Appendix J

Minerals Specialist Report

Resource: Minerals

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Past Management Actions in the Area

Mineral management of LCM began in 1862 with the first miners to work the gold deposits of the area (Oliver, 1962). Owing to the absence of established law and issues concerning claims, the miners drafted their own code of laws. These laws designated a recorder to keep a record of claims, specified the types and dimensions of claims, circumstances constituting claim abandonment, how often claims must be worked, and how many claims a miner could hold.

In 1866, the Federal Government took over mineral management on public lands. Congress passed the 1866 Mining Act designating recognition and protection of existing claims and declaring public lands open to mineral entry for any United States citizen. Included in the law were provisions for claimants of lode deposits to obtain title by patenting; the Placer Act of 1870 amended the 1866 law to allow patenting of placer claims. In 1872, Congress combined the mining laws into a single statute known as the United States Mining Act of 1872 (Kesler, 1994). The Federal Land Policy and Management Act was passed in 1976, requiring the BLM to prevent unnecessary or undue degradation of public lands from hardrock mining. To this end, the BLM published the 43 CFR 3809 surface mining regulations in 1980, which took effect in January 1981 (USDI BLM, 2000b). Efforts were made in 1991 to amend the regulations, but congressional consideration of major reforms to the 1872 Mining Law held up this action for several years (USDI BLM, 2000a). A final rule updating the "3809" regulations took effect on January 20, 2001; further modifications in another final rule took effect on December 31, 2001 (USDI BLM, 2001). Most provisions of the January 20, 2001 mining regulations were retained while several "unduly burdensome" provisions were removed.

None of the public lands within the LCM area have been withdrawn from mineral entry. Thus, mineral resources in the area have been managed according to the 43 CFR 3809 regulations and the mining laws to prevent unnecessary or undue degradation of public lands while providing for economic mineral development.

Brief Existing Environment/Condition

The LCM area geology consists mainly of the Canyon Mountain Ophiolite Complex of the Baker terrane, located in the Blue Mountains physiographic province of northeastern Oregon (Orr and others, 1992). The ophiolite complex formed in the late Triassic (200 million years ago) as oceanic crust was faulted, folded and metamorphosed during accretion of the Baker terrane to the west coast of the North American continent. The main rock types include gabbro, pyroxenite, peridotite, and dunite; much of the peridotite and dunite has been metamorphosed into serpentine (Brooks and Ramp, 1968; Thayer and others, 1981). Various volcanic and sedimentary rocks are also present. During the late Jurassic to early Cretaceous (between 160 and 120 million years ago), the area was intruded by magmas that later cooled to form batholiths and stocks of granodiorite and gabbro (Orr and others, 1992). Gold-bearing veins of massive white quartz and calcite were formed in the fractured host rock along the batholith margins and in the batholiths themselves (Brooks and Ramp, 1968; Thayer and others, 1981).

Gold has been the most important economic mineral commodity from the LCM area with less significant quantities of silver also being produced. Between discovery in 1862 and 1908, an estimated 600,000 ounces of gold were produced from the Canyon Mining District, which includes lands adjacent to the LCM area (Thayer and others, 1981). Dredges in Canyon Creek and in the John Day valley around the city of John Day produced 124,000 and 13,000 ounces of gold and silver respectively from 1916-1929 and from 1935-1942 (Brooks and Ramp, 1968; Thayer and others, 1981). Relatively small amounts of gold have been produced from the Canyon Mining District since the last dredge was dismantled in 1942.

Currently, there are 18 active gold claims on LCM including 12 placer, 5 lode, and 1 mill site. In addition, there is the Great Northern Mine, a patented lode claim. Modern production data from these claims are unavailable, as information from individual mining companies is no longer accessible to the public (Orr and others, 1992).

Other minerals found in the LCM area include serpentine, chrysotile asbestos, nickel, platinum-group metals, and quartz. None of these minerals have been economically produced from the LCM area though some placer platinum was recovered as a by-product of gold dredging on the John Day River (Thayer and others, 1981).

