-01
Actions involving drafting equipment from water bodies	When drafting water from streams, pumps should be screened and located away from spawning areas to prevent entrainment of fish and aquatic organisms. During the spawning season for native fish, pumping sites should be located away from spawning gravels. Drafting equipment should be cleaned and inspected for aquatic invasive species prior to use in a water body	Removal action activities involving the use of drafting equipment – **potential TBC**	KNFLMP (2015) FW-GDL-RIP-04

Potential Federal and State To Be Considered Information (TBCs)
Mitchell Jackson Project Area
Lincoln County, Montana

Management Areas: Media/Location/Action	Requirements	Prerequisite	Citation(s)
Actions involving the use or expansion of a gravel pit	Mineral materials are made available based upon public interest, material availability, in-service needs, and protection of other resource values, including consistency with desired conditions for other resources. Geologic features are conserved for their intrinsic values and characteristics. Reclamation of abandoned mine sites occurs where human health and environmental degradation risks should occur, with reclamation priority given to mine sites with human health risks.	Removal action activities involving the use or expansion of a gravel pit - **potential TBC**	KNFLMP (2015) FW-DC-MIN-01
Actions that have the potential to disturb historic human remains	Historic human remains should be left undisturbed unless there is an urgent reason (e.g., human health and safety, natural event, etc.) for their disturbance.	Removal action activities that could disturb historic human remains – **potential TBC**	KNFLMP (2015) FW-GDL-CR-02
Actions occurring within management area 6 of the Kootenai National Forest	Management activities should be consistent with the Scenic Integrity Objective of Low to High.	Removal action activities in management area 6 of the Kootenai National Forest – **potential TBC**	KNFLMP (2015) MA6-GDL-AR-05
Actions occurring within management area 7 of the Kootenai National Forest	Removal of mineral materials is not allowed at Turner Mountain Ski Area.	Removal action activities in management area 7 of the Kootenai National Forest – **potential TBC**	KNFLMP (2015) MA7-STD-MIN-01
Actions occurring within management area 7 of the Kootenai National Forest	Management activities should be consistent with the Scenic Integrity Objective of Low to High.	Removal action activities in management area 7 of the Kootenai National Forest – **potential TBC**	KNFLMP (2015) MA7-GDL-AR-05
Actions occurring within management area 7 of the Kootenai National Forest	Management activities in the Lake Koocanusa Area should be consistent with the Scenic Integrity Objective of Moderate.	Removal action activities in management area 7 of the Kootenai National Forest – **potential TBC**	KNFLMP (2015) MA7-GDL-AR-06

Appendix C

Detailed Analysis of Alternatives

This page intentionally left blank.

Appendix C
Detailed Analysis of Remedial Alternatives

Table C-1. Evaluation Summary of Factors for Effectiveness

Subcriterion for Evaluation of Effectiveness		Alternative 1 Vegetation and Transportation Management Activities using the Existing Road System	Alternative 2 Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System
Overall Protection of Human Health and the Environment	Adequate protection of human health and the environment shall be evaluated for long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site	▪ This alternative would contribute to protectiveness of human health in OU3 until a final remedy for OU3 is selected. ▪ RAOs would be addressed through proposed vegetation and transportation management activities as follows: • The reduction of fuels via vegetation management activities (Figure 4-1, Table 1; 5,404 acres of harvest and 3,550 acres of other activities) in the Mitchell Jackson Project Area would reduce the likelihood of wildland fires starting and moving into OU3 that would potentially release LA from forest media and result in exposure to firefighters and erosion and runoff to surface water. • Transportation management activities (Figure 4-2, Table 2) would facilitate access for fuels management activities, manage public access to reduce the likelihood of fire starts, and improve firefighter response to minimize the intensity and spread of fire starts into OU3, which could reduce firefighter exposure to and movement of LA-contaminated media. ▪ Based on fire behavior modeling (Appendix A) of USFS-managed land, the resulting effect of implementing this alternative is that wildland fires within the Mitchell Jackson Project Area are more likely to be surface fires that are more conducive to direct fire suppression activities that would reduce the potential for fire spread into the adjacent OU3. Expected surface fire flame lengths would be reduced, canopy base heights would increase, and canopy bulk densities would decrease, all of which lead to reduced crown fire potential (discussed in detail with respect to the long-term effectiveness and permanence subcriterion). Short-term impacts to the community, environment, and workers include additional traffic and air quality impacts associated with timber haul trucks, heavy machinery, and prescribed burning, and the safety risks associated with logging, heavy equipment operation, and hand tools, particularly on steep terrain or around streams and other water bodies. This alternative would also include both temporary and long-term road and trail access changes. ▪ Short-term impacts would be mitigated by the implementation of BMPs, including adherence to ARARs and TBCs, and communication with the community regarding proposed vegetation and transportation management activities. ▪ For the small segment of road improvement conducted within the OU3 boundary, surface disturbance of LA-contaminated media, such as soil/duff, could pose short-term risks to the community. Dust suppression, establishment of work zones, air monitoring, and establishment of proper work procedures, including LA-contaminated soil management procedures, are examples of safety measures that could be implemented to protect the community.	▪ This alternative would contribute to protectiveness of human health in OU3 until a final remedy for OU3 is selected. ▪ RAOs would be addressed through proposed vegetation and transportation management activities as follows: • The reduction of fuels via vegetation management activities (Figure 4-4, Table 1; 6,301 acres of harvest and 3,786 acres of other activities) in the Mitchell Jackson Project Area, with additional vegetation management activities focused in the densely vegetated warm/dry areas in the western portion of the project area upwind of OU3, would reduce the likelihood of wildland fires starting and moving into OU3 that would potentially release LA from forest media, and result in exposure to firefighters and erosion and runoff to surface water. • Transportation management activities (Figure 4-6, Table 2), including construction of new NFS roads primarily in the western portion of the project area, would facilitate access for fuels management activities, manage public access to reduce the likelihood of fire starts, and improve firefighter response to minimize the intensity and spread of fire starts into OU3, which could reduce firefighter exposure to and movement of LA-contaminated media. • Based on fire behavior modeling (Appendix A) of USFS-managed land, the resulting effect of implementing this alternative is that wildland fires within the Mitchell Jackson Project Area are more likely to be surface fires that are more conducive to fire suppression activities that would reduce the potential for fire spread into the adjacent OU3. Expected surface fire flame lengths would be reduced, canopy base heights would increase, and canopy bulk densities would decrease, all of which lead to reduced crown fire potential (discussed in detail with respect to the long-term effectiveness and permanence subcriterion). Reduction of crown fire potential is specifically targeted in critical western portions of the Mitchell Jackson Project Area via the construction of new National Forest System roads to facilitate vegetation management activities. Units in this area have a warm/dry biophysical setting, a buildup of fuels, and are located upwind from OU3 in the prevailing wind directions in the Kootenai National Forest, making this area the most likely location for wildland fire start and spread into OU3 (Appendix A). ▪ Short-term impacts to the community, environment, and workers include additional traffic and air quality impacts associated with timber haul trucks, heavy machinery, and prescribed burning, and the safety risks associated with logging, heavy equipment operation, and hand tools, particularly on steep terrain, at stream crossings, and around other water bodies. This alternative would also include both temporary and long-term road and trail access changes. ▪ Short-term impacts would be mitigated by the implementation of BMPs, including adherence to ARARs and TBCs, and communication with the community regarding proposed vegetation and transportation management activities. ▪ For the small segments of road improvements conducted within the OU3 boundary, surface disturbance of LA-contaminated media, such as soil/duff, could pose short-term risks to the community. Dust suppression, establishment of work zones, air monitoring, and establishment of proper work procedures including LA-contaminated soil management procedures are examples of safety measures that could be implemented to protect the community.
Compliance with ARARs and Other Criteria, Advisories, and Guidance	Compliance with chemical specific ARARs	▪ The following types of contaminants/media identified as part of Alternative 1 would involve chemical-specific ARARs (Appendix B) that would be complied with: • Particulate matter released to the air during activities such as grading, clearing, excavation (e.g., constructing temporary roads), and/or existing road maintenance • Particulate matter released to air during prescribed burns ▪ The primary approach for compliance with air quality standards for particulate matter would be using engineered controls and BMPs.	▪ The following types of contaminants/media identified as part of Alternative 2 would involve chemical-specific ARARs (Appendix B) that would be complied with: • Particulate matter released to the air during activities such as grading, clearing, excavation (e.g., constructing temporary roads), and/or existing road maintenance • Particulate matter released to air during prescribed burns ▪ The primary approach for compliance with air quality standards for particulate matter would using engineered controls and BMPs.

Subcriterion for Evaluation of Effectiveness		Alternative 1 Vegetation and Transportation Management Activities using the Existing Road System	Alternative 2 Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System
Compliance with ARARs and Other Criteria, Advisories, and Guidance (continued)	Compliance with location-specific ARARs	▪ If the following locations/conditions are present, location-specific ARARs (Appendix B) would be complied with for Alternative 1: • USFS-managed lands • Endangered or threatened species (e.g., grizzly bear) or their critical habitat • Migratory birds (e.g., harlequin duck) and their habitat • Bald or golden eagles and their habitat • Cultural and archaeological resources and artifacts • Eligible wild and scenic rivers (i.e., Kootenai River) • Streams (i.e., waters of the U.S.) • Wetlands • Floodplains ▪ The primary approaches for compliance would be adjusting the locations of staging areas for remediation work and adjusting work windows or the timing of specific activities.	▪ If the following locations/conditions are present, location-specific ARARs (Appendix B) would be complied with for Alternative 2: • USFS-managed lands • Endangered or threatened species (e.g., grizzly bear) or their critical habitat • Migratory birds (e.g., harlequin duck) and their habitat • Bald or golden eagles and their habitat • Cultural and archaeological resources and artifacts • Eligible wild and scenic river (i.e., Kootenai River) • Streams (i.e., waters of the U.S.) • Wetlands • Floodplains ▪ The primary approaches for compliance would be adjusting the locations of staging areas for remediation work and adjusting work windows or the timing of specific activities.
	Compliance with action-specific ARARs	▪ The following activities for Alternative 1 would involve action-specific ARARs in Appendix B that would be complied with: • Site preparation activities (e.g., erosion and sedimentation control measures) • Discharge requirements of fill materials to streams and/or modification of streams for transportation management activities • Discharge requirements (point or nonpoint) to streams or wetlands from point or nonpoint sources during vegetation and transportation management activities ▪ The primary approaches for compliance would be adjusting the locations of discharges and fill placement and using BMPs to mitigate effects.	▪ The following activities for Alternative 2 would involve action-specific ARARs (Appendix B) that would be complied with: • Site preparation activities (e.g., erosion and sedimentation control measures) • Discharge requirements of fill materials to streams and/or modification of streams for transportation management activities • Discharge requirements (point or nonpoint) to streams or wetlands from point or nonpoint sources during vegetation and transportation management activities ▪ The primary approaches for compliance would be adjusting the locations of discharges and fill placement and using BMPs to mitigate effects.

