Monarch Vegetation Management Plan

Prepared for:

MONARCH
EST. MOUNTAIN 1939

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1.0 Introduction

Monarch Mountain Ski Area (Monarch) is owned and operated by PowderMonarch LLC and consists of 1,420 acres that is managed under special use permit (SUP) from the Pike and San Isabel National Forests; Cimarron and Cimarron National Grasslands (PSICC). In early fall of 2012, upon noticing significant die-off of the subalpine fir (*Abies lasiocarpa*), managers of Monarch met with representatives from the PSICC to discuss this trend and identify possible methods of treatment. At the conclusion of the meeting, it was decided that it would be best to develop a full Vegetation Management Plan (VMP) that would address vegetation within the developed Monarch Mountain Ski Area and provide treatment guidance.

Figure 1. Aerial view of Monarch

Therefore, in late fall of 2012, a Common Stand Exam (CSE) inventory on the forested acres within the developed ski area SUP boundary was completed with the purpose of developing baseline conditions of the forest, uncover forest insect and disease issues unknown or unobservable from coarser scale observations and to provide a snapshot of the forested conditions of the area. The data points were spread out across the SUP area and designed to sample differing vegetation types, aspects and elevations within the SUP.

During the routine vegetation plots, it was found that the subalpine fir mortality was caused by a combination of armillaria (*Armillaria sp.)* root disease and western balsam bark beetle (*Dryocoetes confusus*)**.** This combination was present on 14 of 31 plots (45%). Additionally, a recent attack of spruce beetles (*Dendroctonus rufipennis*) was discovered in the Engelmann spruce (*Picea engelmannii*). Spruce beetles were found on 7 of 31 plots

(23%). Consultation with the US Forest Service (USFS) Forest Health Protection Unit in Gunnison, Colorado concluded that the current spruce beetle outbreak will most likely become an epidemic, killing most, if not all of the standing spruce population within the SUP area as it has in the adjacent Rio Grande National Forest (Tom Eager, Personal Communication). Follow-up plots completed by the US Forest Service Health Protection Unit in the summer of 2013 further confirmed this outbreak and most-likely epidemic.

This comprehensive VMP has been completed to ensure that active management can be utilized to provide for forest health, including responding to the current and future mortality of subalpine fir and Engelmann spruce. This VMP includes a full assessment of forest stands, including subalpine fir mortality and spruce bark beetle activity, and outlines potential treatments to manage the vegetation resources. The treatments outlined in the VMP are designed to meet Monarch's operational needs while at the same time achieving the PSICC goals and objectives as outlined in the 1984 Pike and San Isabel Land and Resource Management Plan (Forest Plan).

1.1 Scope of Work

This VMP is written to cover the 880 acres that occurs within the developed Monarch Ski Area Winter Sports permit area. This VMP does not include the 540 acres of Monarch Cat Skiing Outfitter & Guide permitted land that is used for backcountry skiing. As highlighted previously, a major focus of this plan is to manage the current and future mortality of both the subalpine fir and Engelmann spruce.

This VMP is intended to be a planning document that provides current information regarding conditions on the ground that can be utilized to design stand-level projects with prescriptions that can be approved by the Forest Service on a site-by-site basis. It is recognized by PowderMonarch LLC and the Forest Service that all statements, plans, and prescriptions may require National Environmental Policy Act (NEPA) review and approval prior to implementation. It is also understood that Monarch and the Forest Service will work together to develop projects to meet the objectives identified within this VMP and the Forest Service will determine which actions require further NEPA review. Strategically, Monarch may propose VMP projects that spatially align with ski area projects included in the 2011 Monarch Master Development Plan (MDP).

1.2 Regulatory Framework

1.2.1 Consistency with Forest Plan

Monarch operations take place on National Forest System Lands (NFS) and are managed under a SUP. Therefore, all actions must comply with management direction as outlined in the Forest Plan. Written in 1984, the plan includes 21 Management Areas with recommendations that are based on management goals and objectives and overall Forest direction. Monarch's ski operation and SUP fall under Management Area 1B-1 (Existing

Winter Sports Sites). As outlined in the Forest Plan, general direction and goals for this area is as follows:

> "Management emphasis provides for downhill skiing on existing downhill ski sites. Management integrates ski area development and use with other resource management to provide healthy tree stands, vegetative diversity, forage production for wildlife and livestock, and opportunities for non-motorized recreation" (USDA 1984).
>
> "Visual resources are managed so that the character is one of forested areas interspersed with openings of varying widths and shapes. Facilities may dominate, but harmonize and blend with the natural setting. Harvest methods in forested areas between ski runs are clearcutting in aspen, 3-step shelterwood, single tree selection or group selection in Engelmann spruce-subalpine fir, lodgepole pine, ponderosa pine and mixed conifers, or as specified in an approved site specific vegetation management plan" (USDA 1984).

This VMP is written utilizing these standards as well as specific goals and objectives developed by PowderMonarch LLC for this VMP. While this VMP is designed as a strategic document for providing current vegetation conditions and potential treatments to meet Monarch and Forest Service goals, it is understood that prior to implementation, VMP and MDP projects must have additional environmental review/analysis and a decision document per NEPA.

1.2.2 Consistency with the Monarch SUP

As outlined in the Monarch SUP, Monarch is required to prepare and annually revise Winter and Summer Operating Plans. As specified:

> "The provisions of the Operating Plan and the annual revisions shall become a part of this permit and shall be submitted by the holder and approved by the authorized officer of their designated representatives. This plan shall consist of at least the following sections:…10. Vegetation Management" (USDA 2002).

This VMP is designed to meet the above-stated SUP requirement. Additionally, the SUP has the following requirements for the cutting of trees:

> "Trees or shrubbery on the permitted area may be removed or destroyed only after the authorized office has approved and marked, or otherwise designated, that which may be removed or destroyed. Timber cut or destroyed shall be paid for by the holder at appraised value, provided that the Forest Service reserves the right to dispose of the merchantable timber to others than the holder at no stumpage cost to the holder" (USDA 2002).

2.0 Goals and Objectives

The overall desired future condition is to manage the vegetation within the Monarch SUP area in a manner that allows for current and future use of the site as a developed recreation facility with potential for visitor use growth, while also providing for a "vigorous and healthy forest" (USDA 1984) which is a major purpose of the Forest Plan and this VMP. The specific Goals and Objectives necessary to achieve a healthy forest come from the Forest Plan (which includes Forest Direction and Management Area Direction) and specific goals developed PowderMonarch LLC.

2.1 Forest Direction

As defined in the 1984 Forest Plan (USDA 1984): "Forest Direction consists of goals, objectives and management requirements which are generally applicable to the entire Forest."

> "Goals are concise statements describing a desired condition to be achieved sometime in the future. They are expressed in broad general terms and are timeliness in that they have no specific date by which they are to be completed."

The following are goals that relate to vegetation management within the SUP boundary at Monarch:

1. "Maximize present net value while emphasizing opportunities to improve water, fish and wildlife, outdoor recreation, and other amenity values."
2. "Provide a broad spectrum of developed and dispersed recreation opportunities in accordance with identified needs and demands."
3. "Provide opportunity for winter sports to meet expected demand."
4. "Practice vegetation management to provide multiple benefits using a comprehensive timber management program as a tool."
5. "Implement an integrated pest management program emphasizing silvicultural management of timber stands to prevent and control insect infestations and disease."
6. "Improve age class and species distribution of tree stands forest-wide."
7. "Improve the health and vigor of all vegetation types."
8. "Enhance and/or preserve scenic values along heavily traveled roads, use areas and trails through management activities."

2.2 Management Area Direction

In addition to overall Forest Direction, specific direction for an area/resource comes from Management Area Direction. As stated in the Plan,

> "Management Area Direction contains management requirements specific to individual areas within the Forest and are applied in addition to the Forest Direction Management requirements. Management Direction responds to public issues,

management concerns, and opportunities within the availability, suitability, and capability of the land and resources" (USDA 1984).

The Monarch SUP falls into Management Area 1B-1 (Existing Winter Sports Sites). As covered in Section 1, Management Area 1B-1 has general direction and goals. Additionally, there is specific Standards and Guidelines that relate to particular management activities that may take place within Management Area 1B-1. The following sections describe each management activity.

2.2.1 Visual Resource Management

The general theme of this management activity is to "emphasize visually appealing landscapes (vista openings, rock outcroppings, diversity of vegetation, etc.)" (USDA 1984). In terms of standards and guidelines, management activities can't exceed an Adopted Visual Quality Objective (VQO) of modification. In areas where this objective is not currently being met, it may be necessary to apply rehabilitation practices.

2.2.2 Recreation Site and Construction and Rehabilitation

This management activity has two primary purposes:

1. "Design and locate improvements on winter sport sites to provide safety to users and to harmonize with the natural environment."
2. "Design and construct ski areas to blend the lift line, ski runs, and related developments with the natural character of the landscape." This is accomplished utilizing the following direction:
    a. Use vegetative screening of structures where vegetative recovery is slow.
    b. Stabilize cut and fill slopes or areas cleared of vegetation as soon as possible using both structural and vegetative techniques.
    c. Design ski runs to avoid snow scour and to favor deposition of snow.
    d. Avoid or control avalanche or flood hazard areas.
    e. Avoid vegetation removal or location of structures that favors the loading of avalanche starting zones (USDA 1984).

To meet the standards and guidelines, those doing the work need to follow construction and reconstruction standards that are specified in the approved MDP.

2.2.3 Management of Developed Recreation Sites

The premise of this management activity is to "provide opportunities for year-round recreation use of the permitted area and facilities" (USDA 1984). Monarch does not currently operate during the winter off-season, and according to the MDP, at this time; "does not support summer operations such as mountain biking, hiking, chairlift rides, special events, etc." (Monarch 2011).