Existing Environment/Condition

The LCM area is located in the Blue Mountains physiographic province of northeastern Oregon. Seas covered all of Oregon in Late Triassic time (200 million years ago) and the Pacific Coast shoreline was to the east (Orr and others, 1992). Exotic landmasses known as “terranes” began accreting to the west coast of the North American continent, thus forming the foundation of the Blue Mountains province and causing the ocean shoreline to shift westward. Five terranes are recognized and include the Wallowa, Baker, Grindstone, Izee, and Olds Ferry Terranes.

LCM resides in the Canyon Mountain Ophiolite Complex of the Baker Terrane (Orr and others, 1992). During accretion of the Baker Terrane, deep ocean sediments and blocks of oceanic crust were faulted, uplifted, and metamorphosed, producing a complex arrangement of fault-bounded ultramafic rocks known as an ophiolite sequence. These rocks include gabbro, peridotite, dunite, and pyroxenite; much of the peridotite and dunite has been metamorphosed into serpentine (Brooks and Ramp, 1968; Thayer and others, 1981).

During the late Jurassic to early Cretaceous (between 120 and 160 million years ago), the terranes of northeastern Oregon were intruded by magmas that later cooled to form batholiths and stocks of granodiorite and gabbro (Orr and others, 1992). Gold-bearing veins of massive white quartz were formed in the fractured host rock along the batholith margins and in the batholiths themselves (Brooks and Ramp, 1968). Such veins are present in the upper slopes of LCM as lode deposits. Erosion through geologic time has removed gold from exposed veins exposed at the surface and transported it to nearby streams. Hydrodynamic separation by fluvial processes concentrated the gold in placer deposits on the lower slopes of LCM, in Canyon Creek, and in the John Day River.

Like most deposits, the gold found in the LCM area is a naturally occurring alloy with silver (Lindgren, 1901). As a result, significant amounts of silver were produced as a by-product of gold mining.

Placer mining in the LCM area began in the summer of 1862 with the discovery of gold. The earliest mining operations focused on the gravel bars along Canyon Creek and in the surrounding gulches (Brooks and Ramp, 1968). In subsequent years, lode deposits were discovered on the upper slopes of LCM; one such deposit was discovered at the Great Northern Mine in 1898 (Lindgren, 1901; Brooks and Ramp, 1968). Relative to placer mines, production from the lode mines has been small.

Reliable gold production figures from the LCM area during early years are not available (Lindgren, 1901). Between 1862 and 1908, an estimated 600,000 ounces of gold were produced from the entire Canyon Mining District, which includes areas outside of LCM (Thayer and others, 1981). Production was highest in 1862 with an estimated 90-94% decline over the years following until 1870. From 1871 to 1908, production remained relatively constant at 2-4% that of 1862 and by 1916, production was nearly insignificant (Brooks and Ramp, 1968). The use of dredges in Canyon Creek and in the John Day valley around the city of John Day revived production from 1916-1929 and from 1935-1942. The combined output of the dredging operations was 124,000 and 13,000 ounces of gold and silver respectively (Brooks and Ramp, 1968; Thayer and others, 1981). Relatively small amounts of gold have been produced from the Canyon Mining District since the last dredge was dismantled in 1942.

Currently, there are 18 active claims on LCM including 12 placer, 5 lode, and 1 mill site. In addition, there is the Great Northern Mine, a patented lode claim. Modern production data from these claims are unavailable, as information from individual mining companies is no longer accessible to the public (Orr and others, 1992).

Although mining in the LCM area has focused on gold and silver, there are other minerals that may be sought after sometime in the future. These include serpentine, chrysotile asbestos, nickel, platinum-group metals, and quartz.