Appendix C
Detailed Analysis of Remedial Alternatives

Subcriterion for Evaluation of Effectiveness		Alternative 1 Vegetation and Transportation Management Activities using the Existing Road System	Alternative 2 Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System
Long-Term Effectiveness and Permanence	Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the removal activities	▪ Based on fire behavior modeling (Appendix A), the resulting effect of implementing this alternative is that wildland fires within the Mitchell Jackson Project Area are more likely to be surface fires that are more conducive to direct fire suppression activities that would reduce the potential for fire spread into the adjacent OU3. Based on fire modeling, the following are the expected changes in fire behavior from implementing this alternative: • Surface Fire Flame Length: Expected flame lengths from a wildland fire under high to extreme conditions would be reduced to less than 4 feet on about 28% of the acres with vegetative management activities, and flame lengths kept under 8 feet on 53% of the acres with vegetative management activities. Generally, a fire with flame lengths under 4 feet can be attacked with hand resources, while flame lengths between 4 to 8 feet will need heavy equipment to suppress. Flame lengths above 8 feet are extremely difficult to control. • Canopy base heights would increase, decreasing connectivity between surface and ladder fuels and thereby reducing crown fire potential. Canopy base heights of 0–3 feet, illustrating high connectivity, would be reduced from 82% to 53% of the Mitchell Jackson Project Area. These conditions would result in a greater likelihood of a surface fire that is conducive to direct-attack fire suppression activities and lower likelihood of crown fires. • Canopy bulk densities would decrease, reducing the ease of fire spread because lower densities require more wind to spread crown fires. Canopy bulk densities greater than 0.05 kilograms per cubic meter (indicating dense vegetation vulnerable to fire) would reduce from 93% to 70% of the project area. • Crown Fire Potential: The potential for active and passive crown fires would be reduced from 8% to 6% and 59% to 42%, respectively, of the project area. ▪ While implementation of this alternative would reduce the potential for fire spread into the adjacent OU3, it would not fully eliminate the potential for fire spread into the adjacent OU3. Based on fire behavior modeling (Appendix A), there would remain potential (albeit lower) for crown fires and for fires with larger surface fire flame lengths. ▪ Limitations of Alternative 1 include the potential inability to extinguish fire starts because of conditions in areas with elevated fire potential. Thus, fire starts may grow larger, burn longer, and have greater likelihood of spread into OU3, resulting in exposure to or migration of LA-contaminated media.	▪ Based on fire behavior modeling (Appendix A), the resulting effect of implementing this alternative is that wildland fires within the Mitchell Jackson Project Area are more likely to be surface fires that are more conducive to direct fire suppression activities that would reduce the potential for fire spread into the adjacent OU3. Based on fire modeling, the following are the expected changes in fire behavior from implementing this alternative: • Surface Fire Flame Length: Expected flame lengths from a wildland fire under high to extreme conditions would be reduced to less than 4 feet on about 30% of the acres with vegetative management activities, and flame lengths kept under 8 feet on 55% of the acres with vegetative management activities. Generally, a fire with flame lengths under 4 feet can be attacked with hand resources, while flame lengths between 4 to 8 feet will need heavy equipment to suppress. Flame lengths above 8 feet are extremely difficult to control. • Canopy base heights would increase, decreasing connectivity between surface and ladder fuels and thereby reducing crown fire potential. Canopy base heights of 0-3 feet, illustrating high connectivity, would be reduced from 82% to 49% of the Mitchell Jackson Project Area. These conditions would result in a greater likelihood of a surface fire that is conducive to direct attack fire suppression activities and lower likelihood of crown fires. • Canopy bulk densities would decrease, reducing the ease of fire spread because lower densities require more wind to spread crown fires. Canopy bulk densities greater than 0.05 kilograms per cubic meter (indicating dense vegetation vulnerable to fire) would reduce from 93% to 69% of the project area. • Crown Fire Potential: The potential for active and passive crown fires would be reduced from 8% to 6% and 59% to 40%, respectively, of the project area. ▪ Reduction of crown fire potential is specifically targeted in critical western portions of the Mitchell Jackson Project Area via the construction of new National Forest System roads to facilitate vegetation management activities. Units in this area have a warm/dry biophysical setting, a buildup of fuels, and are located upwind from OU3 in the prevailing wind directions in the Kootenai National Forest, making this area the most likely location for a fire start and spread into OU3 (Appendix A).While there is additional reduction of the likelihood of intense wildland fire with the implementation of this alternative, including additional vegetation and transportation management activities in areas with high fire potential in the western portion of the Mitchell Jackson Project Area would reduce the potential for fire spread into OU3, it would not fully eliminate the potential for fire spread into the adjacent OU3. Based on fire behavior modeling (Appendix A), there would remain potential (albeit lower) for crown fires and for fires with larger surface fire flame lengths. ▪ While there are limitations of Alternative 2 that include the potential inability to extinguish fire starts because of conditions in areas with elevated fire potential, Alternative 2 proposes additional vegetation management activities in the western part of the Mitchell Jackson Project Area and along the northern OU3 boundary. The western portion of the Mitchell Jackson Project Area is particularly critical for vegetation and transportation management because of the high density of ladder fuels, the warm/dry biophysical setting, and its location upwind of OU3 in the direction of the prevailing winds.

Subcriterion for Evaluation of Effectiveness		Alternative 1 Vegetation and Transportation Management Activities using the Existing Road System	Alternative 2 Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System
Long-Term Effectiveness and Permanence (continued)	Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the site	▪ Fire behavior for both natural and anthropogenic fire starts involves randomness and inherent uncertainty. Given the proximity of the Mitchell Jackson Project Area to human populations human activity increases the likelihood of fire starts. However, the fuels reduction and species management activities proposed for Alternative 1 are climate change adaptation/climate resiliency strategies recognized in the Montana Climate Assessment (Whitlock et al. 2017) to reduce wildland fire risk and intensity. ▪ The vegetation and transportation management activities would lower the likelihood and intensity of wildland fire starting in the Mitchell Jackson Project Area and maintain or improve firefighter response in the event of a fire start. While these activities do not directly affect LA contamination in OU3, they further mitigate the likelihood of wildland fire spreading into OU3 and the resulting distribution or redistribution of LA (i.e., the generation of post-fire ash and subsequent erosion and migration) within OU3. As a result, these activities address the unacceptable human health exposure risk to LA and migration to surface water of LA-contaminated media within the forested portions of OU3. ▪ The results of fire modeling (Appendix A) for Alternative 1 indicate reduction of crown fire potential through increased canopy base height (achieved via the reduction of ladder fuels), reduction of canopy density, and reduction of overall surface fire flame length for a wildland fire start, all of which reduce crown fire potential. Proposed vegetation management activities also have ecosystem benefits in addition to reducing fire intensity, including reducing stresses from disease and invasive insects. These ecosystem benefits further provide effectiveness because the healthier ecosystem would have reduced burn potential. ▪ Because of the regenerative nature of the forest, vegetation management activities may need to be conducted repeatedly over time. Vegetation regrowth rates vary based on a variety of site and environmental factors and the specific recurrence interval on particular acreage may vary. However, vegetation management activities may need to be repeated every 15–20 years to maintain effectiveness. The need for additional vegetation management activities over time is also dependent on the long-term effectiveness of the remedial action ultimately selected by EPA for forested areas within OU3. ▪ During implementation of this alternative, roads would need to be maintained following standard USFS procedures for road maintenance according to the designated road use (e.g., storage, yearlong versus seasonal access). Upgrading the road network provides improved access for firefighter response and improved reliability for uncertainties that roads could become temporarily unusable because of fire, flood, or other reasons.	▪ Fire behavior for both natural and anthropogenic fire starts involves randomness and inherent uncertainty. Given the proximity of the Mitchell Jackson Project Area to human populations, human activity increases the likelihood of fire starts. However, the fuels reduction and species management activities proposed for Alternative 2 are climate change adaptation/climate resiliency strategies recognized in the Montana Climate Assessment (Whitlock et al. 2017) to reduce wildland fire risk and intensity. ▪ The vegetation and transportation management activities would lower the likelihood and intensity of wildland fire starting in the Mitchell Jackson Project Area and maintain or improve firefighter response in the event of a fire start. While these activities do not directly affect LA contamination in OU3, they further mitigate the likelihood of wildland fire spreading into OU3 and the resulting distribution or redistribution of LA (i.e., the generation of post-fire ash and subsequent erosion and migration) within OU3. As a result, these activities address the unacceptable human health exposure risk to LA and migration to surface water of LA-contaminated media within the forested portions of OU3. ▪ Alternative 2 proposes management activities through the Mitchell Jackson Project Area, with a particular emphasis on the western portion of the site because of its warm/dry biophysical setting, buildup of ladder fuels, and location upwind of OU3. This focus is critical for the adequacy and reliability of the mitigation of wildland fire spread into OU3 and the accompanying potential exposure and migration impacts. ▪ The results of fire modeling (Appendix A) for Alternative 2 indicate reduction of crown fire potential through increased canopy base height (achieved via the reduction of ladder fuels), reduction of canopy density, and reduction of overall surface fire flame length for a wildland fire start, all of which reduce crown fire potential. Proposed vegetation management activities also have ecosystem benefits in addition to reducing fire intensity, including reducing stresses from disease and invasive insects. These ecosystem benefits further provide effectiveness because the healthier ecosystem would have reduced burn potential. ▪ Because of the regenerative nature of the forest, vegetation management activities may need to be conducted repeatedly over time. Vegetation regrowth rates vary based on a variety of site and environmental factors and the specific recurrence interval on particular acreage may vary. However, vegetation management activities may need to be repeated every 15–20 years to maintain effectiveness. The need for additional vegetation management activities over time is also dependent on the long-term effectiveness of the remedial action ultimately selected by EPA for forested areas within OU3. ▪ During implementation of this alternative, roads would need to be maintained following standard USFS procedures for road maintenance according to the designated road use (e.g., storage, yearlong versus seasonal access). Upgrading and expanding the road network provides improved access for firefighter response and improved reliability for uncertainties that roads could become temporarily unusable because of fire, flood, or other reasons.
Reduction of Toxicity, Mobility, or Volume through Treatment	The treatment processes, the alternative uses, and materials they will treat	▪ This alternative would not treat LA-contaminated forest media. As such, there would be no reduction of toxicity, mobility, or volume of contamination through treatment.	▪ This alternative would not treat LA-contaminated forest media. As such, there would be no reduction of toxicity, mobility, or volume of contamination through treatment.
	The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated		
	The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment		
	The degree to which the treatment is irreversible		
	The type and quantity of residuals that will remain following treatment		
	Whether the alternative will satisfy the preference for treatment		

Appendix C
Detailed Analysis of Remedial Alternatives

Subcriterion for Evaluation of Effectiveness		Alternative 1 Vegetation and Transportation Management Activities using the Existing Road System	Alternative 2 Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System
Short-Term Effectiveness	Short-term risks that might be posed to the community during implementation of an alternative	▪ Smoke from prescribed burning as part of vegetation management activities could impact air quality in nearby communities, though there are generally few air quality issues because the USFS complies with all laws, regulations, and policies pertaining to smoke management. Prescribed burns are planned in coordination with air quality agencies for days with good smoke dispersal. There would be public notifications of planned burning activities. ▪ Potential impacts to the community from transporting timber removed from harvest units include increases in log truck traffic, potential safety risks from local traffic congestion, and vehicular pollution on public roads and throughout the community. These community impacts could be reduced through measures such as best practices to minimize traffic safety hazards, such as traffic control signs, implementation of work hour restrictions to minimize public safety hazards. ▪ Timber generated from the proposed harvests from the Mitchell Jackson Project Area does not contain unacceptable levels of LA, so contamination would not be disturbed or transported throughout the community. ▪ Work area restrictions are examples of measures that could be implemented to reduce safety risks to the community recreating in the Kootenai National Forest within the site when implementing this alternative. ▪ Access to certain trails, roads, or other recreational areas within the site may be reduced when implementing this alternative. ▪ There are potential community impacts because of noise, including actions near residential areas. These impacts could be mitigated through measures such as implementing appropriate work hours. ▪ For the small segment of road improvement conducted within the OU3 boundary, surface disturbance of LA-contaminated media, such as soil/duff, could pose short-term risks to the community. Dust suppression, establishment of work zones, air monitoring, and establishment of proper work procedures including LA-contaminated soil management procedures are examples of safety measures that could be implemented to protect the community.	▪ Smoke from prescribed burning as part of vegetation management activities could impact air quality in nearby communities, though there are generally few air quality issues because the USFS complies with all laws, regulations, and policies pertaining to smoke management. Prescribed burns are planned in coordination with air quality agencies for days with good smoke dispersal. There would be public notifications of planned burning activities. ▪ Potential impacts to the community from transporting timber removed from harvest units include increase in log truck traffic, potential safety risks from local traffic congestion, and vehicular pollution on public roads and throughout the community. These community impacts could be reduced through measures such as best practices to minimize traffic safety hazards, such as traffic control signs, implementation of work hour restrictions to minimize public safety hazards. ▪ Timber generated from proposed harvests from the Mitchell Jackson Project Area does not contain unacceptable levels of LA, so contamination would not be disturbed or transported throughout the community. ▪ Work area restrictions are examples of measures that could be implemented to reduce safety risks to the community recreating in the Kootenai National Forest within the site when implementing this alternative. ▪ Access to certain trails, roads, or other recreational areas within the site may be reduced when implementing this alternative. ▪ There are potential community impacts because of noise, including actions near residential areas. These impacts could be mitigated through measures such as implementing appropriate work hours. ▪ For the small segments of road improvement (realignment and new NFS road construction) conducted within the OU3 boundary, surface disturbance of LA-contaminated media, such as soil/duff, could pose short-term risks to the community. Dust suppression, establishment of work zones, air monitoring, and establishment of proper work procedures including LA-contaminated soil management procedures are examples of safety measures that could be implemented to protect the community.
	Potential impacts on workers during removal action and the effectiveness and reliability of protective measures	▪ The logging industry as a whole is an industry with elevated physical health and safety risks. Vegetation management activities proposed in this alternative present potential safety risks to workers, especially when implemented on steep and difficult terrain, and when performing hand work (chain sawing, slashing, piling). In addition, prescribed burning has potential safety risks to workers through inhalation of smoke and exposure to fires. Worker risks can be reduced through training, planning, and the use of BMPs. ▪ There are potential safety risks to workers for increased traffic associated with truck hauling of timber. These worker risks could be reduced with careful selection of the size and type of vehicles used, haul routes, and the time windows they are used within the community to minimize traffic safety hazards. ▪ Other potential impacts could be from safety hazards, such as noise, falls, and mechanical hazards, when implementing vegetation and transportation management activities. These other potential impacts could be mitigated through measures such as adherence to safety requirements and standard operating procedures. ▪ For the small segments of road improvements conducted within the OU3 boundary, surface disturbance of LA-contaminated media, such as soil/duff, could pose short-term risks to workers. Dust suppression, use of PPE, establishment of work zones, air monitoring, and establishment of proper work procedures are examples of safety measures that could be implemented to protect workers.	▪ The logging industry as a whole is an industry with elevated physical health and safety risks. Vegetation management activities proposed in this alternative present potential safety risks to workers, especially when implemented on steep and difficult terrain, and when performing hand work (chain sawing, slashing, piling). In addition, prescribed burning has potential safety risks to workers through inhalation of smoke and exposure to fires. Worker risks can be reduced through training, planning, and the use of BMPs. ▪ There are potential safety risks to workers for increased traffic associated with truck hauling of timber. These worker risks could be reduced with careful selection of the size and type of vehicles used, haul routes, and the time windows they are used within the community to minimize traffic safety hazards. ▪ Other potential impacts could be from safety hazards, such as noise, falls, and mechanical hazards, when implementing vegetation and transportation management activities. These other potential impacts could be mitigated through measures such as adherence to safety requirements and standard operating procedures. ▪ For the small segments of road improvements conducted within the OU3 boundary, surface disturbance of LA-contaminated media such as soil/duff could pose short-term risks to workers Dust suppression, use of PPE, establishment of work zones, air monitoring, and establishment of proper work procedures are examples of safety measures that could be implemented to protect workers.

