Assessment of Risk of Physical Contact between Rocky Mountain Bighorn Sheep and Domestic Sheep in the Weminuche Grazing Analysis Landscape

Columbine Ranger District
San Juan National Forest

Prepared By:

Chris Schultz
Wildlife Program Leader
Columbine Ranger District
Jan. 27, 2016

Photo: View north over Ruby Lake into the Needle Creek drainage from Mountain View Crest, Tank Creek Allotment.

Contents

Tables

Figures

INTRODUCTION

Rocky Mountain bighorn sheep are native to the Weminuche Landscape. Desert bighorn sheep are not known or thought likely to occur in or near the Weminuche Landscape. For this reason, this document and analysis refers only to Rocky Mountain bighorn sheep.

In North America, bighorn sheep have declined substantially in geographic extent of overall range and population size since European settlement (Cahn et al. 2011, CAST 2008). Carpenter et al. (2014) state current bighorn range may be just 30% of their historic distribution, and populations may be less than 5% of their numbers in the mid-1800s. Substantial declines in abundance and the distribution of herds occurred from the late 1800s through the early 1900s from factors such as over harvest, habitat alteration, competition with domestic livestock, and disease transmission from domestic livestock (Carpenter et al. 2014, Wehausen et al. 2011, CAST 2008, George et al. 2008). Bighorn sheep abundance and distribution have failed to rebound to the same extent as other ungulates whose populations declined during the same time period, due in large measure to recurrent herd-level respiratory disease outbreaks (Carpenter et al. 2014).

Rocky Mountain bighorn sheep are designated by the Forest Service Rocky Mountain Region (Region 2) as a Sensitive Species on National Forest System lands within the Region (USDA Forest Service 2013d). This designation implies there is concern for the long-term viability and/or conservation status of bighorn sheep on NFS lands in the Region (Beecham et. al 2007). For this reason, all agency actions that have the potential to affect bighorn sheep conservation are analyzed for their potential impacts to bighorn sheep. Analyzing and disclosing the potential effects of domestic sheep grazing on bighorn sheep, a designated sensitive species, and their requisite habitats is needed to meet Forest Service Manual (FSM) 2670 direction for sensitive species management, as described in FSM 2672.4, and to meet Forest Service national and regional policy (USDA Forest Service 2011a, USDA Forest Service 2011b, USDA Forest Service 2012, USDA Forest Service 2014a, USDA Forest Service 2014b).

The Weminuche Landscape is within an area known as the “Brunot Area”. The Brunot Area results from the 1874 Brunot Agreement between the United States government and bands of Ute Indians that were residing in Colorado at the time. Today descendants of these bands include the Southern Ute and the Ute Mountain Ute Tribes. The area that is involved in the treaty was removed from the tribes' reservation lands in 1874 after the discovery of gold in the San Juan Mountains to allow mining and settlement in the region by US Citizens. Although no longer reservation land, Article II of the agreement states that “The United States shall permit the Ute Indians to hunt upon said lands so long as the game lasts and the Indians are at peace with the white people”. The Brunot area’s boundaries are roughly U.S. 160 on the south, the southern boundaries of Gunnison and Montrose counties on the north, just west of Cortez on the west, and the middle of Mineral County on the east.

The Southern Ute Tribe began to exercise their treaty rights in 2009 (Weinmeister 2012). In 2013 the Ute Mountain Ute signed a Memorandum of Understanding (MOU) with the State of Colorado concerning Wildlife Management and Enforcement in the Brunot Area (Colorado Parks and Wildlife 2013b) to “(a) promote cooperation and communication in the management and use of the Brunot Area wildlife resources so that those resources and the Brunot Area habitat are preserved and protected for tribal and non-tribal purposes; (b) avoid confrontation related to the exercise of enforcement jurisdiction by the Tribe and the State; (c) provide a process to avoid and resolve conflicts; (d) facilitate exercise of the Tribe’s Brunot Agreement rights in a manner that is respectful

of the interests of the Tribe, the Southern Ute Indian Tribe, and the State in the shared wildlife resources of the Brunot Area." This MOU underlines the importance of continued big game hunting to the Ute Mountain Ute and the Southern Ute Indian Tribes. The Weminuche landscape falls within the Brunot Area and bighorn sheep are among the game species for which Brunot treaty hunting licenses are issued. Brunot licenses are calculated as a percentage of all licenses within the unit (Weinmeister 2012). For this reason both tribes have traditional and treaty right interests in the management and conservation of bighorn sheep within the Weminuche Landscape.

Although habitat degradation from fire suppression, highways, unmanaged livestock grazing, and human disturbance is of concern to the conservation of bighorn sheep, the susceptibility of bighorn sheep herds to population declines or extirpation due to respiratory diseases which can be transmitted from closely related domestic sheep or goats (Drew et al. 2014, Cassirer et al. 2013, Besser et al. 2012b, and 2012d, Cahn et al. 2011, Beecham et al. 2007) appears to be the greatest concern for bighorn sheep population persistence in the western United States and on the San Juan National Forest (USDA Forest Service 2013a).

Respiratory disease is multi-factorial, often caused by bacteria in the family Pasteurellaceae, especially the genera *Pasteurella, Bibersteinia* and *Mannheimia*, and thus is often referred to by the generic term 'pasteurellosis' (Besser 2013, Drew et al. 2013, CAST 2008). *Mycoplasma ovipneumoniae* is a bacterium that is most consistently detected in lambs and adult bighorn sheep with pneumonia than any single pasteurella species (Besser et al. 2012b). *M. ovipneumoniae* is strongly associated with bronchopneumonia in bighorn sheep at both the individual and population levels but is difficult to detect and is commonly overgrown later in infection by other bacteria (Besser 2013). It likely plays a primary role in bighorn sheep pneumonia outbreaks (Besser et al. 2012b).

Mortality of all age classes and depressed lamb recruitment resulting from pathogens introduced by domestic livestock are regarded as the primary limiting factor for bighorn sheep in Colorado (George et al. 2009). Physical contact between domestic sheep or goats and bighorn sheep increases the risk of disease transmission from domestic animals to bighorn sheep (Sells et al. 2015, Lawrence et al. 2010, Wehausen et al. 2011), with potential for a subsequent bighorn sheep mortality event and/or extended period of reduced recruitment (Besser et al. 2012b).

The primary disease agents are respiratory diseases to which domestic sheep and goats are typically resistant or unaffected, and to which bighorn sheep have little resistance (Carpenter et al. 2014, Cassirer et al. 2013, Besser et al. 2012a, Besser et al. 2012b, CAST 2008, George et al. 2008, Western Association of Fish and Wildlife Agencies 2012). Pneumonia caused by bacterial respiratory pathogens is considered the most virulent disease impacting bighorn sheep today (Besser et al. 2012b, George et al. 2009, Beecham et al. 2007). Pneumonia can result in all age die-offs followed by suppressed lamb recruitment for up to several decades after the initial die-off (The Wildlife Society 2015, George et al. 2008). Survivors become carriers of the disease and serve as a source of infection for other animals in the same herd, newborns, and other populations through natural movements, forays, or translocations (Sells et al 2015, Cassirer et al. 2013, Besser et al. 2012b).

The complete range of mechanisms and/or causal agents that lead to disease events and low recruitment in bighorn sheep is still debated, and not all bighorn sheep disease events can be attributed to contact with domestic sheep or goats (Sells et al. 2015, Drew et al. 2014, Shannon et al. 2014, Colorado Parks and Wildlife 2013a, Besser et al. 2012b, Wehausen et al. 2011, George et. al. 2009, Aune et al. 1998, Onderka and Wishart 1984). However, when contact between bighorn sheep and domestic sheep or goats has been documented the severity of the bighorn sheep die-off is typically more pronounced (Aune et al. 1998, Martin et al. 1996). In some cases, bighorn sheep

disease events can be devastating population-limiting events with outbreaks affecting animals of all age classes, and resulting in prolonged periods of low lamb survival (Sells et al. 2015, Cassirer et al. 2013, Besser et al.2012b, and 2012d).

The preponderance of scientific literature supports the potential for respiratory diseases to be transmitted from domestic sheep and goats to bighorn sheep, frequently followed by bighorn mortality events after observed contact or close association with domestic sheep in captive and free range situations (Sells et al. 2015, Shannon et al. 2014, Drew et al. 2014, Besser et al. 2014, Carpenter et al. 2014, Cassirer et al. 2013, Besser et al. 2012a, b, c, and 2012d, Western Association of Fish and Wildlife Agencies 2012, USDA Forest Service 2011a, Wehausen et al. 2011, Lawrence et al. 2010, USDA Forest Service 2010a, CAST 2008, Jeffress 2008, Rudolph et al. 2003, Schommer and Woolever 2001, Martin et al. 1996).

It is recognized that opposing arguments question this science and dispute the connection. Western Association of Fish and Wildlife Agencies (2012) states "that debate is founded largely on criticisms of experimental design or rigor, and limitations of drawing inferences about natural disease events when compared to controlled experiments in confined settings. However, it is WAFWA's collective opinion that enough is known about potential pathogen transmission from domestic sheep or goats to wild sheep that efforts toward achieving effective spearation are necessary and warranted."

Research continues on the science of disease transmission, bighorn mortality events, and the potential for development of effective vaccines (The Wildlife Society 2015, Besser 2013, Miller 2011, Srikumaran 2011, Subramaniam et al. 2011, Wehausen et al. 2011). But until the science is better understood and/or effective vaccines are developed many organizations and researchers recommend it is prudent to consider and implement management actions designed to keep the species separate as a means to prevent the potential for disease transmission and subsequent bighorn mortality events (The Wildlife Society 2015, Colorado Parks and Wildlife 2013a, Western Association of Fish and Wildlife Agencies 2012, American Sheep Industry Association 2011, Cahn et al. 2011, USDA Forest Service 2011a, George et al. 2009, USAHA Joint Working Group 2009, CAST 2008, Beecham et al. 2007, Schommer and Woolever 2001).

The bighorn sheep Core Herd Home Ranges (CHHRs) referred to throughout this document are the 2013 summer range maps provided by Colorado Parks and Wildlife (CPW). CPW maps the summer range of bighorn sheep herds as that part of their overall range where 90% of individual bighorn sheep are located between spring green-up and the first heavy snowfall. Summer range does not necessarily include all bighorn occurrences during the summer season because small numbers (< 10%) of bighorn sheep may occur outside the mapped summer range. In addition, small numbers of bighorn sheep rams and ewes may leave their CHHR during summer and disperse (i.e. foray). For these reasons it is important to consider the proximity of bighorn CHHR, as well as the amount and juxtaposition of suitable bighorn summer source habitats in relation to active domestic sheep allotments and driveways when considering the potential for interaction between the species.

Within the Weminuche Landscape, portions of two active domestic sheep and goat allotments (Canyon Creek and Tank Creek), and portions of four vacant sheep allotments (Cave Basin, Flint Creek, Pine River and Rock Creek) overlap with Core Herd Home Range (CHHR) for bighorn sheep, as mapped by Colorado Parks and Wildlife (CPW). In some portions of these six allotments, direct overlap exists between mapped Core Herd Home Range (CHHR) for bighorn sheep and areas suitable for grazing by domestic sheep. Additional source (suitable) habitat for bighorn sheep extends across other areas of these allotments, suggesting that bighorn sheep could travel or disperse (i.e. foray) outside their mapped Core Herd Home Range via suitable source habitat, creating a potential risk of physical contact between bighorn and domestic sheep. The risk of

contact between bighorn sheep foraying outside their mapped Core Herd Home Range and domestic sheep allotments corresponds to the number of bighorn sheep in a herd, the proximity of domestic sheep allotments and bighorn CHHR's, the distribution of suitable sheep grazing areas within an active allotment, the distribution of bighorn sheep source habitats (suitable habitat) across the landscape, and the distance and frequency of bighorn sheep forays outside their CHHR. Several other factors that might influence the potential for physical contact between individual domestic and bighorn sheep animals are discussed in later sections of this document.

PURPOSE OF THIS DOCUMENT

This "Risk Assessment" document is a specialist report intended to inform the decision maker about the relative potential for risk of physical contact between bighorn and domestic sheep in relation to the selection of one action alternative over another. This "Risk Assessment" is not a decision document in and of itself. Rather, it is a presentation of a detailed analysis of biological data and information regarding bighorn sheep in relation to the action alternatives proposed by this Environmental Impact Statement (EIS) for the management of domestic sheep grazing on National Forest System lands in the Weminuche Landscape project analysis area. This "Risk Assessment" does not state what an 'acceptable' level of risk should be, nor does it state where each action alternative fits in relation to an 'acceptable' level of risk. Determining what an 'acceptable' level of risk is will be completed by the decision-maker based on the full content of information contained in the project record and presented in the Record of Decision for this Environmental Impact Statement.

This Risk Assessment presents the best available quantitative data and qualitative information about the risk of physical contact between bighorn and domestic sheep in relation to management direction contained within the San Juan National Forest Land and Resource Management Plan (USDA Forest Service 2013e). This Risk Assessment then ranks the proposed alternatives as to their relative degree of risk and/or change from current condition in relation to preventing physical contact between the species. This Risk Assessment then provides a range of possible scenarios regarding length of time between contacts and the effect those scenarios may have in terms of potential for disease transmission and subsequent mortality events within resident bighorn herds. Finally, conclusions are drawn about the relative potential for each of the action alternatives to maintain bighorn viability across the planning area, as required by the National Forest Management Act (36 CFR 219.19) and Forest Service national and regional policy (USDA Forest Service 2011a, USDA Forest Service 2011b, USDA Forest Service 2012, USDA Forest Service 2014a, USDA Forest Service 2014b).

The goal of this "Risk Assessment" is to provide the decision maker with an objective evaluation of the risk of physical contact between bighorn sheep and domestic sheep in each allotment in the Weminuche Landscape. As part of this analysis process, the Risk of Contact Tool, prepared by the USDA Forest Service Bighorn Sheep Working Group (USDA Forest Service 2013b), was used to help evaluate bighorn sheep movements outside their CHHR, and assess the potential for risk of contact between bighorn sheep and domestic sheep allotments in the Weminuche Landscape. Results from the Risk of Contact Tool provide the decision maker with an objective evaluation of foray probabilities and potential contact rates between bighorn sheep and each domestic sheep allotment in the Weminuche Landscape. Other qualitative information is provided and combined with results from the Risk of Contact Tool to determine a final ranking of risk of physical contact between bighorn sheep and domestic sheep individuals. The decision maker will then use the results of this "Risk Assessment", along with other management considerations shown in the environmental impact statement such as mitigation measures and adaptive management options, as an important

factor of consideration in their decision regarding domestic sheep grazing in the Weminuche Landscape.

This "Risk Assessment" analysis is focused on the potential for physical contact between bighorn sheep and domestic sheep. No presumption is made that physical contact would lead to disease transmission or a subsequent bighorn sheep mortality event. The assumption is made however, based on the preponderance of scientific evidence, that increased physical contact between bighorn sheep and domestic sheep can increase the potential for a disease transmission event to occur, with increased potential for a subsequent bighorn mortality event. Because of the potential for disease transmission to follow physical contact it is prudent to manage the risk of disease transmission by reducing the risk of physical contact and/or increasing the distance and/or degree or effectiveness of separation between the two species (Colorado Parks and Wildlife 2013a, Western Association of Fish and Wildlife Agencies 2012, American Sheep Industry Association 2011, USDA Forest Service 2011a, USAHA Joint Working Group 2009, George et al. 2009, Beecham et al. 2007, Besser et al. 2007).

As with most quantitative and qualitative approaches to evaluating risk of contact, there are a variety of uncertainties that should be recognized and considered. A more detailed discussion about uncertainties associated with the Risk of Contact Tool, with domestic sheep management techniques, and with ecological factors unique to the Weminuche Landscape is provided later in this document.

PROJECT AREA

The Weminuche Landscape is located Hinsdale, La Plata and San Juan Counties, Colorado. The area is located northeast of Durango in Townships 36-40 North, Ranges 4-9 West, N.M.P.M., and is within the Columbine Ranger District of the San Juan National Forest (see Figure 2, at the end of this document). Most of the Weminuche Landscape analysis area is within the congressionally designated Weminuche Wilderness, the largest single wilderness area in the state of Colorado.

The Weminuche Landscape includes about 166,627 acres, of which about 162,599 acres (98%) is National Forest System (NFS) land. The remaining 4,028 acres are split out between Durango Reservoir Grant lands (City Reservoir) at 2,962 acres, and private lands at 1,066 acres. On National Forest System lands, 85% of the analysis area is in the Weminuche Wilderness. The remaining 15% is non-wilderness.

Within the Weminuche Landscape, domestic sheep grazing is currently permitted on about 57,983 acres (36%) of National Forest System (NFS) lands in 5 active allotments (Burnt Timber, Endlich Mesa, Spring Gulch, Tank Creek, and Virginia Gulch), and 8 vacant allotments (Canyon Creek, Cave Basin, Fall Creek, Flint Creek, Johnson Creek, Leviathan, Pine River, and Rock Creek). Approximately 58,408 acres (36%) of NFS lands are suitable for domestic sheep grazing, and 50,239 acres (31%) of NFS lands are suitable for cattle grazing.

The only allotment in the Weminuche Landscape with currently permitted cattle grazing is the Canyon Creek Allotment. Canyon Creek Allotment however, will be analyzed as either a cattle allotment or a domestic sheep allotment, but not both classes of livestock simultaneously. A portion (1,544 acres) of the West Needles Allotment, which was closed to grazing in the Silverton Grazing Analysis, is proposed to be added to existing allotments and re-authorized for domestic sheep grazing under this EIS.

The majority of the Weminuche Landscape analysis area is located west and south of the Continental Divide, in extremely rugged and colorful volcanic mountains, with elevations ranging from about 7,200 feet to 14,100 feet. The Florida and Pine Rivers as well as Vallecito Creek have their headwaters in the analysis area. The analysis area is principally alpine tundra, mountain grassland, and spruce-fir forest. There are smaller areas of aspen, mixed conifer, ponderosa pine, and mountain shrub communities. Cirques and talus slopes, along with numerous streams, fens, and lakes add diversity to the rugged landscape.

Various sections of roads and trails may be used for trailing livestock. Some of these trailing routes are outside the Weminuche Landscape but they have been included in this analysis because they are integral to the function and management of allotments within the Weminuche Landscape.

The trailing routes include the following:

> U.S. Hwy 160, County Roads 151, 172, 240, 243, 318, 319, 421, 501, 502, 521, 523, 527, Forest Roads #076 (Red Rim #2), #081 (Lime Mesa), #595 (Red Rim), #597 (Endlich Mesa), #602 (Pine River), #682 (Missionary Ridge), #724 (Middle Mountain), #775 (Saul's Creek), and sections of the Pine River Trail #523, Vallecito Creek Trail #529, Cave Basin Trail #530, Young's Canyon Trail #546, and Lime Mesa Trail #676. This analysis also includes a pre-existing right of way across MacDonald Becket Family Trust properties, and their successors, for access to the Canyon Creek allotment and cattle allotments in an adjacent Landscape (Missionary).

Domestic livestock grazing, both sheep and cattle, has occurred in the Weminuche Landscape for over a century and has been authorized by the Forest Service since the early 1900's. The current San Juan National Forest Land and Resource Management Plan of 2013 (Forest Plan), along with Allotment Management Plans (AMPs) and Grazing Permits, regulate the current numbers and type of livestock, dates of use, salting, vegetation manipulation and other activities undertaken for the purpose of grazing domestic livestock on NFS lands.

Domestic sheep are the primary livestock permitted to graze in the Weminuche Landscape, and their principle forage areas are in the alpine zone. Alpine rangelands in this Landscape have been used for grazing domestic sheep since the late 1800's. Prior to government control, sheep were herded in tightly grouped bands and continuously bedded in the same location for several nights in a row, which resulted in some areas of intense forage utilization and soil impacts from trampling and trailing. Some sites in the Weminuche Landscape still display these historic effects of long periods of intensive domestic sheep grazing decades after the allotments were last grazed. There are no additional bands of domestic sheep being grazed on adjacent or intermingled non-federal lands, in addition to the bands permitted to graze on the Forest Service allotments under analysis in this document.

FOREST PLAN RESOURCE DIRECTION

Project level and planning-level direction for land management decisions is provided by the Land and Resource Management Plan (Forest Plan) in the form of objectives, goals, standards and guidelines. The following definitions and resource direction is excerpted from the 2013 Forest Plan.

> "A standard is an approach or condition that is determined to be necessary to meet desired future conditions and objectives, and/or to ensure the long-term viability of resources. A standard describes a course of action that must be followed or a level of attainment that

> must be reached. Deviations from standards would require analysis and documentation through a subsequent land management plan amendment."
>
> "A guideline is presumptively a requirement to meet desired future conditions and objectives, and/or to ensure the long-term viability of resources. Guidelines are put forward in this LRMP in recognition that there may be circumstances that could generate or require alternative, more appropriate means of meeting desired future conditions and objectives, and/or to ensure the long-term viability of resources." "If the Responsible Official for a project decision finds that deviation from a guideline is necessary, he or she must record the reasons for deviation as part of the project decision and explain how the intent of the guideline,-as established by the desired future conditions and objectives, and/or need to ensure long-term viability of resources-is being met through alternative means. If the intent of the guideline is met through alternative means, a land management plan amendment typically would not be required."

No matter the management strategies analyzed and chosen for project-level implementation of Forest Plan guidance, all project-level management strategies must meet Forest Plan resource direction to provide for bighorn population viability on the administrative unit.

The core of Forest Plan resource direction is focused on providing the ecological framework for sustaining ecological function across the planning area. Bighorn sheep were utilized in Plan development, along with a cross-section of other species occurring across the planning landscape, as a planning tool in the development of the ecological approach. As such, over 150 plan components provide for maintaining the basic ecological needs of healthy and self-sustaining bighorn populations (USDA Forest Service. 2013a). These plan components range in scope from maintenance of soil and vegetation conditions, to design criteria specifically focused on bighorn sheep such as activity timing limitations for projects operating in production areas. In total, these plan components support the conditions necessary for healthy and self-sustaining bighorn populations.

A Forest-wide risk assessment (USDA Forest Service 2013a) evaluated a wide array of potential factors of concern on the San Juan NF related to bighorn sheep ecology, habitat, population dynamics, population status and trends. The Forest-wide risk assessment determined that risk of physical contact between bighorn sheep and domestic sheep and goats is the most significant factor that could affect bighorn sheep population viability on the planning area. This Forest-wide risk assessment determined that Forest Plan resource direction, and the potential for project-level application of Best Management Practices and other site-specific design criteria, will continue to be analyzed in all project-level decision documents and risk assessments.

The Forest Plan resource direction discussed below are only those Standards and Guidelines directly applicable to the project purpose and need and/or project alternatives.

Forest Plan Resource Direction for Terrestrial Wildlife

Standard 2.3.39 **Bighorn sheep** (*Ovis canadensis*): during project-level planning on domestic sheep (*O. aries*) allotments, management options must be developed to prevent physical contact between domestic sheep and bighorn sheep. Actions may include but are not limited to boundary modification, livestock-type conversion, or allotment closures.

Standard 2.3.40 **Bighorn Sheep:** Grazing permit administration in occupied bighorn sheep habitat must utilize measures to prevent physical contact between domestic sheep and bighorn sheep.

Permit administration actions may include but are not limited to use of guard dogs, grazing rotation adjustments, or relocation of salting and bed grounds.

Standard 2.3.41 **Bighorn Sheep:** Management of recreational pack goats and other domestic goats (*Capra aegagrus hircus*) must utilize measures to prevent physical contact with bighorn sheep.

Standard 2.3.42 **Bighorn Sheep:** Domestic goats used for invasive plant control must be veterinarian certified as free of pathogens transmissible to bighorn sheep, except in areas where there is no risk of contact with bighorn sheep.

Guideline 2.3.64 **Bighorn Sheep:** Projects or activities that adversely impact bighorn sheep production areas by reducing habitat effectiveness should be limited or avoided, using access restrictions during the following periods (see Figure 2.3.3):

- Rocky Mountain bighorn sheep (*Ovis Canadensis Canadensis*): April 15-June 30.
- Desert bighorn sheep (*O.c. nelsoni*): February 1-May 1.

Guideline 2.3.65 **Bighorn Sheep:** Projects or activities that adversely impact bighorn sheep severe winter range and winter concentration areas by reducing habitat effectiveness should be limited or avoided using access restrictions during the following periods:

- Rocky Mountain bighorn sheep: November 1-April 15
- Desert bighorn sheep: December 1-April 15.

Forest Plan Resource Direction For Livestock and Rangeland Management

Standard 2.7.11 Grazing permit administration in occupied bighorn sheep habitat must utilize measures to prevent physical contact between domestic sheep and bighorn sheep. Permit administration actions may include but are not limited to use of guard dogs, grazing rotation adjustments, or relocation of salting and bed grounds.

Standard 2.7.12 Management of domestic sheep must utilize measures to prevent physical contact with bighorn sheep.

ALTERNATIVES EVALUATED BY THE ENVIRONMENTAL IMPACT STATEMENT

The four alternatives being evaluated by the Weminuche Landscape Environmental Impact Statement (EIS) and addressed in this Risk Assessment are:

1- No Grazing Alternative;
2- Current Management Alternative;
3- Adaptive Management w/ Forage Reserves Alternative;
4- Adaptive Management/Closing Vacant Allotments Alternative, the Preferred Alternative.

Alternative 1 – No Grazing Alternative.

No term livestock grazing permits would be issued on any of the allotments in the landscape. Following current direction, existing permits would be phased out after giving permittees notice as provided for in Forest Service policy.

Alternative 2 – Current Management Alternative.

Traditional livestock management authorized under a term permit as it has been in the recent past using a pre-defined number of livestock, seasons of use, pasture rotation systems, and allotment configurations (see EIS Table 2-1). All six currently stocked allotments would continue to be active, and the seven vacant allotments would remain vacant. The vacant allotments would be available for permitted livestock grazing through grant and issuance of term grazing permits with stocking based on historic numbers and adjusted based on suitability on each allotment. This alternative would require the District to go through the grant process and offer new term grazing permits, possibly to new permittees. Figure 5, at the end of this document, and EIS Figure 1-4, show the relationship between domestic sheep allotments, allotment status, and bighorn sheep Core Herd Home Range, as mapped by CPW, under the allotment configuration analyzed in Alternative 2.

It should be noted that allotment boundaries have been adjusted between the preceding Draft EA and this EIS. This was done to correctly display the current condition and how the landscape is actually being used. Administrative boundary adjustments can be done at any time without a NEPA decision (36 CFR 222.(a) (7) and FSH 2209.13 sec 16.1). This allows a more accurate representation of the current conditions for comparison to the other action alternatives.

Table 1. Current Domestic Sheep Grazing (Alternative 2), by Allotment, in the Weminuche Landscape.

Allotment	Total Acres	Permitted Numbers	Actual Use (5-Year Average)	On Date Range	Off Date Range	Days of Use	Last Year of Actual Use
Burnt Timber-Tank Creek Band	5,092	700	700	6/25 - 7/5	9/18 - 9/24	18	2015
Burnt Timber-Virginia Gulch Band	*	850	775	6/26 - 7/6	9/16 - 10/1	27	2015
Endlich Mesa	11,223	700	775	1-July	25-Sept	87	2015
Spring Gulch	3,077	700	700	6/15 - 6/30	9/22 - 10/5	16	2015
Tank Creek	10,884	700	700	6-July	14-Sept	71	2015
Virginia Gulch	12,571	850	775	10-July	15-Sept	68	2015
Burnt Timber-Canyon Creek Band	*	600	600	6/24 - 7/4	9/14 - 9/30	27	2012
Canyon Creek	6,328	600 Sheep, Or 120 Cattle	0 Sheep, 120 Cattle	5-July 11July	13-Sept 30-Sept	71	2010 2015
Cave Basin	22,452	750	**	1-July	15-Sept	77	1988
Fall Creek	11,385	1000	**	1-July	15-Sept	77	1968
Flint Creek	16,359	950	**	1-July	15-Sept	77	1972
Johnson Creek	9,461	388	**	16-July	15-Sept	62	1968
Leviathan	6,530	582	**	1-July	15-Sept	77	1970

Needles Mountains	1,544	Closed	Closed	Closed	Closed	0	N/A
Pine River	38,843	850	**	1-July	15-Sept	77	1980
Rock Creek	10,880	850	**	1-July	15-Sept	77	1970
Total	**166,628**	**5,700**	**5,625**				

**N/A, allotments vacant more than previous 5 years
~Active allotments are shaded in the table~

Those design criteria as indicated in the EIS Tables 2-2 and 2-3, marked by an "X" in the Alternative 2 column, are included as part of Alternative 2. These criteria apply to all active allotments across the landscape at all times.

Under Current Management, livestock grazing continues with current AMP's or under the Annual Operating Instructions (AOI's). Permitted livestock numbers are shown below in Table 1.

Existing improvements would continue to be maintained as assigned in Term Livestock Grazing Permits and may be re-constructed once the useful life has been met and the need identified. New improvements would not be developed unless authorized in a NEPA decision.

Alternative 3 – Adaptive Management w/ Forage Reserves Alternative.

This alternative is to continue to permit domestic livestock grazing on NFS lands by incorporating a variety of Adaptive Management strategies (Quimby 2005) that would allow the lands within the landscape to meet or move towards meeting Forest Plan direction standards and guidelines and desired conditions identified in this EIS. Adaptive Management strategies are "tools" or management actions designed to maintain suitable resource conditions, or move unacceptable resource conditions towards desired conditions in a timely manner (Quimby 2005). However, if monitoring shows that desired conditions are not being met, or if movement toward achieving the desired conditions in an timely manner is not occurring, then an alternate set of management actions, as described and evaluated under this NEPA analysis, would be implemented to achieve the desired results. Adaptive Management is designed to be flexible in nature, and is based on conditions on the ground; not regulated by fixed livestock numbers, type of livestock, or seasons of use. Figure 6, at the end of this document, shows the relationship between domestic sheep allotments, allotment status, and bighorn sheep Core Herd Home Range, as mapped by CPW, under the allotment configuration analyzed in Alternative 3. Figure 2-1 of the EIS shows sheep grazing status in each allotment under Alternative 3.

It should be noted that allotment boundaries have been adjusted between the preceding Draft EA and this EIS. Some of those items that were proposed in the Draft EA, such as changing allotment boundaries, have already been accomplished administratively. This was done to correctly display the current condition and how the landscape is actually being used. Administrative boundary adjustments can be done at any time without a NEPA decision (36 CFR 222.(a) (7) and FSH 2209.13 sec 16.1).

This alternative would incorporate adaptive management options for the active grazing allotments (Burnt Timber, Canyon Creek, Endlich Mesa, Spring Gulch, Tank Creek and Virginia Gulch), including boundary adjustments, trailing, and design criteria. This Alternative would authorize the Canyon Creek Allotment to be converted from sheep to cattle, but would also allow the allotment to remain a vacant domestic sheep allotment that could be restocked administratively with sheep at a

later date. For this reason, the Canyon Creek Allotment is analyzed as both an active cattle allotment and a vacant sheep allotment, but not both classes of livestock in the same year.

This Alternative would authorize the creation of a new domestic sheep forage reserve allotment out of portions of the Johnson Creek, Leviathan and Rock Creek Allotments. The remaining four vacant sheep allotments (Cave Basin, Fall Creek, Flint Creek, and Pine River) would be entirely closed to domestic sheep grazing. Finally, a cattle forage reserve allotment would be created out of the lower third of the Cave Basin Allotment. See the EIS for a detailed list of specific actions that would be authorized under this Alternative.

Forage reserve is a specific designation for an allotment on which there is no current term permit obligation, but for which a determination has been made to occasionally use the available forage on the allotment, for the purpose of enhancing management flexibility on other allotments. Forage reserve allotments may be occasionally used by authorized livestock from another allotment when there is a loss of forage availability on the home allotment from a variety of factors such as drought, fire, rangeland restoration activities, or resource conflicts. For this analysis, occasional use is defined as grazing the reserve for a maximum of three years out of ten. This limitation is due to current and historical grazing conditions that preclude annual grazing on these allotments.

Table 2. Allotment Status under Current Management (Alternative 2), under the Forage Reserve Alternative (Alternative 3), and under the Preferred Alternative (Alternative 4) in the Weminuche Landscape grazing analysis area.

Allotment	Current Management (Alternative 2)	Forage Reserve (Alternative 3)	Preferred Alternative (Alternative 4)
Burnt Timber-Tank Creek Band	Active Sheep	Active Sheep	Active Sheep
Burnt Timber-Virginia Gulch Band	Active Sheep	Active Sheep	Active Sheep
Endlich Mesa	Active Sheep	Active Sheep	Active Sheep
Spring Gulch	Active Sheep	Active Sheep	Active Sheep
Tank Creek	Active Sheep	Active Sheep	Active Sheep
Virginia Gulch	Active Sheep	Active Sheep	Active Sheep
Burnt Timber-Canyon Creek Band	Vacant Sheep	Vacant Sheep	Vacant Sheep
Canyon Creek	Vacant Sheep	Vacant Sheep Active Cattle	Vacant Sheep Active Cattle
Canyon Creek	Vacant Sheep	Vacant Sheep	Vacant Sheep
Cave Basin	Vacant Sheep	Cattle Forage Reserve	Closed
Fall Creek	Vacant Sheep	Closed	Closed
Flint Creek	Vacant Sheep	Closed	Closed
Johnson Creek	Vacant Sheep	Sheep Forage Reserve	Closed
Leviathan	Vacant Sheep	Sheep Forage Reserve	Closed
Pine River	Vacant Sheep	Closed	Closed
Rock Creek	Vacant Sheep	Sheep Forage Reserve	Closed

~Active allotments are shaded in the table~

This Alternative continues to permit domestic sheep grazing on the five active allotments (Burnt Timber, Endlich Mesa, Spring Gulch, Tank Creek and Virginia Gulch), and would permit sheep grazing on portions of three forage reserve allotments (Johnson Creek, Leviathan and Rock Creek). The northern 2/3 of Rock Creek Allotment (7,344 acres), all of Leviathan Allotment (6,530 acres), and most of Johnson Creek Allotment (7,757 acres) would be designated as a single sheep forage reserve allotment. The remaining parts of Johnson Creek (1,699 acres) and Rock Creek (3,536 acres) allotments would be closed to all livestock grazing. Three other vacant allotments would be closed to all livestock grazing: Fall Creek, Flint Creek and Pine River. The entire Cave Basin Allotment would be closed to sheep grazing. However, the southern quarter of the Cave Basin Allotment would be designated a cattle forage reserve allotment. The Canyon Creek allotment was converted administratively to a cattle allotment in 2013 but would remain available for sheep grazing as a vacant sheep allotment that could be restocked administratively at a later date. Access to allotments would continue through trailing from private lands to National Forest System lands. The USFS has no authority to authorize, or not authorize, use of trailing routes on non-National Forest lands.

Adaptive management strategies would be incorporated into all permitted livestock grazing allotments (see Table 2, below). Boundary adjustments have already been made to Tank Creek and Virginia Gulch allotments to reduce the potential for contact between domestic sheep and bighorn sheep and more accurately reflect natural geographic and vegetation boundaries and better reflect potential and actual domestic sheep use areas on the ground. As part of the boundary adjustments, the western most parts of Tank Creek would be closed to grazing. In response to a request from the Permittee, in 2013 the Canyon Creek Allotment was converted administratively from domestic sheep to cattle grazing. However, this Alternative also analyzes the Canyon Creek Allotment as a vacant sheep allotment remaining available for restocking administratively at a later date.

Those design criteria as indicated in the EIS Tables 2-2 and 2-3, marked by an "X" in the Alternative 3 column are included as part of Alternative 3. These criteria apply to all active allotments across the landscape at all times.

Alternative 3 was presented as the agency's Proposed Action during scoping and in the Draft EA. After further consideration of internal and external comments, specialist input, and other factors such as management of sheep allotments on other NFS units, the deciding officer (District Ranger) determined that Alternative 4 would now be the Forest Service Preferred Alternative.

Alternative 4 – Adaptive Management/Closing Vacant Allotments Alternative, the Preferred Alternative.

This is the agency's Preferred Alternative under the EIS. The Preferred Alternative is to continue to permit domestic livestock grazing on NFS lands by incorporating a variety of Adaptive Management strategies. Adaptive Management strategies are "tools" or management actions designed to maintain suitable resource conditions, or move unacceptable resource conditions towards desired conditions (Quimby 2005). Adaptive Management is designed to be flexible in regards to livestock numbers and season dates. Figure 7, at the end of this document, shows the relationship between domestic sheep allotments, allotment status, and bighorn sheep Core Herd Home Range, as mapped by CPW, under the allotment configuration analyzed in Alternative 4. Figure 2-1 of the EIS shows sheep grazing status in each allotment under Alternative 4, and Figure 3-2 of the EIS shows bighorn herd areas (GMUs) in relation to proposed open allotment boundaries.

This alternative incorporates all the adaptive management options of Alternative 3 for the active grazing allotments (Burnt Timber, Canyon Creek, Endlich Mesa, Spring Gulch, Tank Creek and Virginia Gulch), including boundary adjustments, trailing, and design criteria that would maintain

or move resource conditions toward meeting Forest Plan direct ion, standards and guidelines and desired conditions identified in this EIS.

It should be noted that allotment boundaries have been adjusted between the preceding EA and this EIS. Some of those items that were proposed in the Draft EA, such as changing allotment boundaries, have already been accomplished administratively. This was done to correctly display the current condition and how the landscape is actually being used. Administrative boundary adjustments can be done at any time without a NEPA decision (36 CFR 222.(a) (7) and FSH 2209.13 sec 16.1). Also, the sunset clause on grazing active domestic sheep allotments described in the draft EA was removed from the EIS. It should also be noted that the type class of livestock on any allotment could change in accordance with changes described below, as long as the project purpose and need, desired conditions, and design criteria shown in the EIS are met. This EIS also includes updated/clarified language in some design criteria (see EIS Tables 2-2, 2-3, and 2-4). Design criteria were added to the EIS specific to cattle grazing on those allotments and/or portions of allotments where it is being proposed under this Alternative, including range improvements that may be needed.

A primary difference between this Alternative and Alternative 3 is that no forage reserves would be authorized under this Alternative. No sheep forage reserves would be authorized. No cattle forage reserves would be authorized. In addition, all seven currently vacant allotments (Cave Basin, Fall Creek, Flint Creek, Johnson Creek, Leviathan, Pine River, and Rock Creek) would be entirely closed to domestic livestock grazing. Similar to Alternative 3, the Canyon Creek Allotment would remain an active cattle allotment, but it is also being analyzed under this alternative as a vacant domestic sheep allotment available for restocking administratively at a later date.

Another primary difference between this Alternative and Alternative 3 is that this Alternative proposes to incorporate and authorize cattle grazing as an adaptive management option in substantial additional areas that were not analyzed for cattle grazing under any alternative in the EA. This Alternative proposes to authorize cattle to be grazed in all or portions of four currently active domestic sheep allotments: Burnt Timber (all of the allotment), Endlich Mesa (southern third of the allotment), Spring Gulch (all of the allotment), and Tank Creek (southern half of the allotment). If domestic sheep grazing were discontinued on any or all of these four allotments (Burnt Timber, Endlich Mesa, Spring Gulch and Tank Creek) then the allotment could be converted to a cattle grazing allotment and operated as an active cattle allotment. Within an individual allotment, domestic sheep grazing would have to be discontinued before cattle grazing would be authorized to begin (i.e. an allotment would not be used for both sheep and cattle grazing in the same season). To be operated as an active cattle allotment, infrastructure improvements such as fencing and water developments would need to be installed and/or improved before cattle would be authorized to be stocked to anticipated full allotment capacities.

See the EIS for a detailed list of specific actions that would be authorized under this Alternative.

Those design criteria as indicated in the EIS Tables 2-2 and 2-3, marked by an “X” in the Alternative 4 column are included as part of Alternative 4. These criteria apply to all active allotments across the landscape at all times. For Alternative 4, design criteria would be the same as Alternative 3 for current active allotments, but would not apply to closed allotments.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

These, among other suggestions, were considered but not included in a detailed analysis for the reasons stated. Additional details can be found in the EIS section 2.1:

- Leave vacant allotments vacant, instead of closing them, until a vaccine that could prevent disease transmission from domestic to bighorn sheep could be developed. At that time, a decision could be made as to whether or not to stock the vacant allotments. The best available science indicates a usable vaccine with practical field application is not available at this time (The Wildlife Society 2015, Srikumaran 2011, Subramaniam et al. 2011, Miller 2011, Wehausen et al. 2011) and is unlikely to be readily available within the next 10 to 15 years (Srikumaran 2011). We did not consider the anticipated long term duration for research and development of an effective usable vaccine (10 to 15 years) to be a reasonable basis on which to make management decisions for the immediate future (less than five years). If a useable and effective vaccine is developed in the future, a new NEPA analysis could be undertaken to consider re-opening the allotments to domestic sheep grazing.

- We considered moving domestic sheep bands from currently active allotments where the perceived risk of contact with bighorn sheep is high to other currently vacant allotments where the perceived risk of contact with bighorns may be lower (i.e. replacement allotments as described in USDA Forest Service 2014a; American Sheep Industry Association 2011). The only vacant allotments on the Columbine Ranger District are more suitable for cattle grazing than sheep grazing. The sheep permittee was offered the choice of converting to cattle and moving to some vacant cattle allotments on the District, but he was not interested in changing livestock class.

  The Pagosa Ranger District has two small sheep forage reserve allotments, but does not have any vacant sheep allotments. The Dolores Ranger District has some vacant sheep allotments, but no recent NEPA has been done to authorize re-stocking them; additionally, the permittee is not interested in allotments which would require trucking sheep from his base property.

  The Rio Grande National Forest may have some vacant sheep allotments adjacent to the Weminuche Landscape to the north, but moving Columbine sheep to them would still require either trailing through the same country they would be moving from, thus not solving the issue of bighorn risk of contact; or would require trucking, which is not a financially viable option for the permittee.

- We considered a forage reserve for cattle on the upper portion of the Pine River Allotment. Through scoping and internal review, this was dropped due to limited accessibility to the area, distance from cattle allotments, and perceived high potential for recreation conflicts. There was also concern regarding the amount of wetlands and fens in this allotment and how cattle might impact them.

KEY CONCEPTS

The documents described below provide suggestions for consideration by land management agencies evaluating domestic sheep grazing activities within or in proximity to bighorn sheep range. These documents provide recommendations similar to “best management practices” and as such are not required. As generally accepted principles for achieving consensus-based conservation of bighorn sheep, these documents provide key concepts that can help land management agencies achieve species conservation goals while also meeting multiple use goals. These documents, and a

wide variety of scientific literature, were reviewed and key concepts were considered in the development of design criteria (EIS Tables 2-2 and 2-3) and this Risk Assessment.

1. Colorado Bighorn Sheep Management Plan (George et al. 2009): directs Colorado Parks and Wildlife (CPW; formerly Colorado Division of Wildlife) to, among other things, prioritize conservation of bighorn sheep herds in Colorado on the basis of herd size, native status, management history, and potential for interaction with domestic sheep. State goals for the management of bighorn sheep herds affected by domestic sheep grazing in this Landscape were considered by local CPW staff who provided information regarding affects this project might have on bighorn sheep.

2. Memorandum of Understanding (Colorado Parks and Wildlife 2013a): dated October 14, 2013, and signed by USDA Forest Service Rocky Mountain Region, USDI Bureau of Land Management Colorado State Office, Colorado Parks and Wildlife, Colorado Department of Agriculture, and the Colorado Woolgrowers Association. This document recognizes, among other things, that contact between domestic sheep and bighorn sheep increases the probability of respiratory disease outbreaks in bighorn sheep, but also recognizes that not all disease outbreaks and reduced recruitment in bighorn sheep can be attributed to contact with domestic sheep. The stated goal is to minimize contact by decreasing the opportunities for domestic/bighorn sheep interaction, while still recognizing that some vacant sheep allotments are important to the domestic sheep industry as forage reserves or for other economic or management reasons. The bighorn sheep management concepts specifically agreed to by the USFS are stated in section IV, parts a through h, of the MOU. It is agreed by CPW and Colorado Woolgrowers in section V that closure of active sheep allotments will not be recommended based solely on the potential for interaction between domestic and bighorn sheep. It is also recognized that land management agencies (USFS and BLM) will follow existing regulation and direction regarding closure or modification of active allotments to resolve documented resource conflicts.

3. Western Association of Fish and Wildlife Agencies Recommendations for Domestic Sheep and Goat Management in Wild Sheep Habitat (Western Association of Fish and Wildlife Agencies 2012): a report published by a collection of state and provincial wildlife management agencies. This group seeks to work collaboratively with livestock industry to reduce the potential for bighorn sheep die-offs. This report articulates concerns about the potential for disease transmission between domestic sheep and goats and bighorn sheep, and suggests an array of management approaches to minimize such risks. This report advocates, among other things, that effective separation (both temporal and/or spatial) of bighorn and domestic sheep should be a primary management goal, and recognizes that effective separation does not necessarily require the removal of domestic sheep.

   Often referred to as the 'WAFWA Guidelines', this document is widely recognized as the best available source for BMPs to minimize the potential for physical contact between bighorn and domestic sheep. Many of the 'WAFWA Guidelines' were incorporated into design criteria for the Weminuche Landscape. The WAFWA Guidelines state that BMPs "are intended to provide a responsible and common-sense approach for reducing risk of association. However, there is no science-based evidence or evaluation that assesses the effectiveness of these actions to reduce risk or enhance separation." "Effectiveness of management practices designed to reduce risk of association are not proven and therefore should not be solely relied upon to achieve effective separation. Such practices could however, help achieve separation when applied outside of occupied wild sheep range or connected and potentially mitigate impacts associated with straying domestic sheep or goats, or wandering wild sheep."

4. A Process for Finding Management Solutions to the Incompatibility Between Domestic and Bighorn Sheep (Schommer and Woolever 2001): provides Forest Service staff with recommendations for using a collaborative approach to find management solutions to reduce or eliminate contact between bighorn sheep and domestic sheep.