Serpentine is a soft mineral used as an ornamental stone and also as a substitute for jade (Klein and Hurlbut, 1993). A fibrous polymorph of serpentine, chrysotile is an asbestos mineral used for heat and corrosion resistant fabrics, brake linings, insulation, and roofing shingle (Kesler, 1994). Due to concerns about lung diseases linked to asbestos exposure, asbestos was banned in the U.S. in 1989, though the U.S. Court of Appeals overturned the ban in 1992. Moreover, chrysotile is not as strongly linked to disease as other forms of asbestos (Kesler, 1994; Klein and Hurlbut, 1993). As the debate over asbestos continues, the potential remains for interest in developing chrysotile in the LCM area. Although serpentine is abundant, the known chrysotile deposits are generally small and of limited quantity (USDI BLM, 1984).

Nickel is utilized for alloys and as plating where temperature and corrosion resistance are required; the manufacture of stainless steel consumes about one half of US nickel production (Kesler, 1994). Occurring in peridotite, nickel substitutes for magnesium in amounts of 0.1 to 0.3% in the olivine and serpentine minerals (Thayer and others, 1981). Currently, there is no economically feasible method for recovering nickel from these deposits. Should an economic recovery process be developed, the potential nickel resource from LCM and surrounding areas would be immense.

The platinum-group metals are primarily used in catalytic converters and in the electrical and electronics industries (Kesler, 1994). Like nickel, the platinum-group metals are found in peridotite and appear to be most concentrated in the chromite minerals (Thayer and others, 1981). Assays for platinum-group metals in the area have proven sub-economic. However, some placer platinum was produced by dredges on the John Day River as a by-product of gold mining.

The massive white quartz present in the lode veins and tailings piles is useful as a decorative aggregate for landscaping. However, transportation costs are a major factor for the economic viability of aggregate production and the need to crush stone adds about 20% to the production cost (Kesler, 1994). Owing to the remote location and the need to extract and crush quartz from relatively small deposits, the quartz resources in LCM will probably not be economical for some time, if ever.

Detailed Existing Environment/Condition – Adjoining Lands

The adjoining lands to the LCM area are very much the same with respect to mineral resource condition and environment. Gold placer deposits are located in Canyon Creek and the John Day River west and north of LCM (Brooks and Ramp, 1968). Placer and lode deposits are located in the Prairie Diggings to the east at the base of Canyon Mountain. Another gold lode deposit is located on Miller Mountain to the southwest. Similar deposits of serpentine, nickel, platinum-group metals, and quartz also occur on adjoining lands. Other minerals on adjoining lands include chromite, copper, and mercury; geothermal resources are also present.

Deposits of chromite (ore of chromium) are located on the northern slopes of Canyon Mountain and on the west side of Canyon Creek. Individual chromite deposits, ranging from a few hundred kilograms to 115,000 tons, occur as pods and lenses in peridotite, dunite, and serpentinite (Thayer, 1940; Thayer and others, 1981). At least 100 chromite deposits are recognized but most occurrences contain less than 100 tons.

Historically, the chromite deposits of Grant County have not been able to compete with foreign sources with the exception of the three time periods of war (Thayer and others, 1981). Mining of the chromite deposits began in 1916 when World War I cut off chromium imports and continued until the war's end in 1918. Production resumed in 1939 and continued through most of World War II, ending in 1944. The last phase of production occurred from 1951 to 1958 as the U.S. government stockpiled strategic minerals during the Korean War (Thayer and others, 1981; Orr and others, 1992). In all, chromite production in Grant County reached 30,000 tons.

Copper deposits are found chiefly on the Stawberry Range crest between the summit of Canyon Mountain and Indian Creek Butte; a few other deposits occur just outside the western boundary of the Strawberry Mountain Wilderness (Thayer and others, 1981). Chalcopyrite, malachite, and chrysocolla are the primary copper-bearing minerals and occur mainly in lenticular quartz veins placed in gabbro host rock. All known copper deposits in the area are either too small or have an insufficient grade for production.