Subcriterion for Evaluation of Effectiveness		Alternative 1 Vegetation and Transportation Management Activities using the Existing Road System	Alternative 2 Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System
Short-Term Effectiveness (continued)	Potential adverse environmental impacts from implementation of an alternative and the reliability of mitigation measures in preventing or reducing the potential impacts	▪ The removal of vegetation and alteration of soil properties from harvest and fuels management activities may adversely impact slope stability and water quality through erosion. Measures such as erosion control procedures and BMPs could be used to minimize impacts to streams. ▪ There could be impacts to the environment when implementing this alternative from using heavy construction and hauling equipment. Hauling and use of other heavy construction equipment impacts local air quality because of emissions from increased truck traffic. Use of fuel-efficient and low-emission equipment vehicles, when possible, could reduce environmental impacts. ▪ Vegetation management activities may impact wildlife (e.g., grizzly bear, Canadian lynx, various migratory birds) and their habitat. All vegetation management activities would be performed with respect to the standards and guidelines outlined in the Forest Plan. ▪ For the small segments of road improvements conducted within the OU3 boundary, surface disturbance of LA-contaminated forest media such as soil/duff could pose potential adverse impacts through dispersion of dust. Water- or chemical-based suppression is an example of a measure that could be used for controlling LA-contaminated media and dust during construction. ▪ Development of the on-site gravel pit for transportation management activities could adversely impact the environment. Mitigation measures could include reclaiming the gravel pit after use. ▪ Smoke from prescribed burning could impact air quality in the environment, though there are generally few air quality issues because the USFS complies with all laws, regulations, and policies pertaining to smoke management. Prescribed burns are planned in coordination with air quality agencies for days with good smoke dispersal. ▪ There are potential impacts to streams and other water bodies (e.g., impacts to aquatic wildlife, impacts to water quality) from actions close to water bodies. These impacts could be mitigated through adherence to BMPs.	▪ The removal of vegetation and alteration of soil properties from harvest and fuels management activities may adversely impact slope stability and water quality through erosion. Measures such as erosion control procedures and BMPs could be used to minimize impacts to streams and other water bodies such as wetlands. ▪ There could be impacts to the environment during the implementation of this alternative because of the use of heavy construction and hauling equipment. Hauling and use of other heavy construction equipment impacts local air quality because of emissions from increased truck traffic. Use of fuel efficient and low-emission equipment vehicles when possible could reduce environmental impacts. ▪ Vegetation management activities may impact wildlife (e.g., grizzly bear, Canadian lynx, and various migratory birds) and their habitat. All vegetation management activities would be performed with respect to the standards and guidelines outlined in the Forest Plan. ▪ For the small segments of road improvements conducted within the OU3 boundary, surface disturbance of LA-contaminated forest media such as soil/duff could pose potential adverse impacts through dispersion of dust. Water- or chemical-based suppression is an example of a measure that could be used for controlling LA-contaminated media and dust during construction. ▪ Development of the on-site gravel pit for transportation management activities could adversely impact the environment. Mitigation measures could include reclaiming the gravel pit after use. ▪ Smoke from prescribed burning could impact air quality in the environment, though there are generally few air quality issues because the USFS complies with all laws, regulations, and policies pertaining to smoke management. Prescribed burns are planned in coordination with air quality agencies for days with good smoke dispersal. ▪ There are potential impacts to streams and other water bodies (e.g., impacts to aquatic wildlife, impacts to water quality) from actions close to water bodies. These impacts could be mitigated through adherence to BMPs.
	Time until protection is achieved	▪ Some of the proposed vegetation and transportation management activities could begin within this calendar year (assumed to be 2024). ▪ Completion of vegetation and transportation management activities proposed in Alternative 1 would require approximately 15 years, though partial benefits would be achieved as individual units of vegetation management or road improvements are completed. Protection from elements of transportation management activities may be achieved sooner because of the sequencing of implementation of this alternative. ▪ The selected remedy for OU3 will be responsible for providing overall protection from risks posed by unaddressed LA in forest media within OU3. However, this alternative would contribute to protection of human health in the short term until a final remedy for OU3 is selected.	▪ Some of the proposed vegetation and transportation management activities could begin within this calendar year (assumed to be 2024). ▪ Completion of vegetation and transportation management activities proposed in Alternative 2 would require approximately 15 years, though partial benefits would be achieved as individual units of vegetation management or road improvements are completed. Protection from elements of transportation management activities may be achieved sooner because of the sequencing of implementation of this alternative. ▪ The selected remedy for OU3 will be responsible for providing overall protection from risks posed by unaddressed LA in forest media within OU3. However, this alternative would contribute to protection of human health in the short term until a final remedy for OU3 is selected.

Appendix C
Detailed Analysis of Remedial Alternatives

Table C-2. Evaluation Summary of Factors for Implementability

Subcriterion for Evaluation of Implementability		Alternative 1 Vegetation and Transportation Management Activities Using the Existing Road System	Alternative 2 Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology	▪ Vegetation and transportation management activities are generally implemented relatively easily; however, there may be additional challenges in implementing these activities in areas with steep or difficult terrain or crossing streams and other water bodies. ▪ Working with heavy equipment and many trucks and managing vegetation management activities in multiple different areas simultaneously could add logistical difficulties. ▪ Timber management activities are often performed in winter conditions to minimize impacts from erosion. Short-term delays can arise if roads are closed because of winter safety and accessibility concerns, such as heavy snow or ice.	▪ Vegetation and transportation management activities are generally implemented relatively easily; however, there may be additional challenges in implementing these activities in areas with steep or difficult terrain or crossing streams and other water bodies. ▪ Working with heavy equipment and many trucks and managing vegetation management activities in multiple different areas simultaneously could add logistical difficulties. ▪ Timber management activities are often performed in winter conditions to minimize impacts from erosion. Short-term delays can arise if roads are closed because of winter safety and accessibility concerns, such as heavy snow or ice.
	Reliability of the technology, focusing on technical problems that will lead to schedule delays	▪ If specialized equipment is required for crossing streams and other water bodies or for areas with steep or difficult terrain, it could result in slowdowns in implementation progress. ▪ Schedule delays may arise if blasting is required for the 0.5-mile realignment of Lower Rainy Road within OU3 because of the presence of LA in forest media and likely generation of LA-contaminated materials.	▪ If specialized equipment is required for crossing streams and other water bodies or for areas with steep or difficult terrain, it could result in slowdowns in implementation progress. ▪ Schedule delays may arise if blasting is required for the 0.5-mile realignment of Lower Rainy Road and ~0.25 miles of new NSF road construction within OU3 because of the presence of LA in forest media and likely generation of LA-contaminated materials.
	Potential future response actions, difficulty to implement PRSC measures or operation and maintenance (O&M) or future remedial actions	▪ The vegetation and transportation management activities included in this alternative do not preclude future response actions within the Mitchell Jackson Project Area nor do they preclude future remedial actions at OU3. ▪ Future remedial actions in OU3 will address LA in forest media posing unacceptable risks. By providing the vegetation and transportation management activities for the Mitchell Jackson Project Area under this alternative, it would reduce potential risks of fire spreading into OU3 from the Mitchell Jackson Project Area until the OU3 remedy is implemented. ▪ Visual inspections for vegetation and transportation management activities and monitoring of fuels conditions could be performed, if needed, to monitor effectiveness of the alternative.	▪ The vegetation and transportation management activities included in this alternative do not preclude future response actions within the Mitchell Jackson Project Area nor do they preclude future remedial actions at OU3. ▪ Future remedial actions in OU3 will address LA in forest media posing unacceptable risks. By providing the vegetation and transportation management activities for the Mitchell Jackson Project Area under this alternative, it would reduce potential risks of fire spreading into OU3 from the Mitchell Jackson Project Area until the OU3 remedy is implemented. ▪ Visual inspections for vegetation and transportation management activities and monitoring of fuels conditions could be performed, if needed, to monitor effectiveness of the alternative.
	Ability to monitor the effectiveness of the alternative		
Administrative Feasibility	Evaluate alternative for compliance with the statutory limits which requires the alternative to remain under $2 million or completed within a 12-month limit	▪ This removal action is not a fund-financed removal action; therefore, the statutory limit of $2 million and 12-month duration does not apply.	▪ This removal action is not a fund-financed removal action; therefore, the statutory limit of $2 million and 12-month duration does not apply.
	Evaluate whether alternative will require off-site permits or other factors including easements, right-of-way agreements, or zoning variances	▪ Off-site removal of LA-contaminated forest media may be required for the small segments of road improvements conducted within the OU3 boundary. These activities may require additional coordination with EPA, Lincoln County, or other entities. No other off-site removal activities would be conducted under this alternative. ▪ Periodic road closures to reduce human-caused fire starts would be feasible to implement on USFS property. Road closures during periods of elevated fire danger are routinely implemented by the USFS to reduce human-caused fires. ▪ Agreements with Stimson Lumber Company and other private landowners for the use of private roads as haul routes are already in place. ▪ Activities under this alternative would require coordination between multiple government agencies including the EPA and DEQ, especially within OU3 if off-site disposal of remediation wastes such as PPE are required.	▪ Off-site removal of LA-contaminated forest media may be required for the small segments of road improvements conducted within the OU3 boundary. These activities may require additional coordination with EPA, Lincoln County, or other entities. No other off-site removal activities would be conducted under this alternative. ▪ Periodic road closures to reduce human-caused fire starts would be feasible to implement on USFS property. Road closures during periods of elevated fire danger are routinely implemented by the USFS to reduce human-caused fires. ▪ Agreements with Stimson Lumber Company and other private landowners for the use of private roads as haul routes are already in place. ▪ Activities under this alternative would require coordination between multiple government agencies including the EPA and DEQ, especially within OU3 if off-site disposal of wastes such as PPE are required.
Availability of services and materials	Availability of adequate off-site treatment, storage capacity, and disposal capacity and services	▪ Alternative 1 requires off-site disposition of timber. It is anticipated that local timber mills have the capacity to accept the volume of timber generated from implementation of this alternative. ▪ Wastes associated with the proposed realignment of Lower Rainy Road within OU3 (Figure 4-2) may require off-site disposal of remediation wastes such as PPE.	▪ Alternative 2 requires off-site disposition of timber. It is anticipated that local timber mills have the capacity to accept the volume of timber generated from implementation of this alternative. ▪ Wastes associated with the proposed realignment of Lower Rainy Road and new NFS road construction within OU3 (Figure 4-5) may require off-site disposal of remediation wastes such as PPE.
	Availability of personnel and technology to maintain the removal schedule	▪ The technology, equipment, subcontractors, personnel, and facilities required to successfully complete this alternative are available in the marketplace but could be affected by competing activities during the construction season such as fire response. All proposed activities are standard practice and USFS has equipment and personnel to support implementation. ▪ Suitable road materials (i.e., gravel) for implementation of the transportation management activities are available from the on-site gravel pit. Other materials (i.e., culverts, gates, etc.) are readily available from off-site vendors.	▪ The technology, equipment, subcontractors, personnel, and facilities required to successfully complete this alternative are available in the marketplace but could be affected by competing activities during the construction season such as fire response. All proposed activities are standard practice and USFS has equipment and personnel to support implementation. ▪ Suitable road materials (i.e., gravel) for implementation of the transportation management activities are available from the on-site gravel pit. Other materials (i.e., culverts, gates, etc.) are readily available from off-site vendors.
	Availability of services and materials (i.e., laboratory testing capacity, turnaround for chemical analyses, adequate supplies and equipment for on-site activities, or installation of extra utilities)		
	Availability of prospective technologies		

Appendix C
Detailed Analysis of Remedial Alternatives

Subcriterion for Evaluation of Implementability		Alternative 1 Vegetation and Transportation Management Activities Using the Existing Road System	Alternative 2 Enhanced Vegetation and Transportation Management Activities with Expansion of the Existing Road System
Support Agency Acceptance	State concerns will be considered in determining the recommended alternative in the EE/CA and in the final selection of the alternative in the Action Memorandum	▪ This criterion is not directly evaluated in this EE/CA (Section 4.6).	▪ This criterion is not directly evaluated in this EE/CA (Section 4.6).
Community Acceptance	Acceptance from the community will be considered in determining a recommendation for the EE/CA and in the final selection of the alternative in the Action Memorandum	▪ This criterion is not directly evaluated in this EE/CA. For detailed explanation please refer to Section 4.7.	▪ This criterion is not directly evaluated in this EE/CA. For detailed explanation please refer to Section 4.7.

Appendix D

Costs

This page intentionally left blank.

The cost spreadsheets included in this appendix were developed in accordance with EPA 540-R-00-002 (OSWER 9355.0-75) July 2000.

These costs should be used to compare alternative relative costs. Costs for project management, removal design, and construction management were determined as percentages of capital cost per the guidance. Costs for these work items may not reflect costs for implementation. These costs are determined based on specific client requirements during implementation.

Alternative Cost Summary

TABLE CS-ALT

ALTERNATIVE COST SUMMARY

Site: Mitchell Jackson Project Area
Location: Lincoln County, Montana
Phase: Engineering Evaluation/Cost Analysis (-30%/+50%)
Base Year: 2024

Alternative	Total Capital Cost[1]	Total PRSC Cost[2]	Total Cost[2]	Total Present Value Cost[3]
1	$45,760,000	$0	$45,760,000	$34,721,000
2	$57,752,000	$0	$57,752,000	$43,819,000

Notes:

1 - Capital costs and PRSC costs are presented on tables CS-1 through CS-2. See tables TAC-1 through TAC-2 for distribution of these costs.