5. National and Regional Letters of Direction for Bighorn Sheep NEPA Analysis (USDA Forest Service 2011a, USDA Forest Service 2011b, USDA Forest Service 2012, USDA Forest Service 2014a, USDA Forest Service 2014b): these unpublished letters direct National Forest units considering projects that could affect the potential for physical contact between bighorn and domestic sheep with subsequent potential for disease transmission to conduct a Risk Assessment analysis. These letters state "Forests that have necessary data, issue complexity, and the ability to conduct a quantitative bighorn sheep viability analysis may do so. However, a qualitative approach to NEPA analysis for bighorn sheep viability is sufficient as long as clear and reasonable rationale for the decision is displayed" (USDA Forest Service 2011a). And, "the level of analysis should be commensurate with the level of risk to bighorn sheep and the significance of loss of a bighorn sheep herd" (USDA Forest Service 2011b). As directed in these letters, the "Risk Assessment" displayed below utilizes the four-step process outlined in the Holtrop letter (USDA Forest Service 2011a). The "Risk Assessment" uses a combination of quantitative and qualitative approaches to arrive at a conclusion about risk of physical contact between bighorn and domestic sheep in the Weminuche Landscape and provides an analysis of bighorn sheep viability. This letter directs units to identify "management practices with the goal of separation between domestic and bighorn sheep where necessary to provide for Forest-wide bighorn sheep viability." A follow-up letter (USDA Forest Service. 2014a) states "There is a need to clarify the importance of balancing multiple-use demands with the management practices to support viable populations of bighorn sheep and a healthy domestic sheep industry. Best Management Practices to maintain separation need to be applied to the extent they are effective in supporting both uses."

HISTORY OF DOMESTIC SHEEP GRAZING IN THE WEMINUCHE LANDSCAPE

Prior to the establishment of the San Juan Forest Reserve in 1905, the San Juan Mountains were used as summer range by large bands of domestic sheep from both Colorado and New Mexico, with the first small bands of sheep arriving in the Pagosa Springs, Bayfield, and Durango areas in 1882 (Scott 1932). It is estimated that by 1902, there were approximately 268,000 sheep in the San Juan Mountains. Sheep grazing was generally confined to the higher elevation range above 10,000 feet in elevation (DuBois 1903). Prior to the establishment of Forest Reserves, livestock grazing was unregulated, with season of use based on weather and vegetative development. Generally, sheep would begin slowly working their way up into the high country in May or June, eventually arriving on the highest elevation summer ranges in early July. They started to leave the high country sometime between September 15 and October 1 (DuBois 1903).

At this time, there was no division of allotments, so range was grazed on a first come first serve basis, with some areas grazed multiple times in a season. Domestic sheep were usually herded close together, which made it easier for herders to keep watch over the flocks and prevent individual animals from wandering. These large, close-herded bands were constantly moving ahead into fresh grazing, which in some areas resulted in damage to forage from close cropping and trampling. Bed grounds that were used for long periods of time, or that were used season after season, also became impacted (Roberts 1963). DuBois (1903) reported that large numbers of sheep prior to 1903 had

already left definite trails through some alpine areas – especially in topographic constrictions (narrow, steep or rocky terrain). Domestic sheep also impacted previously well-defined trails by widening the trails, causing braiding of the trails and making the actual trail more difficult to locate (DuBois 1903).

Following the establishment of the San Juan Forest Reserve in 1905, many changes in management were implemented in an effort to more effectively manage the rangeland resource. Some of the noteworthy changes included dividing the domestic sheep ranges into distinct grazing districts (allotments) and assigning these areas to specific permittees with designated numbers and seasons of use, including the designation of specific trailing areas to be used to access the allotments. Other important management changes implemented during this time included the adoption of open herding, which allowed sheep to spread-out and graze with a minimum of driving, which resulted in less intensive grazing and less impacts from trampling. Use of bed grounds was also restricted to only a few nights in one place in order to reduce impacts to soils and vegetation.

Although it is difficult to precisely track historic sheep stocking rates, a search of historic records gives a general picture of the early days of regulated grazing on the San Juan NF (see Figure 4, below). The earliest grazing reports located were from the Annual Grazing Report for the SJNF, 1908, and show 109,359 sheep and goats authorized to graze on the SJNF (in the area now covered by the Pagosa and Columbine Ranger Districts). Historic records show stocking of domestic sheep and goats in that same area in 1920 to be approximately 198,400. By 1930 the number of sheep reached the highest recorded at approximately 216,600 (M. Tucker pers. com.; see Figure 4, below). From that period on, there were steady declines in stocking, including approximately 173,000 sheep in 1940, 107,000 in 1950, 73,000 in 1960, 33,000 in 1980, 19,000 in 1991, 11,000 in 2004, and 12,550 in 2013. The number of domestic sheep permitted in 2013 was approximately 5% of the historical high of 216,600 in 1930. Many factors contributed to the steady decades-long decline in domestic sheep stocking across the SJNF, the most important of which was a steady decline in demand for wool and lamb. Demand for lamb and wool products however has increased recently.

Concurrently in the first half of the 20th century, as domestic sheep stocking rates were increasing in the San Juan Mountains, bighorn sheep populations were decreasing. Much of this decrease in bighorn sheep populations is thought likely due to the effects of unregulated hunting for markets and local food supplies (Weinmeister pers. comm.). As remnant bighorn herds became smaller and more isolated from each other and more separated from domestic sheep, the potential for physical contact and potential for subsequent disease outbreaks in remnant bighorn herds was also likely reduced. In addition, both black and grizzly bears were present in this area during this time and thought responsible for substantial losses of domestic sheep. For this reason, domestic sheep herders typically used close herding techniques to reduce losses, which likely further reduced the potential for stray domestic sheep coming into contact with the much smaller and more isolated bighorn herds that remained in the landscape (Weinmeister pers. comm.).

Historic records indicate that domestic sheep grazing either directly overlapped or occurred in close proximity to much of the suitable and/or occupied bighorn sheep habitats across most of the San Juan NF. Beginning in the late 1960s and earlier in the case of some domestic sheep allotments on the Columbine Ranger District, forest managers began to note questions concerning competition between domestic sheep and bighorn sheep, and encouraged research programs on disease and predation of bighorns. During this same period, managers began discussions to reduce or limit domestic sheep grazing on bighorn sheep range in portions of the currently designated Weminuche Wilderness for the purpose of maintaining or enhancing known bighorn sheep herds.

AFFECTED BIGHORN SHEEP HERDS

This section provides a summary, for each of the bighorn herds in the Weminuche Landscape, of bighorn management objectives identified by CPW for each herd, of population status and habitat present within the Weminuche Landscape, and of population estimates for bighorn herds addressed in this assessment. A separate discussion is provided for each herd which summarizes the baseline conditions for each bighorn herd. This information will be used later in the analysis to evaluate the potential for physical contact with domestic sheep.

Colorado Parks and Wildlife (CPW) has traditionally managed bighorn sheep based on Game Management Units (GMUs) and Data Analysis Units (DAUs). GMUs are smaller geographic areas that allow localized management of relatively distinct bighorn subgroups, whereas the generally much larger DAUs group several GMUs to represent frequently interacting subgroups that comprise a relatively discrete population (George et al. 2009). In the context of bighorn social structure, GMUs represent relatively discrete herds (subgroups), and DAUs represent frequently interacting herd complexes (populations). Genetic interchange and biological connections among herds that make up a frequently interacting meta-population structure, especially through movements and exchanges of rams, is an important characteristic of bighorn sheep ecology and population structure (George et al. 2009, Beecham et al. 2007).

The Weminuche Landscape intersects the mapped summer range (referred to as Core Herd Home Range – CHHR in this document) of three bighorn sheep herds, with each herd representing a Game Management Unit (GMU). The three herds (GMUs) with summer range intersecting the Weminuche Landscape are: S-16 the Cimarrona Peak Herd, S-28 the Vallecito Creek Herd, and S-71 the West Needles Herd. See Figures 5, 6 and 7 at the end of this document, and the EIS Figure 1-4 for maps displaying the locations of these three bighorn herds in the Weminuche Landscape and the domestic sheep grazing allotment they overlap. There is about 2,457 acres of mapped overlap with the CHHR for the West Needles Herd S-71 in the Canyon Creek and Tank Creek Allotments. There is about 39,516 acres of mapped overlap with the CHHR for the Vallecito Creek Herd S-28 in the Cave Basin, Flint Creek, Pine River and Rock Creek Allotments. There is about 4,080 acres of mapped overlap with the CHHR for the Cimarrona Peak Herd S-16 in the Pine River Allotment.

The S-16 Cimarrona Peak Herd and the S-28 Vallecito Creek Herd are considered by CPW to represent one large interconnected meta-population, along with S-15 the Sheep Mountain herd to the east. Together, these three herds (GMUs) comprise the Weminuche Population Data Analysis Unit (DAU RBS-20). The CPW estimate for the Weminuche Population RBS-20 in 2012 was 425 bighorn sheep, which includes 200 sheep in S-15, 135 sheep in S-16, and 90 sheep in S-28 (Weinmeister 2012). The CPW population objective for the Weminuche Population is to allow the population to expand to a maximum of 4.4 bighorn sheep/square kilometer. The 2010 population estimate for the Weminuche DAU was 2.2 bighorn sheep/square kilometer (Weinmeister 2012), well below the population objective of 4.4 sheep/square kilometer.

There is mapped overlap between one domestic sheep allotment (Pine River) and mapped summer range for S-16, and overlap between four sheep allotments and S-28 (see Figure 5 at the end of this document, and EIS Figure 1-4). There is no mapped overlap between domestic sheep allotments in the Weminuche Landscape and mapped summer range for S-15, although the Weminuche Population is considered to be an interconnected meta-population. Because the three GMU's are considered to be an interconnected meta-population, it is likely that decisions regarding domestic sheep grazing in the Weminuche Landscape could have indirect effects to the S-15 Sheep Mountain Herd through biological connections with S-16 and S-28. The level of risk to S-15 from indirect effects through exchange of individual bighorns across the larger meta-population is thought to be

lower as compared to the direct effect of domestic sheep grazing in close proximity to S-16 and S-28 and potentially coming into contact with foraying members of the S-16 and S-28 herds.

Domestic sheep grazing activities within proximity to S-15 are managed by the Pagosa Ranger District, and by the Divide Ranger District of the Rio Grande National Forest (RGNF). There are no active domestic sheep grazing allotments on NFS lands managed by the Pagosa Ranger District in S-15. A 2010 NEPA decision closed all vacant allotments in S-15 on the Pagosa Ranger District due to concerns for the high risk of contact between domestic and bighorn sheep. In another recent NEPA decision, the Divide Ranger District on the Rio Grande National Forest vacated the Fisher/Ivy/Goose Allotment in S-15 due to concerns for high risk of contact between domestic and bighorn sheep.

The Weminuche Population (DAU RBS-20) is one of the largest indigenous bighorn sheep populations in the state (Weinmeister 2012). A DAU management plan was developed for the Weminuche Population, DAU RBS-20 (Weinmeister 2012). The Weminuche Population (DAU RBS-20) is a Tier 1 population. Primary (Tier 1) populations are regarded as those large, native populations comprised of one or more interconnected herds that have received few, if any, supplemental releases of bighorn sheep in the past. These populations likely represent those indigenous bighorn populations that have maintained the greatest genetic diversity, and their ranges represent habitats where bighorns have best been able to persist in sizeable numbers despite various adversities (George et al. 2009). As such, CPW considers the Weminuche Population to be among the most important bighorn herds in the state, which places the population in the top priority State-wide for inventory and monitoring, habitat protection and improvement, disease prevention, and research. A Tier 1 population has >/= 100 animals for >/=90% of the years since 1986, and native populations comprised of one or more interconnected herds that have received few (<50 animals total), if any, supplemental releases of bighorn sheep in the past (George et al 2009). For all these reasons, George et al. (2009) recommend considering all opportunities to reduce the potential for physical contact with domestic sheep, thereby reducing potential for subsequent disease transmission and bighorn mortality events.

CPW's 2012 population estimate of 425 bighorn sheep in the Weminuche Population is based on summer and winter helicopter surveys, and coordinated ground counts conducted by CPW and Forest Service employees on the SJNF and RGNF. The population is currently performing well as evidenced by continued growth, lamb production and recruitment, particularly in S-15 and S-16 (Weinmeister 2012). Bighorn sheep are being observed in places they have not previously been reported and they are presumed to be re-occupying historic ranges and filling gaps between disjunct core use areas. Weinmeister (2012) states "Lamb production is good with typical observed postseason lamb:ewe ratios within 40-50:100. Age ratios obtained during the summer are similar to those from winter which indicates excellent lamb survival and the absence of a significant disease type that is limiting population growth."

With the exception of the unique Cave Basin event, there have been no documented or hypothesized disease transmission events in the Weminuche Landscape or elsewhere on the San Juan NF. The Cave Basin event, described below in the Vallecito Creek Her S-28 section and later in Cave Basin Allotment section, did not involve members of the home herd (S-28) and was restricted to only the transplanted individual bighorn sheep. It was also a unique situation for domestic sheep grazing practices because it was a one-year stocking event in an allotment that had been vacant for years and has remained vacant ever since.

Weinmeister (2012) describes habitat conditions in the Weminuche Population as "most of the habitat within the DAU appears to be in good or excellent condition. Summer range is extensive and

provides room for population growth. Winter range and lambing areas are more limited. Currently winter range and bighorn distribution on winter range is not limiting. Identified lambing areas in the DAU are limited.

A DAU management plan has not been completed for GMU S-71, the West Needles Herd (Weinmeister pers. com). The West Needles Herd is not a Tier 1 or a Tier 2 population. Bighorn herds such as S-71 that are not Tier 1 (primary) or Tier 2 (secondary), are considered to be "unclassified" herds, which places this population at a lower priority for inventorying, habitat protection and improvement, and research, as compared to primary (Tier 1) populations or Tier 2 populations. There is mapped overlap between two domestic sheep allotments in the Weminuche Landscape and mapped summer range for S-71 (see Figure 5 at the end of this document, and EIS Figure 1-4).

CIMARRONA PEAK HERD (S-16):

The majority of the S-16 Cimarrona Peak Herd on the San Juan NF is located on the Pagosa Ranger District. Only a small portion of the GMU is located on the Columbine Ranger District, but all of this is within the Weminuche Landscape (see Figure 5 at the end of this document, and EIS Figure 1-4). The vast majority of bighorn sheep habitat in the GMU occurs in alpine and subalpine habitats in the Weminuche Wilderness, along or adjacent to the Continental Divide. The herd is managed in conjunction with S-28, the Vallecito Creek Herd, and S-15, the Sheep Mountain Herd, and collectively referred to as the Weminuche Population (DAU RBS-20).

Early reports of bighorn sheep in S-16 from Forest Service records date from the early 1920s and note bighorn sheep present on the Piedra Ranger District around Cimarrona Peak. This area is still considered to be core herd home range today. The number of sheep reported ranged from 2 sheep in 1922 to 50 sheep in 1941. Additional early reports of bighorns in the GMU include 30 individuals in 1944 and a population estimate of 35 to 40 animals in 1970 (Bear and Jones 1973). Since these early periods, bighorn sheep have been inventoried and monitored sporadically via helicopter surveys conducted by CPW, ground surveys conducted by CPW and USFS crews, and coordinated ground counts conducted by CPW, USFS, and volunteers. The S-16 population was estimated at 70 animals from 1986 through 1993 (George et al. 2009).

From 1994 through 2004, the recorded population estimate increased and remained at 100 animals, and from 2005 to 2007 the population was estimated at 90 animals, then from 2008 to present increased to 135 animals. Over the last 10 years, the average post-season lamb:ewe ratios have been 50:100, indicating good productivity (Weinmeister 2012).

Recent bighorn observations and reports show a moderate range expansion in S-16, compared to historic records. Bighorns are currently present along the far eastern boundary of the GMU, directly adjacent to S-15. The very close proximity of these two herds coupled with good habitat connectivity increases the likelihood of interaction. If the population of this herd continues to increase, as expected, the recent observed range expansion is also expected to continue. Population increases and range expansions are also generally expected to lead to increased numbers of animals foraying outside their CHHR.

Bighorn sheep were extirpated throughout much of the San Juan Mountains from the late 1800's through the 1960's (Weinmeister 2012). It is surmised that this was influenced by overharvest of bighorn sheep by unregulated hunting, competition for forage with domestic livestock, and disease introduced by livestock. Current bighorn distribution in S-16 is similar to that reported by Bear and Jones (1973), but also includes areas north of Granite Lake and the Continental Divide, east to the

Cliffs above Palisade Lakes (USDA Forest Service 2013a). Habitat along the Continental Divide serves as a natural linkage that may facilitate interaction with bighorn sheep in S-15. There have been no translocations into or out of S-16 (Beecham et al. 2007).

Field reconnaissance and habitat modeling show an extensive amount of well-connected habitat across S-16. CPW has mapped approximately 38,126 acres of summer range within the GMU on the SJNF, which constitutes about 87% of the GMU (USDA Forest Service 2013a). Bighorn sheep in S-16 generally winter and summer in the same terrain. All known lambing and wintering areas for S-16 are on the Pagosa Ranger District, outside the Weminuche Landscape. On the Pagosa Ranger District, bighorns are known to winter in lower elevation portions of S-16 characterized by scattered Douglas-fir within large rocky outcrops and cliff bands. In these locations, canopy cover and sight distance may constrain bighorn distribution, and increase exposure to predation. In contrast, bighorns are also known to winter above timberline where site distances are not constrained by forest vegetation. Summer range is extensive and does not appear to be a limiting factor within S-16. Winter range, however, is somewhat restricted particularly following big snowfalls.

There are several domestic sheep and goat grazing allotments on the Divide Ranger District of the Rio Grande NF that overlap or lie adjacent to S-16, but all are currently vacant due in part to concerns for potential for contact with domestic sheep. All domestic sheep allotments on the portion of S-16 managed by the Pagosa Ranger District were closed to domestic sheep grazing in 2010 (USDA Forest Service 2010b). Only one sheep allotment in the Weminuche Landscape overlaps S-16 (see Figure 5 at the end of this document, and EIS Figure 1-4), the Pine River Allotment, which has remained vacant since it was last grazed by domestic sheep in 1980. There is about 4,080 acres of mapped overlap with the CHHR for the Cimarrona Peak Herd S-16 in the Pine River Allotment.

An extensive amount of spruce bark beetle activity is present in S-16, including those portions of the GMU in the Weminuche Landscape. Large stands of Engelmann spruce have either died or are dying due to an epidemic beetle infestation, causing extensive openings in the overstory forest canopy. The spruce die-offs resulting from this beetle epidemic are expected to increase forbs and grasses in the understory of previously closed-canopy stands, thus having a potentially beneficial impact on bighorn sheep by allowing more abundant and higher quality forage to develop in these stands. Visual barriers caused by stands of living conifers are expected to be reduced, thereby improving the ability of bighorn sheep to detect predators, but predation is not considered to be a factor currently limiting bighorns in S-16. Conversely, increased grass and forb production and reduced visual barriers due to conifer mortality could increase bighorn movements (i.e. forays) which is not considered a factor likely to be limiting bighorns in S-16 .

A variety of summer and winter recreation activities occur in the GMU. During summer, moderate to high amounts of backpacking, day hiking, and horseback riding occur due to the presence of the Continental Divide Trail and popular destination lakes. Most of these activities occur in areas away from known lambing and optimal security habitat and are not limiting factors. Due to the general remoteness of the GMU, and limited access to winter bighorn habitat by winter recreationists, winter recreation activities and associated human disturbances are not considered a limiting factor for bighorns in S-16.

In summary, the bighorn population in S-16 appears to be doing well. The population is estimated at 135 animals. The long-term (25-year) trend in CPW population estimates show this herd has increased moderately in numbers and in distribution. There are no current concerns for bighorns in S-16 associated with habitat quality or quantity, predation, competition with other ungulate species, or human disturbance. The primary management issue of concern for bighorn sheep in S-

16 is the potential for disease transmission contracted through physical contact with domestic sheep.

VALLECITO CREEK HERD (S-28):

Unit S-28, the Vallecito Creek Herd, lies between units S-16 and S-71. S-28 lies almost entirely on the Columbine Ranger District, and nearly all (97%) is on NFS lands (see Figure 5 at the end of this document, and EIS Figure 1-4). The vast majority of bighorn sheep habitat in the GMU occurs in alpine and subalpine habitats in the Weminuche Wilderness. The herd is managed in conjunction with S-15, Sheep Mountain Herd, and S-16, Cimarrona Peak Herd, and they are collectively referred to as the Weminuche Population (DAU RBS-20).

Early records suggesting the presence of bighorn sheep in S-28 are from 1908 on a map titled "Map of the San Juan National Forest Showing Ranger Districts and Grazing Divisions" (USDA Forest Service 2013a). The map identifies the "Mountain Sheep Game Refuge, No Grazing" encompassing the headwaters of Needle Creek (Unit S-71) east to Vallecito Creek (unit S-28), and north to Vallecito Lake.

Other early reports of bighorn sheep in the GMU are from harvests reported in the 1950's and sightings in the 1960's (Bear and Jones 1973). Early accounts of bighorn sheep in the late 1960's and early 1970's include 16 bighorn sheep counted via helicopter in winter 1968, 8 bighorns counted via fixed wing airplane in fall 1969, 11 bighorns in winter 1969, 9 bighorns in spring 1971, and 8 bighorns in summer 1971 (Bear and Jones 1973). Since these early periods, bighorn sheep have been inventoried and monitored sporadically via helicopter surveys conducted by CPW.

The S-28 bighorn population was estimated at 40 animals from 1986 through 1992 (George et al. 2009). In 1993 the population was estimated at 50, and then 60 in 1994. From 1995 through 1999, the recorded population estimate increased and remained at 80 animals, and from 2000 to 2002 the population was estimated at 100 animals, and increased to 125 animals from 2003 to 2011. In 2012 however, the population estimate was reduced to 90 animals (Weinmeister 2012). Over the last 10 years, the average post-season lamb:ewe ratios have been 45-50:100 in the GMU (Weinmeister 2012).

There is some recent concern however for the status of the S-28 Herd. This concern is due to the recent (since 2012) decline in the estimated total population size of S-28. This concern is also due to eight mature rams having been found dead in S28 between 2010 and 2014 and the cause of death remains unknown (Weinmeister pers. comm.), adding concern for the status of the S28 herd. Recent CPW monitoring data indicates lamb production has remained stable during this same time. Why a high number of mature rams have been found dead in S-28, yet lamb production appears to remain stable and normal is unknown. A contributing factor may be the remote nature of this DAU and the core herd areas within it making monitoring activities difficult. Additional monitoring activities and monitoring opportunities in S-28 are being discussed by CPW and the Forest Service in response to observations of recent ram mortality and the perception of a recent decline in overall bighorn observations in S-28.

Bighorn sheep were extirpated throughout much of the San Juan Mountains from the late 1800's through the 1960's (Weinmeister 2012). It is surmised that this was influenced by overharvest of bighorn sheep from unregulated hunting, competition for forage with domestic livestock, and disease introduced by livestock. In 1973, Bear and Jones reported the herd summered and wintered on the alpine ranges bounded by the Pine River, Flint Creek, and Lake Creek (USDA Forest Service 2013a). They also reported animals wintering in the downstream cliffs along the Pine River on

private lands and adjacent National Forest. This represents a very similar distribution to that reported today, but more extensive use of the high ridgeline on the east side of the Pine River has been documented in the past 20 years. Also recently, the alpine ridges east of Emerald Lake are now recognized to be an important year-round use area (Weinmeister 2012).

Based on comparison of historic reports and current observations, it is presumed that the distribution of S-28 may have increased moderately to the east over the past 30 years, but still includes the same areas thought to be core areas in the late 1960's. Bighorn activity has increased over the years along the far eastern boundary of the GMU, directly adjacent to S-16. Habitat along the Continental Divide and the ridge extending from Bald Mountain south to known summer used areas on Three Sisters Peaks and Granite Peak. This habitat serves as a natural linkage that may facilitate interaction between S-28 and S-16. The very close proximity of these two herds, coupled with good habitat connectivity, increases the likelihood of interaction. For this reason, S-28 is considered to be part of the larger interconnected meta-population of the Weminuche Population (DAU RBS-20).

There have been no confirmed bighorn mortality events in any of the native bighorn herds on the San Juan NF (USDA Forest Service 2013a). There is however, strong circumstantial evidence a bighorn mortality event occurred in S-28 in 1988 after physical contact was observed between domestic sheep and translocated bighorn sheep in the Cave Basin Allotment (Weinmeister 2012). None of the translocated bighorn sheep were known to have survived their first winter season, and a complete mortality event of the released bighorns is assumed to have occurred. Disease did not appear to have been transmitted from the translocated bighorns to the native bighorn herd because population size and lamb survival remained stable in S-28 after the event (Weinmeister 2012). *Pasteurella* was suspected as the agent that had caused the die-off, based on the typical pattern of the disease. Weinmeister (2012) states "it is possible that the deaths of the transplanted sheep could have been caused by some other factor, although the swiftness of the deaths is not familiar in other documented causes of mortality." Additional details about this event are provided below in the Cave Basin Allotment section.

The 1988 event was also the only recorded translocation into S-28. It involved 20 bighorns from the Snowmass Unit (Beecham et al. 2007, Weinmeister 2012). At that time, the S-28 herd was considered to be isolated from other herds in the San Juan Mountains and was experiencing continued low recruitment. This translocation was intended to increase the genetic diversity and vigor of S-28 and increase distribution through pioneering, but was considered unsuccessful.

A reliable report of two young ram bighorn sheep seen within ¼ mile of domestic sheep in the Endlich Mesa Allotment was received by the USFS in 2015 (see detailed discussion below in Endlich Mesa Allotment section). The observation occurred in late summer of the 2012 or 2013 grazing season. A reliable report of "2 nice rams, one full curl scoring maybe 170" observed in the Virginia Gulch Allotment was received by CPW in mid-July 2014 (see detailed discussion below in Virginia Gulch Allotment section).

The roughly 2.5 miles distance separating the Endlich Mesa sighting from the S-28 CHHR suggests it is more likely the rams came from S-28 than from S-71 or S-16. The location of the Virginia Gulch sighting nearly equidistant between the S-71 and S-28 CHHRs makes it difficult to suggest which herd the animals originated from. A large radio telemetry data set from Idaho estimated that about 80% of rams and 35% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c).

These reports confirm the presence of foraying bighorns, presumably from S-28 in at least one case, within active allotments and in close proximity to domestic sheep. The very close observed proximity to domestic sheep (less than ½ mile in both cases) suggests there was high risk for physical contact to occur, especially given the known behavioral attraction between the species. However, in both cases the reporting parties stated they did not observe physical contact between the species.

Field reconnaissance and habitat modeling show an extensive amount of well-connected habitat across S-28. CPW has mapped approximately 49,909 acres of summer range on the SJNF, which constitutes 99% of the summer range in the GMU (USDA Forest Service 2013a). Bighorn sheep are known to winter and summer in some of the same areas. Summer range is extensive and does not appear to be a limiting factor; however, winter range is somewhat restricted particularly following big snowfalls (Weinmeister 2012). Bighorns are known to winter in lower elevation portions of S-28 that are characterized by scattered trees within large rocky outcrops, where reduced sight distances may be a constraint for bighorns by increasing their vulnerability to predators (Beecham et al. 2007).

In contrast, bighorns are also known to winter above timberline in S-28 where site distances are not constrained by forest vegetation. Known wintering areas include the Pine River near Runlett Peak, the alpine ridges east of Emerald Lake, and private lands and adjacent NFS lands downstream along the Pine River. Known lambing areas include the ridges on either side of the Pine River downstream from Lake Creek, and the ridges east of Emerald Lake (Weinmeister 2012). CPW has worked with private landowners in the bighorn use areas along the lower reaches of the Pine River to ensure domestic sheep are not present on private lands within known bighorn use areas where there might be potential for physical contact.

Bighorn summer range in S-28 as mapped by CPW overlaps with the Pine River, Flint Creek, Cave Basin and Rock Creek domestic sheep and goat grazing allotments (see Figure 5 at the end of this document, and EIS Figure 1-4). All of these allotments have remained vacant for decades (see Table 1, above). The Pine River Allotment was last stocked with domestic sheep in 1980. The Flint Creek Allotment was last stocked in 1972. Cave Basin Allotment was last stocked in 1988. The Rock Creek Allotment was last stocked in 1970. Since then, there have been no requests to stock these allotments due to their remoteness and access difficulties. There is about 39,516 acres of mapped overlap with the CHHR for the Vallecito Creek Herd S-28 in the Cave Basin, Flint Creek, Pine River and Rock Creek Allotments.

Spruce bark beetle activity in mapped summer range areas for S-28 has not currently reached the epidemic levels seen across much of S-16, but is expected to increase substantially in the near future. If so, significant mortality of overstory Engelmann spruce trees is expected that is likely to increase forb and grass production in the understory of previously closed-canopy stands, thus potentially benefiting bighorn sheep by allowing more abundant and higher quality forage to develop under previously closed-canopy stands. Visual barriers caused by dense stands of living conifers are expected to be reduced, thereby potentially improving the ability of bighorn sheep to detect predators, potentially enhancing movements across the landscape. Changes in spruce forest stand structure due to beetle-induced tree mortality could also increase domestic sheep forage capacity potentially increasing the amount and distribution of suitable domestic sheep grazing areas in the landscape.

A variety of summer and winter recreation activities occur in the Unit, and recreation use can be high in some areas in summer. During summer, moderate to high amounts of backpacking, dayhiking, and horseback riding occur in S-28 due to the presence of the Pine River and Vallecito Creek Trails, and popular destination areas such as Emerald Lake. Past concerns about the

potential for motorized access as a source of human disturbance impacts in lambing areas were addressed by travel management restrictions designed to minimize disturbance in known lambing areas. The use of recreational pack goats has been documented on the Pine River Trail, raising the possibility of potential physical contact and subsequent disease transmission to bighorn sheep from sources outside of authorized domestic sheep grazing within permitted allotments. Substantial winter use by cross-country skiers and snowshoer's occurs along the Pine River Trail to Canyon Creek Ridge. This same area provides quality winter habitat for bighorns, and represents a potential disturbance factor to bighorns during the wintering period. However, at this time, the amount of winter recreational use of this area is not thought to be limiting bighorn use of this important wintering area (Carron pers. comm.). Human disturbance in higher elevation summer range is not thought to be limiting bighorn distribution or habitat use and is not of concern at this time.

In summary, current information suggests that the bighorn population in Unit S-28 may be in decline from previous years, but the reasons for such a decline are not known. The population is estimated at 90 animals, a decline from previous estimates of about 125 animals (see Figure 3, below). Very recent concern for the population status of S-28 stems from observations of recent ram mortality and perception of a recent decline in overall bighorn observations within traditional use areas (Weinmeister pers. comm.). The long-term (25-year) trend in CPW population estimates shows this herd as having increased moderately in both numbers and distribution, but with recent declines in numbers. There are currently no concerns for bighorns in S-28 associated with habitat quality or quantity, or competition with other ungulate species. There is some recent discussion that lion predation could be limiting lamb survival (Weinmeister 2012) but no conclusions have been drawn. Human disturbance in low elevation winter range along the Pine River Trail to Canyon Creek Ridge, and use of recreational pack goats on the Pine River Trail may pose potential risk factors for bighorns in the GMU, but these potential risk factors are not thought to be limiting bighorn distribution or habitat use at this time. The primary management issue of concern for bighorns in S-28 is the potential for disease transmission contracted through physical contact with domestic sheep.

WEST NEEDLES HERD (S-71):

Unit S-71, the West Needles Herd, is located on the west side of the Weminuche Landscape, and on NFS lands, it is entirely on the Columbine Ranger District (see Figure 5 at the end of this document, and EIS Figure 1-4). The majority of bighorn sheep habitat in the GMU occurs in alpine and subalpine habitats in the Weminuche Wilderness in the West Needle Mountains, and on steep, rocky cliffs along the Animas River Canyon north of Rockwood.

Bighorn sheep were extirpated throughout much of the San Juan Mountains from the late 1800's through the 1960's (Weinmeister 2012). It is surmised that this was influenced by overharvest of bighorn sheep by unregulated hunting, competition for forage with domestic livestock, and disease introduced by livestock. Early records suggesting the presence of bighorn sheep in S-71 are from 1908 on a map titled "Map of the San Juan National Forest Showing Ranger Districts and Grazing Divisions" (USDA Forest Service 2013a). The map identifies the "Mountain Sheep Game Refuge, No Grazing" encompassing the headwaters of Needle Creek (Unit S-71) east to Vallecito Creek (Unit S-28), and north to Vallecito Lake. Other reports from the Colorado State Game Department in 1954 note mountain sheep present in the "Trinity" (9 animals, Unit S-71) and "Sunlight" (60 animals, Unit S-71) areas, areas they are not known to occur today of for decades in the past.

The current S-71 West Needles Herd was established with animals translocated from the Georgetown Herd in 2000, and 2002-2003 (Beecham et al. 2007). Bighorn sheep now appear to use the entire Animas River Canyon from Rockwood northeast to Needle Creek, and perhaps somewhat

further north particularly on the west side. The primary summer range of this herd is the West Needle Mountains, and primary winter and lambing range is the Animas River Canyon from Rockwood to the Cascade Wye (Beecham et al 2007), along with more recent evidence of lambing at higher elevations in the West Needle Mountains (Weinmeister pers. comm.). Immediately after release, two bighorns dispersed north into Unit S-21 near Ouray. Based on ear tag observations, several sheep also dispersed northeast into Unit S-33 near Lake City. In addition, six or seven sheep moved into the Hermosa Cliffs area to the west of the Animas River Canyon and remained there for several years (Beecham et al. 2007). Recent observations (summer 2012 through 2015) show increased bighorn use along U.S. Highway 550 near Coal Bank Pass, west of the West Needle Mountains, indicating the herd may be expanding its range to the west and north.

Because S-71 is a translocated herd it is considered by CPW to be an 'unclassified' herd (George et al. 2009). Populations that do not meet criteria for either a Tier 1 or Tier 2 population are characterized as "unclassified" populations (Weinmeister pers. comm.). As an unclassified herd, S-71 is placed at a lower priority for inventorying, habitat protection and improvement, and research, as compared to populations that are considered primary core populations or Tier 2 populations. Also, as a translocated population, CPW recognizes the presence of pre-existing active domestic sheep grazing allotments to the north, east, and west of S-71. CPW does not advocate closure of pre-existing active domestic sheep allotments based solely on the potential for interaction between domestic and bighorn sheep originating from translocated herds (Colorado Parks and Wildlife 2013a). All of the currently active domestic sheep allotments in the Weminuche Landscape were active long prior to the establishment of the S-71 herd by CPW translocations. CPW does, however, suggest working with existing sheep permittees with bands in areas of mapped overlap with bighorn sheep summer range to collaboratively take advantage of opportunities, if/when they arise, to reduce the potential for physical contact between domestic sheep and bighorn sheep, and the subsequent potential for disease transmission to translocated bighorn herds.

Regardless of the origin and status of the S-71 bighorn herd, the San Juan National Forest recognizes the presence of bighorn sheep as a renewable resource with high social and natural resource values. The social value of species such as bighorn sheep is high in terms of their value as highly sought after watchable wildlife, for the current and future hunting opportunities each herd represents, for the potential economic benefits sheep hunters can bring to local economies, and for the traditional hunting opportunities represented through existing treaty obligations in the Brunot Area with the Ute Mountain Ute and Southern Ute Indian Tribes. The designation of bighorn sheep as a Sensitive Species in the Rocky Mountain Region also places high natural resource value on all existing bighorn herds, irrespective of herd origin. Therefore subsequent analyses in this "Risk Assessment" will not differentiate bighorn herds, risk of contact with domestic sheep, management recommendations, or potential effects of the proposed alternatives based solely on CPW's Tier rankings or herd origin. For these reasons, the translocated (unclassified) status of S-71 will not be used as the basis for considering or accepting higher or lower risk of physical contact with domestic sheep.

Population estimates for S-71 were 30 animals in 2001, then 45 in 2002 and 2003. In 2004, the population was estimated at 50 animals, and increased to 70 in 2005, and 75 from 2006 through 2008. The population decreased slightly from 2009 through 2012 where it has remained at 60 animals (Weinmeister pers. comm.). Reproduction and survival are thought to have been good (Beecham et al. 2007).

In June of 2014 the Durango Herald published a photo of 2 young rams 2 young bighorn rams taken near the intersection of Lightner Creek Road and U.S. Highway 160. This location is about 8½ air miles distant from the nearest bighorn CHHR, S-71. In late September of 2015 the CPW

received reports and photos of two young rams seen repeatedly over a period of about two weeks on the south side of Babcock Peak in the La Plata Mountains. At the time, domestic sheep were present in the Gold Run Allotment about 2 air miles away. Babcock Peak is about nine air miles distant from the nearest bighorn CHHR, S-71.

These reports confirm that long-distance forays by bighorn sheep, generally young rams, are occurring near the Weminuche Landscape, presumably originating from the S-71 CHHR. In one case, bighorns were reported in relatively close proximity (about two miles) to domestic sheep. The relatively close proximity of the Babcock Peak location to domestic sheep in the active Gold Run Allotment and the extended duration the rams were observed in the area suggests there was high risk for physical contact to occur, especially given the known behavioral attraction between the species. However, no physical contact between the species has been reported.

If the population of S-71 continues to generally increase, as expected, the recent observed range expansion is also expected to continue. Population increases and range expansions are also generally expected to lead to increased numbers of animals foraying outside their CHHR.

Habitat modeling shows an extensive amount of well-connected summer habitat from the southern portion of the West Needle Mountains north to Silverton on the west side of the Animas River, and on the east side of the Animals River from Lime Mesa east to Sheep Mountain and north to Highland Mary Lakes. CPW has mapped approximately 53,840 acres of summer range within the GMU on the Forest, which constitutes 83% of the summer range in the GMU (USDA Forest Service 2013a). Summer range does not appear to be a limiting factor in S-71. Winter range is somewhat restricted however, particularly following big snowfalls.

The only domestic sheep grazing allotments within the Weminuche Landscape that currently overlap S-71 summer range are the Tank Creek and Canyon Creek Allotments (see Figure 5 at the end of this document, and EIS Figure 1-4). Both are active allotments although Canyon Creek is currently stocked with cattle. There is about 2,457 acres of mapped overlap with the CHHR for the West Needles Herd S-71 in the Canyon Creek and Tank Creek Allotments. Very small portions of the Flume and Deer Creek/Engine Creek Allotments also overlap mapped bighorn summer range. These two allotments were analyzed in the 2009 Silverton Landscape Grazing Analysis (USDA Forest Service 2009).

Available information does not suggest habitat competition by ungulate species as a potential limiting factor for bighorns in S-71 (USDA Forest Service 2013a). A healthy and possibly somewhat expanding population of mountain goats is present in the far eastern portion of the GMU, centered on Chicago Basin and the headwaters of Needle Creek. The Needle Creek drainage is currently outside the area mapped by CPW as bighorn summer range, with speculation that the lack of bighorns in this area where they were thought to occur historically may be evidence of exclusion by mountain goats. Mountain goats are thought to be behaviorally dominant over bighorn sheep, and there is large overlap between the species in habitat use in Colorado and diet (George et al. 2009, Beecham et al. 2007). At this time, potential for transmission of infectious diseases between mountain goats and bighorn sheep is not thought to be a significant risk factor (USDA Forest Service 2013a, George et al. 2009).

A variety of summer and winter recreation activities occur in the GMU. During summer, moderate to high amounts of backpacking, day hiking, and horseback riding occur on trails that access many portions of the Weminuche Wilderness. The bighorn core use areas of S-71, however, such as southern and western portions of the West Needle Mountains, receive relatively little summer recreation use and human disturbance is not thought to be limiting bighorn distribution or habitat

use in S-71. There is no evidence that the presence of the Durango and Silverton Narrow Gauge Railroad that follows the Animas River throughout its canyon has any influence on bighorn sheep use of the Animas River canyon.

In summary, current information suggests that the bighorn population in S-71 is gradually expanding in numbers and in distribution, primarily in a westward direction. The current population is estimated at 60 animals. The long-term (25-year) trend in CPW population estimates show this herd has increased moderately in numbers and in distribution since the herd was established with translocated animals in the early 2000's. There are currently no concerns for bighorns in S-71 associated with habitat quality or quantity, predation, competition with other ungulate species, or human disturbance. There is speculation that the presence of mountain goats may be limiting bighorns in some eastern portions of the GMU. The primary management issue of concern for bighorns in S-71 is the potential for physical contact with domestic sheep.

RISK ASSESSMENT PROCESS

In response to concerns about bighorn sheep conservation on NFS lands, in August of 2011 a four-step approach to risk assessment and viability analysis was outlined by the Deputy Chief of the Forest Service (USDA Forest Service 2011a, USDA Forest Service 2011b). This process directed field units to conduct qualitative, and where possible quantitative analyses of the potential for interaction between domestic and bighorn sheep when the agency is making decisions requiring National Environmental Policy Act (NEPA) analysis regarding livestock grazing activities. The goal of these analyses is to minimize the potential for physical contact between domestic and bighorn sheep, thereby minimizing the potential for disease transmission and a subsequent mortality event of bighorn sheep.

The analysis process outlined in the August 2011 Washington Office letter of direction consists of four steps. First, gather applicable data and information from appropriate sources. Second, assess spatial and temporal overlap of bighorn sheep core herd home ranges with domestic sheep allotments, use areas, and driveways. Third, Assess likelihood of contact based on spatial and temporal overlap between allotments and bighorn sheep herds. And fourth, identify management practices with the goal of separation between domestic and bighorn sheep where necessary to provide for Forest-wide bighorn sheep viability.

It is recognized that even one contact between domestic and bighorn sheep could lead to disease transmission, with potential for a subsequent bighorn mortality event. Increased contact rates between bighorn and domestic sheep increases the likelihood of disease transmission and potential for a subsequent bighorn mortality event. Vaccines that could reduce the potential for disease transmission are in development (Miller 2011, Subramaniam 2011), but are unlikely to be ready for use in the field in less than 10-15 years (Srikumaran 2011). Due to a current lack of field-ready vaccines (Miller 2011), it is widely recognized that the most effective means of reducing the risk of disease transmission is to minimize the potential for contact through effective separation of bighorn sheep and domestic sheep and goats (The Wildlife Society 2015, USDA Forest Service 2014, Colorado Parks and Wildlife 2013a, Western Association of Fish and Wildlife Agencies 2012, American Sheep Industry Association 2011, USDA Forest Service 2011a, George et al. 2009, CAST 2008, Beecham et al. 2007, Schommer and Woolever 2001). Effective separation is complicated by the tendency of bighorn sheep, both rams and ewes, to leave their core herd home range and carry out occasional exploratory movements (a.k.a. forays).

This Risk Assessment process involved participation by FS wildlife biologists, rangeland management specialists, decision makers, Colorado Parks and Wildlife (CPW) terrestrial biologists

and District Wildlife Managers, and affected grazing permittees. A series of meetings were held to review maps of the affected bighorn sheep herds and domestic sheep grazing allotments.

The focus of the risk assessment process was on active, vacant and forage reserve domestic sheep and goat allotments within the Weminuche Landscape (see Figures 5, 6 and 7 at the end of this document). Because vacant allotments could be restocked administratively, it is important to assess the potential for physical contact between bighorn and domestic sheep in the event the allotment was restocked. As stated previously, for this project we define forage reserve allotments as allotments that may be stocked up to a maximum of three years out of any ten consecutive years. For the purpose of this model, forage reserve allotments are treated as active allotments during the years they are stocked. Allotments that were already closed (such as the Needles Allotment) were not specifically reviewed but would have received a rating of low risk.

The objective of this risk assessment is to provide the project decision-maker with an objective assessment of the risk of physical contact between bighorn sheep and domestic sheep and goats, by allotment and alternative, for allotments within the Weminuche Landscape. This objective implements NFS national and regional letters of direction and policy (USDA Forest Service 2011a, USDA Forest Service 2011b, USDA Forest Service 2012, USDA Forest Service 2014a, USDA Forest Service 2014b). It also provides a means of direct evaluation of conformance with Forest Plan direction (primarily Standards and Guidelines) relating to bighorn sheep management on the San Juan NF (USDA Forest Service 2013e).This Risk Assessment considers and is consistent with recommendations contained in Best Management Practices (Western Association of Fish and Wildlife Agencies 2012, USAHA Joint Working Group 2009), MOUs (Colorado Parks and Wildlife 2013a), industry working groups (American Sheep Industry Association. 2011), and the best available science contained in the peer-reviewed scientific literature.

Both qualitative and quantitative information was considered and incorporated into the risk assessment process. Ultimately, the risk assessment provides a qualitative ranking (High, Moderate, or Low; see USDA Forest Service 2011a) of the risk of physical contact of bighorn and domestic sheep within each allotment in the Weminuche Landscape. This measure was chosen as the primary product of the risk assessment because it provides the most comprehensive means for combining different types of information into a meaningful evaluation of conformance with Forest Plan direction regarding management of bighorn sheep and domestic livestock on the Forest. It also meets agency national direction for assessing the likelihood of contact based on spatial and temporal overlap between allotments and bighorn sheep herds (USDA Forest Service 2011a).

The qualitative rank of the risk of physical contact assigned to each domestic sheep allotment is a combination of multiple independent lines of qualitative and quantitative information. Examples of qualitative information considered in the ranking include sources such as the professional opinions of wildlife managers and rangeland management specialists, and livestock grazing permittees. Examples of quantitative information considered in the ranking include sources such as measures of separation distance, acres of habitat correspondence or overlap, bighorn population sizes and mapped use areas, and quantitative outputs from the Risk of Contact Tool.

It is important to recognize that the quantitative outputs from the Risk of Contact Tool do not equate directly to the qualitative rank of the risk of physical contact between the species. The Risk of Contact Tool provides quantitative estimates of the annual rates that foraying bighorn sheep are predicted to leave their core herd home range (CHHR) and contact the nearest portion of a given allotment. The Risk of Contact Tool's estimated rates of contact with the nearest portion of an allotment do not equate to estimates of the rates of physical contact that might occur between individual animals within the body of the allotment. For this reason, the Risk of Contact Tool

outputs were an important component considered in the rank assignment but were not the controlling factor for the qualitative rank of the risk of physical contact between bighorn and domestic sheep within a given allotment.