Mercury was discovered in 1963 near the confluence of the East Fork of Canyon Creek and Canyon Creek (Thayer and others, 1981). Cinnabar (ore of mercury) occurs as fracture fillings and replacements in greywacke host rock. Production from the deposit totaled 3,830 kg between 1963 and 1968.

One hot spring and two warm springs around the Strawberry Mountains suggest the presence of geothermal energy (Thayer and others, 1981). The Blue Mountain Hot Springs, located 5 km northeast of the Strawberry Mountain wilderness, have a discharge of 250 liters per minute and a temperature of 58 ^{o}C. Limekiln Spring issues from the ground near the confluence of Indian and Overholt Creeks, flowing at a few liters per minute with a temperature of 21 ^{o}C. Another warm spring is located along Canyon Creek about 16 miles south of John Day, also flowing at a few liters per minute but has a warmer temperature of 39 ^{0}C. According to Thayer and others (1981), there is no significant geothermal reservoir associated with these springs.

Reasonably foreseeable management actions in the area not including the LCM Project

Given the historic mining use, number of active claims, and likely presence of more gold lode and placer deposits, all of the LCM area will probably remain open to mineral entry in accordance with the 43 CFR 3809 regulations and mining laws to prevent unnecessary or undue degradation of public lands. The aforementioned presence of serpentine, chrysotile, nickel, platinum-group metals, and quartz and the potential interest in developing these minerals may have implications for management, land use, and ground disturbance. If produced in commercial quantities, all of these minerals would be primarily mined by the open-pit method though some platinum can be incidentally recovered from hydraulic gold mining.

Environmental Effects of No Management Action

Direct Effects on Resource (1 year, 5 years & 10 years)

The mineral resources primarily occur underground in veins and fluvial gravel deposits and would not be directly affected by issues relating to bark beetle infestation, fuel load, and wildland fire.

Indirect Affects on Resource (1 year, 5 years & 10 years)

Under this alternative, no beetle-infested trees would be removed and no fuels reduction would take place. If left unmitigated, bark beetles may continue to kill trees and substantially reduce or eliminate timber resources for mining-related use on claims. In addition, increasing dead and down fuels would probably further increase the risk of fire damage to timber resources, mining-related structures and equipment and increase the probability of lost production time. However, should a stand-replacement fire occur, it is possible for the ground exposure caused by fire and suppression activities to lead to more economic mineral discoveries.

If bark beetles and/or fire kill large numbers of trees on mining claims, the timber will remain salvageable for a few years following die off. Thus, the availability of timber for mining use could be affected in as little as three years from the present. The fire hazard to mining structures and equipment associated with beetle-killed stands of timber would probably continue to worsen over the next few to several years.

Brief summary of impacts of No Management Action

The fire hazard and loss of trees related to continued bark beetle infestation may reduce or eliminate available timber resources on claims for mining-related use and pose a fire hazard to mining-related structures and equipment, resulting in lost production time. However, should a stand-replacement fire occur, ground exposure due to fire and suppression activities could lead to additional economic mineral discoveries.

Comparison of Alternatives

The BMBP and "Historic" Condition alternatives have potentially negative impacts on mining. The restrictions suggested by the BMBP severely limit the amount of fuels reduction and treatment of bark beetle infestation. Timber resources for mining-related use would remain under an increasing threat from bark beetles and fire. Miners, mining-related equipment and structures, and production time would also face an increasing fire threat. Under the "Historic" Condition alternative, timber stands would be thinned to a target basal area of 30-50-ft^2 from areas that were "historically" grassland/steppe communities while historically forested areas would be maintained at a target basal area of 60-100-ft^2. While mitigating the fire hazard, the "Historic" Condition alternative would limit timber resources for mining-related use on some existing and future mining claims.