2 - Total cost in 2024 dollars.

3 - Total Present Value Cost is the total cost including present value. Present value cost does not include escalation. See Table ADRFT for discount rate and discount factor details.

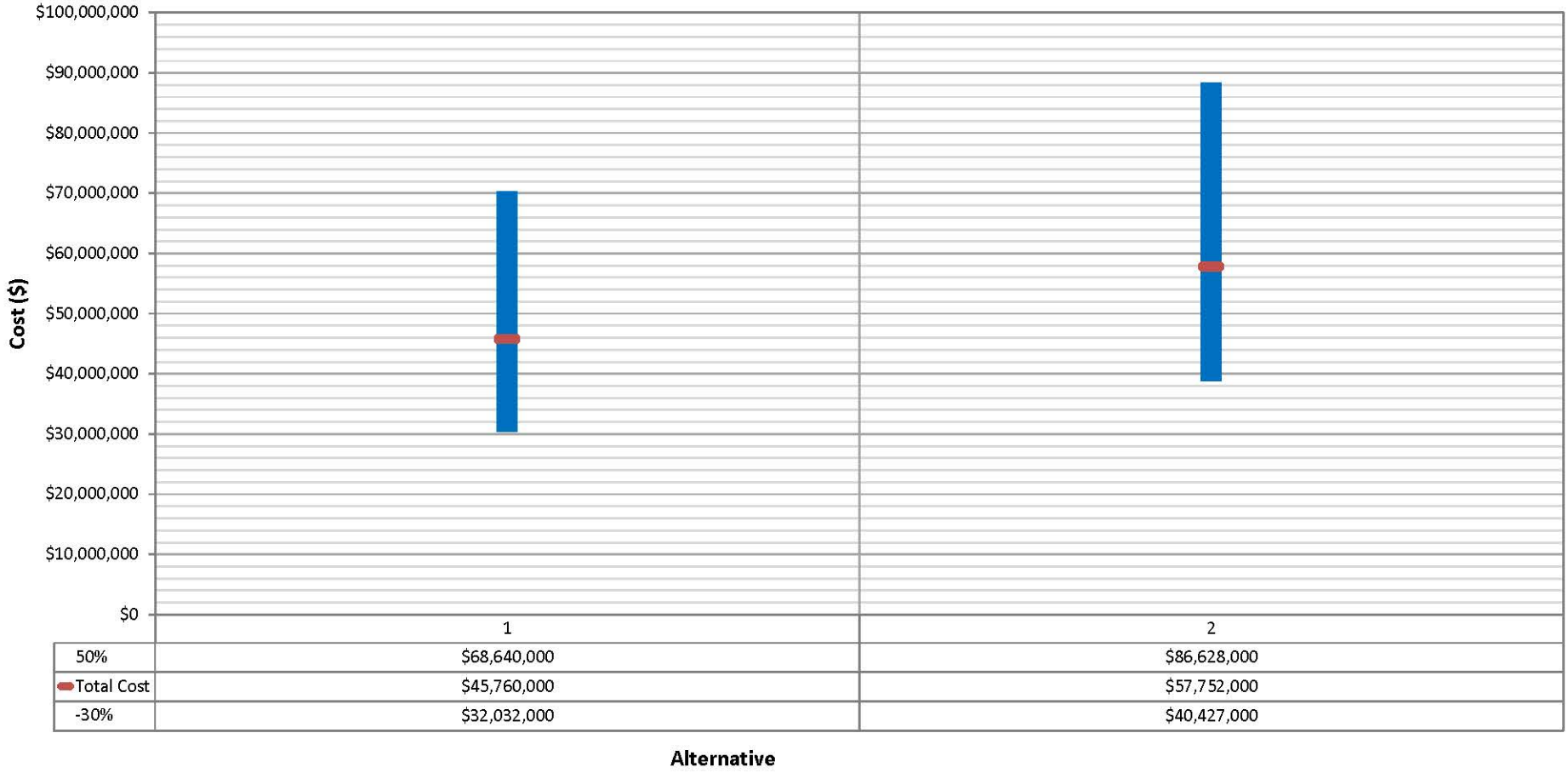
Costs presented for these alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between these alternatives for feasibility study level evaluation purposes.

Alternative 1 - Vegetation and Transportation Management Activities Using the Existing Road System

Alternative 2 - Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System

Cost Estimate Accuracy Ranges

Exhibit 1
Total Cost Estimate Accuracy Ranges

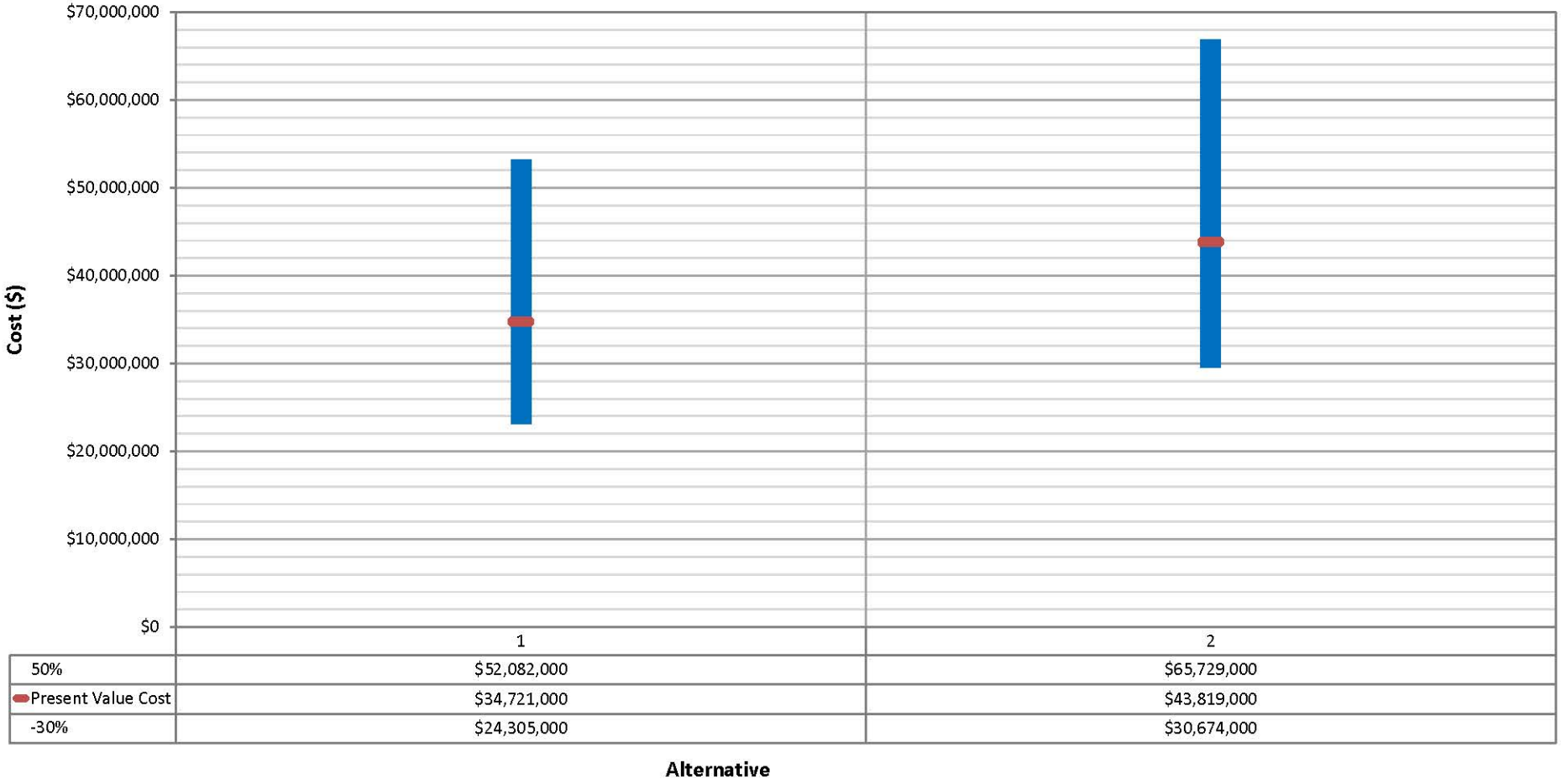


Note:

Alternative 1 - Vegetation and Transportation Management Activities Using the Existing Road System

Alternative 2 - Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System

Exhibit 2
Total Present Value Cost Estimate Accuracy Ranges



	1	2
50%	$52,082,000	$65,729,000
Present Value Cost	$34,721,000	$43,819,000
-30%	$24,305,000	$30,674,000

Note:

Alternative 1 - Vegetation and Transportation Management Activities Using the Existing Road System

Alternative 2 - Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System

Alternative 1

Vegetation and Transportation Management

Activities Using the Existing Road System

TABLE CS-1

Alternative 1
Vegetation and Transportation Management Activities Using the Existing Road System

DETAILED COST ESTIMATE SUMMARY

Site: Mitchell Jackson Project Area
Location: Lincoln County, Montana
Phase: Engineering Evaluation/Cost Analysis (-30%/+50%)
Base Year: 2024
Date: May 2024

Description: Alternative 1 would address the RAOs through a combination of vegetation and transportation management activities within the Site. Harvest vegetation management activities include various approaches to the felling and removal of trees from the forest. Harvest vegetation management activities would be carried out via both ground-based and cable yarding methods. Merchantable timber would be transported to mills via haul routes; however, this cost estimate does not take into account the merchantable value of the timber. Non-harvest vegetation management activities include methods for units where no harvest occurs and includes slashing, pre-commercial thinning, under burning, mastication, and weed treatments. Transportation management activities includes existing road system improvements, realignment, and temporary road construction. The total capital cost presented is distributed over a 15-year period. The alternative assumes that a greater portion of the costs would be incurred in the first five years, with lesser costs incurred in later years.

CAPITAL COSTS (Assumed for Entire 15-Year Period of Analysis)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
PROPOSED VEGETATION MANAGEMENT ACTIVITIES					
Harvest Related Fuels and Site Prep Treatments					
Excavator Pile, Burn Piles	3,783	AC	$527.00	$1,993,641	Assumes excavator piling Type 1 and burning excavator piles Type 2
Excavator Pile, Masticate	87	AC	$1,993.00	$173,391	Assumes excavator piling Type 1 and mastication
Masticate	92	AC	$1,574.00	$144,808	Assumes mastication only
Under burn	1,401	AC	$403.00	$564,603	Assumes under burn for areas greater than 40 AC, in WUI/adjacent to WUI
Harvest Method		AC			
Ground-based	4,083	AC	$1,904.00	$7,774,032	Assumes average skidding distance of 1,200 feet
Haul Cost for Ground Based	4,083	AC	$870.00	$3,552,210	Assumes hauling offsite
Cable Yarding	1,324	AC	$2,835.00	$3,753,540	Assumes average yarding distance of 1,600 feet
Haul Cost for Cable Yarding	1,324	AC	$870.00	$1,151,880	Assumes hauling offsite
Landing Pile Burning	1,324	AC	$15.00	$19,860	Assumes 1 landing pile per 10 acres of harvest
Other Vegetation Treatments		AC			
Precommercial Thin Hand	1,343	AC	$289.00	$388,127	Assumes hand felling cost only
Precommercial Thin Mechanical	175	AC	$1,574.00	$275,450	Assumes mechanical harvest (feller buncher) cost only
Slash Hand	1,768	AC	$501.00	$885,768	Assumes Type 2
Slash Mechanical	255	AC	$525.00	$133,875	Assumes Type 2
Under burn	9	AC	$1,569.00	$14,121	Assumes burning area less than 40 AC within WUI/adjacent to WUI
Fireline Hand	11	MI	$9,300.00	$102,300	Based on USFS-derived unit costs
Fireline Mechanical	9	MI	$2,900.00	$26,100	Based on USFS-derived unit costs
Reforestation	3,159	AC	$335.00	$1,058,265	Based on USFS-derived unit costs
Other Vegetation Natural Fuels Treatments					
Hand pile, Burn Piles	652	AC	$1,503.00	$979,956	Assumes Type 1 piling and Type 2 burning
Masticate	430	AC	$1,574.00	$676,820	Assume only masticating costs
Under burn	1,298	AC	$403.00	$523,094	Assume under burning greater than 40 AC, in WUI/adjacent to WUI
Noxious Weed Treatments					
Backpack (Off-road)	228	AC	$286.00	$65,208	Assume 2 labors at GS rate and 0.5 acre per hour production rate.
Truck (Using Roads)	605	AC	$72.00	$43,560	Assume 2 labors at GS rate and 2 acre per hour production rate.
UTV (Along Powerline)	42	AC	$72.00	$3,024	Assume 2 labors at GS rate and 2 acre per hour production rate.
Cheatgrass Population Mapping (Drones)					
Northern OU3 Boundary	113	AC	$20.00	$2,260	Assumes flying in good conditions, project scientist performs data analyses
IRA Areas with >60% Cover	2,672	AC	$20.00	$53,440	Assumes flying in good conditions, project scientist performs data analyses
PROPOSED TRANSPORTATION MANAGEMENT ACTIVITIES					
Transportation Management					
Tubb Gulch/Lower Rainy Creek Realignment	0.5	MI	$748,092.00	$374,046	USFS-derived unit cost from latest for NS-74 work.
Dust Suppression in OU3	5.8	MI	$51,254.00	$297,273	Assumes a production rate of 1 mile of construction/reconstruction per month with two trucks
Temporary Road Construction	3.6	MI	$29,401.00	$105,844	Slope maps were used to determine appropriate sides slopes and timber cruise information was
Haul Routes, National Forest System Roads	92.0	MI	$47,150.00	$4,337,800	Unit cost is derived for road chosen as most representative (ML1, LOS J roads).
Haul Routes, Other System Roads	6.4	MI	$85,791.00	$549,062	Assumes nearly all of these roads are on ML 1/LOS J roads in high country on Stimson Lumber
Undetermined Roads Added to the System	2.1	MI	$196,200.00	$412,020	No dust abatement or watering during construction is included in this cost.
Intermittent Stored Service (Road Storage)	4.8	MI	$4,485.00	$21,528	Adjusted price for intermittent storage
Road Decommissioning	3.4	MI	$8,969.00	$30,495	Adjusted price for full recontour
Convert Road to Non-motorized Trail	0.9	MI	$3,360.00	$3,024	Assumes gate and drain dips/out slope, scarify 2-3" seed & fertilizer
Travel Access Management Changes	6.0	EA	$4,511.00	$27,066	Assumes a new gate
Culvert Installation	7.0	EA	$3,394.00	$23,758	Based on averaging two 24" culvert installations.
SWPPP Site Wide	1.0	LS	$20,001.00	$20,001	Technical assumption based off previous SWPPP experience in Montana. Assumes annual reporting, routine inspection, periodic maintenance.
Gravel Pit Expansion					
Existing Pit – Reclaim in Current Condition	2.0	AC	$6,205.00	$12,410	Assume 1 acre/day production rate using, 1 bull dozer, 1 excavator and 1 artic haul truck.
Existing Stockpile – Continue Existing Use	0.5	DAY	$1,874.00	$937	Assumes stockpiles only need to be loaded out. Rate could be less if truck drivers were loading
Expansion Area	5.0	AC	$6,864.00	$34,320	Assumes clearing/grubbing of surface only and that gravel material is immediately below topsoil.
SUBTOTAL				$30,608,917	