The assignment of a rank of the risk of physical contact for a given allotment was produced by combining several parallel but independent lines of reasoning into a single qualitative rank for each allotment. The parallel but independent lines of reasoning considered in this analysis include factors such as: 1) the Risk of Contact Tool results for the allotment; 2) past grazing history within the allotment and the observations and experiences of the grazing permittee; 3) the distribution, proximity and connectedness of bighorn summer source habitats between core herd home ranges and the allotment; 4) known bighorn locations and use areas, as well as the professional opinions of wildlife and rangeland managers; and 5) inferences about the past history of livestock grazing and disease occurrence in the primary bighorn herds that comprise the Weminuche Landscape. The numeric order of these factors should not be inferred to represent a particular order of priority of one line of information over another. All lines of information were considered to be equally important when factored together.

INFORMATION CONSIDERED IN THE RISK ASSESSMENT PROCESS

1. **Bighorn sheep mapped summer ranges, summer concentration areas, production areas, and winter ranges**; GIS products provided by Colorado Parks and Wildlife. Definitions provided below are from the metadata provided by CPW along with their layers. The CPW bighorn sheep layers described below and used in this analysis were downloaded from CPW's website on October 24, 2013:

    - **Summer Range** (referred to in this document as Core Herd Home Range - CHHR) is that part of the overall range where 90% of individual bighorn sheep are located between spring green-up and the first heavy snowfall. Summer range is not necessarily exclusive of winter range; in some areas winter range and summer range may overlap. Summer range does not necessarily include all occurrences during the summer season. These polygons are presumed to represent habitat areas where bighorns generally occur during summer. However, bighorns do not necessarily occur in all portions of the polygon all the time. Some portions of the polygon may have bighorn occurrence only rarely. Summer range polygons are not intended to imply that bighorn sheep do not occur outside the polygon during summer (i.e. imply vacant summer habitat) because the potential for bighorn forays outside their Core Herd Home Range is not represented in this polygon.

      It should be noted that CPW does not map bighorn Core Herd Home Range. For the purposes of this analysis, we believe the CPW summer range polygons provide the best available information representing bighorn summer use areas and therefore this document refers to the CPW summer range polygons as bighorn Core Herd Home Range (CHHR). The CPW summer range polygons were used as the inputs depicting bighorn CHHR in the Risk of Contact Tool analysis, which is described in greater detail in the next section below.

    - **Summer Concentration Areas** are those areas where bighorn sheep concentrate from mid-June through mid-August. All mapped summer concentration areas in the Weminuche Landscape are also mapped by CPW as bighorn summer range (Core Herd Home Range). High quality forage, security, and lack of disturbance are generally characteristics of these areas to meet the high energy demands of lactation and lamb

rearing. These polygons are presumed to represent habitat areas where bighorn sheep normally occur during summer, but bighorns do not necessarily occur in all portions of the polygon all the time. Some portions of the polygon may have bighorn occurrence only rarely.

- **Production Areas** are defined by CPW as that part of the overall range occupied by pregnant females during a specific time period in the spring. This time period is May 1 to June 30 for Rocky Mountain bighorn sheep. Only known production areas are mapped by CPW and therefore the polygons are not presumed to represent all areas where production occurs. High quality forage, security, and lack of disturbance are generally characteristics of these areas. Production areas mapped by CPW were considered but domestic sheep generally do not go on to permitted allotments where lambing is known to occur until after lambing has completed (generally by mid-June). In addition, all lambing areas mapped by CPW in the Weminuche Landscape are also mapped as bighorn summer range (Core Herd Home Range). These polygons are presumed to represent habitat areas where bighorn sheep normally occur during lambing season, but bighorns do not necessarily occur in all portions of the polygon all the time. Some portions of the polygon may have bighorn occurrence only rarely.

- **Winter Range** is defined by CPW as that part of the overall range where 90% of the individuals are located during the average five winters out of ten, from the first heavy snowfall to spring green-up. Winter range areas mapped by CPW were considered but not used in greater detail in this analysis because domestic sheep are not permitted in any of the Weminuche Landscape allotments during winter. Domestic sheep leave permitted allotments generally from mid-September through early October, generally well before the first heavy snowfall. Most areas in the Weminuche Landscape mapped by CPW as bighorn winter range are in the vacant Flint Creek, Cave Basin and Pine River Allotments which have been vacant since 1972, 1988 and 1980, respectively. Only very small portions of mapped winter range occur in the active Canyon Creek and Tank Creek Allotments. The mapped winter range areas in Canyon Creek and Tank Creek Allotments are in western margins of the allotments that are typically not used by domestic sheep. Given the lack of overlap between active domestic sheep use areas and mapped winter range areas, the potential for forage competition between the species is thought to be low. All mapped winter range areas in the Weminuche Landscape are also within areas mapped by CPW as bighorn summer range and thus are considered to be within bighorn Core Herd Home Range (CHHR).

- **Winter Concentration** is defined by CPW as that part of the winter range where animal densities are at least 200% greater than the surrounding winter range density during the same period used to define the winter range, in the average five winters out of ten.

- **Severe Winter Range** is defined by CPW as that part of the winter range where 90% of the individual animals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten. Not all populations exhibit migratory behavior during severe winters. Many will stay within the defined winter range regardless of conditions. Thus, some populations may not have a mapped severe winter range distribution.

  Winter concentration and severe winter range areas mapped by CPW were considered but not used in greater detail in this analysis because in the Weminuche Landscape

these small areas are also mapped by CPW as bighorn summer range and thus are considered to be within bighorn Core Herd Home Range (CHHR). In addition, in the Weminuche Landscape, these two types of bighorn winter use areas are mapped as identical polygons. Most areas in the Weminuche Landscape mapped by CPW as bighorn winter concentration and severe winter ranges are in the vacant Flint Creek and Cave Basin Allotments, but very small portions of mapped winter concentration and severe winter range are in the active Canyon Creek and Tank Creek Allotments. The mapped winter concentration and severe winter range areas that overlap with the Canyon Creek and Tank Creek Allotments are in western margins of the allotments that are typically not used by domestic sheep.

- **Overall Range** is defined by CPW as the area which encompasses all known activity areas within the observed range of a population. The habitat map distributed by the Western Association of Fish and Wildlife Agencies (Western Association of Fish and Wildlife Agencies 2011) used CPW's overall range as the layer labeled "Bighorn Sheep Occupied Habitat". It should be noted that bighorn core herd home range (CHHR) is not equivalent to bighorn overall range. CHHR as it used in the Risk of Contact Tool is either equivalent to or a subset of the area defined by CPW as bighorn overall range.

  For the three bighorn herds that overlap the Weminuche Landscape analysis area, CHHR is either the same as or a slightly smaller subset of CPW's overall range. For S-16, the Cimarrona Peak Herd, CHHR is the same as CPW's overall range. For S-28, the Vallecito Creek Herd, and for S-71, the West Needles Herd, CHHR is a slightly smaller subset of CPW's overall range. For S-71, CHHR is 4.9% smaller than CPW's overall range and the area where the difference occurs is outside the Weminuche Landscape. For S-28, CHHR is 14.9% smaller than CPW's overall range and the difference occurs in two domestic sheep allotments (Flint Creek and Pine River) that have remained vacant for decades (since 1972 and 1980, respectively). Because CHHR differs little from CPW's overall range and none of the small differences overlap with active domestic sheep allotments, CPW's overall range layer was not used in greater detail in this analysis.

2. **Bighorn Sheep Summer Source Habitat;** GIS product developed by USDA Forest Service and evaluated and modified by Colorado Parks and Wildlife using their extensive State-wide bighorn sheep radio telemetry data set. The summer source habitat model assigns all areas outside of CHHR to one of three bighorn habitat classes: 1) source (suitable) habitat, 2) connectivity areas and 3) non-habitat. The summer source habitat model infers bighorn habitat suitability based on species requisites and observed bighorn habitat preferences including factors such as vegetation cover type, ruggedness and horizontal visibility. Source (suitable) habitat areas meet the model parameters. Connectivity areas do not meet source habitat criteria, but are located within 350 meters of source habitat, or 525 meters if between two areas of source habitat (such as a meadow area between two canyon walls). Areas of non-habitat do not meet these criteria and are located more than 350 meters from source habitat. CPW found this summer source habitat model covered 91% of telemetry points from their pooled state-wide bighorn telemetry location datasets (Eichhoff et al. 2012, S. Wait pers. comm.). Data from other areas indicate bighorn sheep are 34 times more likely to be in source habitat than non-habitat, and are six times more likely to be in source habitat than connectivity areas (Carpenter et al. 2014).

   There is no assumption that areas identified by the model as suitable for bighorns are in fact occupied. The only areas assumed to be occupied by bighorn sheep are the areas mapped by

CPW as bighorn summer range (labeled Core Herd Home Range [CHHR] in this document), summer concentration areas and production areas, which in the Weminuche Landscape are subsets of CHHR. Currently, bighorn summer source habitat does not appear to be limiting for bighorn sheep (Weinmeister 2012), and summer source habitat is well distributed across the Weminuche Landscape, with the exception of the Spring Gulch Allotment. Substantial amounts of bighorn summer source habitat occur across large areas between CPW mapped core herd home ranges (CHHR).

3. **Domestic sheep allotment activity status**; Allotment status is either active (domestic sheep are permitted to the graze the allotment and the allotment is stocked each summer grazing season), vacant (allotment is available for grazing but no term permit exists so the allotment remains ungrazed until such time as a new qualified permittee meets the requirements to stock it) or closed (allotment is not available for grazing).

4. **Changes in allotment boundary configuration**; Based on domestic sheep collar tracking data collected over the past four summers we believe the allotment boundary configurations depicted in Alternatives 3 and 4 are representative of domestic sheep actual use areas within each active allotment.

5. **Domestic sheep grazing suitability maps;**

6. **Vegetation types and topographic features** within the allotment;

7. **Forest-wide Bighorn Risk Assessment** (USDA Forest Service 2013a); a qualitative evaluation of potential factors of concern on the San Juan National Forest related to bighorn sheep ecology, habitat, population dynamics, population status and trends. The risk assessment evaluates livestock allotments forest-wide and highlights domestic sheep allotments where there is apparent concern for potential risk of contact between the species. Finally, this forest-wide risk assessment evaluates bighorn sheep viability across the San Juan National Forest planning area. This analysis was intended to provide project-level decisions with a framework by which proposed actions can be evaluated in greater detail and to which a determination about bighorn sheep viability at the scale of the planning area (Forest-wide) can be tiered.

8. **Western Association of Fish and Wildlife Agencies (WAFWA) maps** (Western Association of Fish and Wildlife Agencies. 2011): a Colorado statewide map showing bighorn sheep habitat and domestic sheep grazing allotments, and identifying areas of potential overlap of bighorn and domestic sheep ranges and where disease transmission might be a concern (USDA Forest Service 2012a). This map, commonly referred to as the 'WAFWA map', represents a joint effort between the Forest Service, Bureau of Land Management, and the Western Association of Fish and Wildlife Agencies Wild Sheep Working Group. A variety of data from the Forest Service, BLM, and Colorado Parks and Wildlife was used to produce the map. The version available for this analysis is dated November 2011. This map used CPW's overall range layer as the layer labeled "Bighorn Sheep Occupied Habitat". It should be noted that bighorn core herd home range (CHHR) as it is defined in the Risk of Contact Tool used CPW's summer range polygons, which for the Weminuche Landscape is generally equivalent to the area defined by CPW as bighorn overall range.

9. **Colorado Parks and Wildlife local staff's professional opinions** (District Wildlife Managers and Terrestrial Biologists);

10. **FS local staff's professional opinions** (Wildlife Biologists, Range Management Specialists, NEPA Specialists, Decision Maker);

11. **Domestic sheep permittees' experience, herding practices and bighorn sheep observations**;

12. **Design Criteria** (see EIS Tables 2-3 and 2-4). Design criteria are expected to enhance the effectiveness of separation of bighorn and domestic sheep, thereby reducing the risk of physical contact and subsequent potential for disease transmission. These management measures are applied with the intent of preventing physical contact between the species, and in the areas they are applied there is a presumption that separation effectiveness will be improved by their application. Discussions with the permittees concluded that the design criteria included as part of Alternatives 3 and 4 (see EIS Tables 2-3 and 2-4) are reasonable and feasible.

    At this time, the best condensed source of Best Management Practices (BMPs) designed to provide more effective separation between bighorn and domestic sheep and goats is the 2012 Western Association of Fish and Wildlife Agencies guidelines (Western Association of Fish and Wildlife Agencies 2012; but, also see USAHA Joint Working Group 2009). Often referred to as the 'WAFWA Guidelines', this document is widely recognized as the best available source for BMPs to minimize the potential for physical contact between bighorn and domestic sheep. Many of the 'WAFWA Guidelines' were incorporated into design criteria for the Weminuche Landscape. The 'WAFWA Guidelines' do not preclude the adoption of other management actions, where appropriate, for achieving effective separation and preventing contact. Additional management practices were added as design criteria after discussion with the domestic sheep permittee. They are applied with the intent of preventing physical contact between the species, and in the areas they are applied there is a presumption that separation effectiveness will be improved by their application.

    It must be recognized that the effectiveness of most individual measures have not been tested or verified using a rigorous scientific approach (see American Sheep Industry Association 2011) and their effectiveness remains largely undocumented (Western Association of Fish and Wildlife Agencies 2012). The WAFWA Guidelines state "Effectiveness of management practices designed to reduce risk of association are not proven and therefore should not be solely relied upon to achieve effective separation." For the Weminuche Landscape, there is scant anecdotal evidence that suggests the degree of effectiveness of the design criteria to prevent contact. For this reason, it is difficult to describe what degree of risk reduction benefit should be expected by the application of these measures.

    Although there is uncertainty regarding their effectiveness, it is logical to expect that full and complete implementation of all design criteria has the potential to provide more effective separation between the species (Western Association of Fish and Wildlife Agencies 2012). The difficulty in describing their level of effectiveness should not be perceived as disqualifying the generally recognized benefits of their application. The WAFWA Guidelines state "such practices [BMPs] could however, help achieve separation when applied outside of occupied wild sheep range or connected and potentially mitigate impacts associated with straying domestic sheep or goats, or wandering wild sheep."

RISK OF CONTACT TOOL

In response to a need for tools to assist with the analysis of risk of contact of between domestic and bighorn sheep, the USDA Forest Service Bighorn Sheep Working Group, and Critegen, Inc, developed a methodology for calculating probabilities and rates of contact between bighorn sheep and domestic sheep allotments. This 'Risk of Contact Tool' is a geospatial desktop application developed for use by resource managers as a tool for evaluating the risk of physical contact between bighorn sheep and domestic sheep allotments under various management scenarios (Carpenter et al. 2014, O'Brien et al. 2014, USDA Forest Service 2013b).

Results from the Risk of Contact Tool provide a consistent framework by which various management scenarios can be compared. Tool results allow the user to compare and contrast management scenarios as to their potential to affect modeled rates of contact between bighorn sheep and domestic sheep allotments (Carpenter et al. 2014, O'Brien et al. 2014). From these results and alternative comparisons, inferences can be drawn about how various management alternatives and project designs might increase or decrease the potential for bighorn contact with livestock allotments and thus potential for physical contact and presumed potential for subsequent disease transmission to adjacent bighorn sheep populations within their core herd home range (Carpenter et al. 2014, O'Brien et al. 2014).

The Risk of Contact Tool does not consider the potential mitigating effect that full implementation of BMPs and design criteria (EIS Tables 2-2 and 2-3) might have on the probability of contact between bighorn and domestic sheep. Design criteria are expected to enhance the effectiveness of separation, thereby reducing the risk of physical contact between foraying bighorn sheep and domestic sheep, thereby reducing the subsequent potential for disease transmission. However, because there is uncertainty about the effectiveness of BMPs and design criteria, it is unknown how much, if any, reduction might be expected in the contact probabilities produced by the Risk of Contact Tool resulting from the full and complete implementation of all design criteria.

Because of uncertainty about the effectiveness of BMPs and design criteria, they are not relied on as the sole reason for assuming actual contact probabilities would be lower than those predicted by the Risk of Contact Tool. Conversely, because the Risk of Contact Tool does not model the behavioral and social attraction between bighorn and domestic sheep the tool may underestimate rates of contact with active allotments or areas within allotments that are occupied by domestic sheep (O'Brien et al. 2014). It is important to recognize that the Risk of Contact Tool predicts rates of contact by foraying bighorn sheep with domestic sheep allotments. For the reasons just stated, predicted rates of contact with an allotment do not necessarily equate to rates of physical contact between domestic and bighorn sheep individuals, or equate to predicted rates of disease outbreak within a bighorn sheep CHHR (O'Brien et al. 2014).

The Risk of Contact Tool utilizes bighorn sheep Core Herd Home Range (CHHR) information, a summer source habitat model representing suitable bighorn summer habitat, ram and ewe foray rates, and domestic sheep allotment boundaries to calculate probabilities that rams and ewes may leave a CHHR, undertake a foray, and subsequently contact a specific domestic sheep allotment (Carpenter et al. 2014, O'Brien et al. 2014, USDA Forest Service 2013b, USDA Forest Service 2013c). Output from the tool also calculates rates of contact between individual bighorns from specific bighorn herds with specific domestic sheep allotments.

The CHHR polygons used as input to the Risk of Contact Tool analysis was the summer range layer provided by Colorado Parks and Wildlife as professional knowledge-based polygons depicted in a Geographic Information System (GIS) database. The Risk of Contact Tool also provides an option whereby CHHR can be calculated by the model using telemetry or observation points provided by the user. For the Weminuche landscape, there were insufficient telemetry and/or observation data

points to calculate a CHHR, therefore the CPW-supplied summer range polygons were used as the best available information on which to base the model calculations. The CPW bighorn summer range layer was downloaded from their website on October 24, 2013.

The bighorn summer source habitat model used as input to the Risk of Contact Tool analysis was developed by the USDA Forest Service, and evaluated and modified by Colorado Parks and Wildlife using their extensive State-wide bighorn sheep radio telemetry data set. CPW found this summer source habitat model covered 91% of telemetry points from their pooled state-wide bighorn telemetry location datasets (Eichhoff et al. 2012, S. Wait pers. comm.). Data from other areas indicate bighorn sheep are 34 times more likely to be in source habitat than non-habitat, and are six times more likely to be in source habitat than connectivity areas (Carpenter et al. 2014).

There is no assumption that areas identified by the model as suitable for bighorns are in fact occupied. The only areas assumed to be occupied by bighorn sheep are the areas mapped by CPW as bighorn summer range (labeled Core Herd Home Range [CHHR] in this document), summer concentration areas and production areas, which in the Weminuche Landscape are subsets of CHHR. Currently, bighorn summer source habitat does not appear to be limiting for bighorn sheep (Weinmeister 2012), and summer source habitat is well distributed across the Weminuche Landscape, with the exception of the Spring Gulch Allotment. Substantial amounts of bighorn summer source habitat occur across large areas between CPW mapped core herd home ranges (CHHR).

Bighorn sheep make occasional long-distance movements beyond their Core Herd Home Range (CHHR). Singer et. al. (2001) called these movements forays, and defined them as any short-term movement of an animal away from then subsequently back to its herd's CHHR. This life-history trait places bighorn sheep at risk of contact with domestic sheep, particularly when bighorn summer source habitats are well connected to or overlap with domestic sheep use areas, even when domestic sheep use areas are well removed from bighorn CHHR areas (Carpenter et al. 2014, O'Brien et al. 2014). The risk of contact between foraying bighorn sheep (mostly rams) and domestic sheep is related to the extent of bighorn sheep source habitat, proximity of domestic sheep allotments, distance of bighorn forays outside their CHHR, and the frequency of bighorn forays outside their CHHR. Because information on foray distance and frequency is lacking for bighorn sheep herds on the San Juan National Forest and the Weminuche Landscape in particular, the analysis in this Risk Assessment uses the default values provided by the Risk of Contact Tool (USDA Forest Service 2013b).

The default value for foray frequency used by the Risk of Contact Tool is 14.1% for rams and 1.4% for ewes, indicating that 14.1% of rams and 1.4% of ewes are predicted to foray outside their CHHR during the summer season. The default values for ram and ewe foray frequency were derived from an extensive radio telemetry dataset on the Payette National Forest (Carpenter et al. 2014, O'Brien et al. 2014, USDA Forest Service 2013b).

Based on known bighorn sheep preferences for each of the three habitat classes, the model estimates the proportion of rams and ewes reaching each one-kilometer band outside their CHHR. The model estimates this proportion out to 35 kilometers (21 miles) away from the CHHR, which incorporates the extent of most forays throughout the western United States (USDA Forest Service 2013b).

The Risk of Contact Tool uses the inputs to conduct a bighorn foray analysis (Carpenter et al. 2014, O'Brien et al. 2014, USDA Forest Service 2013b). This foray analysis determines how frequently bighorn foray movements occur, as well as how far beyond the CHHR bighorn rams and ewes are

likely to travel, relative to the amount and connectivity of bighorn summer source habitat across the landscape. Together, the source habitat, CHHR, and foray models, along with bighorn herd size and sex ratio (i.e. proportion of rams to ewes) are used to estimate the probability that a ewe or a ram from a particular herd will leave their CHHR and reach a domestic sheep allotment in a given year (Carpenter et al. 2014, O'Brien et al. 2014, USDA Forest Service 2013b). Based on these probabilities, rates of contact with a particular allotment by individual rams and ewes from a specific bighorn CHHR can be calculated. Because predicted rates of contact with an allotment are sensitive to bighorn herd size, the largest bighorn herds have the greatest impact on the calculated allotment contact probabilities (USDA Forest Service 2013c). It is important to note that the Tool calculates predicted rates of contact with an allotment and this does not necessarily equate to predicted rates of physical contact between bighorn and domestic sheep within the allotment.

In situations where there is direct overlap between a bighorn CHHR and an allotment the Risk of Contact Tool presumes a 100% probability of contact between bighorns and the allotment when bighorns occupy that portion of their CHHR that overlaps with the allotment (USDA Forest Service 2013b, USDA Forest Service 2013c). Where there is overlap between an allotment and CHHR and thus a 100% probability of contact with the allotment, there is by definition a prediction of at least one bighorn contact per year. Because there is presumed annual contact in the zone of overlap there is no need for the Tool to model the potential for contact by foray because by definition a foray only occurs when an animal leaves their CHHR (Carpenter et al. 2014, O'Brien et al. 2014). Although the Tool assumes a contact rate of 1.0 for allotments that overlap bighorn CHHR, annual contact rates could be higher with multiple contacts occurring per year within the zone of overlap when bighorns occupy that portion of their home range.

The sequence of events by which a contact between bighorn sheep and domestic sheep in a permitted grazing allotment located outside a bighorn CHHR might occur can be broken down into a number of steps. First, to reach an active domestic sheep allotment, a bighorn sheep must (1) leave their CHHR; (2) travel far enough to reach the domestic sheep grazing allotment; and (3) intersect the allotment. For disease transmission to occur, the bighorn must (4) come into physical contact with a domestic sheep in the allotment; and (5) contract a disease from the domestic sheep. Finally, for a disease outbreak to affect the bighorn's home herd, the infected bighorn must (6) return to their CHHR; and (7) transmit disease to other members of their home herd. For domestic sheep allotments that overlap portions of bighorn CHHR, steps 1-3 and 6 do not need to occur, thereby likely increasing the potential for a disease transmission event to occur, and also likely increasing the potential for a subsequent disease outbreak in the bighorn home herd.

The Risk of Contact Tool provides a calculated probability that bighorn forays will intersect a given domestic sheep allotment, and the total annual predicted rate of contact with the allotment (Carpenter et al. 2014, O'Brien et al. 2014, USDA Forest Service 2013b). The total herd contact rate (i.e. aggregate rate of both rams and ewes) is the most important output of the analysis. More frequent contact with an allotment implies a greater probability a foraying bighorn would contact an allotment, and if that allotment is stocked, a greater probability that physical contact with a domestic sheep could occur and thus greater potential for disease transmission and potential for a subsequent bighorn mortality event within the CHHR.

The Risk of Contact Tool represents the best available science for estimating the probability of foraying bighorn sheep contacting domestic sheep allotments (Carpenter et al. 2014, O'Brien et al. 2014, USDA Forest Service 2013c). This Risk Assessment then takes the results from the Risk of Contact Tool, combines it with other types of information, and draws an overall conclusion regarding the relative risk of physical contact between domestic and bighorn sheep individuals, with the potential for disease transmission and subsequent bighorn mortality event and the effect that

event might have on bighorn population viability across the planning area. This Risk Assessment analysis utilizes disease transmission information for comparison to better inform the outcome of each alternative regarding their relative potential for contributing to the long-term viability of bighorn sheep in the planning area. It must be recognized that there are uncertainties regarding the Risk of Contact Tool when considering how to interpret the model's output results. A more detailed discussion about uncertainties associated with the Risk of Contact Tool is provided later in this Risk Assessment document.

RISK ASSESSMENT OUTCOMES

The risk of physical contact between bighorn sheep and domestic sheep in an active allotmentwas given a qualitative rating of "High', "Moderate", or "Low", based on multiple factors relating to spatial and temporal separation. The Risk of Contact tool was one line of evidence considered, in addition to other quantitative and qualitative lines of evidence, that were considered together to determine a qualitative ranking of the risk of physical contact between bighorn and domestic sheep individuals within the allotment. And, although disease transmission is discussed in this assessment, these qualitative ratings of risk of physical contact are not intended to be an estimate of disease transmission probability.

These qualitative ratings are intended to be only an estimate of relative level of risk for physical contact between domestic and bighorn sheep individuals within the allotment. Disease transmission is considered a correlate of physical contact, not an effect. The likelihood of disease transmission following physical contact, and the potential for a subsequent bighorn mortality event, is not known with certainty. The precise sequence of requisite events for a bighorn mortality event to occur remains the subject of scientific debate (Besser et al. 2012b, and 2012c, Drew et al. 2014). For this reason, disease transmission assumptions are not used as the basis for determining qualitative risk rankings.

A rating of "High" risk indicates that contact between domestic sheep and bighorn sheep is thought to be likely in the immediate future, although disease transmission resulting in a subsequent bighorn mortality event is not assumed to be a certainty. Conversely, if allotments have been operated for many years without evidence of disease transmission, this observation is not used to infer a lower risk rating. The fact that contact has not been observed, or a bighorn disease event has not been detected in the past, does not imply a lowered risk for such events occurring in the future. Random chance or insufficient monitoring effort may explain past results (see uncertainties section, below). For this reason, the allotment would still receive a rating of "High" risk.

Similarly, the effectiveness of domestic sheep Best Management Practices (BMPs) and design criteria for preventing contact remains untested and largely undocumented (Highland pers comm. 2014, Western Association of Fish and Wildlife Agencies 2014, American Sheep Industry Association 2011). Because the effectiveness of BMPs is unknown it is difficult to state with certainty to what degree their application would be expected to reduce the risk of physical contact between bighorn and domestic sheep. Therefore the application of BMPs within an allotment that would have otherwise received a ranking of "High" risk would not be used as the sole rationale for assigning a lower risk rating and the allotment would still receive a rating of "High" risk.

A rating of "High" risk would be assigned when there is direct overlap between an allotment and CPW mapped bighorn summer range or summer concentration area (CHHR), or CHHR is within 9 miles (Sells et al. 2015) of an allotment and there is high bighorn source habitat connectivity for bighorn dispersal to an allotment. Sells et al. (2015) defined the zone within 9 miles of bighorn CHHR as being high risk for pathogen exposure. An extensive bighorn collar tracking data set

showed fully half of all animals on a foray reached at least 6 miles away from their CHHR, and nearly one quarter reached 10 miles away (USDA Forest Service 2010e). Because about one quarter of foraying bighorns reached at least 9 miles away from their CHHR this distance was considered to pose a "High" risk of physical contact, especially when there is high bighorn source habitat connectivity between the CHHR and the allotment to facilitate bighorn movement.

Where overlap exists between active domestic sheep allotments and bighorn CHHR (see Figure 5, at the end of this document), the risk of physical contact between domestic sheep and bighorn sheep is considered to be "High". In vacant allotments, the risk of contact is "Low" when the allotment is vacant, but becomes "High" when the allotment is restocked. In forage reserve allotments, similar to vacant allotments, the risk of contact is "Low" during years when the allotment is not stocked, but becomes "High" when the allotment is restocked.

A rating of "Moderate" risk indicates that physical contact between bighorn and domestic sheep may occur at some point in the future, but effective separation may be achieved and/or maintained for many years. The risk of physical contact between bighorn and domestic sheep, with the potential for a subsequent bighorn disease outbreak, is thought to be less than for allotments in the high risk category, but there is still concern for the potential for contact due to proximity with bighorn CHHR and/or there is moderate bighorn source habitat connectivity for bighorn dispersal to an allotment. Factors that reduce the apparent risk of contact could include: the presence of towns, the presence of terrain features and/or habitat features that act as barriers to bighorn sheep movement (Schommer and Woolever 2001), bighorn sheep distribution patterns, and application of BMPs such as herding techniques and other design criteria (EIS Tables 2-2 and 2-3).

A rating of "Moderate" risk could occur when there is no direct overlap between mapped bighorn summer range or summer concentration area (CHHR), and CHHR is 9 to 16 miles from an allotment (USDA Forest Service 2010e), and there is fair or poor bighorn source habitat connectivity for bighorn dispersal to an allotment. An extensive bighorn collar tracking data set showed less than one quarter of animals on a foray reached 9 miles away from their CHHR, and only one animal reached 16 miles away (USDA Forest Service 2010e). Because less than one quarter of foraying bighorns reached 9 miles away from their CHHR this distance was considered to pose a "Moderate" risk of physical contact, especially when there is fair or poor bighorn source habitat connectivity with the CHHR to facilitate bighorn movement into the allotment.

A rating of "Low" risk indicates that physical contact between domestic and bighorn sheep is believed to be unlikely or irregular and highly unpredictable, with the potential for a subsequent bighorn disease outbreak thought to be unlikely or highly unpredictable in the future under the current configuration of allotments and bighorn CHHR's. A rating of "Low" risk could occur when there is no direct overlap between mapped bighorn summer range or summer concentration area (CHHR), and these areas are greater than 16 miles (USDA Forest Service 2010e) from an allotment and there is poor bighorn source habitat connectivity for bighorn dispersal to an allotment An extensive bighorn collar tracking data set showed only one animal reached greater than 16 miles away from its CHHR on a foray (USDA Forest Service 2010e). Because only one bighorn reached greater than 16 miles away from their CHHR, this distance was considered to pose a "Low" risk of physical contact, especially when there is fair or poor bighorn source habitat connectivity with the CHHR to facilitate bighorn movement into the allotment.

For this analysis, "Low" risk is reserved for those allotments proposed to remain open to domestic sheep grazing under this NEPA analysis and where it has been determined there is "Low" risk of physical contact between domestic and bighorn sheep within a permitted grazing allotment. For those allotments the NEPA analysis proposes to close to domestic sheep grazing, there is no further

decision space remaining to the Line Officer regarding management of domestic sheep. Closure of the allotment would result in full discretionary mitigation of the potential for preventing contact between the species. Closing the allotment would result in full discretionary decision space having been exercised within the agency's discretion for managing domestic livestock grazing within the allotment.

In the case of closed allotments, "Low" risk or "No" risk may not be appropriate rankings for the risk of physical contact and potential for subsequent disease outbreak and bighorn mortality events within adjacent bighorn sheep herds. This is because risks for contact with domestic sheep could still be present within or adjacent to the closed allotment. These risks could come from factors outside the scope of this NEPA decision, or from factors beyond agency control on non-federal lands adjacent to the Weminuche Landscape.

Some degree of risk of physical contact between domestic and bighorn sheep still remains for the three primary bighorn herds even after closure of allotments. This risk comes from factors outside the scope of this NEPA analysis. For example, use of recreational pack goats within allotments closed by this analysis is outside the scope of this decision. The use of recreational pack goats continues to be documented within the Weminuche Landscape including within the S-28 CHHR. Contact with goats poses a risk for disease transmission to bighorn sheep (Drew et al. 2014, Cassirer et al. 2013, Besser et al. 2012b, and 2012d, Cahn et al. 2011, Beecham et al. 2007). For this reason, even after closure of an allotment under this NEPA analysis, risk for disease transmission and a subsequent bighorn mortality event within the three primary bighorn herds still remains. For this reason, a rank of "low" or "no" risk may not be appropriate for an allotment after that allotment has been closed.

Some degree of risk of physical contact between the species still remains for the three primary bighorn herds even after an allotment is closed due to the potential for factors beyond the control of the agency. For example, bighorns from one of the three primary herds could foray off NFS lands and contact domestic sheep on non-federal lands adjacent to the Weminuche Landscape. A recent photograph of bighorn sheep in Lightner Creek just west of Durango illustrates the potential for bighorns on a foray to cross extensive distances of non-federal lands. Foraying individuals have the potential to contact domestic sheep off NFS lands, then return to their CHHR on NFS lands and cause a disease outbreak.

Also for example, the Divide Ranger District of the Rio Grande NF could decide to restock currently vacant allotments such as the Fischer-Ivy Goose Allotment which overlaps the S-15 CHHR. The Pagosa Ranger District of the San Juan NF could decide to restock the currently vacant Treasure Allotment, a forage reserve allotment that is within about 2 miles of areas occupied by bighorns in the S-15 CHHR (USDA Forest Service 2010b). Foraying bighorns from either S-16 or S-15 could contact domestic sheep authorized to graze these allotments on neighboring administrative units, contract disease then return to their CHHR and cause a bighorn mortality event that involves bighorn herds on the Columbine Ranger District.

Because factors such as these are outside the control of the Columbine Ranger District and are outside the scope of this NEPA analysis it is unknown what degree of risk (high, moderate, or low) might be posed by these factors.

For the reasons described in the previous paragraphs it would be inappropriate to assign a rank of "Low" risk or "No" risk to allotments proposed to be closed under this NEPA Analysis. Therefore this risk assessment does not assign a risk rank to allotments proposed to be closed. For allotments that are proposed to be closed, the lack of a risk rank assignment should not be assumed to equate

to a value of "No" risk or "Low" risk of physical contact between the species. By extension, closed allotments should not be construed as "Low" or "No" risk for the potential for a disease outbreak within a bighorn CHHR within the Weminuche Landscape.

After assigning an initial risk rating for each allotment under Alternative 2 (see Figure 5 at the end of this document), additional information from the list described above (Information Considered in the Risk Assessment Process) was considered and a determination was made whether to maintain or alter the initial risk rating. Information such as allotment boundaries and application of design criteria (BMPs) differ between Alternative 2 and Alternatives 3 and 4, leading to potentially different risk ratings among the three action alternatives for the same allotment. Because of the uncertainty about effectiveness of design criteria (see Uncertainties section at the end of this document), their application is presumed to improve the effectiveness of separation but they are not relied on as the sole reason for assigning a lower risk rating under Alternative 3 or 4.

RISK ASSESSMENT RESULTS

Under current conditions (Alternative 2) there is direct overlap between mapped bighorn Core Herd Home Range (CHHR) and six domestic sheep grazing allotments in the Weminuche Landscape (see Figure 5 at the end of this document). The six allotments in the Weminuche Landscape which have direct overlap with bighorn CHHR are Canyon Creek (vacant sheep, active cattle), Cave Basin (vacant), Flint Creek (vacant), Pine River (vacant), Rock Creek (vacant), and Tank Creek (active sheep). Under Alternatives 3 and 4, however, allotment boundary adjustments remove all areas of direct overlap with bighorn CHHR from all allotments in the Weminuche Landscape (see Figures 6 and 7 at the end of this document). The analysis and findings for each allotment and alternative is discussed individually in the allotment results sections below.

RISK OF CONTACT TOOL RESULTS:

Table 3, below, displays the input values used in the Risk of Contact Tool for each bighorn herd in the Weminuche Landscape analysis.

The values used for ram and ewe annual foray probabilities were the default values provided by the Risk of Contact Tool application because no similar data was available for bighorn herds in the Weminuche Landscape. The Tool's default values were derived from an extensive bighorn sheep radio telemetry dataset on the Payette National Forest (Carpenter et al. 2014, O'Brien et al. 2014, USDA Forest Service 2013b). The default values represent the proportion of radio-collared adult bighorns observed outside their CHHR during the summer grazing season, May through October.

The values used for bighorn herd sex ratio (ram:ewe) were the default values provided by the Risk of Contact Tool application because only limited sex ratio data was available for bighorn herds in the Weminuche Landscape. Sex ratio data provided by Colorado Parks and Wildlife for bighorn herds in the Weminuche Landscape (Weinmeister pers. comm.) corresponded with the Tool's default values. For this reason, the Tool's default values were assumed to be a reasonable estimate of sex ratios for bighorn herds in the Weminuche Landscape. The Tool's default values for bighorn sex ratios were calculated from an extensive observation dataset of Hells Canyon area herds (USDA Forest Service 2013b).

The values for total population size of bighorn herds in the Weminuche Landscape were provided by Colorado Parks and Wildlife (Weinmeister pers. comm.), and the number of rams and number of ewes in each bighorn herd were then calculated by multiplying the sex ratio by the total population size of each herd.

Table 3. Input values used in the Risk of Contact Tool for bighorn sheep herds in the Weminuche Landscape grazing analysis area.

	S-16 Cimarrona Peak Herd	S-28 Vallecito Creek Herd	S-71 West Needles Herd
Annual Foray Probability (Rams):	0.141	0.141	0.141
Annual Foray Probability (Ewes):	0.015	0.015	0.015
Total Population Size 2012:	135	90	60
Sex Ratio (Ram:Ewe):	35:65	35:65	35:65
Number of Rams:	47	32	21
Number of Ewes:	88	59	39

For the purpose of illustrating results generated by the Risk of Contact Tool, Table 4, below, displays the model's output data for domestic sheep grazing allotments and the Vallecito Creek bighorn herd (S-28) under the current allotment configuration (Alternative 2). The Risk of Contact Tool produced similar output tables for each combination of allotment configuration (13 allotments), bighorn herd (three herds), and action alternative (Alternatives 2, 3 and 4) in the Weminuche Landscape, totaling nine independent tables. For the sake of brevity, only one of the nine tables is presented here. All nine tables can be found in the project record.

Displayed on Table 4, below, is the probability of ram contact and probability of ewe contact. This is the annual probability that once a ram or ewe in the population leaves its CHHR on a foray, it would contact a specific allotment. For example on Table 4, once a ram leaves the Vallecito Creek S-28 core herd home range on a foray, there is a 1.81% probability it would contact the Burnt Timber Allotment during the summer season. For ewes, once a ewe leaves the S-28 CHHR on a foray, there is a 0.47% probability it would contact the Burnt Timber Allotment during the summer season. However, few individual rams or ewes actually leave their CHHR each summer and undertake a foray. For that reason, the values in these two columns, Probability of Ram Contact and Probability of Ewe Contact, need to be multiplied by the proportion of rams or ewes in the population that are likely to leave their CHHR during the summer season and go on a foray. The default foray probabilities are 14.1% for rams, and 1.5% for ewes. The resulting number (Single Ram and Single Ewe) is the probability that a single ram or ewe will leave their CHHR on a summer foray and contact a specific allotment.

Table 4, below, displays the rate of contact for single rams and single ewes. Based on the previous description, for the Burnt Timber Allotment for example, the probability an individual ram would leave the S-28 CHHR on a foray (14.1%) and contact the allotment is 0.0181274 * 0.141 = 0.002555963, about 2.6 per thousand. For ewes in S-28, the value is 0.00473682 * 0.015 = 0.000071, less than 1 per ten thousand. All remaining columns in Table 4 incorporate both the probability an animal goes on a foray (i.e. the probability an individual animal leaves its CHHR on a foray) and the probability a foraying animal subsequently contacts a given allotment.

Table 4. Risk of Contact Tool estimated annual herd contact rates (all adult rams and ewes combined) via foray for all allotments in the Weminuche Landscape grazing analysis area and the S28 Vallecito Creek bighorn sheep herd under the current allotment configuration (Alternative 2).

S28 Vallecito Creek Herd - Alternative 2			Annual Contact Rates via Foray				
Allot_ID	**Prb_Ram_Cont**	**Prb_Ewe_Cont**	**Single Ram**	**Single Ewe**	**Rate_Ram_Cont**	**Rate_Ewe_Cont**	**Rate_Hrd_Cont**
Burnt Timber	0.0181274	0.00473682	0.002555963	0.000071	0.080512847	0.00415656	0.084669407
Canyon Creek	0.00463165	0.00152411	0.000653063	0.000023	0.020571473	0.001337407	0.02190888
Cave Basin	This allotment intersects the S28 core herd home range polygon and thus Rate_Hrd_Cont is assumed to be 1.0.						
Endlich Mesa	0.101754	0.0477196	0.014347314	0.000716	0.451940391	0.041873949	0.49381434
Fall Creek	0.153493	0.102637	0.021642513	0.001540	0.68173916	0.090063968	0.771803127
Flint Creek	This allotment intersects the S28 core herd home range polygon and thus Rate_Hrd_Cont is assumed to be 1.0.						
Johnson Creek	0.133213	0.107925	0.018783033	0.001619	0.59166554	0.094704188	0.686369727
Leviathan	0.100047	0.050655	0.014106627	0.000760	0.444358751	0.044449763	0.488808513
Pine River	This allotment intersects the S28 core herd home range polygon and thus Rate_Hrd_Cont is assumed to be 1.0.						
Rock Creek	This allotment intersects the S28 core herd home range polygon and thus Rate_Hrd_Cont is assumed to be 1.0.						
Spring Gulch	0.00349605	0.000989153	0.000492943	0.000015	0.015527706	0.000867982	0.016395688
Tank Creek	0.0238091	0.0067364	0.003357083	0.000101	0.105748118	0.005911191	0.111659309
Virginia Gulch	0.0630974	0.0167773	0.008896733	0.000252	0.280247102	0.014722081	0.294969183

Active Sheep Allotment

Next, Table 4 displays the rate of contact with a specific allotment for all rams in the population, given the total number of rams in the population. This is the expected number of rams to contact a specific allotment during the summer season. Based on the number of rams in the Vallecito Creek S-28 population (32) and their individual contact probabilities (0.256%), it is estimated that rams from S-28 would foray from their CHHR and make contact with the Burnt Timber Allotment at a rate of 0.08051 times per season. In other words, contact with the Burnt Timber Allotment by a foraying ram from the S-28 CHHR, given the estimate of 32 rams in the S-28 herd, is expected to occur once every 12.4 years (1/0.08051). For ewes in S-28, given a total of 59 ewes and a contact probability of 0.0071% per single ewe, contact with the Burnt Timber Allotment by a foraying ewe is expected to occur at a rate of 0.004156 times per summer season, or once every 241 years.

Finally on Table 4, the total herd contact rate is the number of adult bighorn sheep (rams plus ewes) expected to foray from the CHHR and contact the allotment each summer season. Based on the aggregate ram and ewe contact rates (All Rams + All Ewes; 0.08051 + 0.004156 contacts/year, respectively), it is estimated that an adult bighorn sheep would leave the S-28 CHHR on a foray and make contact with the Burnt Timber Allotment at a rate of 0.08467 times per summer season. In other words, given the estimate of 90 adult bighorns in the Vallecito Creek Herd, adult bighorn sheep from S-28 are expected to contact the Burnt Timber Allotment once every 11.8 years (1/0.08467).

For the purpose of illustrating how results from the Risk of Contact Tool were combined and summarized, Table 5, below, displays the summary results for total annual herd contact rates for all allotments and bighorn sheep herds in the Weminuche Landscape under the current allotment configuration (Alternative 2). Similar summarized tables showing total annual herd contact rates for all allotments and bighorn herds were also produced for Alternatives 3 and 4 (total of three independent tables). Again for the sake of brevity, only one of the three summarized alternative tables is presented here. All three summarized alternative tables can be found in the project record. Continuing with the previous example, the upper left cell of the table shows the predicted total annual herd contact rate by bighorn sheep foraying from the S-28 Vallecito Creek Herd with the Burnt Timber allotment is 0.08467, or one contact every 11.8 years.

Table 5. Summary of Risk of Contact Tool estimated total annual herd contact rates (all adult rams and ewes combined) via foray for all allotments and bighorn sheep herds in the Weminuche Landscape grazing analysis area under current allotment configuration (Alternative 2).

Direct Effects - Alt 2	Annual Herd Contact Rates via Foray				
Allotment	**S28**	**S16**	**S71**	**Total**	**1 Contact/X Years**
Burnt Timber	0.084669407	0.002048664	0.049249802	0.135967873	7.35
Canyon Creek	0.02190888	0.000409824	1.0	1.022318704	0.98
Cave Basin	1.0	0.435493799	0.082396597	1.517890396	0.66
Endlich Mesa	0.49381434	0.051796706	0.120047121	0.665658167	1.50
Fall Creek	0.771803127	0.079309356	0.078905313	0.930017796	1.08
Flint Creek	1.0	0.738863876	0.043360329	1.782224205	0.56
Johnson Creek	0.686369727	0.130234104	0.113329754	0.929933586	1.08
Leviathan	0.488808513	0.117255289	0.112956407	0.719020209	1.39
Pine River	1.0	1.0	0.034211178	2.034211178	0.49
Rock Creek	1.0	0.171840208	0.083181917	1.255022125	0.80
Spring Gulch	0.016395688		0.00516913	0.021564818	46.37
Tank Creek	0.111659309	0.007653963	1.0	1.119313272	0.89
Virginia Gulch	0.294969183	0.047147979	0.182521288	0.52463845	1.91
Total	6.970398173	2.782053768	2.905328838	12.65778078	0.08
1 Contact/X Years	0.14	0.36	0.34	0.08	

CHHR Intersects With Allotment

N/A: Too Far From Allotment

CHHR = Bighorn Core Herd Home Range

The cells shaded in tan in Table 5, above, indicate allotments where there is direct overlap between a herd's CHHR and some portion of that domestic sheep allotment. For example, portions of Canyon Creek and Tank Creek allotments overlap with the CHHR for the West Needles Herd (S-71), and portions of the Pine River Allotment overlap with the CHHR for the Cimarrona Peak Herd (S-16) and other portions of the allotment overlap with the CHHR for the Vallecito Creek Herd (S-28). Because there is overlap between these allotments and bighorn CHHR's, the Risk of Contact Tool presumes contact occurs each year when bighorns use that portion of their CHHR that overlaps with the allotment. The Tool does not attempt any further calculations of the number of contacts per year within that zone of overlap (USDA Forest Service 2013b). This is because the Tool calculates rates of contact by foray and by definition forays only occur when a bighorn leaves its CHHR. Therefore at least one and perhaps multiple contacts per year occurs within the portion of the allotment that overlaps with the CHHR (USDA Forest Service 2013c). For this reason it is appropriate to place a value of 1.0 in this allotment's cell indicating a 100% probability of contact with the allotment is predicted to occur in the zone of overlap with the CHHR (Obrien pers. comm., McCarthy pers. comm.).