The Uniform Treatment, Graded Basal Area Target, and Stratified Basal Area Target alternatives all mitigate existing hazards and threats to miners and mining operations. Each of these alternatives mitigates the fire hazard and beetle infestations while leaving adequate timber resources available for mining-related use.

Environmental Effects of BMBP Management Alternative

Direct Effects on Resource (1 year, 5 years, 10 years)

The mineral resources primarily occur underground in veins and fluvial gravel deposits and would not be directly affected by issues relating to bark beetle infestation, fuel load, and wildland fire.

Indirect Effects on Resource (1 year, 5 years, 10 years)

The Blue Mountain Biodiversity Project (BMBP) attempts to impose guidelines for projects purporting to be for restoration or forest health. The guidelines that potentially affect mining operations include:

- No logging of trees larger than 12" DBH.
- No logging on slopes greater than 30%
- No Logging on slopes greater than 20% in areas that are geologically unstable or prone to erosion, slumping or sliding.
- No logging in riparian areas. PACFISH buffers apply—doubled in areas with slopes greater than 25% or where geologically unstable or geologically unstable or prone to erosion, slumping or sliding
- Heavy machinery that results in compaction may not be used.
- Canopy closure (overstory) of 60% in mixed stands and 45% in ponderosa stands must be retained.
- No commercial logging in non-roaded areas larger than 400 acres.

Under the BMBP alternative, a 1000-ft fuel break would be constructed along the wildland urban interface (WUI) subject to the BMBP restrictions on logging. Should the BMBP suggestions be followed, fuel reduction and control of bark beetles in the LCM area may not be adequate. Areas inside the fuel break would go entirely untreated. Of the 1144 acres within the WUI fuel break as defined, 919 acres would receive no treatment for fuel load or beetle infestations while treatment of the remaining 225 acres may receive insufficient treatment. Untreated and inadequately treated areas could, if drought conditions persist, act as a breeding ground for bark beetles that could spread to and kill healthy trees in both treated and untreated areas. As a result, timber resources available on claims for mining-related operations would remain at significant risk of being lost. Furthermore, the increasing fuel load of dead, dying, and down wood would continue to pose a wildland fire risk to mining equipment, structures, and production time. However, a stand-replacement fire could lead to additional economic mineral discoveries due to ground exposure from fire and suppression activities.

If bark beetles and/or fire kill large numbers of trees on mining claims, the timber would remain salvageable for a few years following die off. Thus, the availability of timber for mining use could be affected in as little as three years from the present. The fire hazard to mining structures and equipment associated with beetle-killed stands of timber would probably continue to worsen over the next few to several years.

Possible Design Criteria or Mitigation Measures to Minimize Impacts

The impacts of the BMBP alternative are essentially the same as those of the No Action alternative but slightly lower in magnitude. Any alteration of the BMBP alternative toward the No Action alternative would worsen the impacts. As such, there is no method available to mitigate the impacts of the BMBP alternative.

Brief Summary of Impacts

The guidelines suggested by the BMBP would substantially limit treatment for bark beetles and fuel load. Untreated and inadequately treated areas could, if drought conditions persist, act as a breeding ground for bark beetles that could spread to and kill healthy trees in both treated and untreated areas. As a result, timber resources available on claims for mining-related operations would remain at significant risk of being lost. Furthermore, the increasing fuel load of dead, dying, and down wood would continue to pose a wildland fire risk to mining equipment, structures, and production time.

Environmental Effects of “Historic Perspective” Alternative

Direct Effects on Resource (1 year, 5 years, 10 years)

The mineral resources primarily occur underground in veins and fluvial gravel deposits and would not be directly affected by issues relating to bark beetle infestation, fuel load, and wildland fire.