TABLE CS-1

Alternative 1

Vegetation and Transportation Management Activities Using the Existing Road System

DETAILED COST ESTIMATE SUMMARY

Site: Mitchell Jackson Project Area
Location: Lincoln County, Montana
Phase: Engineering Evaluation/Cost Analysis (-30%/+50%)
Base Year: 2024
Date: May 2024

Description: Alternative 1 would address the RAOs through a combination of vegetation and transportation management activities within the Site. Harvest vegetation management activities include various approaches to the felling and removal of trees from the forest. Harvest vegetation management activities would be carried out via both ground-based and cable yarding methods. Merchantable timber would be transported to mills via haul routes; however, this cost estimate does not take into account the merchantable value of the timber. Non-harvest vegetation management activities include methods for units where no harvest occurs and includes slashing, pre-commercial thinning, under burning, mastication, and weed treatments. Transportation management activities includes existing road system improvements, realignment, and temporary road construction. The total capital cost presented is distributed over a 15-year period. The alternative assumes that a greater portion of the costs would be incurred in the first five years, with lesser costs incurred in later years.

Contingency (Scope and Bid)	30%	$9,182,675	20% Scope, 10% Bid
SUBTOTAL		$39,791,592	
Project Management	5%	$1,989,580	Low value of the recommended range in EPA 540-R-00-002 was used.
Removal Design	5%	$1,989,580	Low value of the recommended range in EPA 540-R-00-002 was used.
Technical Support	5%	$1,989,580	Low value of the recommended range in EPA 540-R-00-002 was used.
TOTAL		$45,760,332	
TOTAL CAPITAL COST		**$45,760,000**	Total cost is rounded to the nearest $1,000.

Notes:

Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for evaluation

Abbreviations:

AC: Acre
DY: Day
EA: Each
MI: Mile
SWPPP: Stormwater Pollution Prevention Plan
WUI: Wildland Urban Interface Unit
USFS: United State Forest Service
GS: General Schedule
EPA: Environmental Protection Agency

TABLE TAC-1

COST ESTIMATE SUMMARY

Alternative 1
Vegetation and Transportation Management Activities Using the Existing Road System

Site: Mitchell Jackson Project Area
Location: Lincoln County, Montana
Phase: Engineering Evaluation/Cost Analysis (-30%/+50%)
Base Year: 2024

Discount Rate:	7.00%

Year[1]	Calendar Year	Assumed % of Total Capital Costs Incurred in Given Year	Capital Costs[2]	PRSC	Total Annual Expenditure[3]	Discount Factor	Present Value Cost[4]
0	2024	12%	$5,491,200	$0	$5,491,200	1.0000	$5,491,200
1	2025	12%	$5,491,200	$0	$5,491,200	0.9346	$5,132,076
2	2026	12%	$5,491,200	$0	$5,491,200	0.8734	$4,796,014
3	2027	12%	$5,491,200	$0	$5,491,200	0.8163	$4,482,467
4	2028	12%	$5,491,200	$0	$5,491,200	0.7629	$4,189,236
5	2029	6%	$2,745,600	$0	$2,745,600	0.7130	$1,957,613
6	2030	6%	$2,745,600	$0	$2,745,600	0.6663	$1,829,393
7	2031	6%	$2,745,600	$0	$2,745,600	0.6227	$1,709,685
8	2032	6%	$2,745,600	$0	$2,745,600	0.5820	$1,597,939
9	2033	6%	$2,745,600	$0	$2,745,600	0.5439	$1,493,332
10	2034	2%	$915,200	$0	$915,200	0.5083	$465,196
11	2035	2%	$915,200	$0	$915,200	0.4751	$434,812
12	2036	2%	$915,200	$0	$915,200	0.4440	$406,349
13	2037	2%	$915,200	$0	$915,200	0.4150	$379,808
14	2038	2%	$915,200	$0	$915,200	0.3878	$354,915
		TOTALS:	**$45,760,000**	**$0**	**$45,760,000**		**$34,720,035**
					TOTAL ALTERNATIVE COST FOR ALTERNATIVE 1[5]:		**$34,721,000**

Notes:

1 - The period of analysis for alternative was assumed to be 15 years.

2 - Costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-1

3 - Total annual expenditure is the total cost per year with no escalation or discounting.

4 - Present Value Cost is the total cost per year including a discount rate for that year. See Table ADRFT for details.

5 - Total Alternative Cost is rounded to the nearest $1,000.

Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives.

Alternative 2

Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System

TABLE CS-2

Alternative 2

Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System

DETAILED COST ESTIMATE SUMMARY

Site: Mitchell Jackson Project Area
Location: Lincoln County, Montana
Phase: Engineering Evaluation/Cost Analysis (-30%/+50%)
Base Year: 2024
Date: May 2024

Description: Alternative 2 would address the RAOs through a combination of vegetation and transportation management activities within the Site. Harvest vegetation management activities include various approaches to the felling and removal of trees from the forest. Harvest vegetation management activities would be carried out via both ground-based and cable yarding methods. Merchantable timber would be transported to mills via haul routes; however, this cost estimate does not take into account the merchantable value of the timber. Non-harvest vegetation management activities include methods for units where no harvest occurs and includes slashing, pre-commercial thinning, under burning, mastication, and weed treatments. Transportation management activities includes existing road system improvements, realignment, and temporary road construction. Alternative 2 also includes construction of new roads for permanent inclusion in the NFS system. The total capital cost presented is distributed over a 15-year period. The alternative assumes that a greater portion of the costs would be incurred in the first five years, with lesser costs incurred in later years.

CAPITAL COSTS (Assumed for Entire 15-Year Period of Analysis)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
PROPOSED VEGETATION MANAGEMENT ACTIVITIES					
Harvest Related Fuels and Site Prep Treatments					
Excavator Pile, Burn Piles	4,335	AC	$527.00	$2,284,545	Assumes excavator piling Type 1 and burning excavator piles Type 2
Excavator Pile, Masticate	87	AC	$1,993.00	$173,391	Assumes excavator piling Type 1 and mastication
Masticate	92	AC	$1,574.00	$144,808	Assumes mastication only
Under burn	1,744	AC	$403.00	$702,832	Assumes under burn for areas >40 AC, Wildland Urban Interface (WUI)/adjacent to WUI
Harvest Method					
Ground-based	4,428	AC	$1,904.00	$8,430,912	Assumes average skidding distance of 1,200 feet
Haul Cost for Ground Based	4,428	AC	$870.00	$3,852,360	Assumes hauling offsite
Cable Yarding	1,874	AC	$2,835.00	$5,312,790	Assumes average yarding distance of 1,600 feet
Haul Cost for Cable Yarding	1,874	AC	$870.00	$1,630,380	Assumes hauling offsite
Landing Pile Burning	1,874	AC	$15.00	$28,110	Assumes 1 landing pile per 10 acres of harvest
Other Vegetation Treatments					
Precommercial Thin Hand	1,343	AC	$289.00	$388,127	Assumes hand felling cost only
Precommercial Thin Mechanical	175	AC	$1,574.00	$275,450	Assumes mechanical harvest (feller buncher) cost only
Slash Hand	1,981	AC	$501.00	$992,481	Assumes Type 2
Slash Mechanical	278	AC	$525.00	$145,950	Assumes Type 2
Under burn	9	AC	$1,569.00	$14,121	Assumes burning area less than 40 AC within WUI/adjacent to WUI
Fireline Hand	11	MI	$9,300.00	$102,300	Based on USFS-derived unit costs
Fireline Mechanical	9	MI	$2,900.00	$26,100	Based on USFS-derived unit costs
Reforestation	3,376	AC	$335.00	$1,130,960	Based on USFS-derived unit costs
Other Vegetation Natural Fuels Treatments					
Hand pile, Burn Piles	879	AC	$1,503.00	$1,321,137	Assumes Type 1 piling and Type 2 burning
Mechanical Pile, Burn Piles	23	AC	$527.00	$12,121	Assumes Excavator Piling Type 1 and Excavator Pile Burning Type 1
Masticate	430	AC	$1,574.00	$676,820	Assume only masticating costs
Under burn	1,309	AC	$403.00	$527,527	Assume under burning greater than 40 AC, in WUI/adjacent to WUI
Noxious Weed Treatments					
Backpack (Off-road)	210	AC	$286.00	$60,060	Assume 2 labors at GS rate and 0.5 acre per hour production rate.
Truck (Using Roads)	692	AC	$72.00	$49,824	Assume 2 labors at GS rate and 2 acre per hour production rate.
UTV (Along Powerline)	42	AC	$72.00	$3,024	Assume 2 labors at GS rate and 2 acre per hour production rate.
Cheatgrass Population Mapping (Drones)					
Northern OU3 Boundary	113	AC	$20.00	$2,260	Assumes flying in good conditions, project scientist performs data analyses
IRA Areas with >60% Cover	2,672	AC	$20.00	$53,440	Assumes flying in good conditions, project scientist performs data analyses
PROPOSED TRANSPORTATION MANAGEMENT ACTIVITIES					
Transportation Management					
New System Road Construction	8.3	MI	$353,774.00	$2,936,324	Unit cost is derived from weighted average by mile of new roads (NS-9, NS-11, NS-13, NS-44, NS 45, and NS-72)
Tubb Gulch/Lower Rainy Creek Realignment	0.5	MI	$748,092.00	$374,046	USFS-derived unit cost from latest for NS-74 work.
Dust Suppression in OU3	5.8	MI	$51,254.00	$297,273	Assumes a production rate of 1 mile of construction/reconstruction per month with two trucks onsite.
Temporary Road Construction	4.3	MI	$29,401.00	$126,424	Slope maps were used to determine appropriate sides slopes and timber cruise information was used
Haul Routes, National Forest System Roads	108.9	MI	$47,150.00	$5,134,635	Unit cost is derived for road chosen as most representative (ML1, LOS J roads).
Haul Routes, Other System Roads	8.7	MI	$85,791.00	$746,382	Assumes nearly all of these roads are on ML 1/LOS J roads in high country on Stimson Lumber Co.
Undetermined Roads Added to the System	2.1	MI	$196,408.00	$412,457	No dust abatement or watering during construction is included in this cost.
Barriered Roads Used for Administrative Access	4.1	EA	$8,990.00	$36,859	Adjusted price for admin use storage with a new gate assuming approximately one gate per mile.
Intermittent Stored Service (Road Storage)	12.2	EA	$4,485.00	$54,717	Adjusted price for intermittent storage
Road Decommissioning	3.8	MI	$8,969.00	$34,082	Adjusted price for full recontour
Convert Road to Non-motorized Trail	0.9	MI	$3,364.00	$3,028	Assumes gate and drain dips/out slope, scarify 2-3" seed & fertilizer
Travel Access Management Changes	6.0	MI	$4,511.00	$27,066	Assumes a new gate
Culvert Installation	11.0	EA	$3,394.00	$37,334	Based on averaging two 24" culvert installations.
SWPPP Site Wide	1.0	LS	$20,001.00	$20,001	Technical assumption based off previous SWPPP experience in Montana. Assumes annual reporting, routine inspection, periodic maintenance.
Gravel Pit Expansion					
Existing Pit – Reclaim in Current Condition	2.0	AC	$6,205.00	$12,410	Assume 1 acre/day production rate using, 1 bull dozer, 1 excavator and 1 artic haul truck.
Existing Stockpile – Continue Existing Use	0.5	DAY	$1,874.00	$937	Assumes stockpiles only need to be loaded out. Rate could be less if truck drivers were loading
Expansion Area	5.0	AC	$6,864.00	$34,320	Assumes clearing/grubbing of surface only and that gravel material is immediately below topsoil.
SUBTOTAL				$38,630,125	

TABLE CS-2

Alternative 2

Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System

DETAILED COST ESTIMATE SUMMARY

Site: Mitchell Jackson Project Area
Location: Lincoln County, Montana
Phase: Engineering Evaluation/Cost Analysis (-30%/+50%)
Base Year: 2024
Date: May 2024

Description: Alternative 2 would address the RAOs through a combination of vegetation and transportation management activities within the Site. Harvest vegetation management activities include various approaches to the felling and removal of trees from the forest. Harvest vegetation management activities would be carried out via both ground-based and cable yarding methods. Merchantable timber would be transported to mills via haul routes; however, this cost estimate does not take into account the merchantable value of the timber. Non-harvest vegetation management activities include methods for units where no harvest occurs and includes slashing, pre-commercial thinning, under burning, mastication, and weed treatments. Transportation management activities includes existing road system improvements, realignment, and temporary road construction. Alternative 2 also includes construction of new roads for permanent inclusion in the NFS system. The total capital cost presented is distributed over a 15-year period. The alternative assumes that a greater portion of the costs would be incurred in the first five years, with lesser costs incurred in later years.