Because total annual herd contact rates are additive, they can be summed across multiple allotments within an individual bighorn herd, or summed across bighorn herds for each allotment (Obrien pers. comm., McCarthy pers. comm.). Annual herd contact rates can be added across bighorn herds because the bighorn total population size and sex ratio for each herd has already been incorporated into the calculation process prior to estimating total herd contact rates. For example, given the additive nature of total herd contact rates, the Risk of Contact Tool predicts that

bighorn sheep from the Vallecito Creek Herd (S-28) would contact an allotment in the Weminuche Landscape about 7 times per year under the current allotment configuration (Alternative 2). This compares to an overall rate of 2.7 times per year for bighorns from the Cimarrona Peak Herd (S-16), and a rate of 2.9 times per year for bighorns from the West Needles Herd (S-71).

Finally, from the total annual herd contact rates discussed above in Table 5, for each action alternative (Alternatives 2, 3 and 4), the combined overall herd contact rates were converted to a rate of one contact per total number of years and displayed below in Table 6. Thus Table 6 summarizes the results from all of the calculation processes described above in Tables 3, 4 and 5, across all three action alternatives (Alternatives 2, 3 and 4), and displays the total annual combined herd contact rates in the form of the number of years per contact for each allotment for all bighorn herds combined. Numbers less than one indicate a prediction of multiple contacts per year.

Table 6. Risk of Contact Tool estimated total annual herd contact rates for each allotment, for all bighorn sheep herds combined, under each action alternative (Alternatives 2, 3 and 4), displayed as the predicted number of years per contact.

Direct Effects	Annual Total Herd Contact Rates via Foray (1 Contact/X Years)		
Allotment	**Alternative 2**	**Alternative 3**	**Alternative 4**
Burnt Timber	7.4	7.4	7.4
Canyon Creek	1.0	8.9	8.9
Cave Basin	0.7		
Endlich Mesa	1.5	1.5	1.5
Fall Creek	1.1		
Flint Creek	0.6		
Johnson Creek	1.1	1.3	
Leviathan	1.4	1.4	
Pine River	0.5		
Rock Creek	0.8	1.8	
Spring Gulch	46.4	47.8	47.8
Tank Creek	0.9	3.0	3.0
Virginia Gulch	1.9	1.9	1.9
Total	0.1	0.3	0.6

CHHR Intersects With Allotment (C

N/A: Allotment Proposed Closed

Active Sheep Allotment

CHHR = Bighorn Core Herd Home Range

The cells shaded in tan in Table 6, above, indicate allotments where there is direct overlap between a herd's CHHR and some portion of that domestic sheep allotment. The cells shaded in blue indicate allotments proposed for closure under that alternative. For example, portions of Pine River and Cave Basin allotments overlap with the CHHR of the Vallecito Creek Herd (S-28) under current allotment configuration (Alternative 2). However, both allotments are proposed to be closed to domestic sheep grazing under Alternatives 3 and 4.

Also for example in Table 6, above, the Risk of Contact Tool estimates that bighorn sheep from S-16, S-28 or S-71 would contact the Canyon Creek Allotment at a rate of 1 contact every 0.98years under current allotment configuration (Alternative 2). This compares to an estimated rate of one contact every 8.86years under Alternatives 3 and 4. Therefore, the Risk of Contact Tool predicts that allotment boundary adjustments proposed to occur in the Canyon Creek Allotment under Alternatives 3 and 4 would reduce the predicted rate of contact from one contact every 0.98 years to one contact every 8.86 years.

Further from Table 6, above, the Risk of Contact Tool predicts, for example, that under the current allotment configuration (Alternative 2) a bighorn from one of the three herds would contact a domestic sheep allotment somewhere in the Weminuche Landscape about 12.5 times per year (1/0.08) while foraying outside their CHHR. Under the allotment configuration proposed in Alternative 3, the combined total predicted rate of allotment contact across the Weminuche Landscape would be reduced to about 4 contacts per year (1/0.26). Under Alternative 4, the predicted rate of contact would be further reduced to less than 2 contacts per year (1/0.56).

Similar to Table 6, above, Table 7, below, summarizes the results from all calculation processes described above in Tables 3, 4 and 5, across all three action alternatives (Alternatives 2, 3 and 4), and displays the total annual combined herd contact rates in the form of total number of years per contact for all allotments combined. Numbers less than one indicate a prediction of multiple contacts per year.

For example, the Risk of Contact Tool estimates that bighorn sheep from the S-16 Cimarrona Peak Herd foraying outside their CHHR would contact an allotment somewhere in the Weminuche Landscape at a predicted rate of about 2.8 contacts per year (1/0.36) under the current allotment configuration (Alternative 2). This compares to a predicted rate of one contact every 2.12 years under Alternative 3, and one contact every 9.04 years under Alternative 4. Therefore, the Risk of Contact Tool predicts that allotment boundary adjustments and allotment closures proposed to occur under Alternatives 3 and 4 would reduce the predicted rate of allotment contacts by bighorns from the Cimarrona Peak Herd from 2.8 contacts per year under Alternative 2 to one contact per 2.1 years under Alternative 3, and one contact per 9.0 years under Alternative 4.

Table 7. Risk of Contact Tool estimated total annual herd contact rates for individual bighorn sheep herds across all allotments combined, under each action alternative (Alternatives 2, 3 and 4), displayed as the number years per contact.

	Annual Total Herd Contact Rates via Foray (1 Contact/X Years)		
Bighorn Sheep Herd	**Alternative 2**	**Alternative 3**	**Alternative 4**
Cimarrona Peak S-16	0.36	2.12	9.04
Vallecito Creek S-28	0.14	0.41	0.96
West Needles S-71	0.34	1.06	1.55
Total	0.08	0.26	0.56

CHHR Intersects With an Allotment

CHHR = Bighorn Core Herd Home Range

Also for purposes of illustration, Figure 1, below, provides a graphical display produced by the Risk of Contact Tool that illustrates bighorn ram CHHR for the Vallecito Creek Herd (S-28), distribution of summer source habitat across the Weminuche Landscape, domestic sheep allotment configurations under the action alternatives (Alternatives 2, 3 and 4), and estimated rates of ram contact extending out from the S-28 CHHR in 1 km distance bands. The Risk of Contact Tool produced similar individual output graphical displays for estimated rates of ram and ewe contact

for the Cimarrona Peak Herd (S-16) and the West Needles Herd (S-71), for a total of six graphical displays. Figure 2, below, provides the same graphical display of rates of ewe contact in 1-km distance bands extending out from the S-28 CHHR. Again for the sake of brevity, only two of the six graphical displays are presented here. All six graphical displays can be found in the project record.

Figure 1. Map of ram foray probabilities from the Vallecito Creek Herd S-28; output from the Risk of Contact Tool.

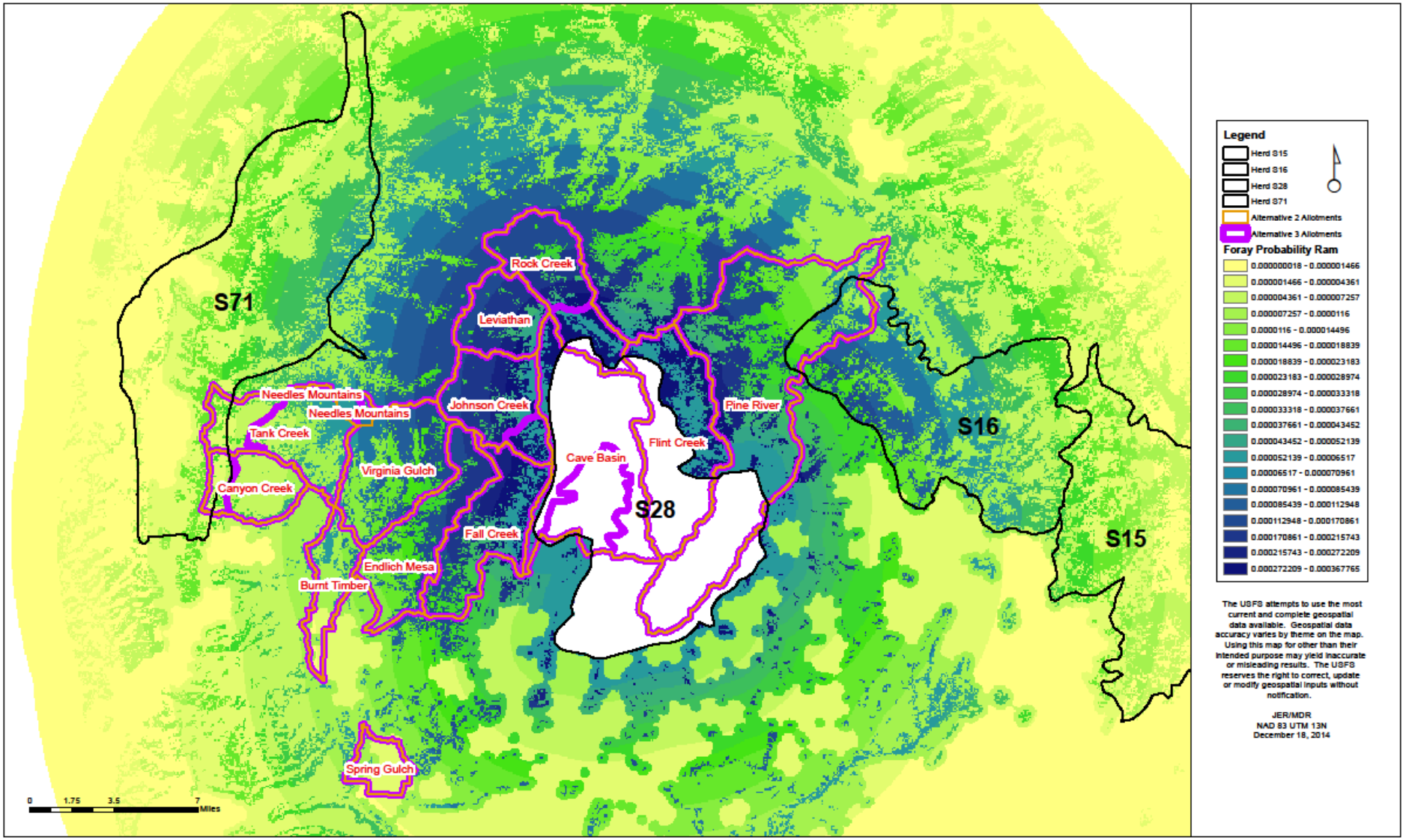
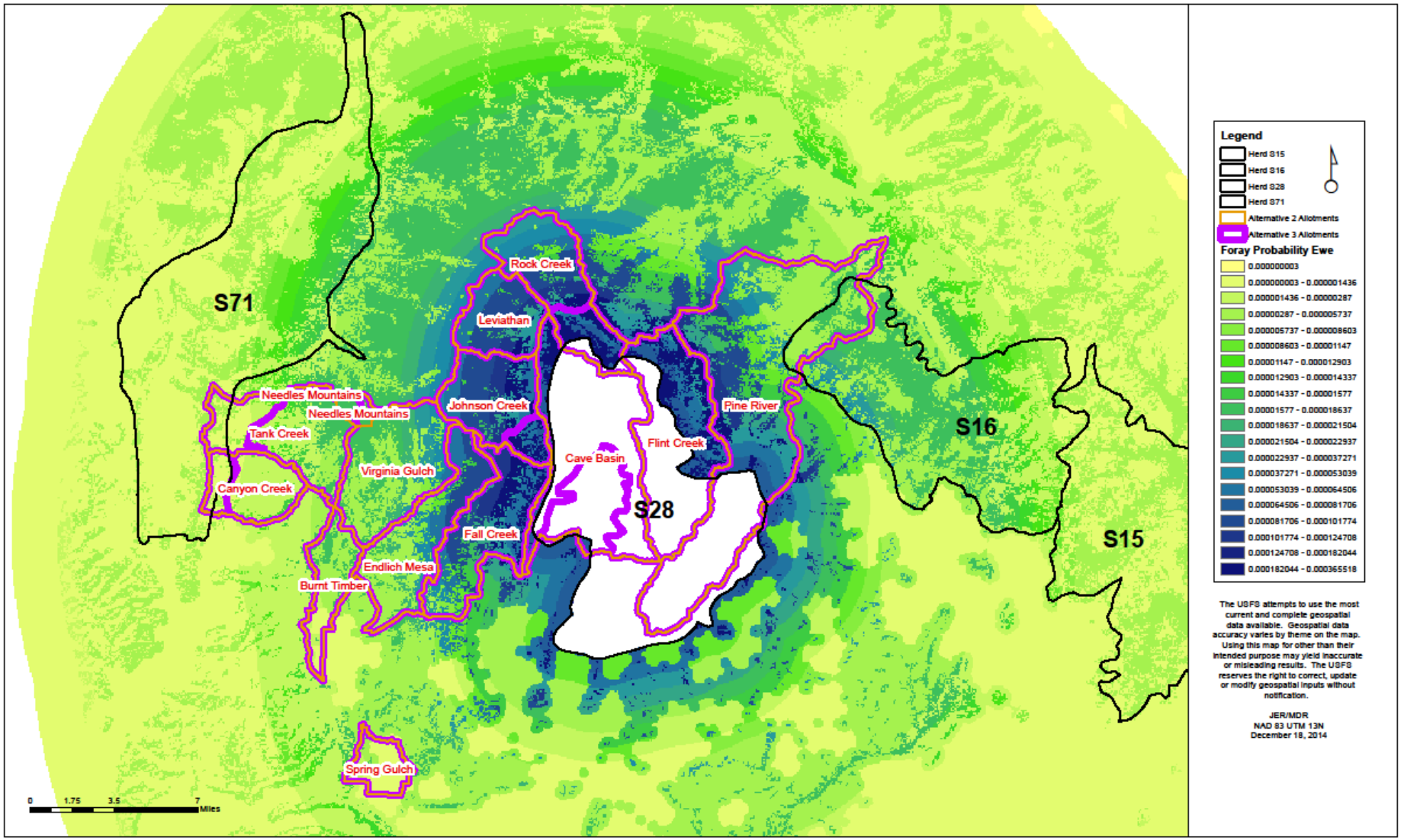


Figure 2. Map of ewe foray probabilities from the Vallecito Creek Herd S-28; output from the Risk of Contact Tool.



RESULTS FOR INDIVIDUAL DOMESTIC SHEEP ALLOTMENTS:

The following sections display the results for each domestic sheep grazing allotment individually. The Risk of Contact Tool results are presented for each allotment, along with statistics for the distance of the allotment from bighorn CHHR's, total size of the allotment, amount of suitable domestic sheep grazing range, bighorn sheep summer source habitat, and amount of overlap between suitable domestic sheep range and bighorn sheep source habitat within each allotment. Descriptions are provided of the distribution of bighorn summer source habitat within the allotment and connectivity outside the allotment with adjacent bighorn CHHR. Known bighorn occurrence information is also provided, along with relevant information provided by the permittee for active allotments. Finally, the qualitative ranking of risk of physical contact between bighorn and domestic sheep is presented for each allotment.

Burnt Timber Allotment (active sheep allotment):

Table 8. Risk of Contact Tool estimated total herd contact rates for the Burnt Timber Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Burnt Timber Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.002	0.085	0.049	0.136	7.4
Alternative 3	0.002	0.085	0.049	0.136	7.4
Alternative 4	0.002	0.085	0.049	0.136	7.4

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 9. Acreage statistics for the Burnt Timber Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	4.1 mi – S-71 7.1 mi – S-28 19.2 mi – S-16	5,092	3,900 (77%)	1,257 (25%)	788 (20%)
Alternative 3	Same Distances	5,092	3,900 (77%)	1,257 (25%)	788 (20%)
Alternative 4	Same Distances	5,092	3,900 (77%)	1,257 (25%)	788 (20%)

The Burnt Timber Allotment is located southeast of the CHHR for the West Needles Herd S-71 and west of the CHHR for the Vallecito Creek Herd S-28. There is no overlap between the Burnt Timber allotment and bighorn CHHR for any bighorn herd under any of the project alternatives. It is primarily a trailing allotment, providing the Tank Creek and Virginia Gulch

bands and the recently vacant Canyon Creek allotment with access to higher elevation primary grazing ranges. About half of the allotment is located within the Weminuche Wilderness.

A minor boundary adjustment was made administratively after the draft EA to correctly display the current condition and how the landscape is actually being used by the permittee. Administrative boundary adjustments can be done at any time without a NEPA decision per 36 CFR 222(a) (7) and FSH 2209.13 sec 16.1.A minor boundary adjustment at the far north end of the allotment slightly reduced the size of the allotment. The purpose of the boundary adjustment was to reduce impacts of sheep trailing along the Lime Mesa Trail corridor, and to provide greater flexibility for the Tank Creek and Virginia Gulch bands in the immediate proximity of the trail corridor.

The highest elevation in the allotment is about 11,700 feet on the northwest side of the allotment. Most of the central and southern portions of the allotment are at moderate and lower elevations. The majority of the allotment and of the suitable domestic sheep grazing areas are below the alpine zone in natural meadows and old timber harvest areas.

Compared to other allotments in the Weminuche Landscape, the Burnt Timber Allotment has a relatively high percentage of the allotment suitable for domestic sheep grazing (77% of the Allotment; 3,900 acres; see Table 9, above). Most bighorn source habitat in the allotment is along the western and eastern sides of the allotment, in the upper half of the allotment. Although there is a relatively large amount of suitable domestic sheep grazing range in the allotment, there is a relatively low amount of overlap between suitable grazing range and bighorn summer source habitat. About 20% of suitable domestic sheep grazing range is also bighorn summer source habitat (see Table 9, above). The minor boundary adjustment had little impact on the amount of overlap between suitable domestic sheep grazing range and bighorn summer source habitat with only about a 1% decline in overlap from the previous allotment configuration.

The domestic sheep permittees report they have not seen bighorn sheep in the allotment. The Forest Service has not received any reports from the public or CPW of bighorn sheep observed in the allotment during the summer grazing season.

The nearest bighorn CHHR to the Burnt Timber Allotment is the West Needles Herd S-71. The distance to the West Needles Herd CHHR is 4.1 miles away at its closest point (Table 9, above). A large radio telemetry data set from Idaho estimated that about half of rams and 20% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The nearest distance to S-28, the Vallecito Creek Herd CHHR, is 7.1 miles away, with about 25% of rams and 15% of ewes on a foray expected to reach this distance from their CHHR. The nearest distance to S-16, the Cimarrona Peak Herd CHHR, is 19.2 miles away, with about 1% of bighorns on a foray expected to reach this distance from their CHHR.

It should be noted that under all alternatives the Risk of Contact Tool predicted the highest total herd contact rates with the Vallecito Creek Herd S-28 (0.085; 7.1 miles away) rather than the much closer West Needles Herd S-71 (0.049; 4.1 miles). The reason for the higher predicted total herd contact rate with S-28 than S-71 is its larger population size (90 versus 60 animals), and more extensive bighorn source habitat connectivity between the allotment and the CHHR for S-28, compared to that with S-71. Connectivity of bighorn source habitat with S-28 CHHR is fair, and that with S-71 CHHR is poor, despite its closer proximity.

Estimated total herd contact rates from the Risk of Contact Tool for the Burnt Timber Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 8. The herd closest to the allotment, West Needles S-71 (4.1 miles), has an estimated total herd contact rate of 0.049 under all allotment configurations. This estimate equates to a predicted average of one contact with the allotment by a foraying bighorn (ram or ewe) from S-71 every 20.4 years. For S-16, the Cimarrona Peak Herd, the contact rate is estimated at 0.002, or one contact with the allotment every 500 years. For S-28, the Vallecito Creek Herd, the contact rate is estimated at 0.085 or one contact every 12.0 years. When contact rates from all three bighorn herds are combined, there is estimated to be one contact with the allotment by a bighorn from one of the three herds every 7.4 years.

Based on the information presented above, a rank of **Moderate Risk** was assigned to the Burnt Timber Allotment for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment. The reasons for assigning a rank of Moderate Risk to the Burnt Timber Allotment under all alternatives are:

- There is no direct overlap of the allotment with bighorn CHHR under any alternative.
- There are moderate total herd contact rates (about 0.08, or less; Table 8, above) from the Risk of Contact Tool (USDA Forest Service 2010a) for all bighorn herds and action alternatives, resulting in moderate estimated lengths of time between potential for bighorn contact with the allotment (once per 11.8 years to 500 years).
- There is moderate separation from the two nearest bighorn CHHRs (S-71 and S-28) in terms of both distance (4.1 to 19.2 miles; Table 9, above) and geographic terrain, with fair to poor connectivity between bighorn source habitat and CHHRs for dispersal of bighorns from S-71 and S-28 to the allotment.
- About half of foraying bighorns from S-71 are predicted to reach the distance away from their CHHR that is equal to the distance to the nearest allotment (S-71, 4.1 miles; see Table 9, above). About one quarter of foraying bighorns are predicted to reach the distance away from the S-28 CHHR to the allotment (7.1 miles). This indicates moderate potential for bighorns from S-71 contacting the allotment, and lower potential for bighorns from S-28 contacting the allotment.
- There is a relatively low amount (about 20%) of suitable domestic sheep grazing range that overlaps with bighorn source habitat under all alternatives (Table 9, above). This indicates lower likelihood that foraying bighorns reaching the allotment might find and physically contact domestic sheep on suitable grazing range.
- The allotment is dominated by forested habitats and old timber harvest areas, and the few areas that are mapped as bighorn source habitats are generally small in size with fair to poor connectivity across the allotment and with bighorn CHHRs. This indicates fair to poor potential for bighorns that have reached the allotment to come into physical contact with domestic sheep on suitable grazing range.
- Grazing permittees report they have not seen bighorn sheep in the allotment, and no reports have been received by the Forest Service from the public or CPW of bighorn sheep observed in the allotment during the summer grazing season.
- Design criteria applied under Alternatives 3 and 4 (EIS Tables 2-2 and 2-3), when fully and completely implemented, are expected to enhance the effectiveness of separation between the species and are intended to prevent physical contact.

Summary of Risk Rating for Burnt Timber Allotment:

Risk Rating: Alternative 2 – Moderate
Alternative 3 – Moderate
Alternative 4 – Moderate

Canyon Creek Allotment (vacant sheep and active cattle allotment):

Table 10. Risk of Contact Tool estimated total herd contact rates for the Canyon Creek Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Canyon Creek Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.0004	0.022	1.000	1.022	1.0
Alternative 3	0.0004	0.022	0.090	0.113	8.9
Alternative 4	0.0004	0.022	0.090	0.113	8.9

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 11. Acreage statistics for the Canyon Creek Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	Overlap – S-71 9.6 mi – S-28 20.5 mi – S-16	6,328	3,467 (55%)	964 (15%)	178 (5%)
Alternative 3	0.06 mi – S-71 9.6 mi – S-28 20.5 mi – S-16	4,740	3,382 (71%)	590 (17%)	172 (5%)
Alternative 4	Same Distances	4,740	3,382 (71%)	590 (17%)	172 (5%)

The Canyon Creek Allotment is located along the eastern edge of the Weminuche Landscape and overlaps with the CHHR for the West Needles Herd S-71. This allotment was stocked with sheep for many years prior to the CPW releases of bighorn sheep into the Animas River canyon in 2000 and 2002-2003. The allotment was grazed by domestic sheep annually through the 2011 season, was vacant in the 2012 grazing season, and was stocked with cattle in the 2013 and 2014 grazing seasons. CPW has not advocated closure of the allotment to domestic sheep grazing based solely on the presence of the introduced S-71 herd (Colorado Parks and Wildlife 2013a).

A boundary adjustment proposed under Alternatives 3 and 4 and endorsed by the permittee would eliminate the entire zone of overlap between the allotment and the mapped S-71 CHHR. This zone of overlap was not used by the permittee due to unsuitable terrain and vegetation. The remainder of the allotment could be converted to and operated as a cattle allotment, or could be operated as a domestic sheep allotment. Under current management (Alternative 2) it is considered a vacant domestic sheep allotment that was stocked temporarily with cattle but is available to be restocked with sheep. For this reason, under all alternatives the Canyon Creek Allotment will be analyzed as a vacant sheep allotment and as an active cattle allotment.

The highest elevation in the Canyon Creek Allotment is about 11,400 feet on the northern edge allotment. None of the allotment is within designated wilderness. Most of the suitable domestic sheep range consists of large open natural parks on moderately sloped hillsides surrounded by spruce-fir and mixed aspen-conifer forests at moderate elevations. Some additional grazing areas are in older timber harvest areas within the spruce-fir forest zone. The entire allotment is below the alpine zone.

Under current condition (Alternative 2) there is about 1,101 acres of mapped overlap with the S-71 CHHR, about 17 percent of the allotment. All of the overlap area is on the east side of the Animas River. Within this area of mapped overlap, about 65 acres (6%) is suitable domestic sheep grazing range. Also within this area of overlap, CPW has mapped 347 acres as bighorn summer concentration area, of which about 47 acres are classified as suitable domestic sheep range. Under Alternatives 3 and 4, the entire area of overlap with the S-71 CHHR, including the bighorn summer concentration area within it, would be removed from the allotment and closed to domestic sheep grazing. This allotment boundary adjustment was endorsed by the domestic sheep grazing permittee.

The domestic sheep permittees reported they have not seen bighorn sheep in the allotment. The Forest Service has not received any reports from the public or CPW of bighorn sheep observed in the allotment during the summer grazing season.

Under Alternative 2, the Canyon Creek Allotment has about 3,467 acres of suitable domestic sheep grazing range, about half (56%) of the Allotment (see Table 11, above). There is a relatively small amount of bighorn source habitat in the allotment, 964 acres or 15% of the allotment (Table 11, above). Nearly all bighorn source habitat in the allotment is along the northern and eastern boundary of the allotment on the opposite side of the allotment from the CHHR for S-71. Although there is a substantial amount of suitable domestic sheep grazing range in the allotment (3,467 acres), there is only a very small overlap of that suitable range with bighorn source habitat (177 acres, about 5% of suitable domestic sheep range in the allotment; see Table 11, above).

The boundary adjustment proposed under Alternatives 3 and 4 that removes the zone of mapped overlap with the S-71 CHHR would have little effect on the amount or distribution of useable domestic sheep grazing range remaining in the allotment (see Table 11, above). Because the zone of mapped overlap was generally not used by the sheep permittees in previous years, closure of this zone of overlap was endorsed by the permittee and would only slightly reduce the acres of suitable domestic sheep grazing range in the allotment.

Estimated total herd contact rates from the Risk of Contact Tool for the Canyon Creek Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 10.

Under Alternative 2, the allotment overlaps with the West Needles Herd S-71 CHHR. By definition, contact with the allotment occurs whenever bighorns use the portion of their CHHR that overlaps with the allotment (USDA Forest Service. 2013c) and therefore a contact rate of 1.0 (contact occurring at least once every year) for S-71 under Alternative 2 is the appropriate value from the Risk of Contact Tool (Obrien pers. comm., McCarthy pers. comm.). Given the boundary adjustment proposed under Alternatives 3 and 4, removing the zone of overlap with the S-71 CHHR results in a total herd contact rate with S-71 of 0.09 under Alternatives 3 and 4. This equates to an estimate of one contact with the allotment by a foraying bighorn (ram or ewe) from S-71 every 11.1 years under Alternatives 3 and 4. The nearest distance to the S-71 CHHR from the allotment under Alternatives 3 and 4 is 0.06 miles.

The boundary adjustment proposed under Alternatives 3 and 4 would have little effect on predicted contact rates for the S-28 and S-16 bighorn herds. Under all Alternatives, the predicted total herd contact rate with the Vallecito Creek Herd S-28 (9.6 miles away) is 0.022 or one contact every 45.5 years. For the Cimarrona Peak Herd S-16 (20.5 miles away), the predicted contact rate under all alternatives is 0.004 or one contact every 250 years.

When comparing total herd contact rates for the Canyon Creek Allotment for all bighorn herds combined, for Alternatives 3 and 4 there is predicted to be one contact with the allotment by a bighorn from one of the three herds every 8.9 years (Table 10, above).

The nearest bighorn CHHR to the Canyon Creek Allotment is the West Needles Herd S-71 with direct overlap of CHHR under the current allotment configuration (Alternative 2). The distance to the Vallecito Creek Herd S-28 CHHR is 9.6 miles at its closest point (Table 11, above). A large radio telemetry data set from Idaho estimated that about 20% of rams and 10% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The nearest distance to S-16, the Cimarrona Peak Herd CHHR, is 20.5 miles away, with about 1% of bighorns on a foray expected to reach this distance from their CHHR.

Based on the information presented above, a rank of **High Risk** for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment was assigned to the Canyon Creek Allotment under Alternative 2, but a rank of **Moderate Risk** was assigned under Alternatives 3 and 4. The reasons for assigning a rank of High Risk to the Canyon Creek Allotment under Alternative 2 and rank of Moderate Risk under Alternatives 3 and 4 are:

- There is high risk for physical contact under Alternative 2 because about 18% of the allotment directly overlaps the West Needles Herd S-71 bighorn CHHR. For this reason, it is assumed that under current allotment configuration at least one and potentially multiple bighorn contacts per year with the allotment are possible, and thus there is high risk for physical contact with potential for disease transmission and a subsequent bighorn mortality event within the S-71 CHHR.
- There is moderate risk for physical contact under Alternatives 3 and 4 because the zone of mapped overlap with the S-71 CHHR would be removed from the allotment. The predicted total herd contact rate would decline from a high rate of 1.0 to a moderate rate of 0.09 or one contact every 11.1 years. The area removed from the allotment under Alternatives 3 and 4 was not actually used by the permittee due to terrain and vegetation characteristics. For this reason the permittee supports the

boundary adjustment made under Alternatives 3 and 4. Because this zone of mapped overlap with CHHR was not being used by domestic sheep, the risk of physical contact within this zone of overlap was probably less than that displayed under Alternative 2.

- There is low risk for physical contact with bighorn herds S-16 and S-28 because the total herd contact rates are low (0.02 or less; Table 10, above).
- There is low risk for bighorns from S-28 and S-16 contacting the allotment. This is due to good separation from the S-28 and S-16 CHHRs in terms of both distance (9.6 and 20.5 miles, respectively; Table 11, above) and geographic terrain, with fair to poor connectivity between bighorn source habitat and CHHRs for dispersal of bighorns from S-28 and S-16 to the allotment.
- There is low to moderate risk for physical contact with bighorns from S-28 and S-16 because less than 20% of foraying bighorns from S-28 are predicted to reach the distance away from their CHHR (9.6 miles; Table 11, above) that is equal to the distance to the allotment. Less than 1% of foraying bighorns are predicted to reach the distance away from the S-16 CHHR to the allotment (20.5 miles; Table 11, above). This indicates that few bighorns foraying from S-28 and S-16 are likely to reach the allotment and have potential to contact a domestic sheep.
- Relatively low amount of suitable domestic sheep grazing range overlaps with bighorn summer source habitat (about 5% overlap) in the allotment under all alternatives. This indicates low likelihood that foraying bighorns reaching the allotment might find and contact domestic sheep on suitable grazing range.
- The allotment is dominated by forested habitats, natural parks and old timber harvest areas, and the few areas mapped as preferred bighorn habitats or escape terrain are generally small in size with poor connectivity within the allotment and with bighorn CHHRs.
- The domestic sheep permittees reported they did not see bighorn sheep in the allotment, and no reports have been received by the Forest Service from the public or CPW of bighorn sheep observed in the allotment during the summer grazing season.
- Design criteria applied under Alternatives 3 and 4 (EIS Tables 2-2 and 2-3), when fully and completely implemented, are expected to enhance the effectiveness of separation between the species and are intended to prevent physical contact..

Summary of Risk Rating for Canyon Creek Allotment:

Risk Rating: Alternative 2 – High
Alternative 3 – Moderate
Alternative 4 – Moderate

Cave Basin Allotment (vacant sheep allotment):

Table 12. Risk of Contact Tool estimated total herd contact rates for the Cave Basin Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Cave Basin Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.435	1.000	0.082	1.518	0.7
Alternative 3	Allotment Proposed Closed				N/A
Alternative 4	Allotment Proposed Closed				N/A

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 13. Acreage statistics for the Cave Basin Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	Overlap – S-28	22,452	5,858 (26%)	12,743 (57%)	1,849 (32%)
	5.9 mi – S-16 7.1 mi – S-71				
Alternative 3	Allotment Proposed Closed				
Alternative 4	Allotment Proposed Closed				

The Cave Basin Allotment is located in the middle of the Weminuche Landscape. The entire allotment is located within the Weminuche Wilderness. Most of the allotment overlaps with the CHHR for the Vallecito Creek Herd S-28. Under current condition (Alternative 2) there is about 19,575 acres of overlap with the S-28 CHHR, about 87 percent of the allotment. Within this overlap area, about 5,389 acres (28%) is suitable domestic sheep grazing range. Also within this overlap area, about 11,681 acres (60%) is bighorn summer source habitat. Bighorn sheep are regularly observed in eastern and northern portions of the allotment during summer, and large portions (6,328 acres) of the eastern half of the allotment overlap with areas mapped by CPW as bighorn summer concentration area (28% of the allotment).

Domestic sheep were grazed in the allotment annually from 1928 through 1971, vacant through 1979, then stocked from 1980 through 1982, 1984, and ending in 1988. There is no documentation of official requests by domestic sheep permittees to stock the allotment since 1988. Bighorns have been documented in the area since at least the 1940s.

The only known or suspected bighorn disease-related mortality event on the San Juan National Forest occurred in this allotment in 1988 in a unique series of events. The allotment was last grazed by domestic sheep in 1988 and has remained vacant since then. There is strong circumstantial evidence a bighorn mortality event occurred in the allotment in 1988

following observed physical contact between domestic sheep and translocated bighorns, and that this contact resulted in a presumed complete mortality event of the released bighorns before their first winter. Disease did not appear to have been transmitted from the translocated bighorns to the native bighorn herd because population size and lamb survival remained stable in the native bighorn herd after the mortality event of the released bighorns (Weinmeister 2012). The following description of this unusual event is taken from Weinmeister (2012):

> "In January of 1988, 20 bighorns (12 ewes, 5 lambs, and 3 rams) were captured on Avalanche Creek south of Carbondale and released on the Los Pinos River near Runlett Peak. At that time, the S-28 herd was considered to be isolated from other herds in the San Juan Mountains and was experiencing continued low recruitment. The translocation was an attempt to increase genetic diversity, vigor of the herd, and distribution by pioneering. Domestic sheep happened to be grazed on an allotment *[Cave Basin Allotment]* within the area the same year, after the allotment had not been used for over a decade. In August physical contact was observed between the transplanted wild sheep and domestic sheep when individuals were seen grazing together. By September all but one of the transplanted wild sheep were dead. *Pasteurella* was suspected as the agent causing the die-off, as this is typical pattern for the disease. The released bighorn were monitored intermittently by ground observation and no direct interaction between the transplanted bighorn and the native bighorn were seen. If *Pasteurella* was the cause of mortality the disease was not spread into the native bighorn based on steady lamb recruitment in the population following the death of the transplanted sheep. It is common that lamb recruitment is depressed for years after a *Pasteurella* endemic (George et al 2008). It is also possible that the deaths of the transplanted sheep could have been caused by some other factor although the swiftness of the deaths is not familiar in other documented causes of mortality. The transplant was considered a failure, based on the known mortalities and the lack of performance of the herd following the transplant (Carron, personal communication 2011)."

Under current management (Alternative 2), Cave Basin is a vacant domestic sheep allotment that could be restocked. Under Alternatives 3 and 4, the allotment is proposed to be closed to domestic sheep grazing. Also under Alternative 3, the southern approximately one third of the allotment (6,036 acres, 27% of the allotment) is proposed to be converted to a cattle forage reserve allotment, allowing cattle grazing for a maximum of three out of any ten consecutive years. The entire area of this proposed cattle forage reserve allotment overlaps with bighorn CHHR for the Vallecito Creek Herd S-28. Within this overlap area, about 4,319 acres (72%) is suitable livestock grazing range. Also within this overlap area, about 1,918 acres (32%) is bighorn summer source habitat. Under Alternative 4, the allotment is proposed to be closed to all livestock grazing.

Elevations on the Cave Basin allotment vary from 8,400 to 13,600 feet. More than half of the allotment is too steep or produces too little forage to be suitable for livestock grazing. Most of the suitable grazing range is in the southern third of the allotment, and above about 10,500 feet in elevation in older timber harvest areas within the spruce-fir forest zone. Most of the northern half of the allotment is above timberline.

Under current conditions (Alternative 2) there is about 19,574 acres of overlap with the S-28 CHHR, about 87 percent of the allotment. Within this overlap area, about 5,389 acres (28%) is suitable domestic sheep grazing range. Also within this area of overlap, CPW has mapped

6,328 acres as bighorn summer concentration area, of which about 609 acres are classified as suitable domestic sheep range. Also within this area of overlap, CPW has mapped 164 acres as bighorn production area, of which 14 acres are classified as suitable domestic sheep range. Under Alternatives 3 and 4, the entire area of overlap with the S-28 CHHR, including the entire bighorn summer concentration and production areas, would be closed to domestic sheep grazing.

Under Alternative 2 the Cave Basin Allotment has 22,452 acres within the allotment, of which approximately 5,858 acres (26%) are suitable domestic sheep grazing range (Table 13, above). There is a relatively large amount of bighorn source habitat in the allotment, 12,743 acres or 57% of the allotment (Table 13, above). There is substantial overlap in the allotment between suitable domestic sheep range and bighorn summer source habitat, with 32% of suitable domestic sheep range (1,849 acres) also bighorn summer source habitat. Most of the northern two-thirds of the allotment is bighorn source habitat with large contiguous areas of interconnected habitat patches spanning long distances across alpine ridges and basins.

Total herd contact rates from the Risk of Contact Tool for the Cave Basin Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 12.

Under Alternative 2, the allotment overlaps substantially (87% of the allotment) with the CHHR for the Vallecito Creek Herd S-28. By definition, contact with the allotment occurs whenever bighorns use the portion of their CHHR that overlaps with the allotment and therefore the Risk of Contact Tool assigns a contact rate of 1.0 (contact occurring at least once every year) for S-28 under Alternative 2. Given the overlap between known bighorn use areas and suitable domestic sheep grazing range in the allotment it is likely that multiple contacts per year should be expected with this allotment and thus a contact rate of 1.0 may underestimate the actual rate of contact with the allotment.

The next closest bighorn herd to the allotment, Cimarrona Peak S-16 (5.9 miles away), has an estimated total herd contact rate of 0.435. This equates to an estimate of one contact with the allotment by a foraying bighorn (ram or ewe) from S-16 every 2.3 years. The West Needles Herd S-71 (7.1 miles away) has a total herd contact rate of 0.082 or one contact every 12.3 years. Table 12 does not display total herd contact rates for Alternatives 3 or 4 because the allotment is proposed to be closed to domestic sheep grazing under both alternatives.

As stated earlier, the Cave Basin Allotment directly overlaps a substantial portion of the Vallecito Creek Herd S-28 CHHR. The next nearest bighorn CHHR to the Cave Basin Allotment is the Cimarrona Peak Herd S-16. The closest distance to the Cimarrona Peak Herd S-16 CHHR is 5.9 miles away at its closest point (Table 13, above). A large radio telemetry data set from Idaho estimated that about 30% of rams and 15% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The nearest distance to S-71, the West Needles Herd CHHR, is 7.1 miles away, with about 40% of all bighorns on a foray expected to reach this distance from their CHHR.

Based on the information presented above, a rank of **High Risk** for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment was assigned to the Cave Basin Allotment under Alternative 2.A rank of **Low Risk** was assigned under Alternatives 3 and 4. The reasons for assigning a rank of High Risk to

the Cave Basin Allotment under Alternative 2 and rank of Low Risk under Alternatives 3 and 4 are:

- There is high risk for physical contact between bighorn and domestic sheep under Alternative 2 because about 87% of the allotment directly overlaps the Vallecito Creek Herd S-28 bighorn CHHR under current allotment configuration. Because of extensive overlap between known bighorn use areas and much of the allotment it is assumed that under current allotment configuration multiple bighorn contacts with the allotment per year are likely and thus there is high risk for physical contact with potential for disease transmission and subsequent bighorn mortality event within the S-28 CHHR.
- There is low risk for physical contact under Alternative 3 and 4 because the allotment is proposed to be closed to domestic sheep grazing.
- There is high risk for physical contact with the Cimarrona Peak Herd S-16 because the total herd contact rate is high (0.435, equating to one contact per 2.3 years) and thus risk of contact with S-16 is predicted to be high (Table 12, above). There is moderate risk for physical contact with the West Needles Herd S-71 because the total herd contact rate is moderate (0.08, equating to one contact per 12.3 years) and thus risk of contact with S-71 is predicted to be moderate.
- There is high risk for physical contact with bighorns from S-16 and S-71 because there is only moderate separation from S-16 and S-71 in terms of distance (5.9 and 7.1 miles, respectively; Table 13, above) and there is good connectivity with S-16 in terms of bighorn source habitat for dispersal of bighorns from S-16 to the allotment.
- There is high risk for contact with the allotment because about 40% of foraying bighorns from S-16 and S-71 are predicted to reach the distance away from their CHHR (5.9 and 7.1 miles, respectively; Table 13, above) that is equal to the distance to the allotment. This indicates high risk for bighorns from S-16 and S-71 contacting the allotment.
- There is moderate overlap of suitable domestic sheep grazing range and bighorn summer source habitat (about 32%) in the allotment under current configuration (Alternative 2; Table 13, above). This indicates moderate likelihood that foraying bighorns reaching the allotment from S-16 and S-71 might find and contact domestic sheep on suitable grazing range.
- There is high potential for physical contact within the allotment because most of the northern two-thirds of the allotment is bighorn source habitat with large contiguous areas of interconnected habitat patches spanning long distances across alpine ridges and basins. Large portions of the eastern half of the allotment overlap with areas mapped by CPW as bighorn summer concentration area. This indicates a higher likelihood that contact would occur if domestic sheep and bighorn sheep were present in the allotment during the same season.
- Bighorn sheep are regularly observed in eastern and northern portions of the allotment during the summer grazing season, indicating a high likelihood for physical contact if domestic sheep are present during the same season.

Summary of Risk Rating for Cave Basin Allotment:

Risk Rating: Alternative 2 – High
Alternative 3 – (Allotment Proposed Closed)
Alternative 4 – (Allotment Proposed Closed)

Endlich Mesa Allotment (active sheep allotment):

Table 14. Risk of Contact Tool estimated total herd contact rates for the Endlich Mesa Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Endlich Mesa Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.052	0.494	0.120	0.666	1.5
Alternative 3	0.052	0.494	0.120	0.667	1.5
Alternative 4	0.052	0.494	0.121	0.667	1.5

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 15. Acreage statistics for the Endlich Mesa Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	2.1 mi – S-28 4.5 mi – S-71 12.8 mi – S-16	11,223	4,829 (43%)	6,056 (54%)	1,937 (40%)
Alternative 3	Same Distance	11,223	4,829 (43%)	6,057 (54%)	1,937 (40%)
Alternative 4	Same Distance	11,223	4,829 (43%)	6,057 (54%)	1,937 (40%)

The Endlich Mesa Allotment is located on the southwest side of the Weminuche Landscape. It is located between the Florida River and Vallecito Creek drainages. About three quarters of the allotment is located within the Weminuche Wilderness. There is no direct overlap with bighorn CHHR for any of the bighorn herds in the analysis area.

This allotment was included in the Virginia Gulch allotment during early years. It then became part of the Florida allotment, which no longer exists. In 1962, it was combined with Johnson Creek Allotment, but it is unclear what allotment boundaries or allotment combinations were being used in early years. It was not considered a separate allotment until 1974. In 1986, the boundary was changed to its present configuration and the permitted number of sheep was set at 850. Domestic sheep have been grazed in the area annually since at least 1928, and probably earlier.

The majority of the Endlich Mesa Allotment is in the Florida River watershed and consists primarily of McClure Canyon, Stump Canyon, and numerous unnamed drainages on the east side of the headwaters of the Florida River. Elevations on the allotment range between 9,200 and 13,000 feet. About half of the allotment is either too steep or produces too little forage to be suitable for domestic sheep grazing. Most of the suitable grazing range is located at higher

elevations near or above timberline, but older spruce-fir timber harvest areas in the lower third of the allotment also provide substantial amounts of transitory range. Most of the north half of the allotment is above timberline, with the south half of the allotment primarily within the spruce-fir forest zone. The domestic sheep band typically uses the allotment in a two year rotation pattern: clock-wise rotation in year one and counter clock-wise rotation in year two. Herder camps are used every year but bed grounds are used only every other year to allow for recovery. The permittee moves camps about every 7 days.

The domestic sheep permittees report they have not seen bighorn sheep in the allotment during the decades the family has maintained the permit.

A report of two young ram bighorn sheep about 2.5 years of age seen within ¼ mile of domestic sheep was received by the USFS in 2015. The observation occurred in late summer of the 2012 or 2013 grazing season. The young rams were seen on one side of the Endlich Mesa trail with a "large flock of domestic sheep" seen simultaneously on the other side of the trail. There was an estimated "¼ mile or less separation" between them. The reporting party stated they did not observe physical contact between the species. The domestic sheep permittee did not report the incident to the Forest Service and therefore it is presumed the bighorns were not detected by the herder. CPW considers this report to be reliable. This is the only report received by the Forest Service of bighorn sheep within the Endlich Mesa Allotment during the summer grazing season.