2.2.4 Silvicultural Prescriptions

One of the objectives of this VMP is to have a written plan as required that outlines conditions and treatments. Silvicultural treatments will be the primary tool used to move the vegetative conditions toward desired conditions. This Vegetation Management Plan will identify opportunities for managers to work within the general direction provided through the Forest Plan and SUP/MDP to promote the following vegetative goals:

1. "Manage forest cover types on the permitted area to enhance visual quality, diversity, and recreation opportunities, and to provide for a healthy forest cover in existing winter sports sites."
2. "Manage tree stands between ski runs by three-step shelterwood, single tree selection, or group selection process with minimal site disturbance. Longer skid distances may be used to avoid road construction."
3. "Limit timber harvest activities to periods of low recreation use activity or to coincide with ski area construction activity."
4. "Utilize firewood material using both commercial and noncommercial methods."
5. "The combined water yield effects of type conversion on ski runs and increased on-site water from stand regeneration must be determined. Do not exceed threshold limits of water quality and drainage system stability deterioration."
6. "For management purposes of forested areas between ski trails or other permanent openings, a cut-over area is considered an opening until such time as:
    a. increased water yield drops below 50% if the potential increase,
    b. forage and/or browse production drops below 40% of potential production,
    c. deer and elk hiding cover reaches 60% of potential,
    d. minimum stocking standards by forest cover type and site productivity are met, and
    e. the area appears as a young forest rather than a restocked opening, and takes of the appearance of the adjoining characteristic landscape" (USDA 1984).

2.3 PowderMonarch LLC Specific Goals

PowderMonarch LLC has developed the following goals and objectives in the context of vegetation management:

1. Maintain safety of employees and guests.
2. Protection of ski area infrastructure.
3. Create healthy green forests over time that are aesthetically appealing.
4. Maintain and improve the overall user experience including access to the mountain that includes a variety of types of skiing including gladed (removal of small trees for better access), trail, and tree skiing.

2.3.1 Safety of Employees and Guests and Protection of Ski Area Infrastructure

As a developed winter recreation site, both the Forest Service as well as PowderMonarch LLC consider maintaining the safety of employees and guests a priority. Although winter sports can be inherently dangerous, hazards to employees and guests related to forest vegetation can be reduced through the active management of those resources. The primary

vegetation risk is hazard trees. Hazard trees are those trees, which may contact employees or guests by falling and/or coming in contact with ski area infrastructure such as lifts or buildings. Given the current and predicted beetle induced mortality, this risk is likely to increase over time as the dead trees deteriorate and lose their ability to withstand the elements and fall. The overall goal is to identify hazard trees and implement mitigation measures so that employees and guests are not exposed to the threat of hazard trees and infrastructure is protected from damage.

2.3.2 Forest Health and Visual Resources

Forest health and maintenance of visual resources are primary goals of the 1984 Forest Plan and PowderMonarch LLC recognizes the importance of a creating and maintaining a healthy and vigorous forest that is green and aesthetically appealing. Given the current and predicted insect and disease outbreak, forest stands throughout the SUP are likely to experience high levels of mortality and will change significantly in both species composition and structure over the next 10-20 years. This forest change is likely to affect ski area operations and management as snow retention and skier traffic management are affected by the mortality.

The long-term goal of promoting a healthy forest that is resilient over time may be achieved through a variety of silviculture methods. Different techniques as outlined in the Forest Plan may be used to manage the forested areas to achieve this goal and goals related to vegetation, while at the same reducing the affects to the visual resources. Techniques of harvesting and/or reforestation will move the area towards the desired condition. Maintenance of these areas will be required as well as long-term monitoring. Monitoring will allow managers to identify trends in the vegetation condition, including insect and disease levels. Monitoring should also include other aspects of forest systems such as hydrology, soils and wildlife to give managers more insight into the natural systems within the SUP.

2.3.3 Recreation User Experience

As a developed recreation site, the overall user experience is very important and is considered a major goal of the MDP. Essentially, user experience is best described by what opportunities are and can be provided. In terms of winter recreation, PowderMonarch LLC would like to provide users with a variety of conditions including gladed, trail, and tree skiing.

Currently, the forested islands within the developed ski area are primarily Engelmann spruce with very little structural diversity and few other species represented. Thus, there are a limited variety of vegetation types and conditions present within the SUP for users to experience. The current and predicted insect epidemic is likely to further impact those limited diverse conditions. However, by utilizing a variety of silvicultural methods, management can promote differing conditions that will achieve diverse forest cover and visual quality. Managers can capitalize on the existing vegetation diversity and promote regeneration through different strategies that can move the forest resources within the

SUP towards the desired condition outlined in the Forest Plan and PowderMonarch LLC goals.

3.0 Literature Review

When developing a vegetation management plan, it is important to consider past and current research that pertains to the resource itself and to the primary issues affecting the resource. With Monarch's vegetation being largely Engelmann spruce and subalpine fir, the first section of this literature review will focus on the ecology and silviculture of Engelmann spruce and subalpine fir forests. The second section will discuss the spruce beetle epidemic, the types of concerns that are associated with a landscape level outbreak and why management is important.

3.1 Landscape Overview

While Monarch has several different vegetation types within the developed ski area including lodgepole pine and grass/forbs, the predominate vegetation type is spruce-fir. Throughout Colorado in the Central and Southern Rocky Mountains, Engelmann spruce and subalpine fir forests are located at elevations above 9,000 feet and are considered the largest and most productive timber resource in the Central Rocky Mountains (Alexander 1987; Miller and Choate 1964). Spruce-fir forests have high productivity (Alexander 1980; Miller and Choate 1964) due to their fast growth rate (Miller and Choate 1964) and the fact that they typically occupy the areas with the highest potential water-yielding capacity (Alexander 1977; Alexander and Edminster 1980; Miller and Choate 1964).

Engelmann spruce is normally larger than subalpine fir and depending on growing conditions, can reach diameters between 15 and 40 inches (Alexander 1987; LeBarron and Jemison 1953; Miller and Choate 1964). Normally, Engelmann spruce lives for several centuries, reaching maturity between 300-450 years, but continuing to grow steadily throughout the later years (Alexander 1987). Engelmann spruce is considered shade tolerant and can be found growing co-dominantly with subalpine fir (Alexander 1987; Shea 1985). It can also be found growing in pure stands, without the presence of subalpine fir (Alexander 1987). While Engelmann spruce typically grows in even-aged stands (Alexander 1987; Miller and Choate 1964), research has found that two-three storied stands are not uncommon (Alexander 1973; Miller 1970). Varied stands are most likely the result of past disturbances (fire, insect epidemics, windthrow, or cutting) or the product of normal gradual mortality (Alexander and Shepperd 1984). Within spruce-fir habitats, elevation can dictate the overall species composition. For instance, research by Alexander (1987) found that "at mid elevations (10,000-11,000 feet), these forests are frequently pure spruce in the overstory with fir predominating in the understory."

Subalpine fir is typically the smaller of the two species found within the spruce-fir habitat and depending on location, can either be shrub-like (near timberline) or tree-form (under closed-forest conditions) (Alexander 1987; Alexander et al. 1984). In tree-form, subalpine fir can reach diameters of 12-24 inches and heights of 45-100 feet. Subalpine fir is considered a slow growing species, "trees 10 to 20 inches in diameter are often 150 to 200

years old under closed-forest conditions" (Alexander 1987). Similar to Engelmann spruce, subalpine fir can be found growing in pure stands, but is more commonly part of the understory, representing two-thirds to three-fourths of the understory and advanced regeneration (Alexander 1987). This is due in part to the fact that subalpine fir is very shade tolerant (Alexander et al 1984).

3.2 Insect Outbreak Concerns and Management

While insect outbreaks are a natural part of an ecosystem and have been responsible for large disturbances throughout history, it is only through recent research that those involved with natural resource management have began to understand how these disturbances affect the public, and how that relates to management. Past research indicates that insect outbreaks not only cause dead and dying trees, but also affects the overall human dimension for those living near or adjacent to insect outbreaks (Buhyoff, Wellman, & Daniel 1982; Chang et al. 2009; Flint, McFarlane, & Muller 2009; Flint, Qin, & Ganning 2012). This is especially true for communities dependent on forest resources, making them vulnerable to natural risks (Flint & Luloff 2005; Qin & Flint 2005). This section will focus on two primary issues of insect outbreaks: 1) public concerns and 2) management.

Understanding and addressing local public concerns is important, especially with regards to natural resources (Brunson & Shindler 2004; McFarlane et al. 2006). Recent research explains that while perspectives within communities vary widely, overall the public is concerned with insect outbreaks when they occur within or near the community in which they live. For example, research by Flint (2006) on the spruce beetle impacts on the Kenai Peninsula in Alaska, looked at how residents in six different communities (Homer, Anchor Point, Ninilchik, Cooper Landing, Moose Pass, and Seldovia) felt regarding impact from insect outbreaks. The main concerns within these six communities were falling trees, aesthetic loss, fire hazard, land use conflicts, trail and forest accessibility, property value, logging, timber industry, job creation, forest rejuvenation, forest awareness, and firewood. Overall, Flint (2006) found that community residents were very perceptive to impacts from spruce beetle outbreaks, having identified more impacts than the scientific literature had at the time, and that the different communities identified a wide variety of impacts and potential risks.

New research by Flint et al. (2012), found similar results in nine Colorado communities that were experiencing a mountain pine beetle (*Dendroctonus ponderosae*) epidemic. In their study, they surveyed nine mountain communities (Breckenridge, Dillon, Frisco, Granby, Kremmling, Silverthorne, Steamboat Springs, Vail, and Walden) to find out what they felt were the main risks (concerns) associated with large insect outbreaks. Similar to those from the Kenai Peninsula in Alaska, Colorado residents listed the following as their main concerns: forest fire, falling trees, decline in wildlife habitat, impact on livestock grazing, increased erosion and runoff, invasive plant species, loss of forests as an economic resource, loss of scenic/ aesthetic quality, loss of tourism/ recreation, loss of community identity, and impact on property values.

The other main issue associated with large insect outbreaks is management, including support for active management following an epidemic, how the public views those responsible for management, and lessons learned regarding community involvement. New research by Kooistra and Hall found that "people generally support active forest management to mitigate negative impacts associated with disturbance" (2014). Furthermore, "no action" had very low support, illustrating the desire for active forest management (Kooistra and Hall 2014). Finally, those affected by large disturbance recognize that there is practical constraints in dealing with large-scale mitigation, but regardless, still prefer to see active management to mitigate and/or minimize the potential social and ecological concerns associated with outbreaks (Kooistra and Hall 2014).

Although varied across the nine different communities, the research by Flint et al. shows that public satisfaction with land managers is lowest for developers, the U.S. Forest Service, and the Bureau of Land Management; and highest for local fire departments, homeowner associations, and city government (2012). Previous research by Flint highlights public perception of poor management by the federal land management agencies in dealing with insect outbreaks (Flint 2007; Flint et al. 2009). As stated "in other communities, however, there was bitter resentment about what was perceived as decades of neglect to active forest management blamed on federal land management preference for environmental regulations. This led to profound distrust between local residents and forest managers" (Flint et al. 2009).