Contingency (Scope and Bid)	30%	$11,589,038	20% Scope, 10% Bid
SUBTOTAL		$50,219,163	
Project Management	5%	$2,510,958	Low value of the recommended range in EPA 540-R-00-002 was used.
Removal Design	5%	$2,510,958	Low value of the recommended range in EPA 540-R-00-002 was used.
Technical Support	5%	$2,510,958	Low value of the recommended range in EPA 540-R-00-002 was used.
TOTAL		$57,752,037	
TOTAL CAPITAL COST		**$57,752,000**	Total cost is rounded to the nearest $1,000.

Notes:

Percentages used for indirect costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives for evaluation purposes.

Abbreviations:

AC: Acre
DY: Day
EA: Each
MI: Mile
SWPPP: Stormwater Pollution Prevention Plan
WUI: Wildland Urban Interface Unit
USFS: United State Forest Service
GS: General Schedule
EPA: Environmental Protection Agency

TABLE TAC-2

COST ESTIMATE SUMMARY

Alternative 2
Enhanced Vegetation and Transportation Management with Expansion of the Existing Road System

Site: Mitchell Jackson Project Area
Location: Lincoln County, Montana
Phase: Engineering Evaluation/Cost Analysis (-30%/+50%)
Base Year: 2024

Discount Rate: 7.00%

Year[1]	Calendar Year	Assumed % of Total Capital Costs Incurred in Given Year	Capital Costs[2]	PRSC	Total Annual Expenditure[3]	Discount Factor	Present Value Cost[4]
0	2024	12%	$6,930,240	$0	$6,930,240	1.0000	$6,930,240
1	2025	12%	$6,930,240	$0	$6,930,240	0.9346	$6,477,002
2	2026	12%	$6,930,240	$0	$6,930,240	0.8734	$6,052,872
3	2027	12%	$6,930,240	$0	$6,930,240	0.8163	$5,657,155
4	2028	12%	$6,930,240	$0	$6,930,240	0.7629	$5,287,080
5	2029	6%	$3,465,120	$0	$3,465,120	0.7130	$2,470,631
6	2030	6%	$3,465,120	$0	$3,465,120	0.6663	$2,308,809
7	2031	6%	$3,465,120	$0	$3,465,120	0.6227	$2,157,730
8	2032	6%	$3,465,120	$0	$3,465,120	0.5820	$2,016,700
9	2033	6%	$3,465,120	$0	$3,465,120	0.5439	$1,884,679
10	2034	2%	$1,155,040	$0	$1,155,040	0.5083	$587,107
11	2035	2%	$1,155,040	$0	$1,155,040	0.4751	$548,760
12	2036	2%	$1,155,040	$0	$1,155,040	0.4440	$512,838
13	2037	2%	$1,155,040	$0	$1,155,040	0.4150	$479,342
14	2038	2%	$1,155,040	$0	$1,155,040	0.3878	$447,925
		TOTALS:	**$57,752,000**	**$0**	**$57,752,000**		**$43,818,870**
						TOTAL ALTERNATIVE COST FOR ALTERNATIVE 2[5]:	**$43,819,000**

Notes:

1 - The period of analysis for alternative was assumed to be 15 years.

2 - Costs, for purposes of this analysis, are assumed to be distributed as indicated on Table CS-2

3 - Total annual expenditure is the total cost per year with no escalation or discounting.

4 - Present Value Cost is the total cost per year including a discount rate for that year. See Table ADRFT for details.

5 - Total Alternative Cost is rounded to the nearest $1,000.

Costs presented for this alternative are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented. They are prepared solely to facilitate relative comparisons between alternatives.

Annual Discount Rate Factors Tables

TABLE ADRFT

ANNUAL REAL DISCOUNT RATE FACTORS TABLE

Site: Mitchell Jackson Project Area
Location: Lincoln County, Montana
Phase: Engineering Evaluation/Cost Analysis (-30%/+50%)
Base Year: 2024

Real Discount Rate (Percent)[1]:	7.00%		
Year	**Discount Factor**	**Year**	**Discount Factor**
0	1.0000	31	0.1228
1	0.9346	32	0.1147
2	0.8734	33	0.1072
3	0.8163	34	0.1002
4	0.7629	35	0.0937
5	0.7130	36	0.0875
6	0.6663	37	0.0818
7	0.6227	38	0.0765
8	0.5820	39	0.0715
9	0.5439	40	0.0668
10	0.5083	41	0.0624
11	0.4751	42	0.0583
12	0.4440	43	0.0545
13	0.4150	44	0.0509
14	0.3878	45	0.0476
15	0.3624	46	0.0445
16	0.3387	47	0.0416
17	0.3166	48	0.0389
18	0.2959	49	0.0363
19	0.2765	50	0.0339
20	0.2584	51	0.0317
21	0.2415	52	0.0297
22	0.2257	53	0.0277
23	0.2109	54	0.0259
24	0.1971	55	0.0242
25	0.1842	56	0.0226
26	0.1722	57	0.0211
27	0.1609	58	0.0198
28	0.1504	59	0.0185
29	0.1406	60	0.0173
30	0.1314		

Notes:

[1] As outlined in EPA's *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study*, and real discount rates from Appendix C of OMB Circular A-94 should generally be used for all federal facility and non-fund-lead sites.

Unit Cost Development Table

NORTHWINDCDM ADVANTAGE

PROJECT:	Mitchell Jackson Project Area	COMPUTED BY:	Steve Clinch	CHECKED BY:	Justin Nielsen
JOB NO.:	287788	DATE:	5/8/2024	DATE CHECKED:	5/16/2024
CLIENT:	USACE Omaha	UPDATED BY:		PAGE NO.:	Esc Unit Cost
		DATE:			

Description: Unit cost development. Cost were pulled from QTOS sheet

Escalation

Estimate preparation date:	May 2024
Cost estimate prep cost index*:	13532.44
Area Cost Factor (Libby, Montana):**	1.08

Unit Cost Development Table

	UOM	Source QTY	Source COST	Unit Cost	Mo/Year	Esc. Index*	Area Cost Factor**	Esc. Unit Cost	PC OH	PC PF	Burdened Unit Cost	Source	Notes
Harvest Related Fuels and Site Prep Treatments													
Excavator Pile, Burn Piles	AC	1	$502.00	$502.00	April 2022	12898.96	1.08	$527.00	0%	0%	$527.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assumes excavator piling Type 1 and Burning Exacavtor piles Type 2
Excavator Pile, Masticate	AC	1	$1,900.00	$1,900.00	April 2022	12898.96	1.08	$1,993.00	0%	0%	$1,993.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assumes excavator piling Type 1 and Mastication
Masticate	AC	1	$1,500.00	$1,500.00	April 2022	12898.96	1.08	$1,574.00	0%	0%	$1,574.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assumes mastication only
Underburn	AC	1	$384.00	$384.00	April 2022	12898.96	1.08	$403.00	0%	0%	$403.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assumes underburn for areas greater than 40 AC, in WUI/adjacent to WUI
Harvest Method													
Ground Based	AC	1	$1,902.20	$1,902.20	February 2024	13518.12	1.08	$1,904	0%	0%	$1,904.00	USFS derived cost based on recent experience.	
Haul Cost for Ground Based	AC	1	$869.54	$869.54	February 2024	13518.12	1.08	$870	0%	0%	$870.00	USFS derived cost based on recent experience.	
Cable Yarding	AC	1	$2,831.79	$2,831.79	February 2024	13518.12	1.08	$2,835	0%	0%	$2,835.00	USFS derived cost based on recent experience.	
Haul Cost for Cable Yarding	AC	1	$869.54	$869.54	February 2024	13518.12	1.08	$870	0%	0%	$870.00	USFS derived cost based on recent experience.	
Landing Pile Burning	AC	1	$14.10	$14.10	April 2022	12898.96	1.08	$15	0%	0%	$15.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assumes 1 landing pile per 10 acres of harvest
Other Vegetation Treatments													
Precommercial Thin Hand	AC	1	$275.00	$275.00	April 2022	12898.96	1.08	$289.00	0%	0%	$289.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	
Precommercial Thin Mechanical	AC	1	$1,500.00	$1,500.00	April 2022	12898.96	1.08	$1,574.00	0%	0%	$1,574.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	
Slash Hand	AC	1	$500.00	$500.00	February 2024	13518.12	1.08	$501.00	0%	0%	$501.00	USFS derived cost based on recent experience.	
Slash Mechanical	AC	1	$500.00	$500.00	April 2022	12898.96	1.08	$525.00	0%	0%	$525.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assumes Type 2
Underburn	AC	1	$1,496.00	$1,496.00	April 2022	12898.96	1.08	$1,569.00	0%	0%	$1,569.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assumes burning area less than 40 AC within WUI/adjacent to WUI
Fireline Hand	MI	1	$9,300.00	$9,300.00	April 2024	13532.08	1.08	$9,300.00	0%	0%	$9,300.00	USFS derived cost based on recent experience.	
Fireline Mechanical	MI	1	$2,900.00	$2,900.00	April 2024	13532.08	1.08	$2,900.00	0%	0%	$2,900.00	USFS derived cost based on recent experience.	
Reforestation	AC	1	$335.00	$335.00	April 2024	13532.08	1.08	$335.00	0%	0%	$335.00	USFS derived cost based on recent experience.	
Other Vegetation Natural Fuels Treatments													
Hand pile, Burn Piles	AC	1	$1,433.00	$1,433.00	April 2022	12898.96	1.08	$1,503.00	0%	0%	$1,503.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assumes Type 1 piling and Type 2 burning
Mechanical Pile, Burn Piles	AC	1	$502.00	$502.00	April 2022	12898.96	1.08	$527.00	0%	0%	$527.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assumes Type 1 piling (mechanical) and Type 1 burning (mechanical/excavator)
Masticate	AC	1	$1,500.00	$1,500.00	April 2022	12898.96	1.08	$1,574.00	0%	0%	$1,574.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assumes masticating only.
Underburn	AC	1	$384.00	$384.00	April 2022	12898.96	1.08	$403.00	0%	0%	$403.00	Kootenai NF_Activity Fuel Treatment Collection Guide_Final 04-20-2022	Assume underburning greater than 40 AC, in WUI/adjacent to WUI
Noxious Weed Treatments													
Backpack (Off-road)	AC	1	$286.00	$286.00	February 2024	13518.12	1.08	$286.00	0%	0%	$286.00	USFS derived cost based on recent experience.	Assume 2 labors at GS rate and 0.5 acre per hour production rate.
Truck (Using Roads)	AC	1	$71.50	$71.50	February 2024	13518.12	1.08	$72.00	0%	0%	$72.00	USFS derived cost based on recent experience.	Assume 2 labors at GS rate and 2 acre per hour production rate.
UTV (Along Powerline)	AC	1	$71.50	$71.50	February 2024	13518.12	1.08	$72.00	0%	0%	$72.00	USFS derived cost based on recent experience.	Assume 2 labors at GS rate and 2 acre per hour production rate.
Cheatgrass Population Mapping (Drones)													
Northern OU3 Boundary	AC	1	$19.70	$19.70	May 2024	13532.44	1.08	$20.00	0%	0%	$20.00	Online resource; flyguys.com	Assumes flying in good conditions, project scientist performs data analyses
IRA Areas with >60% Cover	AC	1	$19.70	$19.70	May 2024	13532.44	1.08	$20.00	0%	0%	$20.00	Online resource; flyguys.com	Assumes flying in good conditions, project scientist performs data analyses
PROPOSED NON-VEGETATION TREATMENTS													
Transportation Management													
New System Road Construction	MI	1	$353,400.00	$353,400.00	February 2024	13518.12	1.08	$353,774.00	0%	0%	$353,774.00	USFS-derived unit cost.	Unit cost is derived from weighted average by mile of new roads (NS-9, NS-11, NS-13, NS-44, NS 45, and NS-72).
Tubb Gulch/Lower Rainy Road Realignment	MI	1	$747,300.00	$747,300.00	February 2024	13518.12	1.08	$748,092.00	0%	0%	$748,092.00	USFS-derived unit cost.	USFS-derived unit cost from latest for NS-74 work.