This report confirms the presence of foraying bighorns within the allotment and in close proximity to domestic sheep during the summer grazing season. The 2.1 miles separation distance from the S-28 CHHR suggests it is more likely the young rams came from S-28 than from S-71 or S-16. A large radio telemetry data set from Idaho estimated that about 80% of rams and 35% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c).

Under current management (Alternative 2) the Endlich Mesa Allotment is an active domestic sheep allotment. Under Alternatives 3 and 4, the allotment would remain an active domestic sheep allotment.

Minor adjustments to the eastern boundary of the allotment have been made administratively to better reflect actual use areas, and better reflect topographic features of the area. Portions of the southeast section of the allotment were added to the Fall Creek Allotment and thus are proposed to be closed to domestic sheep grazing due to topography and lack of vegetation (mainly rock). Other portions of the eastern edge of the allotment have been expanded to include portions of the Fall Creek Allotment to better reflect actual use by the band and better reflect topographic features of the area. The northern boundary of the allotment was expanded to include portions of the Virginia Gulch Allotment near City Reservoir, providing a more functional allotment arrangement for the permittee.

Under Alternative 2 the Endlich Mesa Allotment has 11,223 acres within the allotment, of which approximately 4,829 acres (43%) are suitable domestic sheep grazing range (Table 15, above). There is a larger amount of bighorn summer source habitat in the allotment, 6,056 acres or 54% of the allotment. There is substantial overlap between suitable domestic sheep range and bighorn summer source habitat with 40% of suitable domestic sheep range (1,937 acres) also bighorn summer source habitat. Most of the northern third of the allotment is bighorn summer source habitat. The northern third of the allotment is dominated by large contiguous patches of bighorn source habitat. In the southern two-thirds of the allotment,

bighorn source habitat is primarily in a narrow strip along the eastern boundary of the allotment and in a few isolated patches within the interior of the allotment.

Total herd contact rates from the Risk of Contact Tool for the Endlich Mesa Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 14.

The estimated total herd contact rate with the Vallecito Creek Herd S-28 (2.1 miles away) is 0.494 under all allotment configurations. The next closest bighorn herd to the allotment, West Needles Herd S-71 (4.5 miles away), has an estimated total herd contact rate of 0.120. The Cimarrona Peak Herd S-16 (12.8 miles away) has a total herd contact rate of 0.052. These total herd contact rates equate to a predicted average of one contact with the allotment by a foraying bighorn (ram or ewe) from the Vallecito Creek Herd S-28 every 2.0 years. For the West Needles Herd S-71 and the Cimarrona Peak Herd S-16, the contact rates equate to one contact with the allotment every 8.3 years and every 19.2 years, respectively.

The allotment boundary adjustments already implemented administratively increase the total herd contact rates for all three bighorn herds. This is because the boundary adjustments expanded the allotment primarily along the eastern and northern ends which also have high amounts of bighorn source habitat. These increases were due to better connectivity across often contiguous blocks of bighorn source habitat, and slight reductions in the distance from the new allotment boundary to the CHHR's for S-28 and S-16. The slight increase in total herd contact rate with S-71 was due primarily to including more bighorn source habitat in the northern portion of the allotment, which also has better bighorn habitat connectivity to the CHHR.

When comparing total herd contact rates for the Endlich Mesa Allotment for all bighorn herds combined, for all Alternatives there is predicted to be one contact with the allotment by a foraying bighorn (ram or ewe) from one of the three herds every 1.5 years (Table 14, above).

The closest distance from the Endlich Mesa Allotment to the Vallecito Creek Herd S-28 CHHR under all allotment configurations is 2.1 miles away at its closest point (Table 15, above). A large radio telemetry data set from Idaho estimated that about 80% of rams and 35% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The next nearest bighorn CHHR to the allotment is the West Needles Herd S-71 which is 4.5 miles away at its closest point. This equates to about 35% of rams and 15% of ewes on a foray are expected to reach this distance away from their CHHR. The nearest distance to S-16, the Cimarrona Peak Herd CHHR, is 12.8 miles away, with about 25% of all bighorns on a foray expected to reach this distance from their CHHR.

Based on the information presented above, a rank of **High Risk** was assigned to the Endlich Mesa Allotment for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment under all alternatives. The reasons for assigning a rank of High Risk to the Endlich Mesa Allotment under all alternatives are:

- There is high risk for physical contact between bighorn and domestic sheep under all alternatives because the allotment is in relatively close proximity to the S-28 CHHR (2.1 miles). For the reasons of close proximity to the S-28 CHHR and good connectivity of bighorn source habitat with the S-28 CHHR, it is concluded that there is high risk for physical contact with bighorns from the S-28 CHHR, with potential for disease transmission and a subsequent bighorn mortality event.

- A reliable report of bighorn sheep seen within ¼ mile of domestic sheep occurred in late summer of the 2012 or 2013 grazing season. This report confirms the presence of foraying bighorns within the allotment and in close proximity to domestic sheep during the summer grazing season.
- There is high risk for contact with the allotment under all alternatives because the total herd contact rate from the Risk of Contact Tool with the Vallecito Creek Herd S-28 is high (0.49), equating to one contact every 2.2 years) and thus risk of contact with S-16 is predicted to be high (Table 14, above). For the West Needles Herd S-71, the total herd contact rate is high (0.12, equating to one contact per 8.3 years) and thus risk of contact with S-71 is predicted to be high. For the Cimarrona Peak Herd S-16, the total herd contact rate is moderate (0.05, equating to one contact per 19.2 years) and thus risk of contact with S-16 is predicted to be moderate.
- There is high risk for contact with the allotment by bighorns from the Vallecito Creek Herd S-28 because of poor separation from the CHHR in terms of distance (2.1 miles). There is moderate separation from S-71 (4.5 miles) and good separation from S-16 (12.8 miles) in terms of distance (Table 15 above). However, there is strong connectivity with S-28 and S-16 in terms of summer source habitat for dispersal of bighorns from these two CHHR's to the allotment thereby increasing the potential for bighorns on a foray reaching the allotment.
- There is high risk for contact with the allotment because about 80% of rams on a foray and about 35% of ewes on a foray from S-28 are predicted to reach the distance away from their CHHR (2.1 miles; Table 15, above) that is equal to the distance to the allotment. This indicates a high risk for bighorns contacting the allotment. For S-71, about 35% of rams and 15% of ewes on a foray are expected to reach this distance from their CHHR (4.5 miles). This indicates a high risk for bighorns contacting the allotment. For S-16, the distance is 12.8 miles, indicating less than about 25% of all bighorns on a foray are expected to reach the allotment from their CHHR indicating a moderate risk for bighorns on a foray contacting the allotment.
- There is high risk for physical contact within the allotment because a relatively high amount (about 39%) of suitable domestic sheep grazing range overlaps with bighorn source habitat in the allotment (Table 15, above). This indicates higher likelihood that foraying bighorns reaching the allotment might find and contact domestic sheep on suitable range within the allotment.
- There is high risk for physical contact between bighorn and domestic sheep because most of the northern third of the allotment is bighorn summer source habitat dominated by large contiguous patches of bighorn source habitat. This indicates a high likelihood that contact would occur in northern portions of the allotment if domestic sheep and bighorn sheep were present in the allotment during the same season. In the southern two-thirds of the allotment, bighorn source habitat is primarily in a narrow strip along the eastern boundary of the allotment and in a few isolated patches within the interior of the allotment. This indicates a lower likelihood for contact occurring in southern portions of the allotment if domestic sheep and bighorn sheep were present in the allotment during the same season.
- The domestic sheep permittees report they have not seen bighorn sheep in the allotment during the decades the family has maintained the permit.
- A report of two young rams seen within ¼ mile of domestic sheep confirms the presence of foraying bighorns within the allotment and in close proximity to domestic sheep during the summer grazing season. CPW considers this report to be reliable.

- Design criteria applied under Alternatives 3 and 4 (EIS Tables 2-2 and 2-3), when fully and completely implemented, are expected to enhance the effectiveness of separation between the species and are intended to prevent physical contact..

Summary of Risk Rating for Endlich Mesa Allotment:

Risk Rating: Alternative 2 – High
Alternative 3 – High
Alternative 4 – High

Fall Creek Allotment (vacant sheep allotment):

Table 16. Risk of Contact Tool estimated total herd contact rates for the Fall Creek Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Fall Creek Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.079	0.772	0.079	0.930	1.1
Alternative 3	Allotment Proposed Closed				N/A
Alternative 4	Allotment Proposed Closed				N/A

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 17. Acreage statistics for the Fall Creek Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	0.1 mi – S-28 5.4 mi – S-71 10.6 mi – S-16	11,386	1,092 (10%)	7,001 (61%)	620 (57%)
Alternative 3	Allotment Proposed Closed				
Alternative 4	Allotment Proposed Closed				

The Fall Creek Allotment is located in the southwest portion of the Weminuche Landscape. It is located entirely on the west side of the Vallecito Creek drainage. The entire allotment is located within the Weminuche Wilderness. There is no direct overlap with bighorn CHHR for any of the bighorn herds in the analysis area. Although there is no direct overlap of the allotment with bighorn CHHR the allotment is immediately adjacent to the Vallecito Creek Herd S-28 CHHR and sheep trailed to the allotment would likely have to pass through the S-28 CHHR to reach the allotment.

Bighorn sheep have not been reported within the allotment during the summer grazing season and no reports have been received within recent decades of bighorn observations along the portion of the Vallecito Creek Trail leading to the allotment. Apparently suitable bighorn sheep habitat is well distributed across the allotment and forms extensive interconnected blocks, especially at higher elevations within the allotment. The area appears to have been historic bighorn sheep range. A 1954 Forest Service memo (USDA Forest Service 1954) listed "mountain sheep" records within the allotment on "Emerson" (30 animals), a short distance north of the allotment in "Sunlight" (60 animals), and further north in "Trinity" (9 animals).

Domestic sheep were grazed in the allotment annually from 1928 through 1968. The last year of domestic sheep grazing was 1968. The allotment was grazed temporarily by cattle from 1969 through the 1974 grazing season but no domestic livestock have been grazed in the allotment since 1974. There is no documentation of official requests by domestic sheep permittees to stock the allotment since 1974. A 1960 grazing analysis showed that 3,397 acres of the allotment were in fair condition, and 2,650 acres were in poor condition. No portion of the allotment's vegetation was considered to be in good or excellent condition classes.

The Fall Creek allotment includes most of the D Creek drainage, Weasel Skin Creek drainage, Fall Creek, Taylor Creek and Sheep Draw. Elevations on the allotment range between 8,500 and 13,000 feet. Most of the allotment is on steep slopes that form the west side of the Vallecito Creek drainage with long open avalanche chutes commonly bisecting the landscape from top to bottom of the slopes. Some portions of the extreme north end of the allotment are above timberline but most of the allotment is within the spruce-fir and mixed aspen-conifer forest zones.

Under current management (Alternative 2) the Fall Creek Allotment is a vacant domestic sheep allotment. Under Alternatives 3 and 4, the allotment is proposed to be closed to all domestic livestock grazing.

Minor adjustments have been made administratively to the western boundary of the allotment to better reflect actual use by the Endlich Mesa domestic sheep band, and better reflect topographic features of the area. Portions of the south-east section of the Endlich Mesa Allotment were added to the Fall Creek Allotment due to topography and few suitable acres. Other portions of the western edge of the allotment were added to the Endlich Mesa Allotment to better reflect actual use by the Endlich Mesa domestic sheep band, and better reflect topographic features of the area. A portion from the southeast corner of the Johnson Creek Allotment was also added to the Fall Creek Allotment.

Under Alternative 2 the Fall Creek Allotment has 11,386 acres within the allotment, of which approximately 1,092acres (10%) are suitable domestic sheep grazing range (Table 17, above). Most suitable domestic sheep grazing range is located along the eastern edge of the allotment along the Vallecito Creek corridor, or in higher elevations along the western edge of the allotment. There is a much larger amount of bighorn source habitat in the allotment (7,001 acres or 61% of the allotment) than suitable domestic sheep grazing range (1,092 acres or 10% of the allotment). There is substantial overlap in the allotment between suitable domestic sheep range and bighorn summer source habitat, with 57% of suitable domestic sheep range (620 acres) also classified as bighorn summer source habitat. Much of the western and northern portions of the allotment are bighorn source habitat, especially near the heads of drainages and in the many avalanche chutes that bisect the allotment. There

are some large contiguous patches of bighorn source habitat along the western boundary of the allotment.

Total herd contact rates from the Risk of Contact Tool for the Fall Creek Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 16. The estimated total herd contact rate with the Vallecito Creek Herd S-28 is 0.772 under current allotment configuration (Alternative 2). The next closest bighorn herd to the allotment, West Needles Herd S-71, has an estimated total herd contact rate of 0.079. The Cimarrona Peak Herd S-16 also has a total herd contact rate of 0.079.

It should be noted that it is about double the distance from the allotment to the S-16 CHHR compared to the distance to the S-71 CHHR, yet the two herds have the same total herd contact rate (0.071). This is because there is a more consistent distribution of bighorn summer source habitat across the landscape to the S-16 CHHR compared to the distribution of bighorn source habitat between the allotment and the S-71 CHHR. This is also because the Risk of Contact Tool results are sensitive to bighorn population size and the population of S-16 (135 animals) is more than double that of S-71 (60 animals). Because S-16 has a larger population size than S-71 there are more bighorns, especially rams, predicted to undertake a foray from S-16 than from S-71 resulting in a higher probability of a contact originating from S-16 than from S-71.

These total herd contact rates equate to a predicted average of one contact with the allotment by a bighorn from the Vallecito Creek Herd S-28 every 1.3 years the allotment is grazed under the current allotment configuration (Alternative 2). For the West Needles Herd S-71 and the Cimarrona Peak Herd S-16, the contact rates equate to one contact with the allotment every 12.7 years. Table 16 does not display total herd contact rates for Alternatives 3 and 4 because the allotment is proposed to be closed to domestic sheep grazing under both alternatives.

The closest distance from the Fall Creek Allotment to the Vallecito Creek Herd S-28 CHHR, under current configuration (Alternative 2), is 0.1 miles away at its closest point (Table 17, above). A large radio telemetry data set from Idaho estimated that nearly all bighorn sheep on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The next nearest bighorn CHHR to the allotment is the West Needles Herd S-71, which is 5.4 miles away at its closest point under current allotment configuration. This equates to about 35% of rams and 15% of ewes on a foray are expected to reach this distance away from their CHHR. The nearest distance to S-16, the Cimarrona Peak Herd CHHR, is 10.6 miles away, with about 30% of all bighorns on a foray expected to reach this distance from their CHHR.

Based on the information presented above, a rank of **High Risk** was assigned to the Fall Creek Allotment under Alternative 2 for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment. However, a rank of **Low Risk** was assigned under Alternatives 3 and 4. The reasons for assigning a rank of High Risk to the Fall Creek Allotment under Alternative 2 and rank of Low Risk under Alternatives 3 and 4 are:

- There is high risk for physical contact between bighorn and domestic sheep under Alternative 2 because the allotment is immediately adjacent (0.1 mile) to the S-28 CHHR, and sheep trailed to the allotment would likely have to pass through the S-28 CHHR to reach the allotment. For the reasons of immediate proximity to the S-28

CHHR, and need for trailing through the S-28 CHHR to reach the allotment it is concluded the risk for physical contact between the species is high.

- The allotment is proposed to be closed to domestic sheep grazing under Alternatives 3 and 4 and thus there is low risk for physical contact between the species under Alternatives 3 and 4.
- There is high risk for physical contact under current condition (Alternative 2) because the total herd contact rate with the Vallecito Creek Herd S-28 from the Risk of Contact Tool is high (0.772), equating to one contact every 1.3 years. For the West Needles Herd S-71 and the Cimarrona Peak Herd S-16, the total herd contact rate is moderate (0.071), equating to one contact per 14.1 years and thus risk of contact with S-71 and S-16 is predicted to be moderate (Table 16, above).
- There is moderate separation from S-71 and S-16 in terms of distance (5.4 and 10.6 miles, respectively; Table 17 above). However, there is stronger connectivity with S-16 than with S-71 in terms of bighorn summer source habitat for dispersal of bighorns foraying from S-16 to the allotment.
- There is high risk for physical contact within the allotment because a relatively high amount (about 57%) of suitable domestic sheep grazing range overlaps with bighorn summer source habitat in the allotment (Table 17, above). This indicates a higher likelihood that foraying bighorns reaching the allotment might find and contact domestic sheep on suitable range. In addition, there is a much larger amount and wider distribution of bighorn summer source habitat in the allotment than suitable domestic sheep grazing range, indicating higher likelihood for bighorns reaching the allotment to make more extensive movements within the allotment and thus be more likely to contact domestic sheep on suitable range within the allotment.
- There is high risk for foraying bighorns to reach the allotment because about 35% of rams on a foray and about 15% of ewes on a foray from S-16 are predicted to reach the distance away from their CHHR (5.4 miles; Table 17, above) that is equal to the distance to the allotment. This indicates a high risk for foraying bighorns to reach and contact the allotment. For S-71, about 30% of all bighorns on a foray are expected to reach this distance from their CHHR (10.6 miles). This indicates a moderate risk for bighorns reaching and contacting the allotment.
- There is high risk for physical contact within the allotment because most of the northern half and western third of the allotment is bighorn source habitat with large contiguous areas of interconnected habitat patches spanning the heads of most alpine basins and avalanche chutes. This high degree of habitat overlap within the allotment indicates a higher likelihood that physical contact could occur if domestic sheep and bighorn sheep were present in the allotment during the same season.
- No reports have been received by the Forest Service from the public or CPW of bighorn sheep observed in the allotment during the summer grazing season.

Summary of Risk Rating for Fall Creek Allotment:

Risk Rating: Alternative 2 – High
Alternative 3 – (Allotment Proposed Closed)
Alternative 4 – (Allotment Proposed Closed)

Flint Creek Allotment (vacant sheep allotment):

Table 18. Risk of Contact Tool estimated total herd contact rates for the Flint Creek Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Flint Creek Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.739	1.000	0.043	1.782	0.6
Alternative 3	Allotment Proposed Closed				N/A
Alternative 4	Allotment Proposed Closed				N/A

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 19. Acreage statistics for the Flint Creek Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	Overlap – S-28	16,358	3,647 (22%)	8,888 (54%)	1,408 (39%)
	3.1 mi – S-16 10.7 mi – S-71				
Alternative 3	Allotment Proposed Closed				
Alternative 4	Allotment Proposed Closed				

The Flint Creek Allotment is located roughly in the middle of the Weminuche Landscape. The entire allotment is located within the Weminuche Wilderness. Much of the allotment overlaps with CHHR for the Vallecito Creek Herd S-28. Under current configuration (Alternative 2) there is about 9,008 acres of overlap with the S-28 CHHR, about 55 percent of the allotment. Within this overlap area, about 1,334 acres (15%) is suitable domestic sheep grazing range. Also within this overlap area, about 4,911 acres (54%) is bighorn summer source habitat. Also within this area of overlap, CPW has mapped 3,812 acres as bighorn summer concentration area, of which about 413 acres are classified as suitable domestic sheep range. Also within this area of overlap, CPW has mapped 2,906 acres as bighorn production area, of which 201 acres are classified as suitable domestic sheep range. Under Alternatives 3 and 4, the entire area of overlap with the S-28 CHHR, including the bighorn summer concentration and production areas within it, would be closed to domestic sheep grazing.

Bighorn sheep are regularly observed in western, northern and southeastern portions of the allotment during summer, and large portions of the western half of the allotment overlap with areas mapped by CPW as bighorn summer concentration area. Bighorns have been documented in the area since at least the 1940s. There is consensus that within the past 20 years bighorn use areas have likely expanded slightly in the southeast portion of the allotment upstream along the west side of the Pine River to just north of Flint Creek. The allotment was last grazed by domestic sheep in 1972.

Inspections cited in the 1969 management plan state that overgrazing in the northeast part of the allotment was a problem leading to erosion and a 50 acre area being closed. Additional exclusions in 1969 were 169 acres around Flint Lake and recreation horse allotments along middle and lower Flint Creek. The reason given for the erosion was lack of herder knowledge and failure to graze according to the prescribed system. In addition to the closures, the high areas in the Basin-Hole and Blue Lake-Bench sections were scheduled for light use. Domestic sheep grazing in the allotment began in 1928. The allotment was originally the Flint Creek and Flint Lakes allotment. Sometime between 1938 and 1943 the allotments were combined to form the present Flint Creek allotment. The last year this allotment was grazed by domestic sheep was 1972. The last grazing permit was a nonuse permit issued to the Southern Ute Sheep Association in 1974. The Association waived all grazing permits back to the San Juan National Forest in 1975. There is no documentation of official requests by domestic sheep permittees to stock the allotment since 1975.

Under current management the Flint Creek Allotment is a vacant domestic sheep allotment. Under Alternatives 3 and 4 the allotment is proposed to be closed to all domestic livestock grazing.

The Flint Creek allotment includes most of the Flint Creek drainage south from the Continental Divide to the Pine River, including Emerald Lake and the east side of the Lake Creek drainage. Elevations on the allotment range between 9,200 and 13,000 feet. Much of the northern half of the allotment is above timberline with rocky basins and alpine lakes. Much of the southern half of the allotment is on steep slopes within the spruce-fir and mixed aspen-conifer forest zones. Much of the mature spruce-fir forest in this allotment has been recently (within the past 5 years) heavily affected by spruce bark beetle resulting in mortality of overstory spruce trees exceeding 75% to 95% in many stands.

Under Alternative 2 the Flint Creek Allotment has 16,359 acres within the allotment, of which approximately 3,647 acres (22%) are suitable domestic sheep grazing range (Table 19, above). There is a relatively large amount of bighorn source habitat in the allotment, 8,888 acres or 54% of the allotment (Table 19, above). There is substantial overlap in the allotment between suitable domestic sheep range and bighorn summer source habitat, with 39% of suitable domestic sheep range (1,408 acres) also bighorn summer source habitat. Most of the northern two-thirds of the allotment is bighorn source habitat with large contiguous areas of interconnected habitat patches spanning long distances across alpine ridges and basins. The western half of the allotment contains extensive areas of known bighorn sheep use and mapped concentration areas.

Total herd contact rates from the Risk of Contact Tool for the Flint Creek Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 18. Under Alternative 2, the allotment overlaps substantially (55% of the allotment) with the CHHR for the Vallecito Creek Herd S-28. By definition, contact with the allotment occurs whenever bighorns use the portion of their CHHR that overlaps with the allotment (USDA Forest Service. 2013c) and therefore a contact rate of 1.0 (contact occurring at least once every year) for S-28 under Alternative 2 is the appropriate value from the Risk of Contact Tool (Obrien pers. comm., McCarthy pers. comm.). Given the extensive overlap between known bighorn use areas and suitable domestic sheep grazing range in this allotment it is likely that multiple contacts per year should be expected with this allotment and thus a contact rate of 1.0 may underestimate the actual rate of contact with the allotment.

The next closest bighorn herd to the allotment, Cimarrona Peak S-16, has an estimated total herd contact rate of 0.739 under current allotment configuration (Alternative 2). The West Needles Herd S-71 has a total herd contact rate of 0.043. These total herd contact rates equate to a predicted average of one contact with the allotment by a bighorn from the Cimarrona Peak Herd S-16 every 1.4 years the allotment is grazed under the current allotment configuration (Alternative 2). For the West Needles Herd S-71, the contact rate equates to one contact with the allotment every 23.3 years. Table 18 does not display total herd contact rates for Alternatives 3 or 4 because the allotment is proposed to be closed to domestic sheep grazing under both alternatives.

As stated earlier, the Flint Creek Allotment directly overlaps a substantial portion of the Vallecito Creek Herd S-28 CHHR. The next nearest bighorn CHHR to the allotment is the Cimarrona Peak Herd S-16. The closest distance to the Cimarrona Peak Herd S-16 CHHR is 3.1 miles away at its closest point (Table 19, above). A large radio telemetry data set from Idaho estimated that about 65% of rams and about 35% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The nearest distance to S-71, the West Needles Herd CHHR, is 10.7 miles away, with about 30% of all bighorns on a foray expected to reach this distance from their CHHR.

Based on the information presented above, a rank of **High Risk** was assigned to the Flint Creek Allotment under Alternative 2 for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment. However, a rank of **Low Risk** was assigned under Alternatives 3 and 4. The reasons for assigning a rank of High Risk to the Flint Creek Allotment under Alternative 2 and rank of Low Risk under Alternatives 3 and 4 are:

- There is high risk for physical contact between bighorn and domestic sheep under Alternative 2 because about 55% of the allotment directly overlaps the Vallecito Creek Herd S-28 bighorn CHHR under current configuration (Alternative 2). Because of extensive overlap between known bighorn use areas and extensive portions of the allotment it is assumed that under current allotment configuration multiple bighorn contacts with the allotment per year are likely and thus there is high risk for physical contact with potential for disease transmission and subsequent bighorn mortality event within the S-28 CHHR.
- There is low risk for physical contact under Alternatives 3 and 4 because the allotment is proposed to be closed to domestic sheep grazing under Alternatives 3 and 4.
- There is high risk for contact with the allotment by bighorns from the Cimarrona Peak Herd S-16 under Alternative 2 because the total herd contact rate is high (0.738, equating to one contact per 1.4 years) and thus risk of contact with S-16 is predicted to be high (Table 18, above). There is moderate risk for physical contact with the West Needles Herd S-71 because the total herd contact rate is moderate (0.043, equating to one contact per 23.3 years) and thus risk of contact with S-71 is predicted to be moderate.
- There is high risk for contact with the allotment by bighorns from S-16 because of poor separation from the S-16 CHHR, and moderate separation from S-71 in terms of distance (3.1 and 10.7 miles, respectively; Table 19 above). In addition, there is strong connectivity with S-16 in terms of summer source habitat for dispersal of bighorns from S-16 to the allotment indicating a higher likelihood that bighorns on a foray could reach the allotment.

- There is moderate risk for physical contact between the species in the allotment because a moderate amount (about 39%) of suitable domestic sheep grazing range overlaps with bighorn source habitat in the allotment under current configuration (Alternative 2; Table 19, above). In addition, there is a much larger amount and wider distribution of bighorn summer source habitat in the allotment than suitable domestic sheep grazing range, indicating higher likelihood for bighorns reaching the allotment to make more extensive movements within the allotment and thus be more likely to contact domestic sheep on suitable range within the allotment. Taken together this data suggests a higher likelihood that foraying bighorns reaching the allotment could find and contact domestic sheep on suitable range if the two species were present on the allotment during the same season.
- There is high risk for contact with the allotment by bighorns from S-16 because about 65% of rams on a foray and about 35% of ewes on a foray from S-16 are predicted to reach the distance away from their CHHR (3.1 miles; Table 19, above) that is equal to the distance to the allotment. This indicates a high risk for bighorns contacting the allotment. For S-71, about 30% of all bighorns on a foray are expected to reach this distance from their CHHR (10.7 miles). This indicates a moderate risk for bighorns contacting the allotment.
- There is high risk for physical contact between bighorn and domestic sheep within the allotment because most of the northern two-thirds of the allotment is bighorn source habitat with large contiguous areas of interconnected habitat patches spanning long distances across ridges and alpine lake basins. Large portions of the western half of the allotment overlap with areas mapped by CPW as bighorn summer concentration area. This indicates a high likelihood that contact could occur if domestic sheep and bighorn sheep were present in the allotment during the same season.
- There is high risk for physical contact between bighorn and domestic sheep within the allotment because bighorn sheep are regularly observed in western, northern and southeastern portions of the allotment during the summer grazing season, indicating a high likelihood for contact if domestic sheep were present in the allotment during summer.

Summary of Risk Rating for Flint Creek Allotment:

Risk Rating: Alternative 2 – High
Alternative 3 – (Allotment Proposed Closed)
Alternative 4 – (Allotment Proposed Closed)

Johnson Creek Allotment (vacant sheep allotment):

Table 20. Risk of Contact Tool estimated total herd contact rates for the Johnson Creek Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Johnson Creek Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.130	0.686	0.113	0.930	1.1
Alternative 3	0.110	0.580	0.112	0.802	1.2
Alternative 4	Allotment Proposed Closed				N/A

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 21. Acreage statistics for the Johnson Creek Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	0.1 mi – S-28 3.4 mi – S-71 10.3 mi – S-16	9,461	1,067 (11%)	7,222 (76%)	544 (51%)
Alternative 3	0.4 mi – S-28 3.4 mi – S-71 10.3 mi – S-16	7,780	944 (12%)	6,175 (79%)	455 (48%)
Alternative 4	Allotment Proposed Closed				

The Johnson Creek Allotment is located in the north-central portion of the Weminuche Landscape. It is located entirely on the west side of the Vallecito Creek drainage. The entire allotment is located within the Weminuche Wilderness. There is no direct overlap with bighorn CHHR for any of the bighorn herds in the analysis area. Although there is no direct overlap of the allotment with bighorn CHHR under current configuration (Alternative 2), the allotment is immediately adjacent to the Vallecito Creek Herd S-28 CHHR.

Under current management (Alternative 2) the Johnson Creek Allotment is a vacant domestic sheep allotment. Under Alternative 3, it is proposed that approximately the southeastern quarter of the allotment (1,653 acres, 18% of the allotment) would be added to the Fall Creek Allotment and closed to all livestock grazing. The remaining three quarters of the allotment (7,775 acres, 82% of the allotment) are proposed to be combined with the Leviathan Allotment and about two thirds of the Rock Creek Allotment to form a single domestic sheep forage reserve allotment. This would allow domestic sheep grazing for a maximum of three out of any ten consecutive years. Under Alternative 4 the allotment would be closed to all livestock grazing.

Bighorn sheep have not been reported to the Forest Service in recent decades within the allotment during the summer grazing season and no reports of have been received by the Forest Service of bighorn observations along the portion of the Vallecito Creek Trail that is within or near the allotment, or along the Johnson Creek Trail. Apparently suitable bighorn sheep habitat is well distributed across the allotment and forms extensive interconnected blocks, especially at higher elevations within the allotment. The area appears to have been historic bighorn sheep range. A 1954 Forest Service memo (USDA Forest Service 1954) listed “mountain sheep” records just north of the allotment in “Sunlight” (60 animals) and in “Trinity” (9 animals), and just south of the allotment on “Emerson” (30 animals).

Bighorn sheep summer source habitat comprises a relatively large area within the allotment, about 7,222 acres or about 76% of the allotment under Alternative 2, and 6,175 acres or about 79% of the allotment under Alternative 3 (Table 21, above). Much of the western, northern and southern portions of the allotment are bighorn source habitat, especially near the heads of drainages and in the many avalanche chutes that bisect the allotment. There are some large contiguous patches of bighorn source habitat along the western boundary of the allotment.

Suitable domestic sheep grazing range comprises a much smaller area in the allotment, about 1,067 acres or about 11% of the allotment under Alternative 2, and 944 acres or about 12% of the allotment under Alternative 3. The allotment is proposed to be closed to livestock grazing under Alternative 4. There is substantial overlap in the allotment between suitable domestic sheep range and bighorn summer source habitat. About half of the suitable domestic sheep grazing range in the allotment is also classified as bighorn summer source habitat (Table 21, above). Most suitable domestic sheep grazing range is located along the eastern edge of the allotment along the Vallecito Creek corridor, in the lower half of the Johnson Creek drainage, and in higher elevation lake basins along the western edge of the allotment.

Domestic sheep data for the Johnson Creek allotment is absent until 1962, when it was grazed in conjunction with the Endlich Mesa and Virginia Gulch Allotments. Domestic sheep were almost certainly grazed in what is now the Johnson Creek Allotment beginning in the early 1900's. The last year of domestic sheep grazing was 1968. The permittee took non-use in 1969 and 1970. There is no documentation of official requests by domestic sheep permittees to stock the allotment since 1970.

A color-coded vegetation map from 1962 showed approximately 20-25% of the Johnson Creek Allotment was grassland in fair condition, and an additional 10% was conifer with forage in excellent condition. The remainder of the allotment was considered "rock".

The Johnson Creek allotment includes all of the drainages of Grizzly Gulch and Johnson Creek and a portion of Vallecito Creek. Elevations on the allotment range between 9,000 and over 14,000 feet on Windom Peak. Much of the allotment is on steep slopes that form the west side of the Vallecito Creek drainage and sides of the Johnson Creek drainage, with many long open avalanche chutes commonly bisecting the landscape from top to bottom of the slopes. Much of the allotment, especially on the west and north ends, is above timberline in the alpine zone, but lower slopes are mostly in spruce-fir and mixed aspen-conifer forests. Much of the mature spruce-fir forest in this allotment has been recently (within the past 5 years) heavily affected by spruce bark beetle resulting in mortality of overstory spruce trees exceeding 75% to 95% in many stands.

Total herd contact rates from the Risk of Contact Tool for the Johnson Creek Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 20. The estimated total herd contact rate with the Vallecito Creek Herd S-28 is 0.686 under current allotment configuration (Alternative 2). The next closest bighorn herd to the allotment, West Needles Herd S-71, has an estimated total herd contact rate of 0.113. The Cimarrona Peak Herd S-16 has a total herd contact rate of 0.130. These total herd contact rates equate to a predicted average of one contact with the allotment by a bighorn from the Vallecito Creek Herd S-28 every 1.5 years the allotment is grazed under the current allotment configuration (Alternative 2). For the West Needles Herd S-71 and the Cimarrona Peak Herd S-16, the contact rates equate to one contact with the allotment every

8.8 and 7.7 years, respectively. Under Alternative 3, boundary adjustments due to creating the forage reserve allotment would result in total herd contact rates for bighorns from S-28, S-71 and S-16 CHHR's of 0.58, 0.112 and 0.11, respectively. These total herd contact rates equate to one contact with the allotment every 1.7, 8.9 and 9.1 years, respectively. Table 20, above, does not display total herd contact rates for Alternative 4 because the allotment is proposed to be closed to domestic sheep grazing under Alternative 4.

When comparing total herd contact rates for the Johnson Creek Allotment for all bighorn herds combined, under Alternative 2 there is predicted to be one bighorn contact with the allotment every 1.1 years (Table 20, above). Under the allotment boundary configuration proposed for Alternative 3 to facilitate the forage reserve allotment there is predicted to be one bighorn contact with the allotment every 1.2 years. Therefore the boundary adjustment made under Alternative 3 results in a slight (about 15%) reduction in the predicted rate of contact with the allotment. However, under the boundary configuration proposed in Alternative 3 the potential for contact remains high.

The closest distance from the Johnson Creek Allotment to the Vallecito Creek Herd S-28 CHHR, under current configuration (Alternative 2), is 0.1 miles away at its closest point (Table 21, above). A large radio telemetry data set from Idaho estimated that nearly all bighorn sheep on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The next nearest bighorn CHHR to the allotment is the West Needles Herd S-71, which is 3.4 miles away at its closest point under current allotment configuration. This equates to about 60% of rams and 35% of ewes on a foray are expected to reach this distance away from their CHHR. The nearest distance to S-16, the Cimarrona Peak Herd CHHR, is 10.3 miles away. This equates to less than 20% of rams and 15% of ewes on a foray are expected to reach this distance away from their CHHR.

Due to adjustments made in the allotment boundary under Alternative 3 to facilitate the forage reserve allotment, the shortest distance from the allotment to the S-28 bighorn CHHR was increased slightly (increased by 0.3 miles to a distance of 0.4 miles) under Alternative 3 (see Table 21, above). Because of the slight increase in distance to S-28 CHHR there was also a slight decrease in the percentage of bighorns that would be expected to reach the allotment while on a foray.

Based on the information presented above, a rank of **High Risk** was assigned to the Johnson Creek Allotment under Alternatives 2 and 3 for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment. However, a rank of **Low Risk** was assigned under Alternative 4. The reasons for assigning a rank of High Risk to the Johnson Creek Allotment under Alternatives 2 and 3 and rank of Low Risk under Alternative 4 are:

- There is high risk for physical contact between bighorn and domestic sheep under Alternative 2 because the allotment is immediately adjacent to the CHHR for the Vallecito Creek Herd S-28. For the reason of immediate proximity to the S-28 CHHR under Alternative 2 and very close proximity under Alternative 3, it is concluded that under both allotment boundary configurations there is high risk for physical contact with bighorns from the S-28 CHHR.
- There is low risk for physical contact between bighorn and domestic sheep under Alternative 4 because the allotment is proposed to be closed to domestic sheep grazing under Alternative 4.

- There is high risk for contact with the allotment by bighorns from the Vallecito Creek Herd S-28 because the predicted contact rate is high (0.695), equating to one contact every 1.4 years) and thus risk of contact with S-16 is predicted to be high (Table 20, above). For the West Needles Herd S-71, the total herd contact rate is also high (0.113, equating to one contact per 8.85 years) and thus risk of contact with S-71 is also predicted to be high. For the Cimarrona Peak Herd S-16, the total herd contact rate is high (0.132, equating to one contact per 7.58 years) and thus risk of contact with S-16 is predicted to be high.
- Under Alternative 3, the total herd contact rate from the Risk of Contact Tool decreases slightly for the S-28 bighorn herd, compared to Alternative 2, but they remain essentially unchanged for the other two herds. Despite a slight decrease in total herd contact rate for S-28, the potential for contact between bighorns foraying from the S-28 CHHR and the allotment remains high due to very close proximity (0.4 miles).
- The boundary adjustment made under Alternative 3 to facilitate the forage reserve allotment results in a slight (about 15%) reduction in the predicted rate of contact with the allotment for all bighorn herds combined, compared to Alternative 2. However, under the boundary configuration proposed under Alternative 3 the potential for contact remains high.
- There is high risk for contact with the allotment by bighorns from S-28 and S-16 because of poor separation from CHHR's (0.4 and 3.4 miles respectively; Table 21 above). There is moderate separation from S-71 in terms of distance (10.3 miles). There is also strong connectivity with S-28 and S-16 in terms of summer source habitat for dispersal of bighorns from those CHHR's to the allotment indicating a higher likelihood that bighorns on a foray could reach the allotment.
- There is high risk for physical contact between the species in the allotment because a relatively high amount (about 52%) of suitable domestic sheep grazing range overlaps with bighorn summer source habitat in the allotment under current configuration (Alternative 2; Table 21, above). This high degree of habitat overlap within the allotment indicates a high likelihood that physical contact could occur if domestic sheep and bighorn sheep were present in the allotment during the same season.
- There is a much larger amount and wider distribution of bighorn summer source habitat (76% of the allotment) than suitable domestic sheep grazing range (11% of the allotment). This indicates a higher likelihood for bighorns reaching the allotment to make more extensive movements within the allotment and thus be more likely to find and contact domestic sheep on suitable range within the allotment.
- Under the boundary configuration proposed in Alternative 3 to facilitate the forage reserve allotment, the rate of overlap between domestic sheep range and bighorn summer source habitat is slightly reduced (from 51% to 48%). However, this remains a high rate of overlap and therefore the risk for physical contact between the species in the allotment remains high under Alternative 3.
- There is high risk for contact with the allotment by bighorns from S-28 because under current configuration (Alternative 2) nearly all bighorn sheep on a foray are predicted to reach the distance away from their CHHR that is equal to the distance from S-28 to the allotment (0.1 miles; Table 21, above). About 60% of rams on a foray and about 35% of ewes on a foray from S-71 are predicted to reach the distance away from their CHHR that is equal to the distance to the allotment (3.4 miles). This indicates a high risk for bighorns from S-71 contacting the allotment. For S-16, about 20% of rams and 15% of ewes on a foray are expected to reach this distance from their CHHR

(10.26 miles). This indicates a moderate risk for bighorns from S-16 contacting the allotment.

- There is high risk for physical contact between bighorn and domestic sheep within the allotment because much of the western, northern and southern portions of the allotment are bighorn summer source habitat, especially near the heads of drainages and in the many avalanche chutes that bisect the allotment. There are some large contiguous patches of bighorn source habitat along the western boundary of the allotment. This suggests a higher likelihood that foraying bighorns reaching the allotment could find and contact domestic sheep on suitable range if the two species were present on the allotment during the same season.
- The Forest Service has not received reports of bighorn sheep in the allotment during the summer grazing season and no reports have been received by the Forest Service of bighorn observations along the Vallecito Creek or Johnson Creek trails in or near the allotment.
- Design criteria applied under Alternative 3 (EIS Tables 2-2 and 2-3) to facilitate the forage reserve allotment, when fully and completely implemented, are expected to enhance the effectiveness of separation between the species and are intended to prevent physical contact.

Summary of Risk Rating for Johnson Creek Allotment:

Risk Rating: Alternative 2 – High
Alternative 3 – High
Alternative 4 – (Allotment Proposed Closed)

Leviathan Allotment (vacant sheep allotment):

Table 22. Risk of Contact Tool estimated total herd contact rates for the Leviathan Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Leviathan Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.117	0.489	0.113	0.719	1.4
Alternative 3	0.117	0.489	0.114	0.719	1.4
Alternative 4	Allotment Proposed Closed				N/A

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 23. Acreage statistics for the Leviathan Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	0.9 mi – S-28 3.7 mi – S-71 9.9 mi – S-16	6,530	824 (13%)	5,299 (81%)	241 (29%)
Alternative 3	Same Distance	6,530	824 (13%)	5,299 (81%)	241 (29%)
Alternative 4	Allotment Proposed Closed				

The Leviathan Allotment is located in the north-central portion of the Weminuche Landscape. It is located entirely on the west side of the Vallecito Creek drainage. The entire allotment is located within the Weminuche Wilderness. There is no direct overlap with bighorn CHHR for any of the bighorn herds in the analysis area. Although there is no direct overlap of the allotment with bighorn CHHR under current configuration (Alternative 2), the allotment is in very close proximity (0.9 miles) to the Vallecito Creek Herd S-28 CHHR.

Under current management (Alternative 2) the Leviathan Allotment is a vacant domestic sheep allotment. Under Alternative 3, it is proposed to be combined with portions of the Johnson Creek Allotment and about two thirds of the Rock Creek Allotment to form a single domestic sheep forage reserve allotment. This would allow domestic sheep grazing for a maximum of three out of any ten consecutive years. Under Alternative 4 the allotment would be closed to all livestock grazing. The boundary of the Leviathan Allotment would not change between any of the action alternatives.

Bighorn sheep have not been reported to the Forest Service within recent decades in the allotment during the summer grazing season and no bighorn observations reports have been received by the Forest Service along the portion of the Vallecito Creek Trail that is within or near the allotment. Apparently suitable bighorn sheep habitat is well distributed across the allotment and forms extensive interconnected blocks, especially at higher elevations within the allotment. The area appears to have been historic bighorn sheep range. A 1954 Forest Service memo (USDA Forest Service 1954) listed “mountain sheep” records within the allotment in “Sunlight” (60 animals), just northwest of the allotment on “Trinity” (9 animals), and a short distance south of the allotment on “Emerson” (30 animals).

Bighorn sheep summer source habitat comprises a relatively large area within the allotment, about 5,299 acres or about 81% of the allotment under Alternatives 2 and 3 (Table 23, above). Most of the allotment is bighorn summer source habitat with many large contiguous blocks of bighorn source habitat spanning large areas at higher elevations of the allotment.

Suitable domestic sheep grazing range comprises a much smaller area in the allotment, about 834 acres or about 13% of the allotment under Alternatives 2 and 3. The allotment is proposed to be closed to livestock grazing under Alternative 4. There is substantial overlap in the allotment between suitable domestic sheep range and bighorn summer source habitat (249 acres, or 29% of suitable domestic sheep grazing range within the allotment). Most suitable domestic sheep grazing range in the allotment is located along the eastern edge of

the allotment along the Vallecito Creek corridor, along the lower Sunlight Creek drainage, and a few small areas scattered in upper drainage basins.

In the early to mid-1900s, the Leviathan Allotment was grazed together with the Rock Creek Allotment. The two allotments were separated into their current boundaries in 1932. Domestic sheep were almost certainly grazed in what is now the Leviathan Allotment beginning in the early 1900's. The allotment was grazed annually through 1966, was vacant from 1967 through 1969, then grazed for the last time in 1970. There is no documentation of official requests by domestic sheep permittees to stock the allotment since 1970.

Transects done in 1960 indicated that the major part of the allotment was in poor condition due to heavy use. The same report stated the allotment was being used in excess of 200% capacity. A file letter dated in 1974 stated that reasons the allotment was not being used included the importance of recreation use in the area, the limited amount of usable range and its fragile condition, as well as the difficulty in accessing the area due to its long stock driveway.

The Leviathan Allotment includes all of the drainages of Leviathan and Sunlight Creeks from their headwaters to their confluence with Vallecito Creek, and a portion of Vallecito Creek. Elevations on the allotment range between 9,500 and 14,000 feet on Sunlight Peak. Much of the allotment is on steep slopes that form the west side of the Vallecito Creek drainage and sides of the Leviathan and Sunlight Creek drainages, with many long open avalanche chutes bisecting the landscape from top to bottom of the slopes. Much of the allotment, especially on the west and north ends, is above timberline in the alpine zone, but the lower slopes are mostly in spruce-fir forests. Much of the mature spruce-fir forest in this allotment has been recently (within the past 5 years) heavily affected by spruce bark beetle resulting in mortality of overstory spruce trees exceeding 75% to 95% in most stands.

Total herd contact rates from the Risk of Contact Tool for the Leviathan Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 22. The estimated total herd contact rate with the Vallecito Creek Herd S-28 is 0.489 under Alternatives 2 and 3. The next closest bighorn herd to the allotment, West Needles Herd S-71, has an estimated total herd contact rate of 0.113 under Alternative 2 and 0.114 under Alternative 3. The Cimarrona Peak Herd S-16 has a total herd contact rate of 0.117 under Alternatives 2 and 3. These total herd contact rates equate to a predicted average of one contact with the allotment by a bighorn from the Vallecito Creek Herd S-28 every 2.0 years the allotment is grazed. For the West Needles Herd S-71 and the Cimarrona Peak Herd S-16, the contact rates equate to one contact with the allotment every 8.8 and 8.5 years, respectively. Table 22, above, does not display total herd contact rates for Alternative 4 because the allotment is proposed to be closed to domestic sheep grazing under Alternative 4.