Throughout the different research involving large insect outbreaks, several different lessons learned were presented that can be informative information for land managers. Central themes include: communication, trust, coordination, and relationships. As Flint et al. highlight in their 2012 research, "these findings suggest value in regular communication between communities and forest managers about the physical extent of beetle impacts as they evolve over time to coordinate treatment efforts." Furthermore, it may be necessary to decrease the level of distrust and resentment in order to build relationships between communities and forest managers (Flint et al. 2012). Additionally, forest managers can be helped if they work with communities to identify issues of high concern that require management, recognize contentious issues, and be timely with management (Flint 2006). Also, collaborating early with the public and interested stakeholders in the forest decision-making and management process will further help land managers (Flint et al. 2009). Finally, research by Qin and Flint in 2010 shows the importance of recognizing that each community is different and that it is important to tailor resource management to specific communities in the planning stage to facilitate the implementation process (2010).

4.0 Methodology

4.1 General Forest Inventory

In order to better understand the current conditions, a forest inventory was completed within the 880 acres of the developed Monarch Mountain Ski Area Winter Sports permit area in the fall of 2012. The inventory was conducted using the USFS Common Stand Exam protocols and the information collected is archived in the USFS FSVeg database. The

sampling design was developed by Alex Rudney, Silviculturist on the San Isabel National Forest and included the following protocol specifics:

- Random sample plots with the goal of having sufficient plots in every major vegetation type.
- 31 total plots (designed to have sufficient plots in each vegetation type rather than to meet a certain sampling error)
- Plots were completed using a 20 basal area factor variable-radius plot that tallied and measured all trees 5.0 inches Diameter at Breast Height (D.B.H.) and greater.
    - For every tree that was counted with the variable plot, the following information was collected:
        - Diameter at breast height (D.B.H.)
        - Total height
        - Tree status (live or dead)
        - Tree class (desirable, acceptable, growing stock, or rough)
        - Species
        - Crown ratio
        - Crown Class (dominant, co-dominant, intermediate, overtopped)
        - Age and radial growth was collected on the first tree clockwise from North on every plot.
        - Evidence of damage including insects, disease, and animals
- A 1/250th acre fixed-area plot was used to capture all trees smaller than 5.0" D.B.H.
    - For any tree that was counted with the fixed-area plot, the following information was collected:
        - Diameter at breast height (if applicable)
        - Total height
        - Tree status (live or dead)
        - Tree class (desirable, acceptable, growing stock, or rough)
        - Species
        - Crown ratio
        - Crown Class (dominant, co-dominant, intermediate, overtopped)
- A 10th acre fixed-area plot was used to determine surface cover and vegetation cover data using an ocular estimation.

Additionally, the FSVeg database was used for analyzing the data to determine the following:

- Average basal area (BA) for the total forested area
- Average basal area (BA) for each forest type and basal area range
- Average trees per acre (TPA) for each forest type
- Average age per species
- Damage report (including spruce beetle, balsam bark beetle, and armillaria root disease

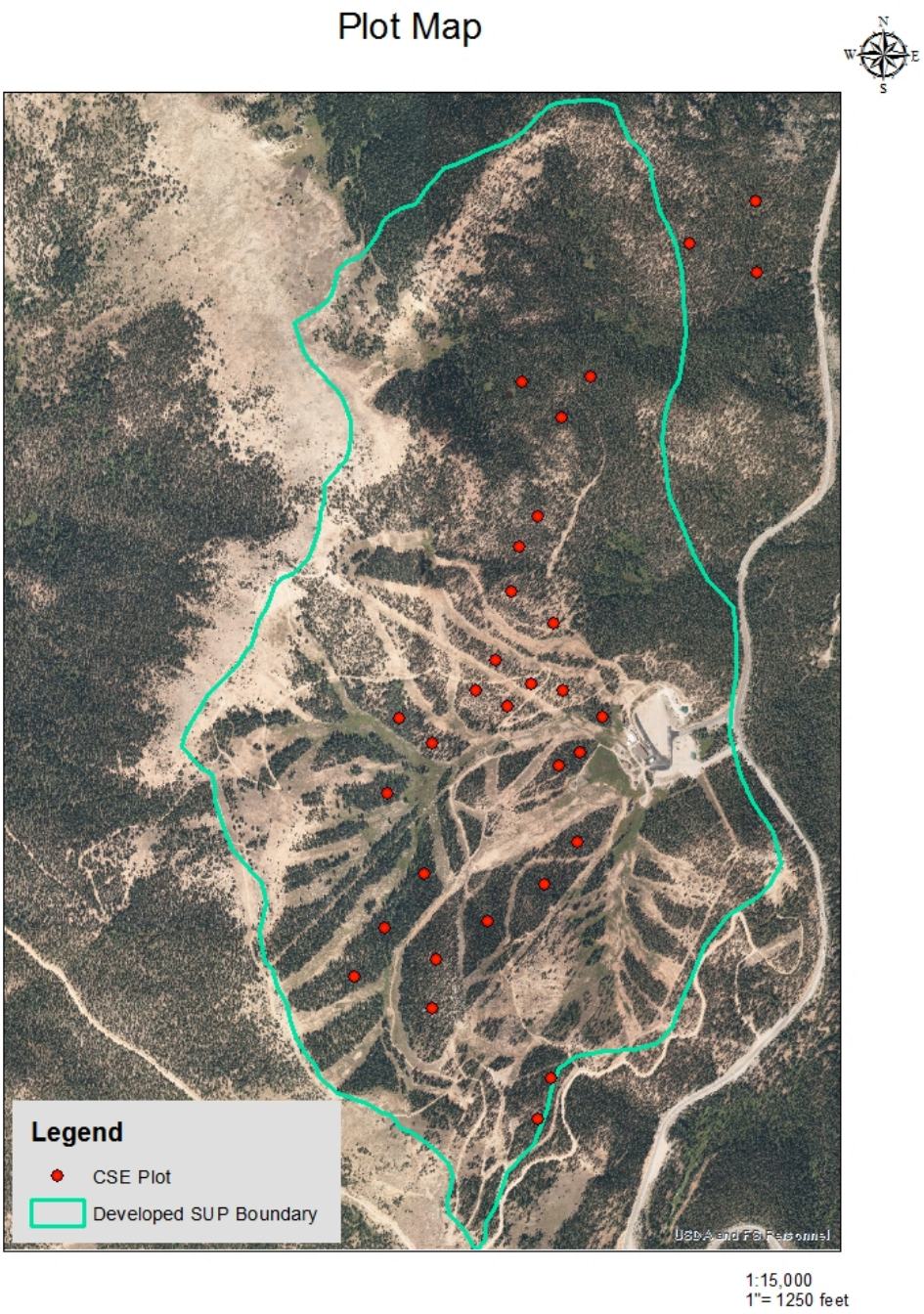

Figure 2. Plot map

4.2 Spruce Beetle Inventory

After finding a significant presence of spruce beetles (23% occurrence within the CSE plots), the US Forest Service Forest Health Protection Unit out of Gunnison, Colorado decided to complete an intensive bark beetle survey in the summer of 2013 to further determine the level of infestation. The sampling design was developed by Tom Eager, Entomologist, and included the following protocol specifics:

- Random sample plots
- 64 total plots (designed to be located within major forest islands rather than meet a specific sampling error)
- 1/30th acre fixed-area plot that measured every tree within the plot greater than 1 inch.
    - For any tree that was counted with the fixed plot, the following information was collected:
        - Diameter at breast height (D.B.H)
        - Species
        - Tree status (live or dead)
        - Presence of spruce beetle
            - Year of spruce beetle attack (estimated)

4.3 Forest Vegetation Simulator (FVS)

The Forest Vegetation Simulator, which is a Forest Service, U.S. Department of Agriculture, nationally supported framework for forest growth and yield modeling, was used for the following modeling:

- Mountain pine beetle (*Dendroctonus ponderosae*) and spruce beetle risk rating

5.0 Existing Ecological Conditions

5.1 General Description

Monarch is located in Chaffee County in South-Central Colorado. Topographically, Monarch is situated on the east side of the Continental Divide, is located in the Sawatch Mountain Range, and has elevations that range from 10,790 feet elevation at the bottom to 11,942 elevation at the summit (Monarch 2011). Aspect is primarily east to southwest with small amounts of north-northwest aspect. Slope varies from almost flat or 0 percent at the lodge and parking area up to very steep on the ski slopes, with slopes greater than 40 percent (Monarch 2011).

5.2 Site History/ Land Use

Monarch was developed in 1939 as a Works Progress Administration (WPA) project, to be utilized for winter recreation. After the initial development, which included a single rope tow up Gunbarrel trail, the ski area was given to the City of Salida. Upon acquiring the ski area, the City of Salida applied for a SUP and further developed the area by adding an additional rope tow and a small lodge. Since that time, the ownership of Monarch has changed numerous time and several additions to infrastructure have been added. The following describes the history of the Monarch Ski Area:

- 1955 – City of Salida sold Monarch to Ray Berry (General Manager)
- 1957 – added T-Bar tow to the top of Little Jo trail
- 1960 – first aerial lift installed at the present Garfield lift location
- 1965 – clearing of many trails and addition of the base lodge and facilities

- 1968 – Monarch sold to Elmo Bevington
- 1968 – Breezeway lift installed
- 1969 – Garfield lift installed and new parking lot developed
- 1979/80 – Monarch sold to Westlake Mortgage and Investment Corporation
- 1980 – Panorama lift installed and base lodge size doubled
- 1981 – Tumbelina lift installed, replacing the Poma lift on Snowflake trail
- 1983 – Patrol clinic building installed
- 1987 – Children Center building installed
- 1987 – Monarch forced into bankruptcy and assets were awarded to the Seventh Elect Church in Israel (Seattle, WA) and State of California by legal judgement.
- 1990 – Monarch comes out of bankruptcy and is sold to Japanese businessman Hidiuki Nakamura.
- 1996 – Nakamura sells Monarch to Goodwin Gaw, who was based in California.
- 1998 – Waste Water Treatment Plan and above ground fuel storage tanks installed
- 1999 – Pioneer lift installed
- 2002 – Sediment mitigation basin installed
- 2002 – Monarch sold to PowderMonarch LLC
- 2002 – Present - $10 million invested including expanding and upgrading the deck (2003), paving the parking lot (2005), addition of the Rental and Lesson Center (2006), conveyor lifts for the Ski & Ride School (2006), new mountaintop Patrol building (2007), a new water storage system (2008), upgraded the Garfield lift terminal (2010), covered Catepillar conveyor lift (2011), a 16,000 square foot expansion of the base lodge (2012, and added an additional 100 parking lot spaces (2013).