Indirect Effects on Resource (1 year, 5 years, 10 years)

This alternative proposes to restore and maintain vegetative communities as they existed in the late 1800s. 1049 acres of “historical” timber stands would be left on the summit of LCM and in the moister drainages while 1448 acres of hillsides and ridge tops would be maintained as grassland/steppe communities. 924 acres of the “historical” stands would be thinned to reduce stand density (target basal area of 60-100 ft^2/acre) and all dead and dying beetle-infected trees would be removed. In the “historical” grassland/steppe areas, most trees would be removed on 1304 acres to target basal area a 30-50 ft^2.

Restoration of the LCM forest to its "historic condition" has implications for miners and mining operations. The large-scale removal of trees from slopes and ridge tops would substantially limit the available timber for mining-related use on a number of existing and future claims. However, the reduction in fuel load would substantially reduce the wildland fire hazard to miners, mining related equipment, and production time. Moreover, the ground exposure in the extensively thinned areas could lead to new mineral discoveries.

The effects of this alternative would occur during and after timber removal from "historical" grassland/steppe areas and continue as long as the "historic condition" is maintained.

Possible Design Criteria or Mitigation Measures to Minimize Impacts

The principle impact of this alternative is the large-scale removal of trees to restore hillsides and ridge tops to "historical" grassland/steppe communities. Many future and existing claims would be left with very limited timber resources for mining-related use. To mitigate this impact, fewer trees could be removed from active claims such that "reasonable" amounts of timber remain. Alternatively, permits could be issued for mining claimants to harvest timber for mining-related use from other BLM-managed lands.

Brief Summary of Impacts

Under this alternative, 924 acres of timber stands on the summit of LCM and in the moister drainages would be thinned to a basal area of 60-100 ft^2 whereas 1304 acres of hillsides and ridge tops would be treated to a basal area of 30-50 ft^2 and maintained as grassland/steppe communities. The large-scale removal of trees from slopes and ridge tops would substantially reduce the available timber for mining-related use on a number of existing and future claims. However, the reduction in fuel load would substantially reduce the fire hazard to miners, mining related equipment, and production time. Moreover, the ground exposure in the extensively thinned areas could lead to new mineral discoveries.

Environmental Effects of Low Basal Area Uniform Treatment Alternative

Direct Effects on Resource (1 year, 5 years, 10 years)

The mineral resources primarily occur underground in veins and fluvial gravel deposits and would not be directly affected by issues relating to bark beetle infestation, fuel load, and wildland fire.

Indirect Effects on Resource (1 year, 5 years, 10 years)

This alternative proposes thinning the LCM area uniformly to a target basal area of 40-60 ft^2/acre while maintaining pre-treatment proportions of pine, fir and hardwood species. All trees that are dead and dying from beetle infestation would be removed. In addition, approximately 0.5 miles of the main access road along Little Pine Creek would be re-routed away from the creek.

Most actions of this alternative would probably have minimal impact on miners and mining operations. Complete removal of infested trees from the area should mitigate the potential loss of timber from bark beetles while leaving sufficient timber resources for mining-related purposes. In addition, thinning of the area should substantially reduce the wildland fire threat to miners, mining-related structures and equipment, and production time. However, re-routing the main access road would reduce road access to parts of two active mining claims.

Possible Design Criteria or Mitigation Measures to Minimize Impacts

This alternative would have no significant impact on minerals or mining in the area. All effects are positive and serve to improve the safety and well being of mining operations. As such, no mitigation measures are needed.

Brief Summary of Impacts

This alternative suggests thinning the entire LCM area uniformly to a target basal area of 40-60 ft^2/acre and all trees that are dead and dying from beetle infestation would be removed. The actions of this alternative would probably have minimal impact on miners and mining operations. Complete removal of infested trees from the area should mitigate the potential loss of timber from bark beetles while leaving sufficient timber resources for mining-related purposes. In addition, thinning of the area should substantially reduce the wildland fire threat to miners, mining-related structures and equipment, and production time. However, re-routing the main access road would reduce road access to parts of two active mining claims.