It should be noted that it is nearly triple the distance from the allotment to the S-16 CHHR compared to the distance to the S-71 CHHR (S-71 distance = 3.7 miles; S-16 = 9.9 miles). However, there is a slightly higher predicted total herd contact rate with S-16 than with S-71 (S-16 contact rate = 0.117; S-71 = 0.114). This is because there is a more consistent distribution of bighorn summer source habitat across the landscape to the S-16 CHHR compared to the distribution of bighorn source habitat between the allotment and the S-71 CHHR. This is also because the Risk of Contact Tool results are sensitive to bighorn population size and the population of S-16 (135 animals) is more than double that of S-71 (60 animals). Because S-16 has a larger population size than S-71 there are more bighorns,

especially rams, predicted to undertake a foray from S-16 than from S-71 resulting in a higher probability of a contact originating from S-16 than from S-71.

When comparing total herd contact rates for the Leviathan Allotment for all bighorn herds combined (0.719; Table 22, above), there is predicted to be one bighorn contact with the allotment every 1.4 years under Alternatives 2 and 3.

The closest distance from the Leviathan Allotment to the Vallecito Creek Herd S-28 CHHR, under current configuration (Alternative 2), is 0.9 miles away at its closest point (Table 23, above). A large radio telemetry data set from Idaho estimated that nearly all bighorn sheep on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The next nearest bighorn CHHR to the allotment is the West Needles Herd S-71, which is 3.7 miles away at its closest point under current allotment configuration. This equates to about 55% of rams and 20% of ewes on a foray are expected to reach this distance away from their CHHR. The nearest distance to S-16, the Cimarrona Peak Herd CHHR, is 9.9 miles away. This equates to less than 20% of rams and 15% of ewes on a foray are expected to reach this distance away from their CHHR. Because the allotment boundary would not change from Alternative 2 to Alternative 3, the minimum distance between the allotment and bighorn CHHR's also would not change between Alternatives 2 and 3.

Based on the information presented above, a rank of **High Risk** was assigned to the Leviathan Allotment under Alternatives 2 and 3 for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment. However a rank of **Low Risk** was assigned under Alternative 4. The reasons for assigning a rank of High Risk to the Leviathan Allotment under Alternatives 2 and 3 and rank of Low Risk under Alternative 4 are:

- There is high risk for physical contact between bighorn and domestic sheep under Alternatives 2 and 3 because the allotment is in very close proximity (0.9 miles) to the Vallecito Creek Herd S-28 CHHR. For the reason of very close proximity to the S-28 CHHR under Alternatives 2 and 3, it is concluded that there is high risk for physical contact, with potential for disease transmission and subsequent bighorn mortality event, with bighorns from the S-28 CHHR.
- There is low risk for physical contact between bighorn and domestic sheep under Alternative 4 because the allotment is proposed to be closed to domestic sheep grazing under Alternative 4.
- There is high risk for contact with the allotment under Alternatives 2 and 3 because the total herd contact rate from the Risk of Contact Tool with the Vallecito Creek Herd S-28 is high (0.489), equating to one contact every 2.0 years and thus risk of contact with S-28 is predicted to be high (Table 22, above). For the West Needles Herd S-71, the total herd contact rate is high (0.113, equating to one contact per 8.8 years) and thus risk of contact with S-71 is predicted to be high. For the Cimarrona Peak Herd S-16, the total herd contact rate is also high (0.117, equating to one contact per 8.5 years) and thus risk of contact with S-16 is predicted to be high.
- There is high risk for contact with the allotment by bighorns from one of the three primary bighorn herds because under Alternatives 2 and 3 the predicted rate of contact with the allotment for all bighorn herds combined is high (every 1.4 years).
- There is high risk for contact with the allotment by bighorns from S-28 and S-71 because of poor separation from S-28 and S-71 in terms of distance to the CHHR (0.9

and 3.7 miles, respectively; Table 23 above). There is moderate separation from the S16 CHHR (9.9 miles) and therefore moderate risk of contact with the allotment. There is strong connectivity with S-28 and S-16 CHHR's in terms of source habitat for dispersal of bighorns from S-28 and S-16 to the allotment indicating a higher likelihood that bighorns on a foray could reach the allotment.

- There is moderate risk for physical contact between the species within the allotment because a moderate amount (about 29%) of suitable domestic sheep grazing range overlaps with bighorn summer source habitat in the allotment under Alternatives 2 and 3; Table 23, above). This moderate degree of habitat overlap within the allotment indicates a higher likelihood that physical contact could occur if domestic sheep and bighorn sheep were present in the allotment during the same season.
- There is a much larger amount and wider distribution of bighorn summer source habitat (81% of the allotment) than suitable domestic sheep grazing range (13% of the allotment). This indicates a higher likelihood for bighorns reaching the allotment to make more extensive movements within the allotment and thus be more likely to find and contact domestic sheep on suitable range within the allotment.
- There is high risk for contact with the allotment by bighorns from S-28 because under Alternatives 2 and 3 nearly all bighorn sheep on a foray are predicted to reach the distance away from their CHHR that is equal to the distance from S-28 to the allotment (0.9 miles; Table 23, above). About 55% of rams on a foray and about 20% of ewes on a foray from S-71 are predicted to reach the distance away from their CHHR that is equal to the distance to the allotment (3.9 miles). This indicates a high risk for bighorns from S-71 contacting the allotment. For S-16, about 20% of rams and 15% of ewes on a foray are expected to reach this distance from their CHHR (9.9 miles). This indicates a moderate risk for bighorns from S-16 contacting the allotment.
- There is high risk for physical contact between bighorn and domestic sheep within the allotment because most of the allotment is bighorn summer source habitat, especially in the high elevation basins and in the many avalanche chutes that bisect the allotment. There are large contiguous blocks of bighorn source habitat spanning large areas at higher elevations of the allotment. Taken together this data suggests a higher likelihood that foraying bighorns reaching the allotment could find and contact domestic sheep on suitable range if the two species were present on the allotment during the same season.
- The Forest Service has not received reports of bighorn sheep in the allotment during the summer grazing season and no reports have been received by the Forest Service of bighorn observations along the Vallecito Creek Trail in or near the allotment.
- Design criteria applied under Alternative 3 (EIS Tables 2-2 and 2-3) to facilitate the forage reserve allotment, when fully and completely implemented, are expected to enhance the effectiveness of separation between the species and are intended to prevent physical contact.

Summary of Risk Rating for Leviathan Allotment:

Risk Rating: Alternative 2 – High
Alternative 3 – High
Alternative 4 – (Allotment Proposed Closed)

Pine River Allotment (vacant sheep allotment):

Table 24. Risk of Contact Tool estimated total herd contact rates for the Pine River Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Pine River Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	1.000	1.000	0.034	2.034	0.5
Alternative 3	Allotment Proposed Closed				N/A
Alternative 4	Allotment Proposed Closed				N/A

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 25. Acreage statistics for the Pine River Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	Overlap – S-28 Overlap – S-16 12.9 mi – S-71	38,843	14,512 (37%)	15,108 (39%)	4,340 (30%)
Alternative 3	Allotment Proposed Closed				
Alternative 4	Allotment Proposed Closed				

The Pine River Allotment is located on the east side of the Weminuche Landscape. It is located at the headwaters of the Pine River drainage. The entire allotment is located within the Weminuche Wilderness. This is one of the oldest domestic sheep allotments on the Columbine Ranger District, and is also the largest sheep allotment on the District.

Under current management (Alternative 2) the Pine River Allotment is a vacant domestic sheep allotment. Under Alternatives 3 and 4 the allotment is proposed to be closed to all livestock grazing. The boundary of the Pine River Allotment would not change under any of the action alternatives.

The Pine River Allotment includes most of the Pine River drainage, and all of Rincon La Osa, North Fork, Rincon La Vaca, Canon Paso, South Canyon, Pope Creek, Sierra Vandera, Blue Spruce Canyon, and Lost Canyon drainages. Elevations on the allotment range between 8,500 and 13,600 feet. Much of the higher elevations of the allotment, especially in northwest portions of the allotment are above timberline with wide alpine basins and hillsides. At slightly lower elevations, spruce-fir forests dominate steep hillsides, and aspen and mixed aspen-conifer forests dominate lower elevations. Within the past five to eight years, spruce beetle mortality has increased rapidly in the headwaters of the Pine River drainage with most

areas experiencing mortality of overstory mature spruce trees in excess of 80% to 95%. The spruce beetle outbreak is continuing to rapidly expand to the south and west across the Weminuche Landscape.

Domestic sheep grazing in what is now the Pine River Allotment probably began in the late 1800's. This allotment is made up of several old allotments that changed names and boundaries multiple times. In 1978 the La Osa, Snowslide-La Vaca, and Divide Paso allotments were combined to form the current Pine River allotment. This was done to enable a portion of the area to be rested every year, in order to accommodate increasing recreation demands. The 1978 memo states that if available forage were the only consideration, this allotment had the capacity to graze twice the number of sheep actually authorized. Heavy recreation use was the limiting factor.

The Divide-Paso Allotment made up the bulk of the combined Pine River allotment. It went from just north of Blue Spruce Canyon to just north of Canyon Paso. Historical use (since 1949) for the Divide-Paso area was by the Southern Ute Sheep Association (SUSA). The last record for this permittee in this area was in 1974, with the permit in nonuse. The SUSA was also the last permittee for the Snowslide – La Vaca area, with the last year of grazing in 1974. The earliest record for this portion of the allotment was for the SUSA in 1949.

The La Osa portion of the Allotment is one of the oldest sheep allotments on the Columbine Ranger District, and grazing use pre-dates the creation of the National Forest by several years. Beginning in the 1930's, seasons were shortened and numbers of sheep were gradually reduced, through 1951, when the use stabilized and remained the same until consolidation into the Pine River Allotment in 1978. The main reason indicated for these reductions was conflict with recreation use. The La Osa portion of the allotment was used annually at capacity from 1949 through to 1971, was vacant 1972 through 1973, vacant again from 1981 through 1983, and no grazing permit has been issued for the area since then. There is no documentation of official requests by domestic sheep permittees to stock the allotment since 1983.

The Pine River Allotment directly overlaps with bighorn CHHR for the Vallecito Creek Herd S-28 and the Cimarrona Peak Herd S-16. Under current configuration (Alternative 2) there is about 10,104 acres of overlap with the S-28 CHHR, about 26 percent of the allotment. This area of overlap is in southern portions of the allotment. Within this overlap area, about 1,489 acres (15%) is suitable domestic sheep grazing range. Also within this overlap area, about 3,107 acres (31%) is bighorn summer source habitat. Within this area of overlap CPW has mapped 742 acres as bighorn production area of which 147 acres are classified as suitable domestic sheep range. Bighorn sheep are known to use these mapped overlap portions of the allotment during spring, summer and fall, and for lambing. Bighorns have been documented in the area since at least the 1940s.

There is an additional 4,080 acres of overlap with the S-16 CHHR in the northeast portion of the allotment. The area of overlap is about 11% of the allotment. Bighorns are also known to use this area of overlap in the allotment. Within the area of overlap with S-16, about 1,744 acres (43%) is suitable domestic sheep grazing range. Under Alternatives 3 and 4, the entire area of overlap with the S-28 and S-16 CHHR's, including the bighorn summer concentration and production areas within S-28, would be closed to domestic sheep grazing.

The Pine River Allotment contains more bighorn summer source habitat than any other allotment in the Weminuche Landscape, about 15,108 acres or about 39% of the allotment

under Alternative 2 (Table 25, above). Much of the northern, central and southern portions of the allotment are bighorn source habitat, especially near the heads of drainages and along ridge crests such as the Continental Divide. There are large contiguous patches of bighorn source habitat throughout the allotment.

The Pine River Allotment also contains more suitable domestic sheep grazing range than any other allotment in the Weminuche Landscape, about 14,512 acres or about 37% of the allotment under Alternative 2. The allotment is proposed to be closed to domestic sheep grazing under Alternatives 3 and 4. There is substantial overlap in the allotment between suitable domestic sheep range and bighorn summer source habitat, with 30% of suitable domestic sheep range (4,340 acres) also classified as bighorn summer source habitat. Most suitable domestic sheep grazing range in the allotment is located in the northern half of the allotment in the alpine basins in the upper La Osa, La Vaca, Sierra Vandera, Snowslide, and North Fork drainages.

Total herd contact rates from the Risk of Contact Tool for the Pine River Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 24.

There is substantial overlap between the allotment and portions of the CHHR for the Vallecito Creek Herd S-28 (10,104 acres or about 26% of the allotment). For this reason a total herd contact rate of 1.0 (contact predicted to occur at least once every year) is assumed for this bighorn herd. By definition, contact with the allotment occurs whenever bighorns use the portion of their CHHR that overlaps with the allotment (USDA Forest Service. 2013c) and therefore a contact rate of 1.0 (contact occurring at least once every year) for S-28 under Alternative 2 is the appropriate value from the Risk of Contact Tool (Obrien pers. comm., McCarthy pers. comm.). Given the extensive overlap between known bighorn use areas in S-28 and suitable domestic sheep grazing range in this allotment it is likely that multiple contacts per year should be expected with this allotment and thus a contact rate of 1.0 may underestimate the actual rate of contact with the allotment.

There is also a smaller area of overlap in the northeast portion of the allotment with the CHHR for the Cimarrona Peak Herd S-16 (4,080 acres or 11% of the allotment). Therefore the total herd contact rate of for S-16 is also 1.0 (contact predicted to occur at least once every year). Also for S-16, the overlap between known bighorn use areas and suitable domestic sheep grazing range suggests it is likely that multiple contacts per year should be expected with this allotment and thus a contact rate of 1.0 may underestimate the actual rate of contact with the allotment.

The West Needles Herd S-71 has an estimated total herd contact rate of 0.034. For the West Needles Herd S-71, the total herd contact rate equates to one contact with the allotment every 29.4 years. Table 24, above, does not display total herd contact rates for Alternatives 3 and 4 because the allotment is proposed to be closed to domestic sheep grazing under Alternatives 3 and 4.

The total herd contact rate for the Pine River Allotment for all bighorn herds combined (2.034; Table 24, above) is predicted to be one bighorn contact with the allotment every 0.5 years.

As stated earlier, the Pine River Allotment directly overlaps portions of the Vallecito Creek Herd S-28 CHHR and portions of the Cimarrona Peak S-16 CHHR under current

configuration (Alternative 2). The CHHR for the West Needles Herd S-71 is 12.9 miles away (Table 25, above) at its closest point under current allotment configuration (Alternative 2). A large radio telemetry data set from Idaho estimated that about 10% of rams and 5% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c).

Based on the information presented above, a rank of **High Risk** was assigned to the Pine River Allotment under Alternative 2 for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment. However, a rank of **Low Risk** was assigned under Alternatives 3 and 4. The reasons for assigning a rank of High Risk to the Pine River Allotment under Alternative 2 and rank of Low Risk under Alternatives 3 and 4 are:

- There is high risk for physical contact between bighorn and domestic sheep under Alternative 2 because about 26% of the allotment directly overlaps the Vallecito Creek Herd S-28 bighorn CHHR and an additional 11% of the allotment directly overlaps the Cimarrona Peak Herd S-16 bighorn CHHR under current allotment configuration. Because of overlap between known bighorn use areas and extensive portions of the allotment it is assumed that under current allotment configuration multiple bighorn contacts with the allotment per year are likely and thus there is high risk for physical contact with potential for disease transmission and subsequent bighorn mortality event within the S-28 and S-16 CHHR's.
- There is low risk for physical contact under Alternatives 3 and 4 because the allotment is proposed to be closed to domestic sheep grazing.
- Under current configuration (Alternative 2), the allotment directly overlaps portions of the S-28 and S-16 CHHR's and therefore the risk of contact within the zones of overlap is high. For the West Needles Herd S-71, the total herd contact rate is low (0.035, equating to one contact per 28.6 years) and thus risk of contact with S-71 is predicted to be low.
- There is high risk for contact with the allotment by bighorns from one of the three primary bighorn herds because under Alternative 2, the total herd contact rate for the Pine River Allotment for all bighorn herds combined is predicted to be at least one bighorn contact with the allotment every 0.5 years (Table 24, above).
- There is moderate risk for contact with the allotment by bighorns from S-71 because of moderate separation from the S-71 CHHR in terms of distance (12.9 miles, Table 25 above). There is also poor connectivity with S-71 in terms of source habitat for dispersal of bighorns from S-71 to the allotment.
- There is moderate risk for physical contact between the species within the allotment because about 30% of suitable domestic sheep grazing range overlaps with bighorn summer source habitat in the allotment under Alternative 2 (Table 25, above). This moderate degree of habitat overlap within the allotment indicates a higher likelihood that physical contact could occur if domestic sheep and bighorn sheep were present in the allotment during the same season.
- There is a slightly larger amount and wider distribution of bighorn summer source habitat (39% of the allotment) than suitable domestic sheep grazing range (37% of the allotment). This indicates a higher likelihood for bighorns reaching the allotment to make more extensive movements within the allotment and thus be more likely to find and contact domestic sheep on suitable range within the allotment.
- There is low risk for contact with the allotment by bighorns from S-71 because under Alternative 2 about 10% of rams on a foray and about 5% of ewes on a foray from S-71

are predicted to reach the distance away from their CHHR that is equal to the distance to the allotment (12.9 miles). This indicates a low risk for bighorns contacting the allotment from S-71, in part due to poor connectivity of bighorn summer source habitat with the allotment.

- There is high risk for physical contact between bighorn and domestic sheep within the allotment because much of the northern, central and southern portions of the allotment is bighorn summer source habitat, especially near the heads of drainages and along ridge crests such as the Continental Divide. There are large contiguous blocks of bighorn summer source habitat throughout the allotment. This extensive distribution of bighorn source habitat suggests a higher likelihood that bighorns reaching the allotment could find and contact domestic sheep on suitable range if the two species were present on the allotment during the same season.
- There is high risk for physical contact between bighorn and domestic sheep within the allotment because bighorn sheep are known to regularly occur during the summer grazing season within the extensive portions of the allotment that overlap with the S-28 and S-16 CHHR's. Portions of these areas of overlap are also mapped by CPW as bighorn summer concentration areas and production areas. Therefore there is high risk for physical contact if domestic sheep and bighorn sheep were present in the allotment during the same season.

Summary of Risk Rating for Pine River Allotment:

Risk Rating: Alternative 2 – High
Alternative 3 – (Allotment Proposed Closed)
Alternative 4 – (Allotment Proposed Closed)

Rock Creek Allotment (vacant sheep allotment):

Table 26. Risk of Contact Tool estimated total herd contact rates for the Rock Creek Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Rock Creek Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.172	1.000	0.083	1.255	0.8
Alternative 3	0.133	0.359	0.071	0.563	1.8
Alternative 4	Allotment Proposed Closed				N/A

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 27. Acreage statistics for the Rock Creek Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

	Distance from Bighorn Core	Total	Suitable Domestic Sheep Grazing	Bighorn Summer Source Habitat Acres	Acres of Overlap Between Suitable Grazing Acres and Bighorn

Alternative	Herd Home Range (CHHR)	Allotment Acres	Acres (% of Allotment)	(% of Allotment)	Source Habitat (% Overlap)
Alternative 2	Overlap – S-28 4.7 mi – S-71 6.3 mi – S-16	10,880	3,188 (29%)	8,951 (82%)	2,053 (64%)
Alternative 3	1.1 mi – S-28 4.7 mi – S-71 8.3 mi – S-16	7,344	2,176 (30%)	6,336 (86%)	1,563 (72%)
Alternative 4	Allotment Proposed Closed				

The Rock Creek Allotment is located in the north-central portion of the Weminuche Landscape. It is located at the headwaters of the Vallecito Creek drainage. The entire allotment is located within the Weminuche Wilderness. Portions of the southern third of the allotment overlap with CHHR for the Vallecito Creek Herd S-28. Under current configuration (Alternative 2) there is about 829 acres of overlap with the S-28 CHHR, about 8 percent of the allotment. Within this overlap area, about 55 acres (7%) is suitable domestic sheep grazing range. Also within this overlap area, about 816 acres (98%) is bighorn summer source habitat. Bighorn sheep are known to use these portions of the allotment during summer. Although there is no overlap of the allotment with areas mapped by CPW as bighorn summer concentration area, this portion of the allotment is in close proximity (less than 0.25 miles) to mapped bighorn summer concentration areas. Under Alternative 3, the area of overlap with the S-28 CHHR would be closed to domestic sheep grazing. The entire allotment would be closed to domestic sheep grazing under Alternative 4.

The Rock Creek Allotment includes the head waters of Vallecito Creek and all of the drainages of Rock Creek to their confluence with Vallecito Creek. The northeastern boundary of the allotment is the crest of the Continental Divide. Elevations on the allotment range from 10,500 to 13,600 feet. For the most part the terrain in this allotment is steep and rocky. An assessment in 1969 indicated that heavily timbered areas existed and these areas were suitable for grazing. Grazing was being used to maintain these forage areas. Shallow unstable soils are a general rule over most of the allotment. Much of the allotment, especially on the north end, is above timberline in the alpine zone, but much of the lower slopes are in spruce-fir forests. Much of the mature spruce-fir forest in this allotment has been recently (within about the past 5 years) heavily affected by spruce bark beetle resulting in mortality of overstory spruce trees exceeding 75% to 95% in most stands.

Under current management (Alternative 2) the Rock Creek Allotment is a vacant domestic sheep allotment. Under Alternative 3, it is proposed that the northern two thirds of the allotment (7,344 acres, 67% of the allotment) be combined with the Leviathan Allotment and about two thirds of the Johnson Creek Allotment to form a single domestic sheep forage reserve allotment. This would allow domestic sheep grazing within the combined forage reserve allotment for a maximum of three out of any ten consecutive years. The remaining approximately southeastern third of the allotment (3,536 acres, 33% of the allotment) would be closed to livestock grazing. Under Alternative 4, the entire allotment would be closed to all livestock grazing.

Domestic sheep grazing in what is now the Rock Creek Allotment began in the early 1900's. Originally, this allotment included the current Leviathan allotment, but was separated from it in 1932. At that time a third allotment, known as Vallecito, was divided into east and west and shared by Rock Creek and Leviathan Allotments. In 1947 both sides of the Vallecito

allotment were incorporated into the Rock Creek Allotment. The combining of Rock Creek and Vallecito allotments, with reduced numbers of sheep, was in response to overuse due to herders' failure to move animals and follow the management plan. The areas mentioned in inspection reports as overused were still in a poor condition class in 1960. Overall however, most of the allotment (66%) was being used under capacity, with only specific areas being overused. The allotment was grazed annually through 1966, was vacant through 1969, and grazed for the final year in 1970. There is no documentation of official requests by domestic sheep permittees to stock the allotment since 1970.

Bighorn sheep have been documented in the area since at least the 1940s. A 1954 Forest Service memo (USDA Forest Service 1954) listed "mountain sheep" records just west of the allotment in "Trinity" (9 animals), a short distance south of the allotment in "Sunlight" (60 animals), and further south of the allotment on "Emerson" (30 animals).The 1969 range management plan for the Rock Creek Allotment states there were possibly bighorn sheep in this area. Reduced use in the Rocky Benches and Hunchback portions of the allotment was suggested to protect the area for bighorn sheep.

In more recent decades, bighorns have not been reported to the Forest Service during the summer grazing season within that portion of the allotment proposed to remain open under Alternative 3 as a forage reserve allotment. No reports have been received by the Forest Service of bighorn observations along the portion of the Vallecito Creek Trail that is within or near the allotment, including along the lower Rock Creek Trail.

Bighorn sheep summer source habitat comprises a relatively large area within the allotment, about 8,951 acres or about 82% of the allotment under Alternative 2 (Table 27, above). Most of the allotment is bighorn summer source habitat with many large contiguous blocks of bighorn source habitat spanning large areas at higher elevations of the allotment. Apparently suitable bighorn sheep habitat is well distributed across the allotment and forms extensive interconnected blocks, especially at higher elevations within the allotment. Under the allotment configuration proposed for Alternative 3, the total allotment size would be reduced to about 7,344 acres in size, of which about 6,336 acres is bighorn summer source habitat, or about 86% of the allotment. The allotment is proposed to be closed to livestock grazing under Alternative 4.

Suitable domestic sheep grazing range comprises a much smaller area in the allotment, about 3,188 acres or about 29% of the allotment under Alternative 2. Under the allotment configuration proposed for Alternative 3, the amount of suitable domestic sheep grazing range is slightly reduced to about 2,176 acres, or about 30% of the allotment.

There is substantial overlap in the allotment between suitable domestic sheep grazing range and bighorn summer source habitat (2,053 acres, or 54% of suitable domestic sheep grazing range within the allotment). Most suitable domestic sheep grazing range in the allotment is located along the Vallecito Creek corridor and the basins south and west of Vallecito Lake, along the Trinity Creek drainage from its headwaters, and the Rock Creek drainage.

Total herd contact rates from the Risk of Contact Tool for the Rock Creek Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 26.

Under Alternative 2, the allotment overlaps a portion of the CHHR for the Vallecito Herd S-28 (829 acres or about 8% of the allotment). For this reason a total herd contact rate of 1.0

(contact predicted to occur at least once every year) is assumed for this bighorn herd (Table 26, above). By definition, contact with the allotment occurs whenever bighorns use the portion of their CHHR that overlaps with the allotment (USDA Forest Service. 2013c) and therefore a contact rate of 1.0 (contact occurring at least once every year) for S-28 under Alternative 2 is the appropriate value from the Risk of Contact Tool (Obrien pers. comm., McCarthy pers. comm.). Given the extensive overlap between known bighorn use areas in S-28 and suitable domestic sheep grazing range in this allotment it is likely that multiple contacts per year should be expected with this allotment and thus a contact rate of 1.0 may underestimate the actual rate of contact with the allotment.

The next closest bighorn herd to the allotment, West Needles Herd S-71, has an estimated total herd contact rate of 0.083. The Cimarrona Peak Herd S-16 has a total herd contact rate of 0.172. These total herd contact rates equate to a predicted average of one contact with the allotment by a bighorn from the Vallecito Creek Herd S-28 every year the allotment is grazed under the current allotment configuration (Alternative 2). For the West Needles Herd S-71 and the Cimarrona Peak Herd S-16, the contact rates equate to one contact with the allotment every 12.1 and 5.78 years, respectively.

It should be noted that it is about double the distance from the allotment to the S-16 CHHR compared to the distance to the S-71 CHHR (under Alternative 3, S-71 distance = 4.7 miles; S-16 = 8.3 miles). However, the predicted total herd contact rate with S-16 is almost double that with S-71 (S-16 contact rate = 0.133; S-71 = 0.071). This is because there is a much more consistent distribution of bighorn summer source habitat across the landscape to the S-16 CHHR compared to the distribution of bighorn source habitat between the allotment and the S-71 CHHR. This is also because the Risk of Contact Tool results are sensitive to bighorn population size and the population of S-16 (135 animals) is more than double that of S-71 (60 animals). Because S-16 has a larger population size than S-71 there are more bighorns, especially rams, predicted to undertake a foray from S-16 than from S-71 resulting in a higher probability of a contact originating from S-16 than from S-71.

Under Alternative 3, boundary adjustments would result in total herd contact rates for bighorns from S-28, S-71 and S-16 CHHR's of 0.359, 0.071 and 0.133, respectively. These total herd contact rates equate to one contact with the allotment every 2.8, 14.1 and 7.5 years, respectively. Table 26, above, does not display total herd contact rates for Alternative 4 because the allotment is proposed to be closed to domestic sheep grazing under Alternative 4.

When comparing total herd contact rates for the Rock Creek Allotment for all bighorn herds combined, under Alternative 2 there is predicted to be one bighorn contact with the allotment every 0.8 years (1.255; Table 26, above). Under the allotment boundary configuration proposed for Alternative 3, there is predicted to be one bighorn contact with the allotment every 1.8 years. Therefore the boundary adjustment made under Alternative 3 results in a substantial (about 55%) reduction in the predicted rate of contact with the allotment. However, under the boundary configuration proposed in Alternative 3 the predicted allotment contact rate remains high (every 1.8 years).

Under all alternatives the Risk of Contact Tool predicted much higher total herd contact rates with the Cimarrona Peak Herd S-16 than with the West Needles Herd S-71, in spite of the fact that S-71 is much closer (about half the distance) to the allotment than S-16. The reason for the higher predicted total herd contact rate with S-16 is its greater population size than S-71, and greater bighorn source habitat connectivity between the allotment and the CHHR

for S-16, compared to that with S-71. Connectivity of bighorn source habitat with S-16 CHHR is fair, and that with S-71 CHHR is poor, despite its closer proximity.

As stated earlier, the Rock Creek Allotment directly overlaps a portion of the Vallecito Creek Herd S-28 CHHR under current configuration (Alternative 2). The next nearest bighorn CHHR to the allotment is the West Needles Herd S-71, which is 4.7 miles away at its closest point (Table 27, above). A large radio telemetry data set from Idaho estimated that about 55% of rams and 25% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The nearest distance to S-16, the Cimarrona Peak Herd CHHR, is 6.3 miles away. This equates to about 35% of rams and 15% of ewes on a foray are expected to reach this distance away from their CHHR. Under the allotment boundary adjustments proposed in Alternative 3, the distance to S-71 remains unchanged, but the distance to S-16 increases substantially to 8.3 miles. This equates to about 25% of rams and 15% of ewes on a foray are expected to reach this distance away from their CHHR.

Based on the information presented above, a rank of **High Risk** was assigned to the Rock Creek Allotment under Alternatives 2 and 3 for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment. However, a rank of **Low Risk** was assigned under Alternative 4. The reasons for assigning a rank of High Risk to the Rock Creek Allotment under Alternatives 2 and 3 and rank of Low Risk under Alternative 4 are:

- There is high risk for physical contact between bighorn and domestic sheep under Alternative 2 because about 8% of the allotment directly overlaps the Vallecito Creek Herd S-28 bighorn CHHR under current configuration (Alternative 2). For this reason, it is assumed that under current allotment configuration multiple bighorn contacts with the allotment per year are possible, and thus there is high risk for physical contact with potential for disease transmission and subsequent bighorn mortality event within the S-28 CHHR.
- There is high risk for physical contact between bighorn and domestic sheep under Alternative 3 because although the portion of the allotment with direct overlap with S-28 CHHR would be closed to all livestock grazing the allotment remains in close proximity (1.1 miles) to the S-28 CHHR and closely connected by bighorn source habitat. For the reason of close proximity and good bighorn habitat connections to the S-28 CHHR under Alternative 3, it is concluded that there is high risk for physical contact with bighorns from the S-28 CHHR, with potential for disease transmission and subsequent bighorn mortality event under Alternative 3.
- There is low risk for physical contact under Alternative 4 because the allotment is proposed to be closed to domestic sheep grazing.
- There is high risk for contact with the allotment under Alternative 2 because the allotment directly overlaps a portion of the Vallecito Creek Herd S-28 CHHR and therefore the risk for physical contact within the zone of overlap is high. For the West Needles Herd S-71, the total herd contact rate is moderate (0.083, equating to one contact per 12.0 years) and thus risk of contact with S-71 is predicted to be moderate (Table 26, above). For the Cimarrona Peak Herd S-16, the total herd contact rate is high (0.173, equating to one contact per 5.8 years) and thus risk of contact with S-16 is predicted to be high.
- There is high risk for contact with the allotment under Alternative 3. Under Alternative 3, the total herd contact rates from the Risk of Contact Tool decrease for all three

bighorn herds, compared to Alternative 2, especially for the S-28 bighorn herd. Despite decrease in total herd contact rates, the potential for contact between bighorns from the S-28 CHHR and the allotment remains high due to very close proximity with their CHHR (1.1 miles) and summer concentration areas. The risk remains moderate for S-71 and remains high for S-16 due to habitat connectivity under Alternative 3.

- There is high risk for contact with the allotment by bighorns from one of the three primary bighorn herds because under Alternative 3 the predicted rate of contact with the allotment for all bighorn herds combined is high (every 1.8 years).
- There is high risk for contact with the allotment by bighorns from S-28, S-71 and S-16 because of poor separation in terms of distance (4.7 and 6.3 to 8.3 miles, respectively; Table 27 above). There is strong connectivity with S-16 in terms of source habitat for dispersal of bighorns from S-16 to the allotment indicating a higher likelihood that bighorns on a foray could reach the allotment.
- There is high risk for physical contact between the species in the allotment because a relatively high amount (64% to 72%) of suitable domestic sheep grazing range overlaps with bighorn summer source habitat in the allotment under Alternatives 2 and 3 (Table 27, above). This high degree of habitat overlap within the allotment indicates a higher likelihood that physical contact could occur if domestic sheep and bighorn sheep were present in the allotment during the same season.
- There is a much larger amount and wider distribution of bighorn summer source habitat (82% of the allotment) than suitable domestic sheep range (29% of the allotment). This indicates higher likelihood for bighorns reaching the allotment to make more extensive movements within the allotment and thus be more likely to find and contact domestic sheep on suitable range within the allotment.
- There is high risk for contact with the allotment by bighorns from S-28 because under Alternative 3 nearly all bighorn sheep on a foray are predicted to reach the distance away from their CHHR that is equal to the distance from S-28 to the allotment (1.1 miles; Table 27, above). About 55% of rams on a foray and about 25% of ewes on a foray from S-71 are predicted to reach the distance away from their CHHR that is equal to the distance to the allotment (4.7miles). This indicates a high risk for bighorns from S-71 contacting the allotment. For S-16, about 25% of rams and 15% of ewes on a foray are expected to reach this distance from their CHHR (8.3 miles). This indicates a high risk for bighorns contacting the allotment, in part due to good connectivity of bighorn source habitat with the allotment.
- There is high risk for physical contact between bighorn and domestic sheep within the allotment because much of the northern, central and southern portions of the allotment are bighorn source habitat, especially near the heads of drainages and along ridge crests such as the Continental Divide. There are large contiguous blocks of bighorn source habitat throughout the allotment. This indicates a higher likelihood that foraying bighorns reaching the allotment could find and contact domestic sheep on suitable range if the two species were present in the allotment during the same season.
- Bighorn sheep have not been reported to the Forest Service during the summer grazing season within the portion of the allotment that would be used as a forage reserve. No reports have been received by the Forest Service of bighorn observations along the portion of the Vallecito Creek Trail that is within or near the allotment, including along the lower Rock Creek Trail.
- Design criteria applied under Alternative 3 (EIS Tables 2-2 and 2-3) to facilitate the forage reserve allotment, when fully and completely implemented, are expected to

enhance the effectiveness of separation between the species and are intended to prevent physical contact..

Summary of Risk Rating for Rock Creek Allotment:

Risk Rating: Alternative 2 – High
Alternative 3 – High
Alternative 4 – (Allotment Proposed Closed)

Spring Gulch Allotment (active sheep allotment):

Table 28. Risk of Contact Tool estimated total herd contact rates for the Spring Gulch Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Spring Gulch Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	Too Far	0.016	0.005	0.022	46.4
Alternative 3	Too Far	0.016	0.005	0.021	47.8
Alternative 4	Too Far	0.016	0.005	0.021	47.8

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 29. Acreage statistics for the Spring Gulch Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	7.7 mi – S28 10.1 mi – S71 22.5 mi – S-16	3,077	2,086 (68%)	113 (4%)	89 (4%)
Alternative 3	Same Distance	3,077	2,086 (68%)	113 (4%)	89 (4%)
Alternative 4	Same Distance	3,077	2,086 (68%)	113 (4%)	89 (4%)

The Spring Gulch Allotment is located south of the Weminuche Landscape, south of Lemon Reservoir. There is no overlap between the Spring Gulch Allotment and bighorn CHHR for any bighorn sheep herd under any alternative. It is primarily a trailing allotment, providing a brief period of forage enroute to and returning from high country allotments. None of the allotment is located within the Weminuche Wilderness. Elevations on the allotment vary between 7,400 and 10,000 feet. The suitable sheep grazing range is on moderately steep slopes, while unsuitable areas are on steep slopes or have too little forage. The major vegetative communities are ponderosa pine with Gambel oak in the understory. As elevation

increases on the allotment, fir and aspen replace the pine and oak. In 2002 the Missionary Ridge fire burned the majority of the allotment.

The allotment was managed by BLM until 1983 when it was transferred to the Forest Service. The allotment was stocked with cattle through 1986, was vacant from 1987 through 1989, and vacant again from 1994 through 1996. In 1997 the permit was waived back to the Forest Service. In 2004 the allotment was converted to a sheep trailing allotment, using the allotment in addition to leased private lands within the allotment. After the 2005 grazing season, use of the allotment was limited to no more than 10 days in the spring and no more than 6 days in the fall. The short-duration of use was based in part on lack of water across most of the allotment. There is no fence separating NFS lands from private lands.

Compared to other allotments in the Weminuche Landscape, the Spring Gulch Allotment has a relatively high percentage of the allotment suitable for domestic sheep grazing (68% of the Allotment; 2,086 acres; see Table 29, above). There is very little bighorn source habitat in the allotment (113 acres, 4% of the allotment). Although there is a relatively large amount of suitable domestic sheep grazing range in the allotment (2,086 acres), there is a relatively low amount of overlap of that suitable range with bighorn source habitat (4% of suitable domestic sheep range is bighorn source habitat).

The domestic sheep permittees reported they have not seen bighorn sheep in the allotment. The Forest Service has not received any reports from the public or CPW of bighorn sheep observed in the allotment during the summer grazing season.

Estimated total herd contact rates from the Risk of Contact Tool for the Spring Gulch Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 28. The herd closest to the allotment, Vallecito Creek S-28 (7.7 miles, Table 29 above), has an estimated total herd contact rate of 0.016 under all Alternatives. This estimate equates to a predicted average of one contact with the allotment by a bighorn from S-28 every 62.5 years.

The next nearest bighorn herd, West Needles Herd S-71 (10.1 miles, Table 29 above), has a total herd contact rate from the Risk of Contact Tool of 0.005 under all alternatives. This estimate equates to a predicted average of one contact with the allotment by a bighorn from S-71 every 200 years the allotment is grazed. The Risk of Contact Tool did not provide total herd contact estimates for the Cimarrona Peak Herd S-16 because the CHHR is too far from the allotment (greater than 21 miles [O'Brien et al. 2014]).

When comparing total herd contact rates for the Spring Gulch Allotment for all bighorn herds combined, under Alternative 2 there is predicted to be one bighorn contact with the allotment every 46.4 years (Table 28, above).

The nearest bighorn CHHR to the Spring Gulch Allotment is the Vallecito Creek Herd S-28. The distance to the S-28 CHHR is 7.7 miles away at its closest point (Table 29, above). A large radio telemetry data set from Idaho estimated that about 25% of rams and 15% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The nearest distance to S-71, the West Needles Herd CHHR, is 10.1 miles away, with about 15% of rams and 15% of ewes on a foray expected to reach this distance from their CHHR. The nearest distance to S-16, the Cimarrona Peak Herd CHHR, is 22.5 miles away, with less than 1% of bighorns on a foray expected to reach this distance

from their CHHR (O'Brien et al. 2014). The distances from the allotment to all three bighorn CHHR's did not change between Alternative 2 and Alternatives 3 and 4.

Based on the information presented above, a rank of **Low Risk** was assigned to the Spring Gulch Allotment for all alternatives for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment. The reasons for assigning a rank of Low Risk for all alternatives to the Spring Gulch Allotment are:

- There is low risk for physical contact between bighorn and domestic sheep under any alternative because there is no direct overlap of the allotment with bighorn CHHR under any alternative.
- There is low risk for contact with the allotment because total herd contact rates from the Risk of Contact Tool are low (less than 0.02; Table 28, above) for all bighorn herds and action alternatives.
- There is low risk for physical contact between the species within the allotment because very little (4%) of the allotment is bighorn source habitat, and very little of the suitable domestic sheep grazing range (4%) overlaps with bighorn summer source habitat. This indicates low likelihood that foraying bighorns reaching the allotment could find and contact domestic sheep on suitable range if the two species were present in the allotment during the same season.
- There is high, moderate and low risk for contact with the allotment by bighorns from S-28, S-71 and S-16 respectively because of poor, fair and good separation in terms of distance (7.7 and 10.1 to 22.5 miles, respectively; Table 29 above). There is poor connectivity with any herd in terms of source habitat for dispersal of bighorns to the allotment, indicating low likelihood that bighorns on a foray could reach the allotment.
- There is high risk for contact with the allotment by bighorns from S-28 because about 25% of rams on a foray and about 15% of ewes on a foray from S-28 are predicted to reach the distance away from their CHHR (Table 29, above) that is equal to the distance to the nearest allotment (S-28, 7.68 miles). For S-71, about 15% of rams and 15% of ewes on a foray are predicted to reach the distance away from the CHHR to the allotment (10.12 miles). For S-16, less than 1% of rams and ewes on a foray are predicted to reach the distance away from the S-16 CHHR to the allotment (22.5 miles). This indicates low risk for bighorns from S-71 and S-16 contacting the allotment.
- There is low risk for physical contact between the species within the allotment because the allotment is dominated by lower elevation forested habitat types, and the few areas that are mapped as bighorn source habitats are generally small in size with poor connectivity to larger blocks of habitat or with bighorn CHHR's.
- Grazing permittees report they have not seen bighorn sheep in the allotment, and no reports have been received by the Forest Service from the public or CPW of bighorn sheep observed in or near the allotment during the summer grazing season.
- Design criteria applied under Alternatives 3 and 4 (EIS Tables 2-2 and 2-3), when fully and completely implemented, are expected to enhance the effectiveness of separation between the species and are intended to prevent physical contact..

Summary of Risk Rating for Spring Gulch Allotment:

Risk Rating: Alternative 2 – Low
Alternative 3 – Low
Alternative 4 – Low

Tank Creek Allotment (active sheep allotment):

Table 30. Risk of Contact Tool estimated total herd contact rates for the Tank Creek Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Tank Creek Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.008	0.112	1.000	1.119	0.9
Alternative 3	0.009	0.125	0.200	0.333	3.0
Alternative 4	0.009	0.125	0.200	0.333	3.0

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 31. Acreage statistics for the Tank Creek Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	Overlap – S-71 8.0 mi – S-28 18.0 mi – S-16	10,884	6,379 (59%)	4,113 (38%)	2,637 (41%)
Alternative 3	0.8 mi – S-71 10.9 mi – S-28 20.9 mi – S-16	8,356	6,221 (74%)	3,973 (48%)	2,872 (46%)
Alternative 4	Same Distance	8,356	6,221 (74%)	3,973 (48%)	2,872 (46%)

The Tank Creek Allotment is located along the northwestern edge of the Weminuche Landscape and directly overlaps the CHHR for the West Needles Herd S-71. This allotment was stocked with sheep for many years prior to the CPW releases of bighorn sheep into the Animas River canyon in 2000 and 2002-2003 that created the current West Needles Herd. CPW has not advocated closure of the allotment to domestic sheep grazing based solely on the presence of the introduced S-71 herd (Colorado Parks and Wildlife 2013a). A boundary adjustment proposed under Alternatives 3 and 4 and endorsed by the permittee would eliminate the entire zone of overlap between the allotment and the mapped S-71 CHHR. This zone of overlap was not used by the permittee due to unsuitable terrain and vegetation. Under Alternatives 3 and 4, the zone of overlap would be removed from the allotment and closed to all livestock grazing.

Domestic sheep grazing began in the Tank Creek Allotment in the early 1900's. Stocking rates were highest in the 1930's, gradually reduced in the 1940's, then stabilized in the 1950's and 1960's. In the mid-1970's, Tank Creek was combined into a single allotment with

the West Virginia and Virginia Gulch areas. The original allotment boundaries were restored in 1986 and have remained in that configuration through today. A range analysis in 1991 indicated the Tank Creek Allotment was being overgrazed in some areas, while other areas were not being impacted. In 1992 the number of permitted sheep was slightly reduced and set to the number permitted today.

The Tank Creek Allotment is in the Animas river watershed and consists primarily of the Tank Creek, Grasshopper Creek, Crazy Woman Gulch, and northern portions of the Canyon Creek drainages. Elevations on the allotment vary from 7,500 to 12,800 feet on the northern edge allotment. A little less than one quarter of the allotment along its northern boundary is within the Weminuche Wilderness. About 40% of the allotment is either too steep or produces too little forage to be suitable for sheep grazing. Most of the suitable domestic sheep grazing range is located at the higher elevations near or above timberline, and in old spruce-fir harvest areas.

Under current condition (Alternative 2) there is about 1,356 acres of overlap with the S-71 CHHR, about 13 percent of the allotment. All of the overlap area is on the east side of the Animas River. Within this overlap area, about 95 acres (7%) is suitable domestic sheep grazing range. Also within this overlap area, about 606 acres (45%) is bighorn summer source habitat. There is no mapped summer concentration area within the area of mapped overlap but is within about a half mile of the allotment on the west side of the Animas River. Under Alternatives 3 and 4, this area of overlap with the S-71 CHHR would be removed from the allotment and closed to all livestock grazing. This allotment boundary adjustment was endorsed by the domestic sheep grazing permittee.

The domestic sheep permittees reported they have not seen bighorn sheep in the allotment. The Forest Service has not received any reports from the public or CPW of bighorn sheep observed in the allotment during the summer grazing season.

The boundary adjustment proposed under Alternatives 3 and 4 that removes the zone of mapped overlap with the S-71 CHHR would have little effect on the amount or distribution of useable domestic sheep grazing range remaining in the allotment (see Table 31, above). Because the zone of mapped overlap was generally not used by the sheep permittees in previous years, closure of this zone of overlap was endorsed by the permittee and would only slightly reduce the acres of suitable domestic sheep grazing range in the allotment (158 acres, 2% of suitable acres).

Under current configuration (Alternative 2) the Tank Creek Allotment has 10,884 acres within the allotment, of which approximately 6,379 acres (59%) are suitable domestic sheep grazing range (Table 31, above). There are substantial amounts of bighorn source habitat in the allotment, 4,113 acres or 38% of the allotment.