Currently, the area is primarily used for winter recreation in the form of downhill skiing and snowboarding. Monarch includes 58 trails, 2 terrain parks, 6 lifts, a main lodge, a day care/ rental facility, plus several other outbuildings for maintenance (Monarch 2011). Presently, vegetation management at Monarch that is approved under their SUP and associated NEPA document includes liability maintenance of dead and dying trees, as well as removal of trees for improved skier traffic and infrastructure maintenance, glading, and new trail construction. Typically, Monarch will flag trees that they feel need to be removed and then will notify the Forest Service. The Forest Service will visit the site and decide on whether the trees need to be removed. Once the trees are felled, Monarch generally uses the material on site. Overall, very little vegetation management has taken place within the 880 acres.

Although little disturbance has taken place within the SUP boundary except for ski area development, Monarch and the surrounding area has a long history of human disturbance prior to 1939. Nearby Monarch Park was once called Chaffee City (later named Monarch) and was home to over a 1000 residents during its boom (Vandebusche 2010). The settlement of Monarch provided services to the Monarch and Madonna Mines, which "produced over $14 million of silver, gold, lead, and zinc during its operation" (Vandebusche 2010). Additionally, much of the area around Monarch, including Monarch Pass, was logged by mining companies during the late 1800's to support the on-going

mining operations. While some was used for building material, a lot was used for charcoal, which was needed in the smelting process (USDA 1935).

5.3 Natural Disturbances

Within the area of the Monarch Ski Area and the surrounding landscape, the only recorded natural disturbance was a very large avalanche that occurred in 1907. The avalanche took place near Chaffee City and destroyed many outbuildings and trees that had not been cut during the intense period of logging (Vandebusche 2010).

5.4 Existing Vegetation Community

Information included in this section comes from the existing Common Vegetation Unit standard GIS layer, which was utilized to determine cover type and vegetation structural stage (VSS) and from data collected during the 2012 CSE forest inventory that is stored in FSVeg. Utilizing the GIS layer, it was determined that of the total 880 acres, there is 599 acres that are forested (68%). Spruce-fir forests dominate the forested landscape of Monarch and represent 89% of the forested acres for a total of 534 acres. Lodgepole pine is the other forest type represented and makes up the remaining forested areas for a total of 65 acres (11%). The remaining 281 acres are non-forested and consists of grass/forbs (ski runs) and bare ground (parking lot and roads).

In terms of VSS, forested stands are typically broken down into 5 stages based on tree diameter. Further breakdowns occur within the VSS 3, 4, and 5 classes into sub-classes that are based on crown cover percentage. The following table outlines the parameters for various structural stages and crown cover classes.

Table 1. Region 2, Rocky Mountain Resource Inventory System(RMRIS) Database Vegetation Structural Stage

Code	Habitat Structural Stage	Tree Size Class	Diameter Range	Crown Cover %
1	Grass-forb	Non-stocked	NA	0-10
2	Shrub/seedling	Established	Less than 1 inch	11-100
3A	Sapling-pole	Small, medium	Trees mostly 1-9 inch	11-40
3B				41-70
3C				71-100
4A	Mature	Large, very large	Trees mostly 9 inches and larger	11-40
4B				41-70
4C				71-100
5A	Old-growth	Large, very large	Varies	11-40
5B				41-70
5C				71-100

5.4.1 Spruce-Fir

The spruce-fir forest type is the largest vegetation cover type within the VMP project area, covering 534 acres, which represents 61% of the total project area. This vegetation type includes stands dominated by Engelmann spruce and subalpine fir. A total of 55 stands are classified as spruce-fir and overall stand size varies from 1 acre to 64 acres. Average age for this forest type is 148 and basal areas vary across the landscape from as low as 41 BA to over 176 BA. The average spruce-fir basal area for all the stands is 115 BA. On average, there are 246 trees per acre (TPA) in trees larger than 5" DBH, and 297 TPA in trees less than 5 inches. All of the smaller trees are categorized as rough, meaning that if they do survive in the future, they will most likely be undesirable trees. Understory vegetation is driven by soil development and soil moisture and the primary species found within the spruce-fir vegetation cover type is myrtleleaf blueberry *(Vaccinium myrtillus*) (USDA 1998). Based on the vegetation GIS layer of the spruce-fir cover type within the VMP project area, the current VSS classes are represented in Figure 3. As highlighted by the pie chart, the spruce-fir cover type is primarily even-aged with large trees and very little structural diversity.

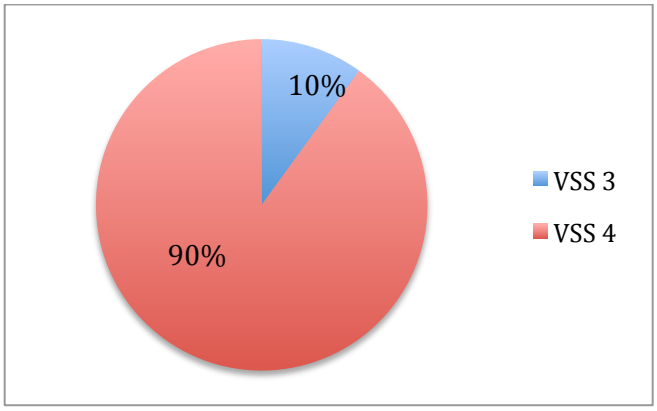

Figure 3. Percentage of spruce-fir by VSS

During the 2012 CSE forest inventory, evidence of recent spruce beetle attacks were found to be present on 7 of 31 plots (23%). Additionally, utilizing the spruce beetle risk rating post processor in FVS, it was found that 54% of the stands currently have physical characteristics that place in the moderate range for spruce beetle risk. Another 15% of the stands are in the low-moderate range and only 25% of the stands are considered low risk for spruce beetle. It is important to recognize that the FVS spruce beetle risk rating post processor is based on populations that start in a stand from a single tree, rather than large epidemic populations such as those currently occurring (Tom Eager, personnel communication). With the lack of management and natural disturbance, stand basal area and average tree diameters have steadily increased since the ski area was developed and now have crossed thresholds that lead to a higher risk of potential spruce beetle mortality. Without a large-scale disturbance such as fire or vegetation management, spruce beetle risk will continue to increase over time. Spruce beetle risk is highest in larger, denser

spruce stands on cool, moist aspects. Age class diversity also plays a large role in reducing spruce beetle risk as younger, smaller diameter stands are less susceptible.

As mentioned in Section 1, the VMP process was started due to the initial concerns regarding the subalpine fir mortality. During the 2012 CSE forest inventory, it was determined that the mortality was caused by a combination of armillaria (*Armillaria sp.*) root disease and western balsam bark beetle (*Dryocoetes confusus*). This combination was present on 14 of 31 plots (45%).

5.4.2 Lodgepole Pine

Lodgepole pine is the other primary forest type in the VMP project area, covering 65 acres, which represents approximately 7% of the total project area. A total of 3 stands are classified as lodgepole pine and stand size varies from 2.3 acres to 42.6 acres. Although these stands are classified as lodgepole, they do have other species including Engelmann spruce and subalpine fir. Average age for this forest type is 117 and average basal area is 152 BA. The BA for just lodgepole pine trees in these stands is 84 BA. Average TPA is 333 for the trees larger than 5" and 333 for trees less than 5 inches. Similar to the spruce-fir, most of the trees less than 5" are considered rough. Understory vegetation is again driven by soil development and moisture, with the two main species being myrtleleaf blueberry and common juniper (*Juniperus communis*). The current VSS classes are represented in Figure 4. Similar to the spruce-fir, none of the lower VSS classes are represented, although there is a greater amount of diversity between VSS classes 3 and 4. Presently, there is no sign of dwarf mistletoe or mountain pine beetle in the lodgepole pine stands, and utilizing the mountain pine beetle risk rating post processor in FVS, it was determined that none of the stands are currently at risk for beetle related mortality. This is most likely due to the fact that the lodgepole pine stands are not pure pine stands and instead have a fair amount of both Engelmann spruce and subalpine fir.

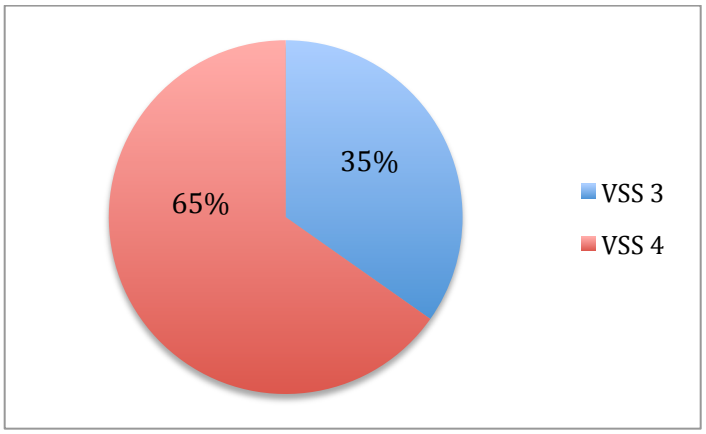

Figure 4. Percentage of lodgepole pine by VSS

5.4.3 Grass/ Forbs

The combined grass/ forb cover type is the second largest vegetation cover type in the VMP project area, containing 264 acres, which equals approximately 30% of the total

project area. This cover type consists of stands classified in the forest cover type layer in GIS as grass and forb. A total of 14 stands are classified as grass, equaling 154 acres and the stand size varies from 1.8 acres to 29.2 acres. The forb component has a total of 8 stands that equal 110 acres and the stand size ranges from 7.3 acres to 21.1 acres. In terms of VSS, all grassland cover types fall into VSS class 1 by definition. The difference in grass cover types is whether or not the acres were previously treed or are perennial grassland types. For instance, VSS 1T indicates that the area was previously treed, whereas VSS1M indicates a pure grassland meadow. Of the 8 forb stands, 6 were previously treed and of the 14 grass stands, 7 were previously treed.

5.4.5 Bare

Bare is smallest cover type in the VMP, accounting for just 2% of the total landscape (17 acres). This cover type represents the parking lot and roads.

5.5 Spruce Beetle

Given the known presence of spruce bark beetles at Monarch from the fall 2012 CSE forest inventory and also the level of spruce mortality taking place south of Monarch on the Rio Grande National Forest, the US Forest Service Health Protection Unit completed an intensive spruce beetle survey in the summer of 2013. The data collected found spruce beetles on 42 out of 64 plots (66%). Of the 42 plots with spruce beetle evidence, 12 plots had only 1 tree infected, 25 plots had 2-8 trees infected, and 5 plots had 9 or more trees infected. Figure 5 shows the spruce beetle plots with corresponding colors of infestation level.