Environmental Effects of Graded Forest Treatments by Elevation Alternative

Direct Effects on Resource (1 year, 5 years, 10 years)

The mineral resources primarily occur underground in veins and fluvial gravel deposits and would not be directly affected by issues relating to bark beetle infestation, fuel load, and wildland fire.

Indirect Effects on Resource (1 year, 5 years, 10 years)

This alternative suggests treating the entire LCM area by grading the basal target area from low to high elevation. The minimum target basal area would be 40 ft^2/acre in and adjacent to the fuel break and would steadily increase upslope to a maximum of 70 ft^2/acre. Pre-treatment proportions of pine, fir, and hardwood species would be maintained. All dead and dying beetle-infested trees would be removed.

The actions of this alternative would probably have minimal impact on miners and mining operations. Complete removal of infested trees from the area should mitigate the potential loss of timber from bark beetles while leaving sufficient timber resources for mining-related purposes. In addition, tree thinning of the area should substantially reduce the wildland fire threat to miners, mining-related structures and equipment, and production time.

Possible Design Criteria or Mitigation Measures to Minimize Impacts

This alternative would have no significant impact on minerals or mining in the area. All effects are positive and serve to improve the safety and well being of mining operations. As such, no mitigation measures are needed.

Brief Summary of Impacts

This alternative suggests treating the entire LCM area by grading the basal target area from a minimum of 40 ft^2/acre in low elevations to a maximum of 70 ft/acre in the high elevations. All dead and dying beetle-infested trees would be removed. This alternative would probably have minimal impact on miners and mining operations. Complete removal of infested trees from the area should mitigate the potential loss of timber from bark beetles while leaving sufficient timber resources for mining-related purposes. In addition, thinning of the area should substantially reduce the wildland fire threat to miners, mining-related structures and equipment, and production time.

Environmental Effects of Stand Condition Stratified Treatment Alternative

Direct Effects on Resource (1 year, 5 years, 10 years)

The mineral resources primarily occur underground in veins and fluvial gravel deposits and would not be directly affected by issues relating to bark beetle infestation, fuel load, and wildland fire.

Indirect Effects on Resource (1 year, 5 years, 10 years)

Under this alternative, the entire area would be treated with target basal areas depending upon individual stand compositions as follows:

0 – 40 ft^2/acre in the western juniper dominated stands,
40 – 50 ft^2/acre in the ponderosa pine dominated stands
50 – 60 ft^2/acre in the mixed conifer (ponderosa/Doug fir) dominated stands
60 – 70 ft^2/acre in the Douglas fir dominated stands

Pre-treatment proportions of pine, fir, juniper, and hardwood species would be preserved. All dead and dying beetle-infested trees would be removed with the option of re-entry for removal of additional trees should a fuel hazard develop from further beetle infestation.

The actions of this alternative would probably have minimal impact on miners and mining operations. Complete removal of infested trees from the area should mitigate the potential loss of timber from bark beetles while leaving sufficient timber resources for mining-related purposes. In addition, tree thinning of the area should substantially reduce the wildland fire threat to miners, mining-related structures and equipment, and production time.

Possible Design Criteria or Mitigation Measures to Minimize Impacts

This alternative would have no significant impact on minerals or mining in the area. All effects are positive and serve to improve the safety and well being of mining operations. As such, no mitigation measures are needed.

Brief Summary of Impacts

This alternative suggests treating the entire LCM area by setting target basal areas according to stand composition as follows:

> 0 – 40 ft^2/acre in the western juniper dominated stands,
> 40 – 50 ft^2/acre in the ponderosa pine dominated stands
> 50 – 60 ft^2/acre in the mixed conifer (ponderosa/Doug fir) dominated stands
> 60 – 70 ft^2/acre in the Douglas fir dominated stands

All dead and dying beetle-infested trees would be removed. This alternative would probably have minimal impact on miners and mining operations. Complete removal of infested trees from the area should mitigate the potential loss of timber from bark beetles while leaving sufficient timber resources for mining-related use. In addition, thinning of the area should substantially reduce the wildland fire threat to miners, mining-related structures and equipment, and production time.