There is substantial overlap in the allotment between suitable domestic sheep range and bighorn summer source habitat, with 41% of suitable domestic sheep range (2,637 acres) also bighorn summer source habitat under Alternative 2. Much of the bighorn source habitat is in medium to small patches, but these bighorn habitat patches are relatively evenly distributed across the allotment. Under Alternatives 3 and 4, about 46% of suitable domestic sheep grazing range is mapped as bighorn summer source habitat.

Estimated total herd contact rates from the Risk of Contact Tool for the Tank Creek Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 30.

Under Alternative 2, the allotment overlaps with the West Needles Herd S-71 CHHR. By definition, contact with the allotment occurs whenever bighorns use the portion of their CHHR that overlaps with the allotment (USDA Forest Service. 2013c) and therefore a contact rate of 1.0 (contact occurring at least once every year) for S-71 under Alternative 2 is the appropriate value from the Risk of Contact Tool (Obrien pers. comm., McCarthy pers. comm.). Given the boundary adjustment proposed under Alternatives 3 and 4, removing the zone of overlap with the S-71 CHHR results in a total herd contact rate with S-71 of 0.20 under Alternatives 3 and 4. This equates to an estimate of one contact with the allotment by a foraying bighorn (ram or ewe) from S-71 every 5.0 years under Alternatives 3 and 4. The nearest distance to the S-71 CHHR from the allotment under Alternatives 3 and 4 is 0.8 miles.

The boundary adjustment proposed under Alternatives 3 and 4 would have little effect on predicted contact rates for the S-28 and S-16 bighorn herds. Under Alternatives 3 and 4, the predicted total herd contact rate with the Vallecito Creek Herd S-28 (10.9 miles away) is 0.125 or one contact every 8.0 years. For the Cimarrona Peak Herd S-16 (20.9 miles away), the predicted contact rate is 0.009 or one contact every 111 years.

When comparing total herd contact rates for the Tank Creek Allotment for all bighorn herds combined, under Alternative 2 there is predicted to be one bighorn contact with the allotment every 0.9 years (Table 30, above). When comparing total herd contact rates for the Tank Creek Allotment for all bighorn herds combined, under Alternatives 3 and 4 there is predicted to be one contact with the allotment by a bighorn from one of the three herds every 3.0 years (Table 30, above).

Therefore for the reasons just described, the boundary adjustment made under Alternatives 3 and 4 results in a substantial (about 70%) reduction in the predicted rate of contact with the allotment. However, under the boundary configuration proposed in Alternatives 3 and 4 the potential for contact with the allotment remains high (every 1 to 3 years).

The nearest bighorn CHHR to the Tank Creek Allotment is the West Needles Herd S-71 with direct overlap of CHHR under the current allotment configuration (Alternative 2). The distance to the Vallecito Creek Herd S-28 CHHR is 8.0 miles away at its closest point (Table 31, above). A large radio telemetry data set from Idaho estimated that less than 20% of rams and about 10% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The nearest distance to S-16, the Cimarrona Peak Herd CHHR, is 18.0 miles away, with about 1% of bighorns on a foray expected to reach this distance from their CHHR.

Due to allotment boundary adjustments made under Alternatives 3 and 4, the distance from the allotment to all three bighorn herds was somewhat increased under Alternatives 3 and 4, compared to Alternative 2 (see Table 31, above). Because of the slight increase in distance to each of the three bighorn herd CHHR's under Alternatives 3 and 4, there was also a slight decrease in the percentage of bighorns that would be expected to reach the allotment while on a foray. For S-71, S-28 and S-16, the distance to each bighorn CHHR under Alternatives 3 and 4 was 0.8, 10.9 and 20.9 miles, respectively.

Based on the information presented above, a rank of **High Risk** for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment was assigned to the Tank Creek Allotment under Alternatives 2, 3 and 4. The reasons for assigning a rank of High Risk to the Tank Creek Allotment under Alternatives 2, 3 and 4 are:

- There is high risk for physical contact between bighorn and domestic sheep under Alternative 2 because about 13% of the allotment directly overlaps the West Needles Herd S-71 bighorn CHHR under current configuration (Alternative 2). For this reason, it is assumed that under current allotment configuration at least one and potentially multiple bighorn contacts per year with the allotment are possible, and thus there is high risk for physical contact with potential for disease transmission and subsequent bighorn mortality event within the S-71 CHHR.
- There is high risk for physical contact between bighorn and domestic sheep under Alternative 3 and 4 because although the portion of the allotment with direct overlap with S-71 CHHR would be closed to all livestock grazing the allotment remains in close proximity (0.8 miles) to the S-71 CHHR. It also remains moderately connected by bighorn source habitat. For the reason of close proximity and moderate bighorn habitat connections to the S-71 CHHR, it is concluded that under Alternatives 3 and 4 there remains high risk for physical contact, with potential for disease transmission and subsequent bighorn mortality event.
- There is high risk for contact with the allotment under Alternative 2 because the allotment directly overlaps a portion of the West Needles Herd S-71 CHHR and therefore the risk of contact within the zone of overlap is high (Table 30, above). For the Vallecito Creek Herd S-28, the total herd contact rate is high (0.112, equating to one contact per 8.9 years) and thus risk of contact with S-28 is predicted to be high. For the Cimarrona Peak Herd S-16, the total herd contact rate is low (0.008, equating to one contact per 125 years) and thus risk of contact with S-16 is predicted to be low.
- There is high risk for contact with the allotment under Alternatives 3 and 4. Under Alternatives 3 and 4, the total herd contacts rates from the Risk of Contact Tool decrease for all three bighorn herds, compared to Alternative 2, especially for the S-71 bighorn herd. Despite decreases in total herd contact rates, the potential for contact between bighorns from the S-71 CHHR and the allotment remains high due to very close proximity with the CHHR (0.8 miles) and summer concentration areas. The risk remains high for S-28 and low for S-16 under the allotment boundary configuration proposed for Alternatives 3 and 4.
- There is high risk for contact with the allotment by bighorns from one of the three primary bighorn herds under Alternatives 3 and 4 because although the boundary adjustments made under Alternatives 3 and 4 result in a substantial (about 70%) reduction in the predicted rate of contact with the allotment the potential for contact with the allotment remains high (every 3.0 years).
- There is moderate risk for contact with the allotment by bighorns from S-28 and low risk of contact with bighorns from S-16 because of moderate separation from S-28 and good separation S-16 in terms of distance (8.0 and 18.0 miles, respectively; Table 31 above). However, there is moderate connectivity with S-28 in terms of source habitat for dispersal of bighorns from S-28 to the allotment indicating a moderate likelihood that bighorns on a foray from S-28 could reach the allotment.
- A relatively high amount (64% to 72%) of suitable domestic sheep grazing range overlaps with bighorn summer source habitat in the allotment under Alternatives 2 and 3 (Table 27, above).

- There is high risk for physical contact between the species in the allotment because a relatively high amount (41% to 46%) of suitable domestic sheep grazing range overlaps with bighorn summer source habitat in the allotment (Table 31, above). This high degree of habitat overlap within the allotment indicates a higher likelihood that foraying bighorns reaching the allotment might find and contact domestic sheep on suitable range and that physical contact could occur if domestic sheep and bighorn sheep were present in the allotment during the same season.
- There is high risk for contact with the allotment by bighorns from S-71 because under Alternatives 3 and 4 nearly all bighorn sheep on a foray are predicted to reach the distance away from their CHHR that is equal to the distance from S-71 to the allotment (0.8 miles; Table 31, above). This indicates a high risk for bighorns from S-71 contacting the allotment under Alternatives 3 and 4. For S-28 under Alternatives 3 and 4, about 25% of rams and 15% of ewes on a foray are expected to reach this distance away from their CHHR (10.9 miles). This indicates a moderate risk for bighorns contacting the allotment from S-28 due in part to moderate habitat connectivity of bighorn source habitat with the allotment, and low risk for bighorns from S-16 (20.9 miles).
- There is moderate risk for physical contact between bighorn and domestic sheep within the allotment because much of the bighorn source habitat is in medium to small patches scattered across the allotment. However, bighorn habitat patches are relatively evenly distributed across the allotment. This indicates a moderate likelihood that foraying bighorns reaching the allotment could find and contact domestic sheep if the two species were present in the allotment during the same season.
- Grazing permittees report they have not seen bighorn sheep in the allotment, and no reports have been received by the Forest Service from the public or CPW of bighorn sheep observed in or near the allotment during the summer grazing season.
- Design criteria applied under Alternatives 3 and 4 (EIS Tables 2-2 and 2-3), when fully and completely implemented, are expected to enhance the effectiveness of separation between the species and are intended to prevent physical contact..

Summary of Risk Rating for Tank Creek Allotment:

Risk Rating: Alternative 2 – High
Alternative 3 – High
Alternative 4 – High

Virginia Gulch Allotment (active sheep allotment):

Table 32. Risk of Contact Tool estimated total herd contact rates for the Virginia Gulch Allotment for individual bighorn sheep herds under each action alternative (Alternatives 2, 3 and 4.

	Annual Herd Contact Rates via Foray				
Virginia Gulch Allotment	**S-16 Cimarrona Peak Herd**	**S-28 Vallecito Creek Herd**	**S-71 West Needles Herd**	**Total**	**1 Contact Per X Years**
Alternative 2	0.047	0.295	0.183	0.525	1.9
Alternative 3	0.047	0.296	0.182	0.526	1.9
Alternative 4	0.047	0.297	0.182	0.526	1.9

Active Sheep Allotment
CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
CHHR = Bighorn Core Herd Home Range

Table 33. Acreage statistics for the Virginia Gulch Allotment for domestic sheep grazing range, bighorn sheep summer source habitat, and acres of overlap between domestic sheep and bighorn sheep grazing acres under each action alternative (Alternatives 2, 3 and 4).

Alternative	Distance from Bighorn Core Herd Home Range (CHHR)	Total Allotment Acres	Suitable Domestic Sheep Grazing Acres (% of Allotment)	Bighorn Summer Source Habitat Acres (% of Allotment)	Acres of Overlap Between Suitable Grazing Acres and Bighorn Source Habitat (% Overlap)
Alternative 2	2.2 mi – S-71 3.7 mi – S-28 13.7 mi – S-16	12,571	7,171 (57%)	7,281 (58%)	3,994 (57%)
Alternative 3	1.5 mi – S-71 3.7 mi – S-28 13.7 mi – S-16	13,113	7,184 (55%)	7,750 (59%)	4,008 (56%)
Alternative 4	Same Distance	13,113	7,184 (55%)	7,750 (59%)	4,008 (56%)

The Virginia Gulch Allotment is located in the west central portion of the Weminuche Landscape. It is located between the Florida River and Lime Mesa. The entire allotment is located within the Weminuche Wilderness. There is no direct overlap with bighorn CHHR for any of the bighorn herds in analysis area.

The domestic sheep permittees report they have not seen bighorn sheep in the allotment during the decades the family has maintained the permit.

There is one recent report of bighorn sheep observed in the Virginia Gulch Allotment during the summer domestic sheep grazing season. In mid-July 2014, Colorado Parks and Wildlife received a report via a third party of "2 nice rams, one full curl scoring maybe 170", on the upper slopes of Mount Kennedy. The rams were reported to have been within about one-half mile of the domestic sheep band. The reporting party stated they did not observe physical contact between the species. The USFS received the report seven days after the observation occurred. CPW and USFS staff conducted two separate foot searches of the sighting area over the next week but failed to locate any evidence of bighorn sheep present in the area. The

domestic sheep permittee stated the bighorns were not detected by the herder. CPW considers this report to be reliable. This is the only report received by the Forest Service of bighorn sheep within the Virginia Gulch Allotment during the summer grazing season.

This report confirms the presence of foraying bighorns within the allotment and in close proximity to domestic sheep during the summer grazing season. The location nearly equidistant between the S-71 and S-28 CHHRs makes it difficult to suggest which herd the animals originated from. However, a large radio telemetry data set from Idaho estimated that about 80% of rams and 35% of ewes on a foray are expected to reach this distance (about 2.5 miles) away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c).

Grazing by domestic sheep took place on this allotment before designation of the National Forest (1908). This allotment was once at least four separate allotments. In 1974, the larger area was divided into present day Virginia Gulch, Tank Creek, and Endlich Mesa Allotments. Two of the three allotments were grazed with a band of 1,025 head each year, while the third was rested. This policy continued until 1986. The allotment boundaries and permitted number have remained the same since then. The sheep band typically uses the allotment in a two year rotation pattern: clock-wise rotation in year one and counter clock-wise rotation in year two. Herder camps are typically used every year and bedgrounds used every other year to allow for recovery. The herder moves camps about every 7 days.

The allotment is entirely within the Florida River watershed and includes Virginia, West Virginia and Missouri Gulches to their headwaters, and Trimble Pass. Elevations on the allotment vary from 9,400 feet to 13,300 feet. About a third of the allotment is either too steep or produces too little forage to be suitable for grazing. Most of the suitable grazing range is located above timberline.

Under current management (Alternative 2) the Virginia Gulch Allotment is an active domestic sheep allotment. Under Alternatives 3 and 4, the allotment would remain an active domestic sheep allotment.

Under current management, the allotment has 12,571 acres, of which approximately 7,171 acres (57%) are suitable domestic sheep grazing range (Table 33, above). There is a slightly larger amount of bighorn summer source habitat in the allotment: 7,281 acres or 58% of the allotment.

There is substantial overlap in the allotment between suitable domestic sheep grazing range and bighorn summer source habitat with 57% of suitable domestic sheep grazing range (3,994 acres) also bighorn summer source habitat under Alternative 2. Large blocks of bighorn summer source habitat occur in the northeast and northwest portions of the allotment. In the southern half of the allotment, bighorn summer source habitat is generally in smaller more widely scattered patches, but those patches are relatively evenly distributed across the allotment.

Under Alternatives 3 and 4 the allotment would be slightly expanded to a total of 12,679 acres in size (Table 33, above), due to minor adjustments to the northern and eastern boundaries of the allotment and additions from the Needles Mountains Allotment. These minor boundary adjustments have already been implemented administratively and are reflected under Alternatives 3 and 4. These adjustments better reflect actual use areas, and better reflect topographic features of the area. Portions of the northeast section of the allotment near City Reservoir were added to the Endlich Mesa Allotment to provide a more

functional allotment arrangement for the permittee. A small portion of the northwestern edge of the allotment was expanded to include portions of the Gem Lake area of the currently closed Needles Mountains Allotment to better reflect actual use by the domestic sheep band, and better reflect topographic features of the area.

Although the areas where the allotment was expanded also happen to be in areas of bighorn summer source habitat, the percentage of bighorn source habitat in the allotment remains nearly unchanged under Alternatives 3 and 4 (59% of the allotment). Also, the percentage of overlap between domestic sheep suitable grazing range and bighorn source habitat remains nearly unchanged (56% of suitable domestic sheep grazing range is also bighorn source habitat).

Total herd contact rates from the Risk of Contact Tool for the Virginia Gulch Allotment with each of the three herds in the Analysis area, under each of the three action alternatives, are shown above in Table 32.

The estimated total herd contact rate with the West Needles Herd S-71 (2.2 miles away; Table 33, above) is 0.183 (Table 32, above) under current allotment configuration (Alternative 2), and 0.182 under Alternatives 3 and 4. The next closest bighorn herd to the allotment, the Vallecito Creek Herd S-28 (3.7 miles away), has an estimated total herd contact rate of 0.295 under Alternative 2, increasing very slightly under Alternatives 3 and 4 to 0.297. The Cimarrona Peak Herd S-16 (13.7 miles away) has a total herd contact rate of 0.047 under all alternatives. These total herd contact rates equate to a predicted average of one contact with the allotment by a foraying bighorn (ram or ewe) from the West Needles Herd S-71 every 5.5 years. For the Vallecito Creek Herd S-28 and the Cimarrona Peak Herd S-16, the contact rates equate to one contact with the allotment every 3.4 years and every 21.3 years, respectively.

It should be noted that it is nearly double the distance from the allotment to the S-28 CHHR compared to the distance to the S-71 CHHR (under Alternative 2, S-71 distance = 2.2 miles; S-28 = 3.7 miles). However, under all alternatives the predicted total herd contact rate with S-28 is substantially higher than with S-71 (S-28 contact rate = 0.295; S-71 = 0.183). This is because there is a much more consistent distribution and better connectivity of bighorn summer source habitat across the landscape to the S-28 CHHR compared to the distribution of bighorn source habitat between the allotment and the S-71 CHHR. This is also because the Risk of Contact Tool results are sensitive to bighorn population size and the population of S-28 (90 animals) is substantially larger than that of S-71 (60 animals). Because S-28 has a larger population size than S-71 there are more bighorns, especially rams, predicted to undertake a foray from S-28 than from S-71 resulting in a higher probability of a contact originating from S-28 than from S-71.

It should also be noted that the minor allotment boundary adjustments that have already been implemented administratively resulted in a slight increase in the total herd contact rate with the West Needles Herd S-71, but resulted in a slight decrease in the contact rate with the Vallecito Creek Herd S-28. Contact rates with S-71 increased slightly because the allotment was expanded slightly to the north and west, slightly reducing the distance from the S-71 CHHR. Contact rates with S-28 declined slightly because portions of the allotment along the eastern side around City Reservoir were removed, removing areas with bighorn source habitat thereby reducing connectivity to S-28 via bighorn source habitat. The total herd contact rate for the Cimarrona Peak Herd S-16 remained unchanged by these minor boundary adjustments.

When comparing total herd contact rates for the Virginia Gulch Allotment for all bighorn herds combined, for all Alternatives there is predicted to be one contact with the allotment by a foraying bighorn (ram or ewe) from one of the three herds every 1.9 years (Table 32, above).

Under the allotment configuration in Alternatives 3 and 4, the contact rates for individual bighorn herds change very little from those for Alternative 2.

The closest distance from the Virginia Gulch Allotment to the West Needles Herd S-71CHHR, under current configuration (Alternative 2), is 2.2 miles away at its closest point (see Table 33, above). A large radio telemetry data set from Idaho estimated that about 80% of rams and about 35% of ewes on a foray are expected to reach this distance away from their CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). The next nearest bighorn CHHR to the allotment is the Vallecito Creek Herd S-28, which is 3.7 miles away at its closest point under current allotment configuration. This equates to about 80% of rams and 35% of ewes on a foray are expected to reach this distance away from their CHHR. The nearest distance to S-16, the Cimarrona Peak Herd CHHR, is 13.7 miles away, with less than 25% of all bighorns on a foray expected to reach this distance from their CHHR.

Due to minor allotment boundary adjustments already implemented administratively, the shortest distance from the allotment to S-71 was slightly reduced (by 0.7 miles) under Alternatives 3 and 4 compared to Alternative 2, but the distance to S-28 and S-16 remained the same under Alternatives 3 and 4 (see Table 33, above). Because of the slight reduction in distance to the S-71 CHHR under Alternatives 3 and 4 there was also a slight increase in the percentage of bighorns that would be expected to reach the allotment while on a foray.

Based on the information presented above, a rank of **High Risk** for the potential for physical contact between bighorn and domestic sheep when domestic sheep are present on the allotment was assigned to the Virginia Gulch Allotment under Alternatives 2, 3 and 4. The reasons for assigning a rank of High Risk to the Virginia Gulch Allotment under Alternatives 2, 3 and 4 are:

- There is high risk for physical contact between bighorn and domestic sheep under all alternatives because the allotment is in relatively close proximity to the S-71 CHHR (2.2 miles and 1.5 miles)and S-28 (3.7 miles). For the reasons of close proximity to the S-71 and S-28 CHHR and good connectivity of bighorn source habitat with the S-28 CHHR, it is concluded that under all allotment configurations there is high risk for physical contact with bighorns from the S-71 and S-28 CHHRs, with potential for disease transmission and a subsequent bighorn mortality event.
- There is high risk for contact with the allotment under Alternatives 3 and 4 because the proximity of the allotment with the S-71 CHHR is somewhat reduced (by 0.7 miles to 1.5 miles) compared to Alternative 2. Good connectivity of the allotment to the S-28 CHHR via bighorn source habitat would be slightly reduced under Alternatives 3 and 4, while moderate connectivity to the S-71 CHHR would be somewhat increased under Alternatives 3 and 4. These changes are due to boundary adjustments that reduce the distance to the S-71 CHHR and slightly reduce the amount of bighorn source habitat connectivity with the S-28 CHHR under Alternatives 3 and 4. For these reasons, the risk of contact with foraying bighorns from the S-71 and S-28 CHHR's remains high under Alternatives 3 and 4.
- There is high risk for contact with the allotment under all alternatives because the total herd contact rate from the Risk of Contact Tool with the Vallecito Creek Herd S-

28 is high (0.295), equating to one contact every 3.4years) and thus risk of contact with S-28 is predicted to be high (Table 32, above). For the West Needles Herd S-71, the total herd contact rate is high (0.183, equating to one contact per 5.5 years) and thus risk of contact with S-71 is predicted to be high. For the Cimarrona Peak Herd S-16, the total herd contact rate is moderate (0.047, equating to one contact per 21.3 years) and thus risk of contact with S-16 is predicted to be moderate.

- There is high risk for contact with the allotment by bighorns from the West Needles Herd S-71 because of poor separation from the CHHR in terms of distance (2.2 miles and 1.5 miles). There is poor separation from S-28 (3.7 miles) and good separation from S-16 (13.7 miles) in terms of distance (Table 33 above). However, there is good connectivity with S-28 and moderate connectivity with S-71 in terms of summer source habitat for dispersal of bighorns from these two CHHR's to the allotment thereby increasing the potential for bighorns on a foray reaching the allotment.
- There is high risk for contact with the allotment because about 80% of rams on a foray and about 35% of ewes on a foray from S-71 and S-28 are predicted to reach the distance away from their CHHR (1.5 miles and 3.7 miles respectively; Table 33, above) that is equal to the distance to the allotment. This indicates a high risk for bighorns from both CHHR's contacting the allotment. For S-16, the distance is 13.7 miles, indicating less than about 25% of all bighorns on a foray are expected to reach the allotment from their CHHR. This indicates a moderate risk for bighorns contacting the allotment.
- The risk for contact with the allotment remains high under Alternatives 3 and 4 because boundary adjustments reduce the distance between the allotment and the S-71 CHHR, compared to Alternative 2. Because of reduced separation distance between the allotment and the CHHR under Alternatives 3 and 4 there would be a slight increase in the percentage of bighorns from S-71 that would be expected to reach the allotment while on a foray.
- There is high risk for physical contact within the allotment because a relatively high amount (about 56%) of suitable domestic sheep grazing range overlaps with bighorn summer source habitat in the allotment under all allotment configurations (Table 33, above). This indicates higher likelihood that foraying bighorns reaching the allotment might find and contact domestic sheep on suitable range within the allotment.
- There is high risk for physical contact between bighorn and domestic sheep because substantial portions of northern and eastern parts of the allotment are bighorn summer source habitats with some large contiguous patches of bighorn source habitat. This indicates a high likelihood that contact could occur in northern portions of the allotment if domestic sheep and bighorn sheep were present in the allotment during the same season.
- The domestic sheep permittees report they have not seen bighorn sheep in the allotment during the decades the family has maintained the permit.
- A report of "two nice rams" seen within ½ mile of domestic sheep confirms the presence of foraying bighorns within the allotment and in close proximity to domestic sheep during the summer grazing season. CPW considers this report to be reliable.
- Design criteria applied under Alternatives 3 and 4 (EIS Tables 2-2 and 2-3), when fully and completely implemented, are expected to enhance the effectiveness of separation between the species and are intended to prevent physical contact..

Summary of Risk Rating for Virginia Gulch Allotment:

Risk Rating: Alternative 2 – High

Alternative 3 – High
Alternative 4 – High

DISCUSSION

ALTERNATIVE COMPARISON AND ALLOTMENT RISK RANKINGS:

Tables 34 and 35, below, compare the qualitative rankings of the risk of physical contact between bighorn and domestic sheep, and the relative rankings of the three action alternatives (Alternatives 2, 3 and 4) proposed in the EIS and the no action alternative based on multiple measures of quantitative and qualitative analysis factors for preventing physical contact between bighorn and domestic sheep.

As displayed in Table 35, below, the Ranking of Alternatives that prevents physical contact between domestic and bighorn sheep from livestock authorized to graze in the Weminuche Landscape is Alternative 1. Alternatives 4, 3 and 2, respectively and in the order of best to least, minimize the potential for physical contact between the species.

Table 34. Summary of Qualitative ratings of the risk of physical contact between domestic and bighorn sheep by allotment under Alternative 2 (current management), Alternative 3 (forage reserves), and Alternative 4 (Preferred Alternative) in the Weminuche Landscape grazing analysis area.

Allotment (Current Status)	Alternative 2 (Current) Allotment Rank of Risk of Physical Contact (Assumes Vacant Allotments would be Stocked)	Alternative 3 (Forage Res's) Allotment Rank of Risk of Physical Contact (Assumes Forage Reserve Allotments would be Stocked)	Alternative 4 (Preferred) Allotment Rank of Risk of Physical Contact (Assumes Vacant Allotment would be Stocked)
Burnt Timber (Active)	Moderate	Moderate	Moderate
Canyon Creek (Vacant)	High: 17%, S-71	Moderate	Moderate
Cave Basin (Vacant)	High: 87%, S-28	Proposed Closed	Proposed Closed
Endlich Mesa (Active)	High	High	High
Fall Creek (Vacant)	High	Proposed Closed	Proposed Closed
Flint Creek (Vacant)	High: 55%, S-28	Proposed Closed	Proposed Closed
Johnson Creek (Vacant)	High	High	Proposed Closed
Leviathan (Vacant)	High	High	Proposed Closed
Pine River (Vacant)	High: 37%, S-16 & S-28	Proposed Closed	Proposed Closed
Rock Creek (Vacant)	High: 8%, S-28	High	Proposed Closed
Spring Gulch (Active)	Low	Low	Low
Tank Creek (Active)	High: 13%, S-71	High	High
Virginia Gulch (Active)	High	High	High

Bighorn CHHR Intersects Allotment: % of Allotment, Bighorn CHHR
Allotment Proposed Closed
Active Sheep Allotment

Table 35. Relative ranking of alternatives based on multiple measures of separation between domestic sheep and bighorn sheep

Alternative	Active, Vacant or Forage Reserve Allotments Overlap With Bighorn CHHR* Acres (% of Landscape)	Suitable Domestic Sheep Grazing Range in Active, Vacant or Forage Reserve Allotments Acres (% of Grazing Range)	Bighorn Summer Source Habitat in Active, Vacant or Forage Reserve Allotments Acres (% of Habitat)	Bighorn Summer Source Habitat Overlap With Suitable Domestic Sheep Grazing Range Acres (% Habitat)	Average Distance from Allotments to Bighorn CHHR's*	Number of Allotments Ranked High Risk for Physical Contact	Average Years to Allotment Contact, from Risk of Contact Tool	Relative Ranking of Alternatives for Preventing Contact between Domestic Sheep and Bighorn Sheep
1	0	0	0	0	N/A	0	N/A	1
2	46,053 (28%)	57,984 (100%)	82,151 (100%)	20,666 (100%)	6.7 miles	11	3.0 Years	4
3	0	28,629 (49%)	37,591 (46%)	12,333 (60%)	7.4 miles	6	6.7 Years	3
4	0	24,700 (43%)	18,758 (23%)	10,082 (49%)	9.0 miles	3	9.4 Years	2

Rank Order: 1 = Greatest prevention of contact, 4 = Least prevention of contact.
CHHR: Bighorn Core Herd Home Range
*CHHR intersects with active or vacant Allotment(s)

COMPARISON OF ALTERNATIVES:

Alternative 1 (No Grazing):

Selecting Alternative 1, the no action alternative, would be wholly and entirely beneficial for bighorn sheep because domestic sheep grazing would not be re-authorized on NFS lands in the Weminuche Landscape. All 13 allotments in the analysis area (Table 34, above) would be closed to domestic livestock grazing. With no domestic sheep grazing there would be no risk for physical contact between bighorn and domestic sheep resulting from livestock grazing activities authorized by the Columbine Ranger District in the Weminuche Landscape, with no subsequent potential for disease transmission from authorized livestock, and no potential for a subsequent bighorn mortality event from contact with authorized livestock. Under Alternative 1 there would be no overlap between bighorn CHHR and active or vacant domestic sheep allotments. There would be no overlap between domestic sheep suitable grazing ranges and bighorn summer source habitats. There would be no potential for forage competition between bighorn and domestic sheep.

Alternative 1 is the only alternative that completely prevents physical contact between bighorn sheep and domestic sheep authorized by the Columbine Ranger District to graze on NFS lands in the Weminuche Landscape because this alternative does not authorize domestic sheep grazing in the Landscape. Alternatives 2, 3 and 4 all result in some potential for physical contact between the species because domestic sheep would continue to be permitted to graze some portions of NFS lands within the Landscape. The relative risk for physical contact between the species, and the area within the Weminuche Landscape where there is some potential for physical contact decreases substantially from Alternative 2 to Alternative 3, and again substantially decreases from Alternative 3 to Alternative 4, respectively.

Benefits to bighorn sheep from selecting Alternative 1 would be most pronounced for the Vallecito Creek Herd S-28, West Needles Herd S-71 and Cimarrona Peak Herd S-16 by removing areas of overlap with active and vacant domestic sheep grazing allotments, thereby eliminating the possibility of disease transmission between the two species from activities authorized by the Columbine Ranger District. Selecting Alternative 1 would also benefit bighorn sheep by removing the possibility of forage competition between bighorns and domestic sheep. The benefits of selecting Alternative 1 would be long term > 10 years) and cover extensive areas of bighorn sheep CHHR's (about 46,053 acres). Benefits would also come from gradual, long term improvements in the condition of moist alpine areas adjacent to riparian zones or wet meadows. However, these potential habitat improvements would be limited to those localized areas where current domestic sheep utilization levels are high and impacts to soil and vegetation are continuing to occur. Because these areas are generally small in scale and localized, benefits to bighorn sheep would likewise be generally small and localized.

Under Alternative 1, bighorn sheep would be expected to continue to occupy areas where they presently occur. Should bighorn populations continue to increase, they would be expected to gradually reoccupy historic ranges that are currently thought to be vacant, and fill gaps between CHHR's where habitat conditions are suitable. Factors that affect bighorn sheep are expected to continue working individually and cumulatively to limit population performance in the Weminuche Landscape. These factors include: predation (from mountain

lions, coyotes, black bears, bobcats, golden eagles, and red foxes), interspecies competition (competitive interaction between bighorns and other wild ungulates such as elk for forage), natural habitat disturbance factors (such as lightning-caused forest fires, avalanches and snow slides, insects and disease impacts to high elevation forests), potential stress caused by human disturbance, and impacts from extreme winter conditions that limit access to forage. Based on the current population status of the three primary bighorn herds in the Weminuche Landscape, and very few reports of incidences related to the factors just listed, it appears these factors are currently having minimal influence on population performance in the Weminuche Landscape (Weinmeister 2012, USDA Forest Service 2013a).

Alternative 2 (Current Management):

Selecting Alternative 2 (see Figures 5 and 8, at end of document) would be the least beneficial for bighorn sheep, compared to selecting Alternatives 1, 3 or 4, in that order.

Selecting Alternative 2 results in some potential for physical contact between the species because domestic sheep would continue to be permitted to graze some portions of NFS lands within the Landscape and most remaining NFS lands would be available for restocking. The relative risk for physical contact between the species, and the area within the Weminuche Landscape where there is some potential for physical contact decreases substantially from Alternative 2 to Alternative 3, and again substantially decreases from Alternative 3 to Alternative 4, respectively.

Selecting Alternative 2 would have both neutral and negative effects for bighorn sheep. Selecting Alternative 2 would have neutral effects for bighorn sheep because current domestic sheep management practices would maintain current habitat capability for bighorn sheep across much of the landscape. Alternative 2 would also have negative effects for bighorn sheep, compared to Alternative 1, because localized areas would continue to be affected by domestic sheep grazing activities, such as near the alpine/spruce-fir interface, moist alpine areas adjacent to riparian zones and wet meadows, and upland willow stands in alpine basins.

Selecting Alternative 2 is expected to result in gradual continued improvement in habitat conditions for bighorn sheep, but at a slower rate than would have occurred under Alternative 1. Habitat conditions for bighorn sheep are expected to continue to gradually improve under Alternative 2, assuming the historic trend of reduced numbers of domestic sheep permitted to graze in the Weminuche Landscape and on the San Juan NF as a whole over the past 40+ years continues (see Figure 4, below). Numbers of domestic sheep permitted to graze in the Weminuche Landscape have dropped about 62% from a high of between about 10,300 and 11,500 animals from the 1940's through the 1970's, down to about 4,400 currently. In addition, numbers of sheep permitted to graze on the San Juan NF have dropped about 95% from a high of about 216,600 animals in the 1930's to about 10,800 currently. As numbers of permitted domestic sheep on the San Juan NF and in the Weminuche Landscape have declined, habitat conditions for bighorn sheep have improved and the potential for contact and risk of subsequent disease transmission between the species has declined. Even if numbers of permitted domestic sheep remain relatively stable over the next few (5+) years, continued gradual improvement in vegetation conditions for bighorn sheep would be expected under Alternative 2. This is because at current domestic sheep stocking levels, the gradual improvement in alpine plant communities observed over the past 40+ years is expected to continue for the next few years.

Although the gradual improvement of resource conditions would be neutral to slightly beneficial for bighorn sheep, selecting Alternative 2 would have negative effects for bighorn sheep, compared to selecting Alternative 1. This is because the allotments where there is currently direct overlap between suitable domestic sheep grazing range and bighorn core herd home range would remain available for grazing by domestic sheep under Alternative 2, thereby maintaining high risk for phsical contact between domestic and bighorn sheep.

Under Alternative 2 (see Figures 5 and 8, at end of document, and Table 36, below), there would continue to be about 46,053 acres of direct overlap between bighorn sheep CHHR and allotments authorized for domestic sheep grazing in the Weminuche landscape. Six of the 13 allotments would continue to overlap with mapped bighorn CHHR (Canyon Creek, Cave Basin, Flint Creek, Pine River, Rock Creek and Tank Creek). Because of direct overlap with bighorn CHHR these six allotments were rated as having "High Risk" for physical contact between domestic sheep and bighorn sheep. Of these six allotments, one is active (Tank Creek) and five are vacant (Canyon Creek, Cave Basin, Flint Creek, Pine River and Rock Creek; Table 34, above). The five vacant allotments were also rated as "High Risk" for physical contact because under Alternative 2 they would be authorized for restocking. If the five currently vacant allotments were restocked the risk of physical contact between domestic bighorn sheep would remain high with potential for disease transmission and subsequent bighorn mortality events.

Under Alternative 2, areas of overlap between suitable domestic sheep grazing range and known bighorn sheep use areas, summer concentration areas and production areas would remain in the Landscape, with high risk for physical contact between the species in these areas. For the reasons stated in the previous two paragraphs, Alternative 2 does not appear to meet the desired condition for bighorn sheep. For these same reasons, Alternative 2 may not meet Forest Plan direction to prevent contact between bighorn and domestic sheep. Under Alternative 2 there would also continue to be potential forage competition between domestic sheep and bighorn sheep in areas of range overlap, maintaining undesirable existing vegetation conditions.

Under Alternative 2, five other allotments (Endlich Mesa, Fall Creek, Johnson Creek, Leviathan and Virginia Gulch) are in close proximity to bighorn CHHR's (generally less than about 2.2 miles). These five allotments were also given a rating of "High Risk" for physical contact between bighorn and domestic sheep due to expected high percentages of bighorns on a foray predicted to reach the allotment from the nearby CHHR (O'Brien et al. 2014, USDA Forest Service 2010c). Due to predicted high rates of reaching the allotment and good distribution of bighorn summer source habitats within the allotment there is also high risk for physical contact between the species within the allotment. These five allotments also had generally good connectivity across bighorn summer source habitats from the allotment to bighorn CHHR. One allotment (Burnt Timber) was rated "Moderate Risk" for physical contact due to substantial separation from bighorn CHHR's and fair to poor connectivity with CHHR's via bighorn source habitat within and near the allotment that might facilitate foraying bighorns reaching the allotment. One allotment (Spring Gulch) was rated "Low Risk" for physical contact due to substantial separation from bighorn CHHR's and poor connectivity with CHHR's via bighorn source habitat within and near the allotment that might facilitate foraying bighorns reaching the allotment.

Table 36. Measures of separation between domestic sheep and bighorn sheep used to assign rank of risk of physical contact for each allotment in the Weminuche Landscape for Alternative 2 (Current Condition).

Allotment	Direct Overlap with Bighorn Core Herd Home Range? % of Allotment	Nearest Distance to Bighorn Core Herd Home Range	Risk of Contact Tool Individual Herd Contact Rates	% Overlap Between Suitable Domestic Sheep Grazing Areas and Bighorn Summer Source Habitat	Connectivity of Bighorn Summer Source Habitat From Allotment to Bighorn Core Herd Home Range	Estimate of Likelihood of Physical Contact Within Allotment	Application of Best Management Practices	Alternative 2 Allotment Rank of Risk of Physical Contact (Assumes Vacant Allotments would be Stocked)
Burnt Timber	No	4.1 mi (S-71): High	About 0.08 or less: Moderate	20%: Low	Fair to Poor Connectivity: Moderate	Moderate	Yes	Moderate Risk
Canyon Creek	Yes: 17%	Overlaps S-71 CHHR: High	1.0 Within Overlap Zone: High	5%: Low	Poor Connectivity Outside Overlap Zone: Moderate	Moderate	Yes	High Risk
Cave Basin	Yes: 87%	Overlaps S-28 CHHR: High	1.0 Within Overlap Zone: High	32%: Moderate	Good Connectivity Outside Overlap Zone: High	High	Yes	High Risk
Endlich Mesa	No	2.1 mi (S-28): High	0.05 to 0.49: High	40%: Moderate	Good Connectivity: High	High	Yes	High Risk
Fall Creek	No	0.1 mi (High)	0.08 to 0.77: High	57%: High	Good Connectivity: High	High	Yes	High Risk
Flint Creek	Yes: 55%	Overlaps S-28 CHHR: High	1.0 Within Overlap Zone: High	39%: Moderate	Good Connectivity Outside Overlap Zone: High	High	Yes	High Risk
Johnson Creek	No	0.1 mi (S-28): High	0.11 to 0.69: High	51%: High	Good Connectivity: High	High	Yes	High Risk
Leviathan	No	0.9 mi (S-28): High	0.11 to 0.49: High	29%: Moderate	Good Connectivity: High	High	Yes	High Risk
Pine River	Yes: 37%	Overlaps S-28 & S-16 CHHR: High	1.0 Within Overlap Zones: High	30%: Moderate	Good Connectivity Outside Overlap Zone: High	High	Yes	High Risk
Rock Creek	Yes: 8%	Overlaps S-28 CHHR: High	1.0 Within Overlap Zone: High	64%: High	Good Connectivity Outside Overlap Zone: High	High	Yes	High Risk
Spring Gulch	No	7.7 mi (S-28): High	0.01 to 0.02: Low	4%: Low	Poor Connectivity: Low	Low	Yes	Low Risk
Tank Creek	Yes: 13%	Overlaps S-71 CHHR: High	1.0 Within Overlap Zone: High	41%: High	Poor Connectivity Outside Overlap Zone: Moderate	High	Yes	High Risk
Virginia Gulch	No	2.2 mi (S-71): High	0.05 to 0.30: High	57%: High	Good Connectivity: High	High	Yes	High Risk

CHHR Intersects Allotment

Allotment Proposed Closed

Active Sheep Allotment

Selecting Alternative 2 would be the least beneficial of the alternatives for bighorn sheep because under Alternative 2, there is a total of about 46,053 acres of overlap between six active and vacant domestic sheep grazing allotments and three bighorn CHHR's (S-71, S-28, and S-16) in the Weminuche Landscape (Tables 35 and 36, above). All of the areas of overlap with bighorn CHHR are proposed to be closed to sheep grazing under Alternatives 3 and 4.

There is high risk for physical contact between bighorn and domestic sheep under Alternative 2 because about 28% of the area that would be authorized for domestic sheep grazing in the Weminuche Landscape directly overlaps with bighorn CHHR (Table 35, above). Because of extensive overlap between known bighorn use areas, mapped summer concentration areas and production areas and portions of six allotments, physical contact between the species is likely within these zones of overlap. In some of these areas, multiple contacts could occur each year. Physical contact between bighorn and domestic sheep is possible when bighorns use that portion of their home range that overlaps with domestic sheep grazing areas. Further, the extensive overlap between known bighorn use areas and suitable domestic sheep grazing range within some of these zones of overlap suggests a high likelihood for physical contact between the species if they are present during the same season. For these reasons there is high risk for physical contact between the species within these zones of overlap, with potential for disease transmission and subsequent bighorn mortality events.

Under Alternative 2 there is higher risk for physical contact between bighorn and domestic sheep in many areas because there is more bighorn sheep summer source habitat than domestic sheep suitable grazing range, and there is substantial overlap between these areas (Table 35, above). Under this alternative there is about 57,984 acres of suitable domestic sheep grazing range in allotments that would be authorized for domestic sheep grazing, about 36% of the total NFS acres in the Weminuche Landscape (162,599 acres). Also under this alternative there is about 82,151 acres of bighorn summer source habitat, about 51% of the NFS acres in the Landscape. Of the 57,984 acres of suitable domestic sheep grazing range, 20,666 acres (36%) is also mapped as bighorn sheep summer source habitat. Because there is a relatively high amount (about 36%) of suitable domestic sheep grazing range overlapping with bighorn summer source habitat, this indicates high likelihood that foraying bighorns reaching an allotment might find and contact domestic sheep on suitable range within an allotment.

Under Alternative 2 there is about 27,832 acres of suitable domestic sheep grazing range in the six currently active domestic sheep allotments, about 17% of the Weminuche Landscape. Within those same six active allotments there is about 19,784 acres of bighorn sheep summer source habitat, about 12% of the Weminuche Landscape. Of these acres, about 9,623 acres are classified as both suitable domestic sheep grazing range and bighorn summer source habitat, about 6% of the Weminuche Landscape.

Alternative 3 (Adaptive Management with Forage Reserves):

Selecting Alternative 3 (see Figures 6 and 9, at end of document) would be more beneficial for bighorn sheep than selecting Alternative 2, but less beneficial than selecting Alternatives 1 or 4, in that order.

Selecting Alternative 3 results in some potential for physical contact between the species because domestic sheep would continue to be permitted to graze some portions of NFS lands within the Landscape. The relative risk for physical contact between the species, and the area

within the Weminuche Landscape where there is some potential for physical contact decreases substantially from Alternative 2 to Alternative 3, and again substantially decreases from Alternative 3 to Alternative 4, respectively.

Selecting Alternative 3 would be more beneficial for bighorn sheep than selecting Alternative 2, but less beneficial than selecting Alternatives 1 or 4, in that order. Under Alternative 3, all areas of direct overlap with bighorn CHHR would be closed to domestic sheep grazing, including all of three vacant sheep allotments (Cave Basin, Flint Creek and Pine River). In addition, the three remaining allotments that overlap with bighorn CHHR under Alternative 2 (Canyon Creek, Rock Creek and Tank Creek), would have those portions of the allotment where overlap occurred under Alternative 2 removed from the allotment and closed to domestic sheep grazing under Alternative 3. For this reason, under the allotment configuration proposed in Alternative 3, no areas of direct overlap between bighorn CHHR and domestic sheep allotments would remain in the Weminuche Landscape.

Selecting Alternative 3 would be generally beneficial for bighorn sheep, although less so than selecting Alternatives 1 or 4, but more so than selecting Alternative 2. The improvements in habitat conditions for bighorn sheep expected to occur over time under Alternative 3 are likely to be generally small and limited to localized areas where habitat conditions are being degraded by sheep grazing activities under current management practices.

Selecting Alternative 3 would have both beneficial and negative effects for bighorn sheep. Selecting Alternative 3 would have beneficial effects for bighorn sheep, compared to selecting Alternative 2, because application of adaptive management strategies and design criteria is expected to result in more rapid improvements in habitat conditions in those localized areas where sheep grazing impacts are degrading habitat conditions for bighorn sheep. Habitat conditions for bighorn sheep are expected to continue to gradually improve under Alternative 3, assuming the historic trend of reduced numbers of domestic sheep permitted to graze in the Weminuche Landscape and on the San Juan NF as a whole over the past 40+ years continues (see Figure 4, below). As numbers of permitted domestic sheep have declined on the San Juan NF and in the Weminuche Landscape, habitat conditions for bighorn sheep have improved and the potential for contact and risk of subsequent disease transmission between the species has declined. Even if numbers of domestic sheep remain relatively stable over the next few (5+) years, continued gradual improvement in vegetation conditions for bighorn sheep would be expected under Alternative 3. This is because at current domestic sheep stocking levels, the gradual improvement in alpine plant communities over the past 40+ years is expected to continue.

Selecting Alternative 3 would have negative effects for bighorn sheep, compared to selecting Alternative 1, because those localized areas of sheep grazing impacts would continue to be degraded by sheep grazing activities, such as near the alpine/spruce-fir interface, moist alpine areas adjacent to riparian zones or wet meadows, and upland willow stands in alpine basins.

Selecting Alternative 3 would be more beneficial for bighorn sheep than selecting Alternative 2, but would be less beneficial than selecting Alternative 1. This is because improvement in habitat conditions would probably occur over a longer time frame than under Alternative 1, but a shorter time frame than under Alternative 2 due to the application of adaptive management strategies and design criteria (see EIS Tables 2-2 and 2-3). In general, habitat conditions for bighorn sheep are expected to continue to gradually improve in most areas under Alternative 3, but localized impacts would continue to occur in some areas.

Compared to Alternative 2, the application of adaptive management strategies and design criteria under Alternative 3 (see EIS Tables 2-2 and 2-3) are expected to result in more rapid improvements in habitat conditions in those localized areas where sheep grazing impacts are currently occurring because adaptive management strategies would not be fully applied under Alternative 2. Although more rapid improvement in habitat conditions for bighorn sheep is expected under Alternative 3 than under Alternative 2, improvements in habitat conditions as a result of the adaptive management approach are likely to be too small to affect bighorn sheep populations or the total amount of habitat available for bighorn sheep in the Weminuche Landscape.