The data showed that 94% of the attacks took place on the entire tree, whereas only 6% of the attacks were considered strip attacks. On the 64 plots, there were a total of 176 Engelmann spruce trees that had been attacked by spruce beetle. The majority (70%) had been attacked in 2013 only, whereas an additional 10% had been attacked in 2013 as well as previous years (see Figure 6). Numbers within the pie chart correspond to number of total trees attacked.

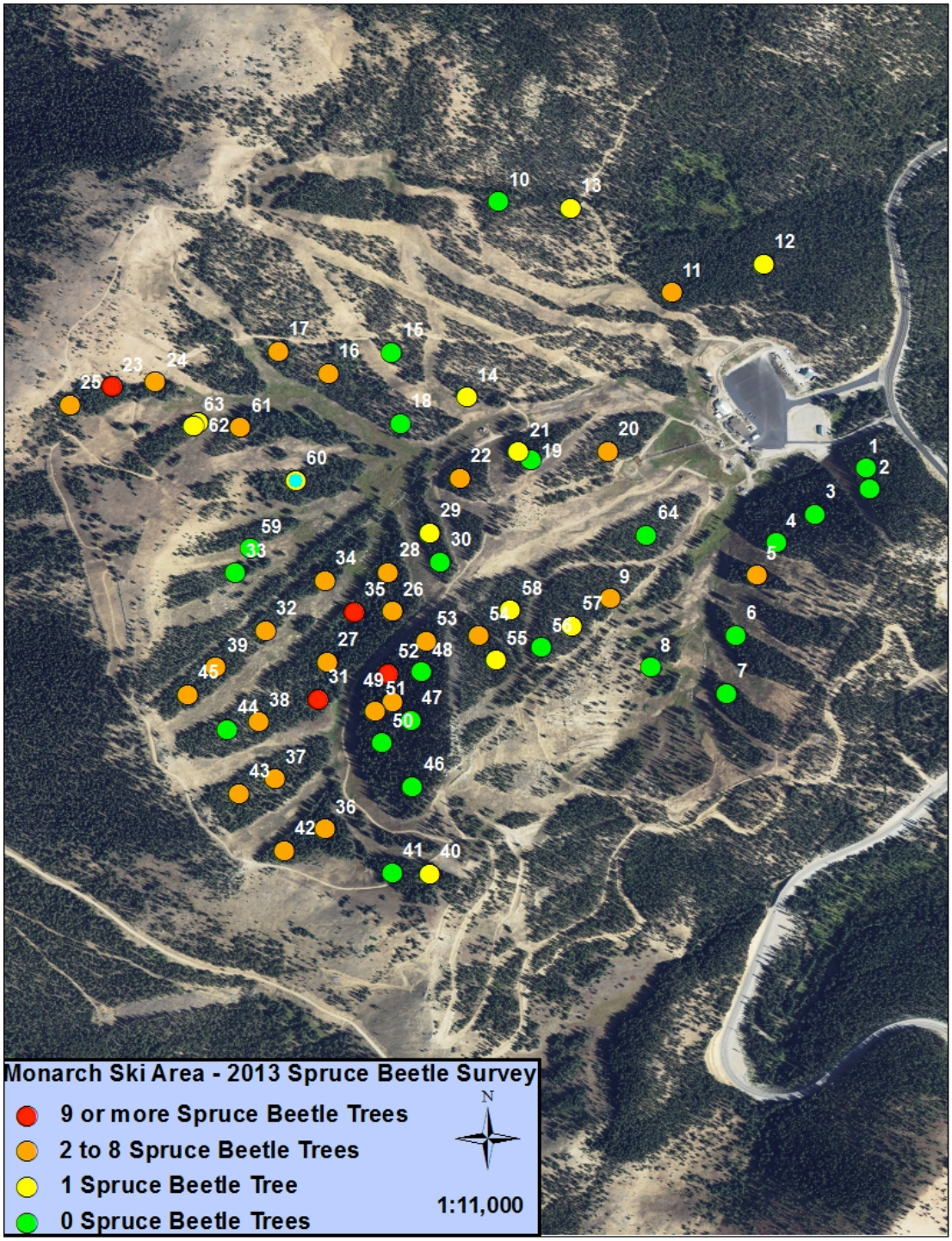

Figure 5. Spruce beetle plots color coordinated with level of infestation

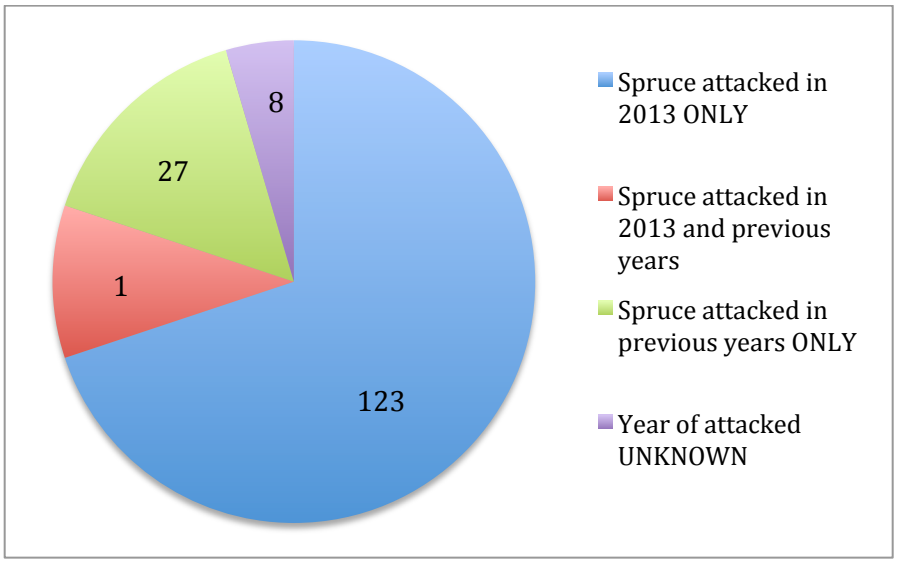

Figure 6. Proportion of spruce beetle attack by years at Monarch ski area.

5.6 Wildlife Habitat

Due to the fact that a significant portion of the 880 acres within the SUP has been developed, the habitat structure that is remaining is very fragmented and disconnected. This is a direct result of permanently clearing vegetation for both lifts and ski trails. Monarch Ski area is currently a mosaic that includes pockets of vegetation that vary in size from a few trees to stands that are 64 acres in size. Very few of these pockets actually connect within the 880 acres and only a few on the outer edges connect to the area outside the special use boundary.

Even though the area is not ideal habit given the development and fragmentation, it is still utilized by many animals for a variety of uses. According to the Environmental Assessment that was prepared by the U.S. Forest Service in 1998 for the Monarch Master Development Plan, the main large animal vertebrate herbivores that use Monarch Ski area include bighorn sheep (*Ovis canadensis*), mule deer (*Odocoileus hemionus*), and American elk (*Cervus Canadensis*). The smaller vertebrate herbivores include red fox (*Vulpus vulpus*), snowshoe hares (*Lepus americanus*), red squirrels (*Sciurus vulgaris*), and ermine (*Mustela erminea*). The two primary bird species found within the Monarch Ski area are the gray jay (*Perisoreus Canadensis*) and the Clark's nutcracker (*Nucifraga columbiana*). Although not large in numbers, these animals play an important role in the ecosystem. For example, the larger species feed on the grasses and shrubs throughout the ski area, stimulating periodic disturbance that increases plant growth. Small mammals and birds feed on conifer seeds, helping to disperse seeds over the landscape.

5.6.1 Canada Lynx Habitat Assessment

According to Welker (2013), all of the acres within the SUP, with the exception of the ski runs themselves, have been identified as primary Canada lynx (*Lynx canadensis*) habitat within the Monarch Lynx Analysis Unit (LAU). The individual ski runs are considered non-

habitat because they are permanent openings in a forest landscape. The majority of the surrounding area on the San Isabel National Forest was also identified as primary lynx habitat (see Figure 7). Primary habitat is defined in the 2013 Lynx Habitat Model for the Pike and San Isabel National Forests as:

- Engelmann spruce-subalpine fir stands
- Aspen stands with ≥ 5% Engelmann spruce – subalpine fire, or lodgepole pine, or white fir with ≥5% spruce-fir component
- Lodgepole pine stands with ≥5% Engelmann spruce/sub-alpine fir
- Any stands with ≥10% ponderosa pine canopy cover or with the presence of Gambel oak were not considered to be lynx habitat (Welker 2013)

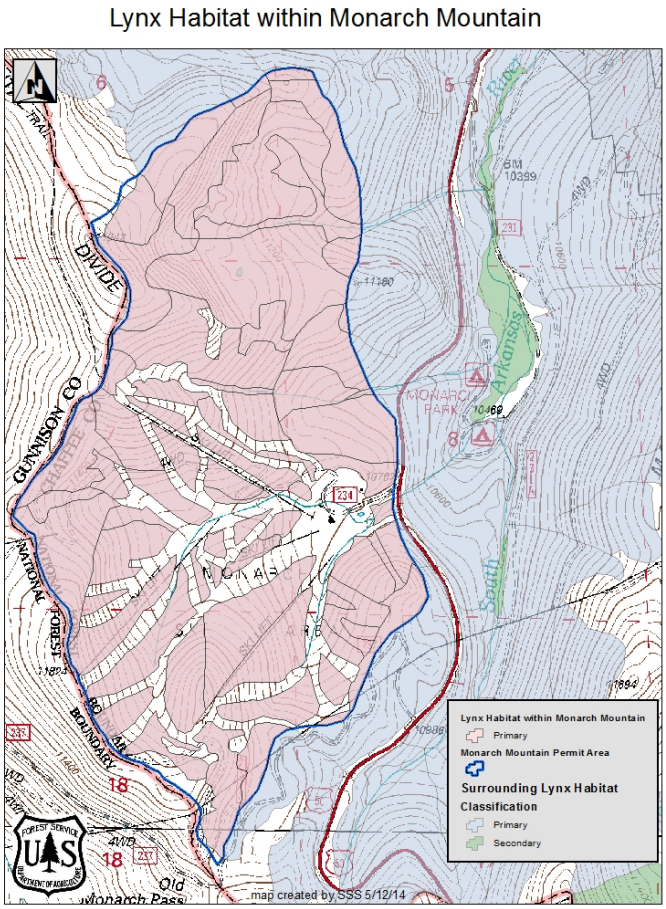

Figure 7. Lynx habitat with Monarch SUP.