NORTHWINDCDM ADVANTAGE

PROJECT:	Mitchell Jackson Project Area	COMPUTED BY:	Steve Clinch	CHECKED BY:	Justin Nielsen
JOB NO.:	287788	DATE:	5/8/2024	DATE CHECKED:	5/16/2024
CLIENT:	USACE Omaha	UPDATED BY:		PAGE NO.:	Esc Unit Cost
		DATE:			

Description: Unit cost development. Cost were pulled from QTOS sheet

Escalation

Estimate preparation date:	May 2024
Cost estimate prep cost index*:	13532.44
Area Cost Factor (Libby, Montana):**	1.08

Unit Cost Development Table

	UOM	Source QTY	Source COST	Unit Cost	Mo/Year	Esc. Index*	Area Cost Factor**	Esc. Unit Cost	PC OH	PC PF	Burdened Unit Cost	Source	Notes
Dust Suppression in OU3	MI	1	$51,200.00	$51,200.00	February 2024	13518.12	1.08	$51,254.00	0%	0%	$51,254.00	USFS-derived unit cost.	This cost includes chemical dust abatement once roads are ready for haul ($7000/Mile) and constant water truck abatement during road construction/reconstruction ($44200/Mile). This assumes a production rate of 1 mile of construction/reconstruction per month with two trucks onsite.
Temporary Road Construction	MI	1	$29,370.00	$29,370.00	February 2024	13518.12	1.08	$29,401.00	0%	0%	$29,401.00	USFS-derived unit cost.	Slope maps were used to determine appropriate sides slopes and timber cruise information was used to determine volume categories. Local knowledge and handbook direction were used to determine the number of drainage features per mile.
Haul Routes, National Forest System Roads	MI	1	$47,100.00	$47,100.00	February 2024	13518.12	1.08	$47,150.00	0%	0%	$47,150.00	USFS-derived unit cost.	Unit cost is derived for road chosen as most representative (ML1, LOS J roads).
Haul Routes, Other System Roads	MI	1	$85,700.00	$85,700.00	February 2024	13518.12	1.08	$85,791.00	0%	0%	$85,791.00	USFS-derived unit cost.	Nearly all of these roads are on ML 1/LOS J roads in high country on Stimson Lumber Co. land. Unit cost is derived for road chosen as most representative (ML1, LOS J roads).
Undetermined Roads Added to the System	MI	1	$196,200.00	$196,200.00	February 2024	13518.12	1.08	$196,408.00	0%	0%	$196,408.00	USFS-derived unit cost.	Unit cost is derived for road chosen as representative (NS-10). No dust abatement or watering during construction is included in this cost.
Barriered Roads Used for Administrative Access	EA	1	$8,980.00	$8,980.00	February 2024	13518.12	1.08	$8,990.00	0%	0%	$8,990.00	USFS-derived unit cost.	Adjusted price for admin use storage (USFS 2020 Cost Guide PG 60) with a new gate ($4500/each from local supplier as 10/23) assuming approximately one gate per mile. Highest listed price due to the high number of removed surface water deflectors replaced with water bars on steep grades. Unit changed to mile as work is lineal in nature.
Intermittent Stored Service (Road Storage)	MI	1	$4,480.00	$4,480.00	February 2024	13518.12	1.08	$4,485.00	0%	0%	$4,485.00	USFS-derived unit cost.	Adjusted price for intermittent storage (USFS 2020 Cost Guide PG 61). Highest listed price due to the high number of removed surface water deflectors replaced with water bars on steep grades. Unit changed to mile as work is lineal in nature.
Road Decommissioning	MI	1	$8,960.00	$8,960.00	February 2024	13518.12	1.08	$8,969.00	0%	0%	$8,969.00	USFS-derived unit cost.	Adjusted price for full recontour (USFS 2020 Cost Guide PG 61). Highest used due to complex terrain and uncertainty.
Convert Road to Non-motorized Trail	MI	1	$3,360.00	$3,360.00	February 2024	13518.12	1.08	$3,364.00	0%	0%	$3,364.00	USFS-derived unit cost.	Assumes gate and drain dips/out slope, scarify 2-3" seed & fertilizer
Travel Access Management Changes	EA	1	$4,500.00	$4,500.00	October 2023	13497.97	1.08	$4,511.00	0%	0%	$4,511.00	USFS-derived unit cost.	Assumes a new gate ($4500/each from local supplier as 10/23)
Culvert Installation	EA	1	$3,390.00	$3,390.00	February 2024	13518.12	1.08	$3,394.00	0%	0%	$3,394.00	USFS-derived cost	Based on averaging two 24" culvert installations.
SWPPP Site Wide	LS	1	$20,000.00	$20,000.00	April 2024	13532.08	1.08	$20,001.00	0%	0%	$20,001.00	Technical assumption based off previous SWPPP experience in Montana	Assumes annual reporting, routine inspection, periodic maintenance.
Gravel Pit Expansion													
Existing Pit – Reclaim in Current Condition	AC	1	$6,041.10	$6,041.10	January 2023	13175.03	1.08	$6,205.00	0%	0%	$6,205.00	USFS Cost Estimating Guide for Road Construction, 2020 cost was escalated by 1.12 to bring to January 2023 price	Assume 1 acre/day production rate using, 1 bull dozer, 1 excavator and 1 artic haul truck. Reshape/contour to approximate 3:1 slope with no depression or pooling areas with no design included.
Existing Stockpile – Continue Existing Use	DY	1	$1,824.88	$1,824.88	January 2023	13175.03	1.08	$1,874.00	0%	0%	$1,874.00	USFS Cost Estimating Guide for Road Construction, 2020 cost was escalated by 1.12 to bring to January 2023 price	Assumes stockpiles only need to be loaded out. Rate could be less if truck drivers were loading themselves.
Expansion Area	AC	1	$6,682.94	$6,682.94	January 2023	13175.03	1.08	$6,864.00	0%	0%	$6,864.00	USFS Cost Estimating Guide for Road Construction, 2020 cost was escalated by 1.12 to bring to January 2023 price	Assumes clearing/grubbing of surface only and that gravel material is immediately below topsoil.

Notes:

* ENR Construction Cost Index History (http://enr.construction.com/economics/historical_indices/Material_Price_Index_History.asp). ENR index is based on 200 hours of common labor at the 20-city average of common labor rates, plus 25 cwt of standard structural steel shapes at the mill price prior to 1996 and the fabricated 20-city price from 1996, plus 1.128 tons of Portland cement at the 20-city price, plus 1,088 board ft of 2 x 4 lumber at the 20-city price.

** DOD AREA COST FACTORS (ACF) PAX Newsletter No 3.2.1, Dated 31 March 2023, TABLE 4-1, UFC 3-701-01. Statewide average area cost factor used.

\- Area factor not applicable because the cost would not change dependent on the area in which construction is conducted.

Definition of Units of Measure (UOM):

AC	acres
BCY	bank cubic yard
DY	day
ECY	embankment cubic yard
LCY	loose cubic yard
SF	square feet
LS	lump sum
HR	hour

General Assumptions and Development of Unit Costs

PROJECT:	Mitchell Jackson Project Area	COMPUTED BY:	Steve Clinch	CHECKED BY:	Justin Nielsen
JOB NO.:	287788	DATE:	5/8/2024	DATE CHECKED:	5/16/2024
CLIENT:	USACE Omaha	UPDATED BY:		WRKSHT NO.:	GA-01
		DATE:			

Description: General assumptions and development of unit costs.

General Assumptions

Estimated Work Week and Work Day Duration

Days per work week:	**5**
Hours per workday:	**8**

Assumed Testing Frequency

Compaction testing frequency for backfill, EA/SF/LIFT:	**10,000**
Compaction testing frequency for trench backfill, EA/LF/LIFT:	**50**

Assumed Material Properties

Common Earth Bulking Factor:	1.2	*Conversion from BCY to LCY*
Common Earth Compaction Factor:	1.05	*Conversion from BCY to ECY*
Common Earth Compaction Factor:	0.88	*Conversion from LCY to ECY*
Unit weight of common earth, LB/BCY:	5,650	*CAT Handbook*
Unit weight of common earth, LB/LCY:	3,900	*CAT Handbook*
Riprap Bulking Factor:	1.50	*Conversion from BCY to LCY*
Riprap Compaction Factor:	1.30	*Conversion from BCY to ECY*
Riprap Compaction Factor:	0.87	*Conversion from LCY to ECY*
Density of riprap, LB/BCY:	4,400	*CAT Handbook*
Density of riprap, LB/LCY:	2,700	*CAT Handbook*
Sand Bulking Factor:	1.12	*Conversion from BCY to LCY*
Sand Compaction Factor:	0.95	*Conversion from BCY to ECY*
Sand Compaction Factor:	0.85	*Conversion from LCY to ECY*
Density of sand (dry), LB/BCY:	2,700	*CAT Handbook*
Density of sand (dry), LB/LCY:	2,400	*CAT Handbook*
Topsoil and compost bulking factor:	1.1	*Conversion from BCY to LCY*
Topsoil and compost compaction Factor:	0.95	*Conversion from BCY to ECY*
Topsoil and compost compaction Factor:	0.86	*Conversion from LCY to ECY*
Gravel Bulking Factor:	1.12	*Conversion from BCY to LCY*
Gravel Compaction Factor:	0.95	*Conversion from BCY to ECY*
Gravel Compaction Factor:	0.85	*Conversion from LCY to ECY*
Density of gravel (pitrun), LB/BCY:	3,650	*CAT Handbook*
Density of gravel (pitrun), LB/LCY:	3,250	*CAT Handbook*
Concrete Demolition Debris Bulking Factor:	1.30	*Conversion from BCY to LCY*
Density of Concrete Debris, LB/LCY:	1,855	
Density of Concrete Debris, TON/LCY:	0.93	

PROJECT:	Mitchell Jackson Project Area	COMPUTED BY:	Steve Clinch	CHECKED BY:	Justin Nielsen
JOB NO.:	287788	DATE:	5/8/2024	DATE CHECKED:	5/16/2024
CLIENT:	USACE Omaha	UPDATED BY:		WRKSHT NO.:	GA-01
		DATE:			

Description: General assumptions and development of unit costs.

Density of Asphalt Debris, LB/LCY:	2,970	
Density of Asphalt Debris, TON/LCY:	1.49	
Density of Wood Chips, LB/CY:	650	
Density of Wood Chips (Hardwoods), CY/TON:	4	*FEMA Debris Estimating Field Guide, FEMA 329, Sept 2010*
Density of Wood Chips (Softwoods), CY/TON:	6	*FEMA Debris Estimating Field Guide, FEMA 329, Sept 2010*
Area Conversion Factor:	43,560	*Conversion from SF to ACR*

Timber Harvest/Quantity Assumptions

Assumed Timber Volumes/Properties

Volume per acre Ground Based, Tons/acre:	57	USFS Provided Document
Volume per acre Cable based, Tons/acre:	40	USFS Provided Document

Assumed Costs for Timber Harvesting Methods

Ground Skidding Cost

Total ground skidding, acres:	2945	USFS Provided Document
Ground based, Tons/acre	57	USFS Provided Document
Ground skidding, $/acre:	$ 1,902.20	USFS Provided unit cost based of recent experience
Haul cost, $/acre:	$ 869.54	USFS Provided Document
Landing Pile Burning, Type 1, $/acre:	$ 14.10	Kootenai NF Activity Fuel Treatment Guide Rearrangement of Fuels

Cable Yarding Costs

Total skyline, acres:	831	USFS Provided Document
Skyline, Ton/acre:	40	USFS Provided Document
Skyline, $/acre:	$ 2,831.79	USFS Provided unit cost based of recent experience
Haul Cost, $/acre:	$ 869.54	USFS Provided Document
Landing Pile Burning, Type 1, $/acre:	$ 14.10	Kootenai NF Activity Fuel Treatment Guide Rearrangement of Fuels

Precommercial Thin Hand Cost

Type 1, $/acre:	$ 275.00	Kootenai NF Activity Fuel Treatment Guide Rearrangement of Fuels (Slashing Rates) Table

Precommercial Thin Mechanical Cost

Mastication, $/acre:	$ 1,500.00	Kootenai NF Activity Fuel Treatment Guide Mastication Table

Slash Hand Cost

Slashing rate, $/acre:	$ 500.00	USFS provided unit cost based on recent experience

PROJECT:	Mitchell Jackson Project Area	COMPUTED BY:	Steve Clinch	CHECKED BY:	Justin Nielsen
JOB NO.:	287788	DATE:	5/8/2024	DATE CHECKED:	5/16/2024
CLIENT:	USACE Omaha	UPDATED BY:		WRKSHT NO.:	GA-01
		DATE:			

Description: General assumptions and development of unit costs.