References

Brooks, H. C. and Ramp, L., 1968. Gold and Silver in Oregon. Oregon Dept. Geol. And Mineral Indus., Bull.61.

This bulletin covers the geology and distribution of gold deposits in Oregon. Included is a discussion of the general geology, deposits, mining, and mineral production of gold and silver in the LCM area.

Kesler, S. E., 1994. Mineral Resources, Economics and the Environment. Macmillan. New York, NY.

This book presents information on mineral occurrence, economics, production methods and related environmental issues. Information is provied for the industrial uses of chrysotile, nickel, platinium-group elements, and quartz, all of which are present in the LCM area. Information on the health issues surrounding asbestos is also provided.

Klein, C. and Hurlbut, C. S. Jr., 1993. Manual of Mineralogy. John Wiley and Sons, Inc. New York, NY.

This book discusses the occurrence, chemistry, physics, and uses of minerals. Included is information on the uses of serpentine and chrysotile, both of which are present in the LCM area.

Lindgren, W., 1901. The Gold Belt of the Blue Mountians of Oregon. U.S. Geol. Survey, 22 Ann. Rept., pt. 2.

This report is the first written description of the Strawberry Mountain geology and ore deposits. Included is a discussion of ore deposits, mining, and gold production as of 1901 in the LCM area.

Oliver, H. and Jackman, E. R. ed., 1962. Gold and Cattle Country. Binfords and Mort. Portland, OR.

This book discusses the history of the early mining days in the LCM area. The author obtained much of the information from direct conversation with the early miners, including the person credited with discovering gold in Canyon Creek.

Orr, E. L., Orr, W. L., and Baldwin, E. M., 1992. Geology of Oregon, fourth edition. Kendall/Hunt. Dubuque IA.

This book discusses general Oregon geology including that of LCM. Included is a discussion of accreted terranes as the most recent geologic model for LCM geology and ore deposits.

Thayer, T. P., 1940. Chromite Deposits of Grant County, Oregon, a preliminary report U.S. Geol. Survey Bulletin 922-D.

This report discusses geology and history of chromite mines in Grant County. Information is provided for the existing condition of adjoining lands to the LCM area.

Thayer, T. P., Case, C. E., and Stotelmeyer, R. B., 1981. Mineral Resources of the Strawberry Mountain Wilderness and Adjacent Areas, Grant County, Oregon. U.S. Geol. Survey Bulletin 1498.

This report includes a broad discussion of the geology and mineral resources of the Strawberry Mountains and surrounding areas, including LCM and adjoining lands.

USDI Bureau of Land Management (BLM), 1984. John Day Resource Management Plan Draft Environmental Impact Statement. U.S. Department of the Interior, Burns District Office. Burns, OR.

This EIS includes information on mineral resources, geology, and past management actions with respect to minerals in the LCM area.

USDI Bureau of Land Management (BLM), 2000a. BLM Publishes Final Environmental Impact Statement on Proposed "3809" Surface Mining Regulations. USDI BLM Office of Public Affairs. Washington DC. http://www.blm.gov/nhp/news/releases/pages/2000/pr001016_3809.htm

USDI Bureau of Land Management (BLM), 2000b. Fact Sheet: Questions and Answers About BLM's Part 3809 Rulemaking. USDI BLM Office of Public Affairs. Washington DC. http://www.blm.gov/nhp/news/releases/pages/1999/qa990209.html

USDI Bureau of Land Management (BLM), 2001. BLM to Retain Key Hardrock Mining Rule Provisions. USDI BLM Office of Public Affairs. Washington DC. http://www.blm.gov/nhp/news/releases/pages/2001/pr011025_3809.htm

The three USDI BLM news releases above provide information on mining regulations including changes through time. The regulations and their changes form much of the basis for past and present management actions in the LCM area.