5.7 Soils

Utilizing the soils data layer in GIS, it was determined that within the 880 acres, there is a total of 8 different soil types that are part of 4 different complexes. The following break down provides information for the 4 different complexes (USDA 2014).

5.7.1 Leighcan Family – Cryaquolls Complex

This soil complex consists of 65% Leighcan and 30% Cryaquolls soils and is typically found on 0-25% slopes. Rooting depth is usually greater than 60 inches and water capacity is very low to moderate. Permeability is slow to moderately rapid and runoff is slow to medium. This soil type has low potential for landslides, debris flows, and avalanches.

5.7.2 Leighcan-Endlich Families Complex

This soil complex is typically found on steeper slopes (40-60%) and consists of 55% Leighcan and 30% Endlich soils, with 15% cliffs and talus. Rooting depth is greater than 40 inches and water capacity is very low to low. Permeability is moderately rapid and runoff is rapid. Landslide potential is low, but debris flows and avalanche potential is considered moderate.

5.7.3 Howardsville-Leighcan Families

This soil complex consists of 60% Howardsville and 25% Leighcan soils, with 10% cliffs and talus and 5% shallow soils on convex slopes. This soil complex is typically found on steep slopes (40-65%) and has a rooting depth that is greater than 20 inches. Water capacity is very low to low, permeability is rapid to moderately rapid, and runoff is medium to rapid. Similar to the Leighcan Family – Cryaquolls complex, potential for landslides, debris flows, and avalaches is low.

5.7.4 Moran Family-Rubble Land - Rock outcrop-Teewinot Family Complex

This soil complex is a combination of Moran family with rubble land, rock outcroppings, and Teewinot family. Moran family values vary from 30-85% and are found in combination with typically 20% rubble land, 30% rock outcropping, and 20-25% Teewinot family. Depending on the combination, effective rooting depth varies from greater than 20 inches to greater than 60 inches. Water capacity is low to moderate and permeability is moderate to moderately rapid. Runoff is considered medium to rapid. Potential for landslides, debris flows, and avalanches is low to moderate.

5.8 Wetlands and Water Resources

According to a 1997 jurisdictional wetlands survey and delineation, approximately 52 acres of wetlands occur with the SUP boundary. The wetlands are considered subalpine wetlands and include the following types: sedge-dominated fen (5%), spruce-fir forested wetlands (51%), peat-rich fen (28%), and sedge-dominated seeps (16%) (USDA 1998). In terms of water resources, Monarch is part of a smaller sub-watershed, which flows into a small, unnamed perennial tributary that makes up the headwaters of the South Arkansas River near Monarch Pass.

5.9 Climate

With Monarch being located very close to the Continental Divide, it is routinely influenced by weather systems that stay on one side of the Divide or other. Climate is described as typical mid-latitude, high elevation with cool summers and cold winters. Humidity is typically low and nighttime temperature fluctuations are high. Most precipitation comes from storms in the Pacific, in the winter and usually comes in the form of snow. Summer precipitation generally occurs as localized thunderstorms. Mid-mountain at Monarch usually receives an average of 350 inches of snow a year (USDA 1998).

5.10 Desired Future Condition

The Desired Future Condition (DFC) goals for Monarch in terms of ecological considerations are to implement a silvicultural program that will prevent and control insect infestations and disease, improve age class and species distribution of tree stands, and improves the health and vigor of all vegetation types (Forest Plan). Specific DFC objectives include the following:

- Increase species diversity
- Treatment of stands to achieve the following residual VSS percentages:
    - VSS 1 = 5%
    - VSS 2 = 15%
    - VSS 3 = 35%
    - VSS 4 = 35%
    - VSS 5 = 10%
- All treated lodgepole stands have a residual Dwarf Mistletoe Rating of 0-1.
- All treated spruce-fir stands have a low to moderate spruce beetle risk rating
- Stands that incur spruce beetle mortality are treated for removal of dead trees and spruce beetle infested trees.
- Treated stands are naturally regenerated to Forest Plan standards within 5 years.

6.0 Social, Cultural, and Economic Considerations

According to the 1998 Environmental Assessment, Chaffee County and the Town of Salida (20 miles to the east of Monarch) have been defined as the primary areas of socio-economic effect. The towns of Garfield and Monarch are not addressed due to the lack of information. The Town of Gunnison and Gunnison County are also not considered as they are outside the area of primary socio-economic impact due to the distance (45 miles west of Monarch) and the small number of residents employed at Monarch.

6.1 Social Considerations

Monarch is located within Chaffee County, which has a total of 649,453 acres, of which 83.1% are public lands (USDA 1998). Chaffee County has an estimated 2013 population of 18,150, which is a 3.9% increase from the 2010 Census. Residents are primarily white (94.8%), have a median household income of $45,713, and most residents fall between the

ages of 18-65 (62.9%). Over 90% of residents have graduated high school and about 33% have completed higher education (USDC 2014).

Monarch has long been considered a "gem" in the Colorado skier market due to its location, affordability and family friendly environment (Monarch 2011). With strong visitor growth (5% average between 2005/2006 and 2010/2011) and the desire to "create a balanced recreation experience which is appealing to guests and is operationally efficient," Monarch updated their MDP in 2011 to "identify a comprehensive plan for future improvements to the ski area" (Monarch 2011). With a goal of increasing the daily carry capacity by 22%, the MDP consists of a variety of projects including changes to the terrain, upgrades to lifts, potential changes to the SUP boundary, multiple construction projects, and development of a snowtubing facility (Monarch 2011). The MDP was written to address the following 5 major issues:

- Improve the never-ever and beginning ski experience at Monarch by providing an appropriate learning progression in an uncongested area and easier access to the children's teaching area.
- Increase amount of intermediate terrain to meet current and anticipated public demand.
- Cater to the growing advanced-intermediate and advanced skier/snowboarder demographic through additional terrain offerings.
- Improve skier circulation and access to the base area through expanded and relocated guest service buildings.
- Enhance the overall recreation experience by providing convenient on-mountain guest services.

The proposed upgrading plan within the MDP addresses each of these issues, with the goal of "maintaining a desired skiing experience with comfortable terrain capacities" (Monarch 2011).

In addition to the MDP and the desire for growth, it is important to recognize the social aspect of forest management, including the concerns associated with the potential spruce beetle epidemic. As highlighted in the literature review, the public is concerned with large insect outbreaks when they occur within or near the community in which they live or recreate and the preference is for active forest management rather than no action.

6.2 Cultural

According the 1998 Monarch Environmental Assessment, 14 prehistoric and historic sites have been found during past inventories, of which 9 fall within the SUP. The prehistoric sites are primarily tied to nomadic big game hunters and includes "small camps, scatters of chipped stones from sites of unknown function, quarries where stone raw materials were mined or collected, game drives, vision quests and miscellaneous other sites. The historic sites are related to the mining that took place in the area and includes the Monarch Mine (formerly called Chaffee City) and the various roads including the Old Monarch Pass (USDA 1998).

6.3 Economic Considerations

Within Chaffee County, government, retail and the service sector provide 52% of the employment. Government including federal, state, and local is the largest employer within Chaffee County, accounting for 1,755 jobs in 2010, which is approximately 19% (Colorado State Demography Office 2010). Government employers include the Bureau of Land Management, Forest Service, Buena Vista Correctional Facility, Colorado Parks and Wildlife, the United States Post Office, local governments and school districts. The service sector, which includes accommodations, food service, and other services, employed 1,710 people in 2010 (19%), making it the second largest employer within the County. Retail is the third largest employer at 14% and construction is the fourth largest employer at 10.5%. Recreation, entertainment, and arts usually employees around 530 individuals, and Monarch is the largest recreational employer with about 317 employees (Colorado State Demography Office 2010, Monarch 2011).

In addition to being a large employer, Monarch also contributes to the county economically through sales tax and special use fees. Monarch averages approximately 171,000 skier visits per season (Monarch 2011), which generates between $300,000 to $440,000 yearly in sales tax revenue (George Cowherd, personal communication). This funding helps pay for roads and schools within Chaffee County (USDA 1998).

Additionally, since PowderMonarch LLC manages the land through a SUP, they are required to pay the Forest Service special use fees. On average, PowderMonarch LLC pays $150,000 to $270,000 yearly in special use fees (George Cowherd, personal communication).

6.4 Desired Future Conditions

The Desired Future Condition (DFC) goals for Monarch in terms of social, cultural, and economic considerations is to recognize the importance of Monarch to Chaffee County and the local communities in terms of employment, sales tax, and recreational opportunities. Specific DFC objectives include the following:

- Manage the area as a developed recreation facility with potential for visitor use growth.
- Protect areas of cultural importance.
- Achieve the goals identified above in the MDP.

7.0 Vegetation Management Diagnosis

As discussed in Section 2, the overall desired future condition is to manage the vegetation within the Monarch SUP area in a manner that allows the site to be utilized as a developed winter recreation facility, while also providing for a "vigorous and healthy forest" (USDA 1984). Given the variability within the 880 acres, the VMP is broken up into 4 treatment groups based on species and amount of recreation use. Within each group, it is recognized that treatment priorities will be based on objectives, especially safety and protection of infrastructure. Table 2 provides details regarding the 4 treatment groups and Figure 8

showcases the treatment groups on an aerial map.