Log Hauling			
Haul cost, $/CCF:	$ 50.47	USFS Provided Document	
Haul cost, $/Ton:	$ 16.77	USFS Provided Document	
Haul cost for Ground Based, $/acre:	$ 869.54	USFS Provided Document	
Haul Cost for Cable Yarding:	$ 869.54	USFS Provided Document	
Reforestation Costs			
Reforestation, $/acre:	$ 335.00		
Assumed Fire/Fuel Treatments			
Excavator Pile, Burn Pile			
Excavator Piling, Type 1, $/acre:	$ 400.00	Kootenai NF Activity Fuel Treatment Guide Excavator Piling Rates Table	
Excavator pile burning, Type 1, $/acre:	$ 102.00	Kootenai NF Activity Fuel Treatment Guide Burning of Piled Material-Excavator and hand piles Rates Table	
Excavator Piling Type 1/Burning Excavator Piles Type 2, $/acre:	$ 502.00		
Excavator pile, Masticate			
Excavator Piling, Type 1, $/acre:	$ 400.00	Kootenai NF Activity Fuel Treatment Guide Excavator Piling Rates Table	
Mastication, $/acre:	$ 1,500.00	Kootenai NF Activity Fuel Treatment Guide Mastication Table	
Excavator Piling, Type 1/Mastication, $/acre:	$ 1,900.00		
Hand pile, Burn piles			
Hand piling, Type 2, $/acre:	$ 945.00	Kootenai NF Activity Fuel Treatment Guide Hand Piling Rates Table	
Hand pile burning, Type 1 $/acre:	$ 488.00	Kootenai NF Activity Fuel Treatment Guide Burning of Piled Material-Excavator and hand piles Rates Table	
Hand piling/Hand pile burning, Type 1, Type 2, $/acre:	$ 1,433.00		
Slashing Rate Type 2, $/acre:	$ 500.00	USFS provided unit cost based on recent experience	
Underburn, < 10 acres, $/acre:	$ 1,496.00	Kootenai NF Activity Fuel Treatment Guide Cost for Underburning Activity Fuel Table	
Underburn, > 40 acres, $/acre:	$ 384.00	Kootenai NF Activity Fuel Treatment Guide Cost for Underburning Activity Fuel Table	
Landing Pile Burning			
Landings Type 1, $/10 acres:	$ 141.00	Kootenai NF Activity Fuel Treatment Guide Landing Pile Burning Rates Table	
Landing Pile Burning, Type 1, $/acre:	$ 14.10		
Fireline Construction			
Hand Line, $/mile:	$ 9,300.00	USFS provided cost based off recent work	
Machine Line, $/mile:	$ 2,900.00	USFS provided cost based off recent work	
Assumed Weed Treatment Properties			
Weed Spraying via truck/UTV			
Average GS Wage for Laborer, $/hour:	$ 19.00	USFS provided cost based off recent work	
Average production rate, acres/hour	2		
Total time for work, hours	20.5		
Cost for weed spraying with two laborers, $:	$ 779.00		

PROJECT:	Mitchell Jackson Project Area	COMPUTED BY:	Steve Clinch	CHECKED BY:	Justin Nielsen
JOB NO.:	287788	DATE:	5/8/2024	DATE CHECKED:	5/16/2024
CLIENT:	USACE Omaha	UPDATED BY:		WRKSHT NO.:	GA-01
		DATE:			

Description: General assumptions and development of unit costs.

Roadway w/ 30 ft ROW, acres/mile:	3.6	USFS provided cost based off recent work
Time per area, hours/acre:	0.5	USFS provided cost based off recent work
Miles of ROW to treat, miles:	11.4	
Acres to be treated, acres:	41	
Chemical cost, $/acre:	$ 40.00	USFS provided cost based off recent work
Total chemical cost, $:	$ 1,640.00	
Vehicle cost, $/hour:	$ 25.00	USFS provided cost based off recent work
Total vehicle cost, $:	$ 512.50	
Total cost for weed spraying, $:	$ 2,931.50	
Total cost for weed spraying, $/acre:	$ 71.50	

Weed Spraying via backpack

Total cost for weed spraying by truck/utv, $/acre:	$ 71.50	Based on calculation above
Production rate of truck compared to backpack spraying, acre/acre:	0.25	Assumes backpack spraying would be at 1/4 the productivity of spraying by truck
Total cost for weed spraying w/ backpack, $/acre:	$ 286.00	

Drone Operation and Data Analyses Assumptions

acres per day in good conditions	500	Information from https://flyguys.com/how-much-do-drone-lidar-services-cost/
acres/Hour	62.5	
Drone cost per day	$ 9,000.00	Information from https://flyguys.com/how-much-do-drone-lidar-services-cost/
Cost per acre	$ 18.00	
Number of days to review data	5	assumption
Number of hours to review	40	assumption
Total acres to analyze	2785	
acres per hour for analyze	69.625	
Cost per acre to analyze	$1.70	
Hourly rate for project scientist	$41.01	FLC Datacenter: 2023 - FLC 19-2041.00 Level 4; Lincoln County, Montana
Total cost per acre drone plus analyses	$19.70	

Assumed Road Construction Properties

Linear Grading Associated with New Road Construction Costs

New System Road Construction, $/mile:	$ 353,400.00	USFS Provided Transportation Unit Costs
Tubb Gulch/Lower Rainey Road Alignment, $/mile:	$ 747,300.00	USFS Provided Transportation Unit Costs
Temporary Road Construction, $/mile:	$ 29,370.00	USFS Provided Transportation Unit Costs
Haul Routes, National Forest System Roads, $/mile:	$ 47,100.00	USFS Provided Transportation Unit Costs
Haul Routes, Other System Roads, $/mile:	$ 85,700.00	USFS Provided Transportation Unit Costs
Undetermined roads added to system, $/mile:	$ 196,200.00	USFS Provided Transportation Unit Costs
Barriered Roads used for Admin Access, $/mile:	$ 8,980.00	USFS Provided Transportation Unit Costs
Intermittent Stored Service, $/mile:	$ 4,480.00	USFS Provided Transportation Unit Costs
Road Decommissioning, $/mile:	$ 8,960.00	USFS Provided Transportation Unit Costs
Convert road to non-motorized trail, $/mile:	$ 3,360.00	USFS Provided Transportation Unit Costs
Travel Access Management Changes, $/hour:	$ 97.20	USFS Provided Transportation Unit Costs

PROJECT:	Mitchell Jackson Project Area	COMPUTED BY:	Steve Clinch	CHECKED BY:	Justin Nielsen
JOB NO.:	287788	DATE:	5/8/2024	DATE CHECKED:	5/16/2024
CLIENT:	USACE Omaha	UPDATED BY:		WRKSHT NO.:	GA-01
		DATE:			

Description: General assumptions and development of unit costs.

Culvert Installation, $/each:	$ 3,390.00	USFS derived cost	

Dust Suppression Costs

Chemical Dust Abatement, cost per mile of constructed road, $/mile:	$ 7,000.00	USFS Provided Transportation Unit Costs
Water truck abatement cost per mile of constructed road, $/mile:	$ 44,200.00	USFS Provided Transportation Unit Costs
Dust Suppression in OU3, $/mile:	$ 51,200.00	

SWPPP Assumption

Lump Sum cost of SWPPP for project life:	$ 20,000.00	Technical assumption based off previous SWPPP prepare/administer experience in Montana

General Dirt work cost assumptions

Gravel Pit Expansion

Clearing/Grubbing Base, $/acre:	$ 2,788.80	R1 Cost Guide*, pg. 33
Adjustment Factor for Percent Ground Slope:	$ 1.10	R1 Cost Guide*, pg. 37
Adjustment Factor for Slash Treatment Method:	$ 1.50	R1 Cost Guide*, pg. 37
Location Adjustment Factor for Public Works Davis-Bacon Zones, MT zone 3:	$ 1.00	R1 Cost Guide*, pg. 13
Clearing/Grubbing, $/acre:	$ 4,601.52	
Ground Based Harvest, $/acre:	$ 1,902.20	
Gravel pit Expansion total Cost, $/acre:	$ 6,503.72	

Existing Stockpile Use

Excavator (28.1-33 MTONS), $/acre:	$ 164.96	R1 Cost Guide*, pg. 102
Excavator Operator. Zone 3, $/acre:	$ 63.15	R1 Cost Guide*, pg. 112
Excavator w/ Operator, $/day:	$ 1,824.88	
Existing Stockpile - Continue Use:	$ 1,824.88	Assume Excavator use only

Gravel Pit Reclamation assumptions

Bulldozer (D8), $/hour:	$ 246.04	R1 Cost Guide*, pg. 100
Tractor Operator, MT Zone 3, $/hour:	$ 63.15	R1 Cost Guide*, pg. 112
Bulldozer w/ Operator, $/day:	$ 2,473.50	
Articulated Rear Dump 18 CY, $/hour:	$ 157.19	R1 Cost Guide*, pg. 100
Dump Truck Driver (over 12 CY), MT Zone 3, cost per hour	$ 60.65	R1 Cost Guide*, pg. 100
Dump Truck w/ Operator, $/day:	$ 1,742.72	

Reclaim Exiting Pit Costs

Excavator w/ Operator, $/day:	$ 1,824.88
Dump Truck w/ Operator, $/day:	$ 1,742.72
Bulldozer w/ Operator, $/day:	$ 2,473.50
Reclamation, $/day:	$ 6,041.10

Quantity Development for Alternative 1

PROJECT:	Mitchell Jackson Project Area	COMPUTED BY:	Steve Clinch	CHECKED BY:	Justin Nielsen
JOB NO.:	287788	DATE:	5/8/2024	DATE CHECKED:	5/16/2024
CLIENT:	USACE Omaha	UPDATED BY:		WRKSHT NO.:	QTO-01
		DATE:			

Description: Quantity development for Alternative 1. Assumes total quantities would be spread over a 15 year period for cost estimation purposes.

Harvest Activities	UOM	Total QTY	
Harvest Related Fuels and Site Prep Treatments			
Excavator Pile, Burn Piles	AC	3783	
Excavator Pile, Masticate	AC	87	
Masticate	AC	92	
Underburn	AC	1401	
Harvest Method			
Ground-based	AC	4083	
Haul Cost for Ground Based	AC	4083	
Cable Yarding	AC	1324	
Haul Cost for Cable Yarding	AC	1324	
Landing Pile Burning	AC	1324	
Other Vegetation Treatments			
Precommercial Thin Hand	AC	1343	
Precommercial Thin Mechanical	AC	175	
Slash Hand	AC	1768	
Slash Mechanical	AC	255	
Underburn	AC	9	
Other Vegetation Natural Fuels Treatments			
Hand pile, Burn Piles	AC	652	
Mechanical Pile, Burn Piles	AC	0	
Masticate	AC	430	
Underburn	AC	1298	
Noxious Weed Treatments			
Backpack (Off-road)	AC	228	
Truck (Using Roads)	AC	605	
UTV (Along Powerline)	AC	42	
PROPOSED NON-VEGETATION TREATMENTS			
Transportation Management			
New System Road Construction	MI	0	*No new roads under Alt 1*
Tubb Gulch/Lower Rainy Road Realignment	MI	0.5	
Dust Control in OU3	MI	0.5	
Temporary Road Construction	MI	3.6	
Haul Routes, National Forest System Roads	MI	92	
Haul Routes, Other System Roads	MI	6.4	
Undetermined Roads Added to the System	MI	2.1	
Barriered Roads Used for Administrative Access	EA	0	
Intermittent Stored Service (Road Storage)	EA	4.8	
Road Decommissioning	MI	3.4	
Convert Road to Non-motorized Trail	MI	0.9	
Travel Access Management Changes	MI	6	
Culvert Installation	EA	7	
SWPPP Site Wide	LS	1	
Gravel Pit Expansion			
Existing Pit – Reclaim in Current Condition	AC	2	
Existing Stockpile – Continue Existing Use	DAY	0.5	*Assume 0.5 day per year*
Expansion Area	AC	5	
Cheatgrass Population Mapping (Drones)			
Northern OU3 Boundary	AC	113	
IRA Areas with >60% Cover	AC	2672	

Quantity Development for Alternative 2

PROJECT:	Mitchell Jackson Project Area	COMPUTED BY:	Steve Clinch	CHECKED BY:	Justin Nielsen
JOB NO.:	287788	DATE:	5/8/2024	DATE CHECKED:	5/16/2024
CLIENT:	USACE Omaha	UPDATED BY:		WRKSHT NO.:	QTO-02
		DATE:			

Description: Quantity development for Alternative 2. Assumes total quantities would be spread over a 15 year period for cost estimation purposes.

Harvest Activities	UOM	Total QTY	
Harvest Related Fuels and Site Prep Treatments			
Excavator Pile, Burn Piles	AC	4335	
Excavator Pile, Masticate	AC	87	
Masticate	AC	92	
Underburn	AC	1744	
Harvest Method			
Ground-based	AC	4428	
Haul Cost for Ground Based	AC	4428	
Cable Yarding	AC	1874	
Haul Cost for Cable Yarding	AC	1874	
Landing Pile Burning	AC	1874	
Other Vegetation Treatments			
Precommercial Thin Hand	AC	1343	
Precommercial Thin Mechanical	AC	175	
Slash Hand	AC	1981	
Slash Mechanical	AC	278	
Underburn	AC	9	
Other Vegetation Natural Fuels Treatments			
Hand pile, Burn Piles	AC	879	
Mechanical Pile, Burn Piles	AC	23	
Masticate	AC	430	
Underburn	AC	1309	
Noxious Weed Treatments			
Backpack (Off-road)	AC	210	
Truck (Using Roads)	AC	692	
UTV (Along Powerline)	AC	42	
PROPOSED NON-VEGETATION TREATMENTS			
Transportation Management			
New System Road Construction	MI	8.3	
Tubb Gulch/Lower Rainy Road Realignment	MI	0.5	
Dust Control in OU3	MI	0.5	
Temporary Road Construction	MI	4.3	
Haul Routes, National Forest System Roads	MI	108.9	
Haul Routes, Other System Roads	MI	8.7	
Undetermined Roads Added to the System	MI	2.1	
Barriered Roads Used for Administrative Access	EA	4.1	
Intermittent Stored Service (Road Storage)	EA	12.2	
Road Decommissioning	MI	3.8	
Convert Road to Non-motorized Trail	MI	0.9	
Travel Access Management Changes	MI	11.1	
Culvert installation	EA	11	
SWPPP Site Wide	LS	1	
Gravel Pit Expansion			
Existing Pit – Reclaim in Current Condition	AC	2	
Existing Stockpile – Continue Existing Use	DAY	0.5	*Assume 0.5 day per year*
Expansion Area	AC	5	
Cheatgrass Population Mapping (Drones)			
Northern OU3 Boundary	AC	113	
IRA Areas with >60% Cover	AC	2672	