Table 2. Treatment Groups

Vegetation Type	Acreage	Description
Grass/Forbs	263	Open meadows/ ski runs
Spruce-fir 1	179	Spruce-fir stands that are lightly skied (Mirkwood)
Lodgepole pine	65	Lodgepole pine stands
Spruce-fir 2	373	Spruce-fir stands that contain infrastructure and are heavily utilized for recreation

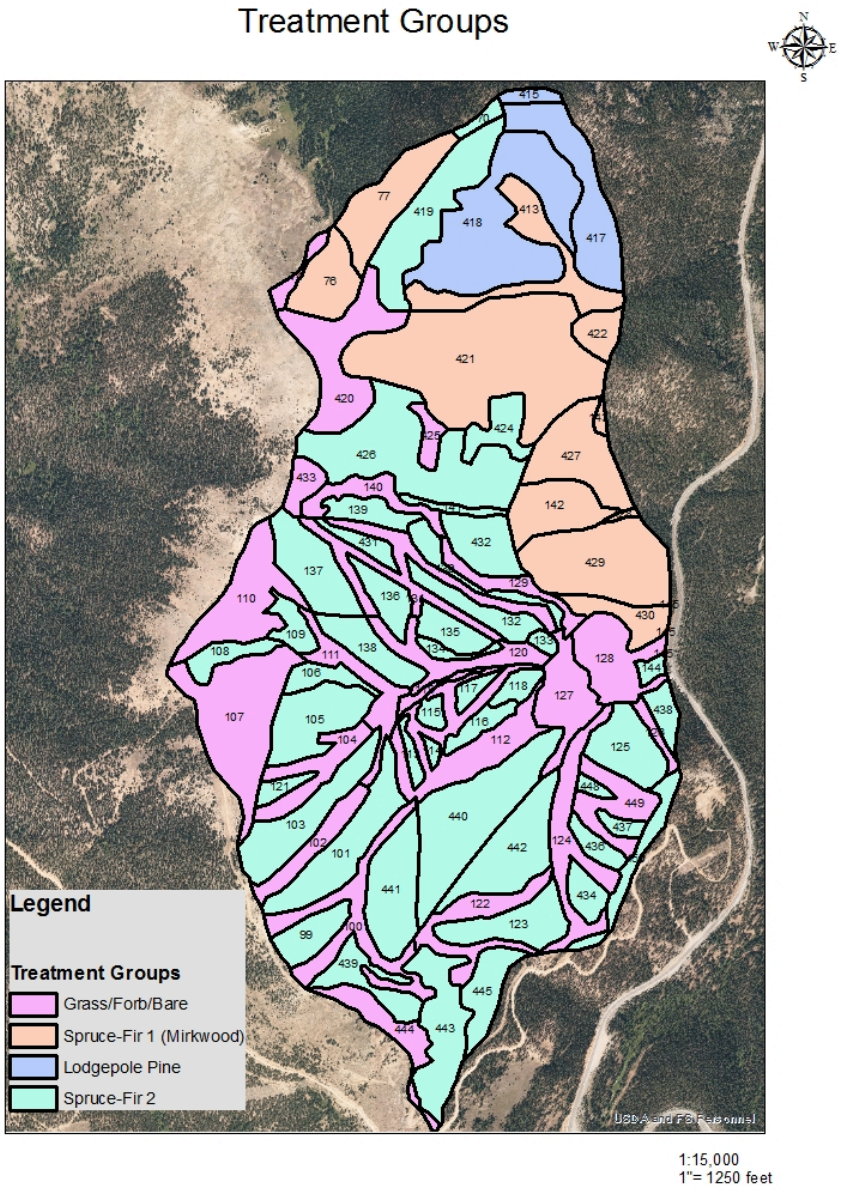

Figure 8. Treatment groups.

7.1 Treatment Scenarios

The treatment scenarios discussed below are based on the 4 treatment groups outlined above and are broken up into different options based on health of the stand and current and future levels of mortality. Reforestation is also discussed and is based on all stand scenarios.

7.1.1 Treatment Group: Grass/Forbs

Given the management direction of maintaining the acres within the SUP as a developed winter recreation facility, this vegetation type should be managed to keep the 264 acres of combined grass and forb stands as open meadows so they can be utilized as ski runs during the winter season. Although many of the stands (13 out of 22) that are now considered grass and forb stands were previously treed, they should be maintained as open meadows to achieve the management direction. Any conifer encroachment of existing grass type stands should be removed either by manual or mechanical methods, providing natural fuelbreaks. In the event of significant spruce-fir mortality, encroaching conifers into the meadows could be transplanted into the forested stands.

7.1.2 Treatment Group: Spruce-fir 1

Spruce-fir 1 consists of 179 acres of spruce-fir stands that are located on the northern end of the SUP boundary in the area generally called Mirkwood Basin. Mirkwood Basin is a non-developed area that is primarily accessible through a 15-minute hike along a cat-track. The stands are fairly dense, but overall recreation use is considerably less compared to the main portion of the resort with developed ski trails.

Treatment Option A – Healthy Stands With Less Than 50% Mortality

This option is designed to move the stands towards uneven-aged management in order to reduce insect susceptibility and create a forest that is structurally diverse at the stand level. As highlighted in Section 5, the spruce-fir cover type within the project area is dominated by stands in VSS 4, with current information showing no stands in VSS 2. The following desired distribution of VSS for spruce-fir is based on a 150-year rotation age:

- VSS 1 = 5%
- VSS 2 = 15%
- VSS 3 = 35%
- VSS 4 = 35%
- VSS 5 = 10%

This distribution meets the PSICC Forest Plan minimum standards and guidelines for a diversity unit minimum of 5% of forested areas in VSS 1 and 10% in VSS 5. As highlighted in the Forest Plan, a more balanced distribution of structural stages improves visual and vegetation diversity, improves vegetation vigor and growth and reduces the risk of insect and disease epidemics (USDA 1984). The desire is to change the VSS distribution shown above by converting those acres currently in VSS 4 into VSS 1-3 by utilizing a combination of silvicultural systems including group selection and thinning from above. Group selection should be utilized to create openings within healthy stands that are ¼ - ½ acre in size or 1

½ the average tree height (to minimize blow down), which will create age diversity, as well as species diversity. Group selection can also be used to remove dead subalpine fir and/or spruce beetle infested trees. In areas with high percentages of advanced regeneration (saplings and small trees), thinning from above should be utilized. Slash should be treated by lop and scatter to provide protection for soil and regeneration and to minimize nutrient loss.

Treatment Option B – Severely Infected Stands with Greater Than 50% Mortality

This option is designed to deal with potential spruce beetle mortality, as well as existing and future subalpine fir mortality. Since this area within the SUP is used considerably less that the main developed area and does not have any existing infrastructure, the treatment should include the following:

- Remove any hazard trees that are near developed trails (up to 1 ½ tree height of tallest surrounding trees).
- Remove all dead trees in areas where skiers routinely gather.
- Manage live trees in clumps so as to minimize windthrow, which is a risk when mortality is high.
- Leave the remaining dead trees to provide protection for regeneration.
- Further protect areas of regeneration with fencing, signing, or barriers where needed to prevent damage from skier traffic.

7.1.3 Treatment Group: Lodgepole Pine

Lodgepole pine is a minor component within the project area, representing just 11% of the forested acres. Similar to the spruce-fir component, the desired future condition is to move the stands toward uneven-aged management. Currently, the lodgepole pine cover type is only represented by VSS 3 and 4, whereas ideally, the distribution would be similar to that identified for spruce-fir. As highlighted above, a more balanced distribution of structural stages improves visual and vegetation diversity, while also improving vegetation vigor and growth and reduces the risk of insect and disease epidemics (USDA 1984). To achieve the desired distribution as well as the target 80-120 BA, silviculture treatments such as group selection and thinning should be utilized. Group selection could be utilized to create small openings that would convert acres currently in VSS 3 and 4 to VSS 1 as well as create additional species diversity. Patch cutting in lodgepole pine stands creates a mosaic of age and size classes, which reduces the acreage of lodgepole pine that could be susceptible to mountain pine beetle at one time.

Thinning lodgepole pine stands is also an option, designed to reduce overall stand density by a measure of basal area to a desired future condition. Average basal area for the lodgepole pine stands is currently 152 BA, which is higher than the recommended 80-120 BA for stands with average DBH of >5.0 inches. This target BA is optimal for lodgepole pine to minimize the risk of blowdown, while also maintaining the low mountain pine beetle risk rating. It is recognized that given the few lodgepole pine stands, it may be difficult to meet the desired VSS distribution. Existing regeneration should be protected and slash should be treated by lop and scatter.

Although none of the stands are currently affected by dwarf mistletoe or mountain pine beetle, these treatments could be utilized to treat infested or highly susceptible stands.

7.1.4 Treatment Group: Spruce-fir 2

Spruce-fir 2 consists of 373 acres of spruce-fir stands that are part of the primary developed recreation area that receives heavy skier use and includes infrastructure such as lifts, towers, and buildings.

Treatment Option A - Healthy Stands With Less Than 50% Mortality
This option is designed to be similar to Spruce-fir 1, with the recognition that these stands are considered tree islands within the developed ski area, and include significant skier related infrastructure such as lifts, towers, and buildings. Some of the stands are fairly open with lots of small trees, whereas others are dense, with very little regeneration. The desire is to move these stands towards uneven-aged management, with a variety of age and size classes, thus creating structural diversity at the stand level. Again, it will be necessary to utilize group selection and thinning from above to convert VSS 3 and 4 stands into VSS 1 and 2 stands. Due to the openness of these stands, windthrow of residual trees is a risk. To prevent blowdown, live trees should be retained in clumps. Windthrow risk is typically higher on ridges and areas where topography funnels winds. Slash should be lopped and scattered to protect soils and regeneration and to minimize nutrient loss.

Treatment Option B - Severely Infected Stands with Greater Than 50% Mortality
Given the heavy skier use and developed infrastructure, the primary objective of this treatment option is to manage the existing subalpine fir mortality and potential spruce beetle and subalpine fir mortality for the protection of life and property. Significant mortality in these stands may create safety hazards to recreational users as well as the infrastructure in the form of falling trees and deadfall. Thus, ski area infrastructure including structures and facilities should be treated to create defensible space. Detailed information on creating defensible space through the use of fuelbreaks can be found using the following link: http://csfs.colostate.edu/pdfs/fuelbreak_guidellines.pdf. Additionally, passenger tramways, ski trails, and summer recreation trails should be managed by removing all hazard trees. For lift lines, all hazard trees within 200 feet of either side of centerline or adjusted based on terrain side-slopes should be removed, as well heavy concentrations of dead and downed woody fuels. For roads, ski trails and summer recreation trails, hazard trees that are within 100 feet of either side should be removed. For the remaining forested areas not covered by the section above, treatment should include the following:

- Manage live trees in clumps so as to minimize windthrow, which is a risk when mortality is high.
- Leave the remaining dead trees to provide protection for regeneration.
- Lop and scatter slash to protect soils and regeneration and to minimize nutrient loss.
- Further protect areas of regeneration with fencing, signing, or barriers where needed to prevent damage from skier traffic.

7.2 Regeneration/ Reforestation

Regeneration is an important component within forested stands, and as discussed earlier, is critical to achieving the desired VSS distribution for the various species as well increasing species diversity. It can also be critical when a stand experiences significant mortality due to insects and disease. Regeneration can occur naturally with existing seed stock found in the stands, or through artificial reforestation in the form of planted seedlings. Typically, natural regeneration is preferred over planted seedlings due to cost, and overall survivability.

As mentioned previously, conifer seedlings found within the existing grass component (ski trails) could be transplanted. A tree-spade would be needed in order to transplant the larger regeneration and success rates may be low. This option may not be appropriate in all areas depending on soils and potential for erosion and runoff.

If natural regeneration is not successful after 7 years, it may be necessary to plant seedlings. To increase the success rate, only seedlings grown from seed collected on site or from similar seed zones should be utilized. If this option is utilized, the standards and guidelines as outlined in the Forest Plan for acceptable restocking rates should be followed. Table 3 presents the required stocking levels.

Given the short growing season and harsh conditions, protection of existing seedlings and new transplants is crucial to achieving desired future conditions. As highlighted by Figure 5, the forested stands within the SUP boundary serve as islands that separate ski runs, helping to direct ski traffic and separating different terrains and skill levels. If seedlings are not protected, the risk of skiers and snowboarders damaging the seedlings can be high, which can prevent seedlings from reaching tree size of significantly increase the amount of time it takes a seedling to reach tree size. To maximize the potential of reforestation efforts, the following management methods should be utilized:

- Fencing, either permanent or temporary
- Retention of standing dead trees (where appropriate)
- Plant seedlings within existing tree islands
- Long-term closure of regenerating areas and re-routing of ski traffic
- Informational signing of regenerating areas and public education is recommended to increase understanding of the importance of protecting regeneration.

Table 3. Acceptable levels of stocking by forest cover type

Forest Cover Type	Regeneration Method	Minimum Established Stocking Levels (Trees/Acre)
Engelmann Spruce/ Subalpine fir	Natural regeneration Planting seedlings	280
Lodgepole pine	Natural regeneration Planting seedlings	280

8.0 Discussion and Recommendations

As highlighted in Section 1, this VMP has been written to ensure that active management can be utilized to provide for forest health, including responding to the current and future mortality of subalpine fir and Engelmann spruce that occur within the developed Monarch Ski Area Winter Sports permit area. This section will build upon the silvicultural treatments discussed in Section 7 by outlining the other elements that are critical to achieving the desired future conditions.

8.1 Adaptive Management

Given that the vegetation at Monarch provides for multiple uses including recreation, wildlife habitat, water resources and scenery; and is predicted to change significantly due to the spruce beetle infestation, it is important that the concept of "adaptive management" is utilized to continually evaluate the need for change and improvement. As discussed by Stankey et al., "the concept of adaptive management has gained attention as a means of linking learning with policy and implementation" (2005). Although a somewhat new term, the concept of adaptive management has origins back to the early 1900s and is used is many different disciplines, not just natural resources (Stankey et al. 2005). Since the potential level of spruce beetle mortality is unknown at this time, this VMP will need to be reviewed annually and changes made as necessary based on the information collected through the monitoring protocol outlined in Section 9. Additionally, Monarch and the Salida Ranger District need to maintain a good working relationship and work together to determine solutions.

8.2 Safety

In order to mitigate dead and dying hazard trees through silvicultural treatments, it is necessary that Monarch employees, as well as Forest Service employees be trained to identify what constitutes a hazard tree. Thus, it is essential that all employees including ski patrol and those forest service employees tasked with management responsibilities for Monarch be required to complete the Hazard Tree Awareness Training that is offered through the U.S. Forest Service Forest Health Protection Unit.

8.3 Spruce Beetle Management

According to the 2013 Aerial Detection Survey Summary for the Rocky Mountain Region of the US Forest Service, the spruce bark beetle has affected approximately 1,144,000 acres since 1996 (Colorado State Forest Service 2014). The spruce beetle is currently the most widespread insect pest of Colorado's forest, and due to significant windthrow that occurred in 2011, the number of acres affected could increase over the next several years. Although very little spruce beetle activity was identified in the Monarch area through the aerial flight, the spruce beetle plots completed by the Forest Health Protection Unit confirms their presence. As discussed in Section 5, spruce beetles were found on 66% of the plots. Thus, in addition to the silviculture treatments outlined previously, the following actions are

recommended:

- Preventative spraying of high valued spruce trees such as those found near gathering areas, those that provide important wind break, those near buildings, etc.
- An extensive public education program that explains the changes occurring in the forest and how the public can help. This public education program should be a joint effort between the U.S. Forest Service, Monarch and local associations such as GARNA.

8.4 Reforestation

In the event that regeneration is not successful following treatments or significant mortality occurs, reforestation will be necessary. In order to ensure the success of a reforestation program, the following steps need to be completed:

- Seed collection of the various conifer species needs to take place as soon as possible and should continue annually until adequate seed has been collected.
- No glading (cutting of small trees to open up areas within tree islands) should be considered until it has been determined that the spruce beetle epidemic is over. Remember, the small trees are what will eventually become the mature, large trees.
- If planting is necessary, a following species mix should be considered:
    - 35% Engelmann spruce
    - 35% subalpine fir
    - 30% lodgepole pine.

This species mix will increase the overall diversity and will help decrease the susceptibility of forest insects.

- Planting of Engelmann spruce and subalpine fir should follow the recommendations discussed in the 1972 publication by Frank Ronco and the 1987 publication by Alexander.
- Consider use of water bladders to increase seedling survivability.

8.5 Snow Retention

As a winter recreation facility, winter precipitation in the form of snow is an essential element and currently, Monarch does not have snowmaking capabilities like many of the resorts in Colorado. Therefore, it is critical that the snowfall Monarch receives is not lost due to wind and evaporation. As discussed by Pugh and Gordon (2012), "forest canopies affect snow accumulation and melt regimes at the forest floor by attenuating incoming sunlight and precipitation and by reducing wind speeds and regulating subcanopy microclimate." Thus, changes in forest structure can significantly affect snow retention on site. For instance, typically up to 60% of snowfall is caught by the forest canopy and of that, as much as 40% will evaporate back into the atmosphere. If the spruce bark beetle epidemic does kill the majority of the overstory, this could increase overall snow accumulation on the ground. But, forest stands with reduced canopy density can have higher wind speeds through dead branches as opposed to healthy, living stands (Pugh and Gordon 2012), meaning that snow loss from wind is highly probable. Given these two

elements, it will be necessary to implement the following strategies in order to minimize snow loss from the site.

- Build snow-retention structures in areas prone to wind scour to help snow accumulation and drift guidance (Martinelli 1965).
- Manage live trees in clumps so as to minimize windthrow
- Leave standing dead trees where feasible to reduce wind scour
- Reforest areas of mortality as quickly as possible to rebuild a forest canopy.

9.0 Monitoring and Evaluation

In order to know and understand changes that are occurring with the vegetation within the SUP area, it is important to consistently monitor and evaluate the project area. Forest Service specialists will perform monitoring throughout the implementation of projects to ensure Best Management Practices and design criteria are followed. Specific monitoring is summarized in Table 4.

9.1 Forest Health

Regular sampling of the different cover types within the permit area should be completed, including specific monitoring for insect and disease. Given the current spruce beetle epidemic, the U.S. Forest Service Forest Health Protection Unit should repeat the survey that was completed in the summer of 2013 to monitor the progression of the epidemic.

On stands that receive silvicultural treatments, post-treatment surveys should be completed to determine whether the treatments met the objective, if regeneration is occurring, and whether additional treatment is needed.

9.2 Regeneration/ Reforestation

Regeneration surveys should be completed for those treatments designed to create regeneration within three to five years post-harvest to measure success of natural regeneration and assess the need for planting to assure compliance with the National Forest Management Act and the Forest Plan. Regeneration surveys may also be necessary in areas with significant spruce and subalpine fir mortality. If artificial regeneration is utilized, survival surveys should be completed the first, third, and fifth year after planting. If stocking levels do not meet the minimums identified in Table 5, additional planting should be scheduled.

9.3 Soil and Water

District personnel should monitor ground disturbing activities including: construction of temporary roads, stream – temporary road crossings, skid trails, and landings to ensure that best management practices (BMP's) are being followed. Logging operations would be suspended when soil moisture is high enough that logging equipment creates ruts that are greater than 3" in depth.

Table 4. Recommended Monitoring Activities

Monitoring Activity	Purpose	Recommendations
Forest Health		
CSE exam	To determine changing conditions	Complete a CSE exam every 5 years to determine changes.
Spruce Bark Beetle Exam	To determine level of infestation	Complete spruce bark beetle exam in 2014 and then every 2 years to determine changes in population.
Post-treatment survey	To determine if treatments met objectives and if additional treatments are needed.	Complete after every treatment.
Regeneration/Reforestation		
Regeneration Survey	To determine if natural regeneration is occurring and if artificial regeneration is necessary	Complete with 3-5 years following treatments.
Survival surveys	To determine level of survivability for artificial regeneration	Complete 1, 3, and 5 years following planting.
Soil and Water		
Water quality	To determine if temporary roads, skid trails, and stream crossings are affecting water quality	Utilize Best Management Practices (BMPs)
Erosion	To determine if treatments and/or treatment activities are causing erosion.	Monitor equipment use during wet periods.
Fire and Fuels		
Fire weather/fuel moisture smoke dispersal	To ensure parameters from burn plan are being met and followed and objectives are being met	Monitor weather and fuel moisture as necessary to determine compliance.
Noxious Weeds		
Noxious weed surveys	To determine if noxious weeds are present on site and if mitigation treatments are needed	Complete noxious weed surveys for the acres within the special use boundary as well as during and after treatment
Cultural Resources		
Monitoring of historic properties	To locate new historic properties and to determine if known historic properties are damaged	Complete archeological surveys before, during, and after treatments.

9.4 Fire and Fuels

If prescribed fire is utilized, required monitoring should include fire weather, fuel moisture, and smoke dispersal to ensure these activities are conducted within the prescription parameters stated in the burn plan.

9.5 Noxious Weeds

District and Forest personnel should monitor the acres within the SUP boundary to determine if noxious weeds are present within the SUP boundary. Follow-up monitoring should occur during and after silvicultural treatments and if noxious weeds are present, appropriate treatments should be scheduled.

9.6 Cultural Resources

If determined necessary by the Zone Archeologist, monitoring of historic properties will be completed during and after treatments. In the event that cultural resources are discovered, all activities in the immediate area will stop and the Zone Archeologist will be notified immediately. Work will not resume in that area until the Zone Archeologist has coordinated with the District Ranger and work has been authorized to continue.

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