Selecting Alternative 3 would be much more beneficial for bighorn sheep than selecting Alternative 2, but less beneficial than selecting Alternative 1 (Table 34, above). Alternative 3 would be less beneficial for bighorn sheep than Alternative 1 because three active allotments rated as high risk for physical contact (Endlich Mesa, Tank Creek and Virginia Gulch) and three forage reserve allotments also rated as high risk for physical contact and in close proximity to bighorn CHHR (Johnson Creek, Leviathan and Rock Creek) would remain open and available to domestic sheep grazing under Alternative 3 (Table 37, below).

Selecting Alternative 3 would be much more beneficial for bighorn sheep than selecting Alternative 2 because four vacant sheep allotments available for restocking under Alternative 2 (Cave Basin, Fall Creek, Flint Creek and Pine River) would be closed to sheep grazing under Alternative 3 (Table 34, above). These four allotments would have high risk for physical contact between the species if they were stocked with domestic sheep under Alternative 2 (Table 36, above), but would be closed to domestic sheep grazing under Alternative 3 (Table 37, below). Under Alternative 3 there would be no potential for physical contact between domestic and bighorn sheep in these four allotments resulting from actions authorized by the Columbine Ranger District and the project's desired condition for bighorn sheep would be met in these four allotments.

Table 37. Measures of separation between domestic sheep and bighorn sheep used to assign rank of risk of physical contact for each allotment in the Weminuche Landscape for Alternative 3 (Adaptive Management with Forage Reserves).

Allotment	Direct Overlap with Bighorn Core Herd Home Range?	Nearest Distance to Bighorn Core Herd Home Range	Risk of Contact Tool Individual Herd Contact Rates	% Overlap Between Suitable Domestic Sheep Grazing Areas and Bighorn Summer Source Habitat	Connectivity of Bighorn Summer Source Habitat From Allotment to Bighorn Core Herd Home Range	Estimate of Likelihood of Physical Contact Within Allotment	Application of Best Management Practices	Alternative 3 Allotment Rank of Risk of Physical Contact (Assumes Forage Reserve Allotments would be Stocked)
Burnt Timber	No	4.1 mi (S-71): High	About 0.08 or less: Moderate	20%: Low	Fair to Poor Connectivity: Moderate	Moderate	Yes	Moderate Risk
Canyon Creek	No	0.1 (S-71): High	About 0.09 or less: Moderate	5%: Low	Poor Connectivity: Moderate	Moderate	Yes	Moderate Risk
Cave Basin	Allotment Proposed Closed							
Endlich Mesa	No	2.1 mi (S-28): High	0.49 to 0.05: High	40%: Moderate	Good Connectivity: High	High	Yes	High Risk
Fall Creek	Allotment Proposed Closed							
Flint Creek	Allotment Proposed Closed							
Johnson Creek	No	0.4 mi (S-28): High	0.11 to 0.58: High	48%: High	Good Connectivity: High	High	Yes	High Risk
Leviathan	No	0.9 mi (S-28): High	0.11 to 0.49: High	29%: Moderate	Good Connectivity: High	High	Yes	High Risk
Pine River	Allotment Proposed Closed							
Rock Creek	No	1.1 mi (S-28): High	0.07 to 0.36: High	72%: High	Good Connectivity: High	High	Yes	High Risk
Spring Gulch	No	7.7 mi (S-28): High	0.01 to 0.02: Low	4%: Low	Poor Connectivity: Low	Low	Yes	Low Risk
Tank Creek	No	0.8 mi (S-71): High	0.01 to 0.20: High	46%: High	Poor Connectivity: Moderate	Moderate	Yes	High Risk
Virginia Gulch	No	1.5 mi (S-71): High	0.05 to 0.30: High	56%: High	Good Connectivity: High	High	Yes	High Risk

CHHR Intersects Allotment

Allotment Proposed Closed

Active Sheep Allotment

Selecting Alternative 3 would be expected to have some positive effects on forage conditions for bighorn sheep. Selecting Alternative 3 would maintain the continued gradual long term improvement in forage habitat conditions for bighorn sheep that has occurred for the past 40+ years, but probably at a slower rate than would have occurred under Alternative 1. Forage habitat conditions for bighorn sheep would be expected to continue their long term gradual improvement under Alternative 3 because there has been a continued long term decline in the number of domestic sheep grazed on the San Juan National Forest over the past 40+ years. In addition, the amount of bighorn source habitat available for domestic sheep grazing in the Weminuche Landscape under Alternative 3 would be reduced to about 46% of that under Alternative 2 (Table 34, above). Therefore selecting Alternative 3 would reduce by 54% the amount of area where forage overlap between domestic and bighorn sheep could potentially occur, and as the number of domestic sheep on the landscape has declined, so too has the risk for direct physical contact between domestic and bighorn sheep and thus the potential for subsequent disease transmission and potential for bighorn mortality event has also declined.

Even if numbers of domestic sheep remain relatively stable over the next few (5+) years, a continued gradual improvement in bighorn sheep forage conditions would be expected under Alternative 3. This is because at current domestic sheep stocking levels, the observed gradual improvement in alpine plant communities is expected to continue, and the application of design criteria and adaptive management practices under Alternative 3 would further reduce affects from domestic sheep grazing.

Under Alternative 3 (see Figures 6 and 9, at end of document), all areas of direct overlap with bighorn CHHR would be closed to domestic sheep grazing, including three vacant sheep allotments (Cave Basin, Flint Creek and Pine River). In addition, the three remaining allotments that overlap with bighorn CHHR under Alternative 2 (Canyon Creek, Rock Creek and Tank Creek), would have those portions of the allotment where overlap occurred under Alternative 2 removed from the allotment and closed to domestic sheep grazing under Alternative 3. For this reason, under the allotment configuration proposed in Alternative 3, no areas of direct overlap between bighorn CHHR and domestic sheep allotments would remain in the Weminuche Landscape.

Under Alternative 3, the Canyon Creek Allotment would be rated “Moderate Risk”, after closure of the portion of the allotment that overlaps with CHHR for the S-71 bighorn herd under Alternative 2. The single allotment with a “Low Risk” rating under Alternative 2 (Spring Gulch) would remain “Low Risk” under Alternative 3, and the single allotment with a “Moderate Risk” rating under Alternative 2 (Burnt Timber) would remain “Moderate Risk” under Alternative 3. The remaining six allotments rated as “High Risk” under Alternative 2 would remain “High Risk” under alternative 3, due primarily to close proximity to bighorn CHHR (less than about 2.1 miles) and mostly good connectivity with CHHR’s via bighorn source habitat within and near the allotment that could facilitate foraying bighorns reaching the allotment (Table 37, above).

Under Alternative 3 there is higher risk for physical contact between bighorn and domestic sheep in many areas because there is more bighorn sheep summer source habitat than domestic sheep suitable grazing range, and there is substantial overlap between these areas (Table 35, above). Under this alternative there is about 28,629 acres of suitable domestic sheep grazing range in allotments that would be authorized for domestic sheep grazing, about 18% of the total NFS acres in the Weminuche Landscape (162,599 acres). Also under

this alternative there is about 37,591 acres of bighorn summer source habitat, about 23% of the NFS acres in the Landscape. Of the 28,629 acres of suitable domestic sheep grazing range, 12,333 acres (43%) is also mapped as bighorn sheep summer source habitat. Because there is a relatively high amount (about 43%) of suitable domestic sheep grazing range overlapping with bighorn summer source habitat, this indicates higher likelihood that foraying bighorns reaching an allotment might find and contact domestic sheep on suitable range within the allotment.

Under Alternative 3 there is about 27,602 acres of suitable domestic sheep grazing range in the six currently active domestic sheep allotments, about 17% of the Weminuche Landscape. Within those same six active allotments there is about 19,739 acres of bighorn sheep summer source habitat, about 12% of the Weminuche Landscape. Of these acres, about 9,866 acres are classified as both suitable domestic sheep grazing range and bighorn summer source habitat, about 6% of the Weminuche Landscape.

Selecting Alternative 3 would have little effect on grazing opportunities for the current domestic sheep permittees on currently active allotments (less than 1% change from Alternative 2 – current condition). Therefore, selecting Alternative 3 compared to Alternative 2 would have little impact on current domestic sheep permittees (less than 1% change in suitable domestic sheep grazing range within active allotments) while also providing substantial benefits to bighorn sheep in the form of protection of summer source habitat. Selecting Alternative 3 would reduce the amount of bighorn summer source habitat within allotments available for domestic sheep grazing in the Weminuche Landscape by 46% (Table 35, above). For this reason, selecting Alternative 3, compared to Alternative 2, would substantially reduce (by 46%) the potential for physical contact between the species and reduce the potential for disease transmission and subsequent bighorn mortality events, while also having little impact (less than 1% change)on current domestic sheep permittees.

Alternative 4 (Adaptive Management/Closing Vacant Allotments – Preferred Alternative):

Selecting Alternative 4 (see Figures 7 and 10, at end of document) would be more beneficial for bighorn sheep than selecting Alternatives 2 or 3, but less beneficial than selecting Alternative 1.

Selecting Alternative 4 results in some potential for physical contact between the species because domestic sheep would continue to be permitted to graze some portions of NFS lands within the Landscape. The relative risk for physical contact between the species, and the area within the Weminuche Landscape where there is some potential for physical contact decreases substantially from Alternative 2 to Alternative 3, and again substantially decreases from Alternative 3 to Alternative 4, respectively.

Under Alternative 4, all portions of the three sheep forage reserve allotments proposed under Alternative 3 (Johnson Creek, Leviathan and Rock Creek) would be entirely closed to domestic sheep grazing under Alternative 4. The single allotment with a “Low Risk” rating under Alternatives 2 and 3 (Spring Gulch) would remain “Low Risk” under Alternative 4, and the two allotments with a “Moderate Risk” rating under Alternative and 3 (Burnt Timber and Canyon Creek) would remain “Moderate Risk” under Alternative 4. The three remaining allotments rated as “High Risk” under Alternatives 2 and 3 (Endlich Mesa, Tank Creek and Virginia Gulch) would remain “High Risk” under alternative 4, due to proximity with bighorn CHHR and connectivity with CHHR’s via bighorn source habitat within and near the allotment that could facilitate foraying bighorns reaching the allotment.

Selecting Alternative 4 would be mostly beneficial for bighorn sheep, although less so than selecting Alternative 1, but more so than selecting Alternative 3 or Alternative 2. The improvements in habitat conditions for bighorn sheep expected to occur over time under Alternative 4 are likely to be generally small and limited to localized areas where habitat conditions are being degraded by domestic sheep grazing activities under current management practices.

Selecting Alternative 4 would have both positive and negative effects for bighorn sheep. Selecting Alternative 4 would be much more beneficial for bighorn sheep than selecting Alternative 2 because application of adaptive management strategies and design criteria is expected to result in more rapid improvements in habitat conditions in those localized areas where sheep grazing impacts are degrading habitat conditions for bighorn sheep. Habitat conditions for bighorn sheep are expected to continue to gradually improve under Alternative 4, assuming the historic trend of reduced numbers of domestic sheep permitted to graze in the Weminuche Landscape and on the San Juan NF as a whole over the past 40+ years continues (see Figure 4, below). As numbers of permitted domestic sheep have declined on the San Juan NF and in the Weminuche Landscape, habitat conditions for bighorn sheep have improved and the potential for contact and subsequent disease transmission between bighorns and domestic sheep has declined. Even if numbers of domestic sheep remain relatively stable over the next few (5+) years, continued improvement in bighorn sheep forage habitat conditions would be expected under Alternative 4. This is because at current domestic sheep stocking levels, the gradual improvement in alpine plant communities over the past 40+ years is expected to continue.

Selecting Alternative 4 would have negative effects for bighorn sheep, compared to selecting Alternative 1, because those localized areas in active allotments where sheep grazing impacts are occurring would continue to be impacted by sheep grazing activities. In general, those impacts appeared to be small in scale, localized in impact, and low in intensity and provide opportunities for application of adaptive management strategies. Areas where sheep grazing impacts were observed include near the alpine/spruce-fir interface, moist alpine areas adjacent to riparian zones or wet meadows, and in some upland willow stands in alpine basins.

Selecting Alternative 4 would be more beneficial for bighorn sheep than selecting Alternative 3 and much more beneficial than selecting Alternative 2, but would be less beneficial than selecting Alternative 1. This is because improvement in habitat conditions would probably occur over a longer time frame than under Alternative 1, but a shorter time frame than under Alternative 2 due to the application of adaptive management strategies and design criteria (EIS Tables 2-2 and 2-3). Improvement in habitat conditions is likely to be faster under Alternative 4 than under Alternative 3 because the three forage reserve allotments that would remain open under Alternative 3 would be closed to domestic sheep grazing under Alternative 4. In general, habitat conditions for bighorn sheep are expected to continue to gradually improve in most areas under Alternative 4, but localized impacts would continue to occur in some areas where sheep grazing would continue.

Compared to Alternative 2, the application of adaptive management strategies and design criteria under Alternative 4 (EIS Tables 2-2 and 2-3) is expected to result in more rapid improvements in habitat conditions in those localized areas where sheep grazing impacts are currently occurring because adaptive management strategies would not be fully applied under Alternative 2. Although more rapid improvement in habitat conditions for bighorn

sheep is expected under Alternative 4 than under Alternative 2, improvements in habitat conditions as a result of the adaptive management approach are likely to be too small to affect populations or the total amount of habitat available for bighorn sheep in the Weminuche Landscape.

Selecting Alternative 4 would be much more beneficial for bighorn sheep than selecting Alternative 2, more beneficial than Alternative 3, but less so than selecting Alternative 1 (Table 34, above). Selecting Alternative 4 would be less beneficial for bighorn sheep than selecting Alternative 1 because three active allotments in close proximity to bighorn sheep CHHR and rated as high risk for physical contact with bighorn sheep (Endlich Mesa, Tank Creek and Virginia Gulch) would remain open to domestic sheep grazing under Alternative 4. Selecting Alternative 4 would be more beneficial for bighorn sheep than selecting Alternative 3 because three forage reserve allotments in close proximity to bighorn CHHR and rated as high risk for physical contact with bighorn sheep (Johnson Creek, Leviathan and Rock Creek) would be closed to domestic sheep grazing under Alternative 4 and the project's desired condition for bighorn sheep would be met in these three allotments. Under Alternative 3 these three forage reserve allotments would be available for grazing up to three years out of every ten consecutive years.

Selecting Alternative 4 would be much more beneficial for bighorn sheep than selecting Alternative 2 because four vacant sheep allotments available for restocking under Alternative 2 (Cave Basin, Fall Creek, Flint Creek and Pine River) would be closed to sheep grazing under Alternative 4 (Table 34, above). These four allotments would have high risk for physical contact between the species if they were stocked with domestic sheep under Alternative 2 (Table 36, above), but would be closed to domestic sheep grazing under Alternative 4 (Table 38, below). Under Alternative 4 there would be no potential for physical contact between domestic and bighorn sheep in these four allotments resulting from actions authorized by the Columbine Ranger District and the project's desired condition for bighorn sheep would be met in these four allotments.

Table 38. Measures of separation between domestic sheep and bighorn sheep used to assign rank of risk of physical contact for each allotment in the Weminuche Landscape for Alternative 4 (Adaptive Management/Closing Vacant Allotments – Preferred Alternative).

Allotment	Direct Overlap with Bighorn Core Herd Home Range?	Nearest Distance to Bighorn Core Herd Home Range	Risk of Contact Tool Individual Herd Contact Rates	% Overlap Between Suitable Domestic Sheep Grazing Areas and Bighorn Summer Source Habitat	Connectivity of Bighorn Summer Source Habitat From Allotment to Bighorn Core Herd Home Range	Estimate of Likelihood of Physical Contact Within Allotment	Application of Best Management Practices	Alternative 4 Allotment Rank of Risk of Physical Contact (Assumes Vacant Allotment would be Stocked)
Burnt Timber	No	4.1 mi (S-71) - High	About 0.08 or less - Moderate	20% - Low	Fair to Poor Connectivity - Moderate	Moderate	Yes	Moderate Risk
Canyon Creek	No	0.1 (S-71): High	About 0.09 or less: Moderate	5%: Low	Poor Connectivity: Moderate	Moderate	Yes	Moderate Risk
Cave Basin	Allotment Proposed Closed							
Endlich Mesa	No	2.1 mi (S-28): High	0.49 to 0.05: High	40%: Moderate	Good Connectivity: High	High	Yes	High Risk
Fall Creek	Allotment Proposed Closed							
Flint Creek	Allotment Proposed Closed							
Johnson Creek	Allotment Proposed Closed							
Leviathan	Allotment Proposed Closed							
Pine River	Allotment Proposed Closed							
Rock Creek	Allotment Proposed Closed							
Spring Gulch	No	7.7 mi (S-28): High	0.01 to 0.02: Low	4%: Low	Poor Connectivity: Low	Low	Yes	Low Risk
Tank Creek	No	0.8 mi (S-71): High	0.01 to 0.20: High	46%: High	Poor Connectivity: Moderate	Moderate	Yes	High Risk
Virginia Gulch	No	1.5 mi (S-71): High	0.05 to 0.30: High	56%: High	Good Connectivity: High	High	Yes	High Risk

CHHR Intersects Allotment
Allotment Proposed Closed
Active Sheep Allotment

Selecting Alternative 4 is expected to have some positive effects on forage conditions for bighorn sheep. Selecting Alternative 4 would maintain the continued gradual long term improvement in forage habitat conditions for bighorn sheep that has occurred for the past 40+ years, but probably at a slower rate than would have occurred under Alternative 1. Forage habitat conditions for bighorn sheep would be expected to continue their long term gradual improvement under Alternative 4 because the amount of bighorn source habitat available for grazing in the Weminuche Landscape under Alternative 4 would be reduced to about 23% of that under Alternative 2, and 23% less than under Alternative 3 (Table 34, above). Therefore, selecting Alternative 4 would reduce by 77% compared to Alternative 2 and 23% compared to Alternative 3 the amount of area where forage overlap between domestic and bighorn sheep could potentially occur. In addition, and as the number of domestic sheep on the landscape has declined, so too has the risk for direct physical contact between domestic and bighorn sheep and thus the potential for subsequent disease transmission and potential for bighorn mortality event has also declined.

Even if numbers of domestic sheep remain relatively stable over the next few (5+) years, a continued gradual improvement in bighorn sheep forage conditions would be expected under Alternative 4. This is because at current domestic sheep stocking levels the observed gradual improvement in alpine plant communities is expected to continue, and the application of design criteria and adaptive management practices under Alternative 4 would further reduce affects from domestic sheep grazing.

Under Alternative 4 (see Figures 7 and 10, at end of document), all areas of direct overlap with bighorn CHHR would be closed to domestic sheep grazing, including three vacant sheep allotments (Cave Basin, Flint Creek and Pine River). In addition, the three remaining allotments that overlap with bighorn CHHR under Alternative 2 (Canyon Creek, Rock Creek and Tank Creek), would have those portions of the allotment where overlap occurred under Alternative 2 removed from the allotment and closed to domestic sheep grazing under Alternative 4. For this reason, under the allotment configuration proposed in Alternative 4, no areas of direct overlap between bighorn CHHR and domestic sheep allotments would remain in the Weminuche Landscape. Further, the three forage reserve allotments in close proximity to bighorn CHHR and rated as high risk for physical contact with bighorn sheep under Alternative 3 (Johnson Creek, Leviathan and Rock Creek) would be closed to domestic sheep grazing under Alternative 4 and the project's desired condition for bighorn sheep would be met in these three allotments.

Under Alternative 4, the Canyon Creek Allotment would be rated "Moderate Risk", after closure of the portion of the allotment that overlaps with CHHR for the S-71 bighorn herd under Alternative 2. The single allotment with a "Low Risk" rating under Alternatives 2 and 3 (Spring Gulch) would remain "Low Risk" under Alternative 4, and the single allotment with a "Moderate Risk" rating under Alternatives 2 and 3 (Burnt Timber) would remain "Moderate Risk" under Alternative 4. The three remaining allotments rated as "High Risk" under Alternatives 2 and 3 (Endlich Mesa, Tank Creek and Virginia Gulch) would remain "High Risk" under alternative 4, due primarily to close proximity to bighorn CHHR (less than about 2.1 miles) and mostly good connectivity with CHHR's via bighorn source habitat within and near the allotment that could facilitate foraying bighorns reaching the allotment (Table 38, above).

It is important to note that the areas of suitable domestic sheep grazing range proposed for closure under Alternatives 3 and 4 are in currently vacant allotments, or in areas of the active allotments that have been rarely used. Fall Creek and the three forage reserve allotments (Johnson Creek, Leviathan and Rock Creek) have all remained vacant since 1970. Flint Creek Allotment has remained vacant since 1972, and the Pine River Allotment has remained vacant since 1980. No currently active allotments would be closed under any of the action alternatives (Alternative 2, 3 or 4). For these reasons the amount of useable domestic sheep grazing range would change very little (less than 1% change) between the three action alternatives (Alternatives 2, 3 and 4).

Under Alternative 4 there is higher risk for physical contact between bighorn and domestic sheep in many areas because there is nearly as much bighorn sheep summer source habitat as domestic sheep suitable grazing range, and there is substantial overlap between these areas (Table 35, above). Under Alternative 4 there is about 24,700 acres of suitable domestic sheep grazing range in allotments that would be authorized for domestic sheep grazing, about 15% of the total NFS acres in the Weminuche Landscape (162,599 acres). Also under Alternative 4 there is about 18,758 acres of bighorn summer source habitat, about 12% of the NFS acres in the Landscape. Of the 24,700 acres of suitable domestic sheep grazing range, 10,082 acres (41%) is also mapped as bighorn sheep summer source habitat. Because there is a relatively high amount (about 41%) of suitable domestic sheep grazing range overlapping with bighorn summer source habitat, this indicates higher likelihood that foraying bighorns reaching an allotment might find and contact domestic sheep on suitable range within the allotment.

Under Alternative 4 there is about 27,602 acres of suitable domestic sheep grazing range in the six currently active domestic sheep allotments, about 17% of the Weminuche Landscape. Within those six active allotments there is about 19,739 acres of bighorn sheep summer source habitat, about 12% of the Weminuche Landscape. Of these acres, about 9,866 acres are classified as both suitable domestic sheep grazing range and bighorn summer source habitat, about 6% of the Weminuche Landscape.

Under Alternative 4, 77% of bighorn source habitats in the Landscape would be removed from domestic sheep grazing opportunities, compared to only 54% under Alternative 3. Under Alternative 4, 51% of bighorn source habitat that overlaps with suitable domestic sheep range would be removed from domestic sheep grazing opportunities, compared to only 40% under Alternative 3. For these reasons Alternative 4 provides a much greater level of separation between bighorn and domestic sheep grazing areas, compared to Alternatives 3 and 2.

Because Alternative 4 would retain nearly all grazing opportunities (less than 1% change) on currently active domestic sheep allotments, Alternative 4 would retain the current condition for domestic sheep permittees and meet agency direction for providing livestock grazing opportunities on NFS lands. Because Alternative 4 closes all currently vacant allotments it meets Plan direction to prevent physical contact between bighorn and permitted domestic sheep on the closed allotments. Because Alternative 4 closes more vacant allotments than Alternatives 3 and 2, Alternative 4 is more likely than Alternative 3 or Alternative 2 to provide for long-term bighorn persistence within a landscape that retains current domestic sheep grazing opportunities on active allotments.

For the reasons discussed in the paragraphs above, Alternative 4 provides greater separation between bighorn sheep and domestic sheep than Alternatives 2 or 3, while also having little effect on the amount of domestic sheep grazing acres in currently active allotments (less than 1% change). Therefore Alternative 4 provides substantial benefits for bighorn sheep, much more than under Alternative 2 and more than Alternative 3, while continuing to provide existing domestic sheep permittees with the same amount of grazing range as in currently active allotments.

Alternative 4 provides the greatest degree of habitat separation, compared to Alternatives 2 and 3, of domestic sheep grazing range and bighorn sheep summer source habitat. The alternative providing the best habitat separation is Alternative 1. However, when the information presented in the preceding paragraphs is viewed in another way, under Alternative 4, 51% of bighorn summer source habitat that overlaps with suitable domestic sheep range would be removed from domestic sheep grazing opportunities. Under the allotment configuration proposed in Alternative 3, about 40% of the bighorn summer source habitat that overlaps with suitable domestic sheep range in the Weminuche Landscape would be removed from domestic sheep grazing opportunities. Therefore Alternative 4 provides the greatest level of separation between bighorn and domestic sheep grazing areas (51%), compared to Alternatives 2 and 3, but Alternative 3 (40%) provides a greater level of separation than Alternative 2 (0%).

Alternative 4 provides the greatest degree of physical separation, compared to Alternatives 2 and 3, between domestic sheep allotments and bighorn sheep CHHR. The alternative providing the best physical separation is Alternative 1. Under Alternative 4, the average distance from allotments to the nearest bighorn CHHR is 9.0 miles (Table 35, above), with no direct overlap with bighorn CHHR and only three sets of allotment/bighorn herd combinations in close proximity (about 2.2 miles) to bighorn CHHR's. Under the allotment configuration proposed in Alternative 3, the average distance from allotments to the nearest bighorn CHHR is 7.4 miles, with no direct overlap with bighorn CHHR and six sets of allotment/bighorn herd combinations within close proximity to bighorn CHHR's. Under Alternative 2, the average is 6.7 miles, with 14 sets of allotment/bighorn herd combinations either in direct overlap or in close proximity.

For the reasons described in the paragraph above, Alternative 4 provides the greatest level of physical separation between bighorn and domestic sheep use areas, compared to the physical separation under the allotment configurations in Alternatives 3 and 2. For the same reasons, Alternative 4 provides the best opportunity for preventing contact between the species, compared to Alternatives 3 and 2.

Under Alternative 4 a total of three allotments receive a rank of "High Risk" for the potential for physical contact between bighorn and domestic sheep in the Weminuche Landscape (Table 35, above). Under Alternative 3, six allotments receive a rank of "High Risk" for the potential for physical contact between bighorn and domestic sheep. Under Alternative 2, a total of 11 allotments receive a rank of "High Risk" for physical contact between bighorn and domestic sheep. Therefore there is a substantial reduction in the number of allotments rated as "High Risk" for the potential for physical contact between bighorn and domestic sheep under Alternatives 4 and 3, compared to Alternative 2. In addition, the areas of concern ("High Risk") are much smaller under Alternative 4 than under Alternative 3.

The four forays documented in the past four years and within two active allotments confirm that both short- and long-distance forays are occurring in the landscape on a regular basis. These observations confirm that forays are contacting allotments and bringing bighorn sheep into very close proximity (less than ½ mile) of domestic sheep. These observations confirm the potential for physical contact within active allotments, and therefore the potential for a subsequent disease transmission and bighorn mortality event. These observations therefore confirm the determinations from multiple lines of reasoning that several active allotments in the Weminuche Landscape present "High Risk" for physical contact between the species.

The Risk of Contact Tool was used to rank the alternatives based on the predicted frequency of contact with allotments by foraying bighorn sheep. The Risk of Contact Tool results confirm conclusions based on other quantitative and lines of reasoning in ranking the order of the alternatives in terms of reducing the risk of physical contact between bighorn and domestic sheep.

The allotment configuration proposed in Alternative 4 is predicted by the Risk of Contact Tool to provide the greatest temporal separation between bighorn and domestic sheep, compared to the temporal separation predicted under the allotment configurations of Alternatives 2 and 3. The average number of years to contact predicted by the Risk of Contact Tool for all sets of allotments and bighorns foraying from the three CHHR's combined is 3.0 years under Alternative 2, increases to 6.7 years under Alternative 3, and increases again to 9.4 years under Alternative 4 (Table 35, above).

The total herd contact rates from the Risk of Contact Tool were compared across the three action alternatives (Alternative 2, 3 and 4) for each individual combination of alternative and allotment. A total herd contact rate less than about 0.08 was determined by an analysis conducted by the Payette National Forest to be a rate of allotment contact by foraying bighorn sheep thought low enough to be likely to maintain long-term bighorn sheep herd persistence under a moderate (25%) rate of contact resulting in a disease event (USDA Forest Service 2013c, USDA Forest Service 2010a, 2010c and 2010d). Logically, if the likelihood of contact is lower, the potential for disease transmission resulting in a bighorn mortality event is also lower.

Results from the Risk of Contact Tool predicts the allotment configuration proposed under Alternative 4 would be more likely than the allotment configuration under Alternative 3 or Alternative 2 to provide for long-term bighorn persistence in a landscape with ongoing domestic sheep grazing opportunities. Under the allotment configuration proposed under Alternative 4, 11 of the 17 (65%) allotment/alternative combinations had Risk of Contact Tool predicted total herd contact rate values less than about 0.08. Conversely, under Alternative 4, six of the allotment/alternative combinations had contact rates in excess of about 0.08. Of the three action alternatives, Alternative 4 had the lowest total number and lowest percentage of allotment/alternative combinations with a total herd contact rate greater than about 0.08. For this reason, Alternative 4 is more likely than Alternative 3 or Alternative 2 to provide for long-term bighorn persistence in a landscape with ongoing domestic sheep grazing opportunities.

For comparison, under the allotment configuration proposed under Alternative 3, 12 of the 26 allotment/alternative combinations (46%) had Risk of Contact Tool predicted total herd contact rate values less than about 0.08. Conversely, under Alternative 3, 14 of the allotment/alternative combinations (54%) had contact rates in excess of about 0.08.

Although the percentage of allotment/alternative combinations with a value greater than about 0.08 was greater under Alternative 3 than under Alternative 2, the total number of allotment/alternative combinations with a value greater than about 0.08 was much less under Alternative 3 than under Alternative 2. For this reason, the Risk of Contact Tool results predicts the allotment configuration proposed under Alternative 3 would be more likely than Alternative 2 to provide for long-term bighorn persistence in a landscape with ongoing domestic sheep grazing opportunities.

Also for comparison, under Alternative 2, 16 of the 38 (42%) allotment/alternative combinations had Risk of Contact Tool predicted total herd contact rate values less than about 0.08. Conversely, under the allotment configuration in Alternative 2, 22 (58%) of the allotment/alternative combinations had contact rates in excess of about 0.08, thereby predicting a reduced likelihood of maintaining long-term bighorn herd persistence due to the potential for the most frequent physical contact with domestic sheep and the possibility of disease transmission and subsequent bighorn mortality event.

Table 39. Total herd contact rates from the Risk of Contact Tool converted to the number of years per contact, shown by allotment and alternative, in the Weminuche Landscape.

Direct Effects	Annual Total Herd Contact Rates via Foray (1 Contact/X Years)		
Allotment	**Alternative 2**	**Alternative 3**	**Alternative 4**
Burnt Timber	7.35	7.36	7.36
Canyon Creek	0.98	8.86	8.86
Cave Basin	0.66		
Endlich Mesa	1.50	1.50	1.50
Fall Creek	1.08		
Flint Creek	0.56		
Johnson Creek	1.08	1.25	
Leviathan	1.39	1.39	
Pine River	0.49		
Rock Creek	0.80	1.78	
Spring Gulch	46.37	47.80	47.80
Tank Creek	0.89	3.00	3.00
Virginia Gulch	1.91	1.90	1.90
Total	0.08	0.26	0.56

CHHR Intersects With Allotment
N/A: Allotment Proposed Closed
N/A: Too Far From Allotment
Active Sheep Allotment

Table 39, above, displays the total herd contact rate converted to the number of years per contact by a bighorn foraying from any of the three primary bighorn herds for each allotment and alternative in the Weminuche Landscape, as predicted by the Risk of Contact Tool.

The Risk of Contact Tool predicts that under Alternative 4, a bighorn from one of the three herds would contact a domestic sheep allotment somewhere in the Weminuche Landscape about 2 times per year while foraying outside their CHHR. Under the allotment configuration of Alternative 3, a bighorn from one of the three herds is predicted to contact a domestic

sheep allotment somewhere in the Weminuche Landscape about 4 times per year. Under the current allotment configuration (Alternative 2) a bighorn from one of the three herds is predicted to contact a domestic sheep allotment somewhere in the Weminuche Landscape about 12 times per year while foraying outside their CHHR.

Therefore the Risk of Contact Tool predicts that selecting Alternative 4 would reduce the rate of allotment contact by foraying bighorns from one of the three herds in the Weminuche Landscape from 12 contacts per year to 2 contacts per year. For this reason, the allotment boundary adjustments and allotment closures implemented under Alternative 4 are predicted by the Risk of Contact Tool to provide a greater degree of spatial and temporal separation than the allotment configuration of Alternative 3 or Alternative 2.

For all the reasons discussed in the preceding paragraphs, the order of alternatives most beneficial for bighorn sheep is Alternative 1, followed by Alternative 4, Alternative 3, and Alternative 2. For most of the quantitative and qualitative factors discussed in the paragraphs above, Alternative 4 provides substantially greater spatial and temporal separation between bighorn and domestic sheep than Alternative 3, which is substantially better for bighorn sheep than Alternative 2. This is accomplished while continuing to provide existing domestic sheep permittees with the same amount of grazing range as in currently active allotments.

ALLOTMENT AND BIGHORN HERD COMPARISON:

Domestic sheep permittees and Forest Service range management specialists meet each winter to discuss annual operating instructions for the upcoming grazing season. In conjunction with this meeting, if necessary, the agency wildlife biologist and CPW staff will meet with the permittee to review the effectiveness of design criteria implementation and any new bighorn sheep information obtained over the previous year. At this time, the risk assessment rank for each active allotment would be reviewed as necessary, and updated with new information as appropriate. Discussions with permittees about management actions, observations, and opinions are a critical component for finding consensus-based solution opportunities to new issues as they arise. The objective of these discussions would be to explore mutually acceptable ways to reduce the risk of physical contact between bighorn sheep and domestic sheep using a flexible adaptive approach to problem solving, and to be more responsive to the management needs of livestock permittees and the dynamic nature of a highly mobile wildlife species.

Annual reviews of risk assessment ranks and the potential for contact between domestic and bighorn sheep may be necessary because the West Needles S-71 and Cimarrona Peak S-16 herds appear to be increasing in numbers and slowly expanding in range. Additional monitoring and survey information is needed to better determine the status of the Vallecito Creek Herd S-28. Because bighorn CHHR's and populations can change over time, an adaptive approach to where and how domestic sheep are managed on the landscape is essential to bighorn conservation and for permittee operations.

The occurrence of multiple recent long-distance and short forays (four documented in the past four years with two events of very close physical proximity) confirms there is high risk for physical contact within the Endlich Mesa and Virginia Gulch Allotments. As predicted by multiple lines of reasoning, including the Risk of Contact Tool, foray contact with allotments

is occurring in the Weminuche Landscape and bighorn forays are travelling substantial distances across and outside the Landscape on a regular basis.

The multiple documented recent events of observed very close proximity (twice within ½ mile of domestic sheep) suggests a need to implement effectiveness monitoring within active allotments rated as "High Risk" for physical contact to document design criteria effectiveness as grazing continues in allotments where close proximity between the species has been demonstrated to occur. Table 39, above, illustrates that Endlich Mesa and Virginia Gulch Allotments consistently have the highest predicted rates of allotment contact by foray of the currently active allotments across all alternatives.

Table 40. Total herd contact rates from the Risk of Contact Tool converted to the number of years per contact, shown by bighorn core herd home range and alternative, in the Weminuche Landscape.

Direct Effects

Bighorn Sheep Herd	Annual Total Herd Contact Rates via Foray (1 Contact/X Years)		
	Alternative 2	**Alternative 3**	**Alternative 4**
Cimarrona Peak S-16	0.36	2.12	9.04
Vallecito Creek S-28	0.14	0.41	0.96
West Needles S-71	0.34	1.06	1.55
Total	0.08	0.26	0.56

Table 40, above, displays the total herd contact rate converted to the number of years per contact that a bighorn from one of the three primary herds is predicted to contact a domestic sheep allotment somewhere in the Weminuche Landscape, by alternative.

Across all alternatives and allotment combinations, outside of areas of direct overlap with CHHR, the Risk of Contact Tool consistently predicts the highest contact rates between bighorns foraying from the Vallecito Creek Herd S-28 and allotments authorized for domestic sheep grazing under each alternative. This prediction is confirmed by two recent observations of bighorns in very close proximity (within ½ mile) to domestic sheep in two active allotments. The Vallecito Creek Herd has the second lowest population size of any bighorn herd on the San Juan NF (90 animals) and the population has declined somewhat in the past five years raising concerns for its population status and potential vulnerability if a disease outbreak were to occur. The Cimarrona Peak Herd S-16 generally has the lowest predicted contact rates with allotments authorized for domestic sheep grazing under each alternative. The West Needles Herd S-71 has contact rates from the Risk of Contact Tool intermediate between S-28 and S-16.

The close proximity of S-28 to several active allotments, and the biological connections between S-28 and other subgroups (GMUs) across the larger Weminuche Population, highlights the need for continuing discussions with CPW and other partners on ways to implement low intensity cost effective monitoring of S-28 in relation to interaction with active allotments. The Risk of Contact Tool results displayed in Tables 39 and 40 suggest the importance of cooperative monitoring of the potential for contact between S-28 and active sheep allotments to provide for long-term bighorn persistence within a landscape that retains current domestic sheep grazing opportunities on active allotments.

The Risk of Contact Tool predicts that under Alternative 4 a bighorn foraying from the S-16 CHHR would contact an allotment somewhere in the Weminuche Landscape every 9 years

(Table 40, above). For bighorns foraying from the S-71 CHHR, the allotment contact rate under Alternative 4 is predicted to be one contact every 2 years, and about 1 contact per year for bighorns from the S-28 CHHR. Under the allotment configuration of Alternative 3, the allotment contact rates for bighorns foraying from each of the three herds are about twice as frequent as those under Alternative 4. Under the current allotment configuration (Alternative 2) bighorns foraying from S-16 and S-71 are predicted by the Risk of Contact Tool to contact an allotment somewhere in the Weminuche Landscape about three times per year, and from S-28, allotments are contacted about seven times per year.

Therefore the Risk of Contact Tool predicts that selecting Alternative 4 would reduce the rate of allotment contact by bighorns foraying from each of the three herds in the Weminuche Landscape by at least half compared to Alternative 3, and by about two-thirds compared to Alternative 2. For this reason, the allotment boundary adjustments and allotment closures implemented under Alternative 4 are predicted by the Risk of Contact Tool to provide a greater degree of spatial and temporal separation for each of the three respective bighorn herds, compared to the allotment configuration of Alternative 3 or Alternative 2.

CONFORMANCE WITH SAN JUAN NATIONAL FOREST LAND AND RESOURCE MANAGEMENT PLAN (Forest Plan)

All Standards and Guidelines in the 2013 Final San Juan National Forest Land and Resource Management Plan (USDA Forest Service 2013e) that are directly applicable to the project purpose and need and/or project alternatives are described and discussed below.

As stated earlier in this document, the products commonly referred to as the 'WAFWA maps' (Western Association of Fish and Wildlife Agencies 2011) used CPW's overall range polygons as their best estimate of bighorn sheep occupied habitat areas in the state of Colorado. In the Weminuche Landscape CPW's summer range polygons are generally equivalent to the overall range polygons. Throughout this document CPW's summer range polygons have been referred to as bighorn Core Herd Home Range (CHHR). Because CPW's summer range polygons are generally equivalent to the overall range polygons in the Weminuche Landscape, in the context of the following Forest Plan resource direction, bighorn CHHR is considered to be the best representation of bighorn sheep occupied habitat areas.

Alternative 1 is completely consistent with all Forest Plan resource direction for bighorn sheep conservation and management on the planning area. Because Alternative 1 does not authorize domestic sheep grazing on NFS lands in the Weminuche Landscape it is the only alternative that completely prevents physical contact between bighorn sheep and domestic sheep. For this same reason, Alternative 1 is completely consistent with all Forest Plan resource direction for conservation of bighorn sheep. Because Alternative 1 does not authorize domestic sheep grazing within the Landscape it presents a management option that completely prevents contact between bighorn and permitted domestic sheep. For this reason, Forest Plan direction under Standard 2.3.39 (below) is met by the range of management options presented in this EIS.

Selecting the Preferred Alternative (Alternative 4) in its entirety is consistent with resource direction in the Forest Plan under Standard 2.3.40 and Guideline 2.3.64, shown below, because it eliminates all areas of overlap that exist under current condition (Alternative 2) between authorized domestic sheep allotments and bighorn CHHR. Because Alternative 4

eliminates all areas of overlap with bighorn CHHR it does not authorize grazing in occupied bighorn habitats and thus it is consistent with Standard 2.3.40 and Guideline 2.3.64. For this same reason, Alternative 3 is also consistent with Standard 2.3.40 and Guideline 2.3.64.

Selecting the Preferred Alternative (Alternative 4) would prevent the risk of physical contact with permitted domestic sheep on 77% of bighorn summer source habitat in the Weminuche Landscape, compared to preventing the risk of contact on 54% of bighorn summer source habitat under Alternative 3, and XX% of bighorn summer source habitat under Alternative 2. Alternative 4 implements the intent of Forest Plan direction to prevent contact between bighorn and domestic sheep by closing 77% of bighorn summer source habitat to domestic sheep grazing.

Selecting Alternative 4 would reduce the number of allotments ranked as high risk for physical contact between bighorn and domestic sheep to three active allotments, compared to six allotments under Alternative 3, and 11 allotments under Alternative 2. Alternative 4 implements the intent of Forest Plan direction to prevent contact between bighorn and domestic sheep by closing all eight currently vacant allotments to domestic sheep grazing.

Selecting Alternative 4 would increase the average distance from bighorn CHHR's to domestic sheep allotments to 9.0 miles, compared to an average distance of 7.4 miles under Alternative 3, and an average distance of 6.7 miles under Alternative 2. By increasing the average distance between bighorn CHHR's and domestic sheep allotments, Alternative 4 implements the intent of plan direction to prevent contact between bighorn and domestic sheep.

Selecting Alternative 4 would increase the average number of years to allotment contact by foraying bighorns, as calculated by the Risk of Contact Tool, to 9.4 years under Alternative 4, compared to an average of 6.7 years under Alternative 3, and an average of 3.0 years under Alternative 2. By increasing the average number of years to predicted allotment contact, Alternative 4 implements the intent of Forest Plan direction to prevent contact between bighorn and domestic sheep.

For all the reasons discussed in the paragraphs above, Alternative 4 better meets the intent of Forest Plan direction for bighorn management than does Alternative 3.

Selecting the Preferred Alternative (Alternative 4) would retain nearly all grazing opportunities (less than 1% change) on currently active domestic sheep allotments in the Weminuche Landscape. Therefore selecting Alternative 4 would retain the current condition for domestic sheep permittees and meets agency direction for providing livestock grazing opportunities on NFS lands.

Because Alternative 4 closes all vacant allotments it meets Plan direction to prevent physical contact between bighorn and permitted domestic sheep on the closed allotments. Because Alternative 4 closes more vacant allotments than Alternatives 3 and 2, Alternative 4 is more likely than Alternative 3 or Alternative 2 to provide for long-term bighorn persistence within a landscape that retains current domestic sheep grazing opportunities on all currently active allotments.

Because the Preferred Alternative (Alternative 4) maintains all active domestic sheep allotments it would provide consistency and maintain economic stability for the domestic

sheep industry. By closing all vacant allotments to domestic sheep grazing the Preferred Alternative would also provide better protection for bighorn sheep wildlife watching and hunting opportunities, compared to Alternative 3 and Alternative 2.

Selecting Alternative 3 is consistent with Forest Plan direction for management of bighorn sheep. Selecting Alternative 3 would eliminate all areas of overlap with bighorn CHHR that exist under current condition (Alternative 2) and thus does not authorize sheep grazing in occupied bighorn habitat. However, although Alternative 3 is consistent with Forest Plan direction, there is greater risk for physical contact than under Alternative 4 due to authorizing the forage reserve allotments under Alternative 3. For the reasons discussed above, Alternative 3 meets direction under Standard 2.3.40 and Guideline 2.3.64.

Selecting Alternative 2 is not consistent with Standard 2.3.40 and Guideline 2.3.64. This is because Alternative 2 continues to authorize domestic sheep grazing in areas of overlap with bighorn CHHR. Because Alternative 2 continues to authorize domestic sheep grazing in areas of overlap with bighorn CHHR it continues to authorize grazing in occupied bighorn habitat without utilizing measures to prevent contact. Alternatives 3 and 4 rely on the application of design criteria to reduce the potential for physical contact between the species and many of those design criteria would not be applied under Alternative 2. For these reasons selecting Alternative 2 is not consistent with Standard 2.3.40 and Guideline 2.3.64.

FOREST PLAN RESOURCE DIRECTION FOR TERRESTRIAL WILDLIFE

Standard 2.3.39 **Bighorn sheep** (*Ovis canadensis*): during project-level planning on domestic sheep (*O. aries*) allotments, management options must be developed to prevent physical contact between domestic sheep and bighorn sheep. Actions may include but are not limited to boundary modification, livestock-type conversion, or allotment closures.

> This standard is met by the EIS providing Alternative 1 as a valid management option. Because Alternative 1 does not authorize domestic sheep grazing on NFS lands in the Weminuche Landscape it presents a management option that completely prevents physical contact between bighorn sheep and domestic sheep permitted to graze NFS lands in the Weminuche Landscape. For this reason, Alternative 1 meets direction under this standard to develop management options that prevent physical contact between domestic and bighorn sheep. Alternative 1 is completely consistent with direction contained in this standard.
>
> In addition, Alternatives 3 and 4 utilize measures including closure of vacant allotment, administrative boundary adjustments, and livestock type conversion (i.e. authorizing cattle grazing on the Canyon Creek Allotment) that eliminate all areas of overlap with bighorn CHHR in the Weminuche Landscape. Alternative 4 followed by Alternative 3 each substantially reduce the amount of bighorn summer source habitat available for domestic sheep grazing, compared to Alternative 2. These management measures are applied with the intent of preventing contact between the species in the areas they are applied and therefore Alternatives 3 and 4 are also in conformance with Standard 2.3.39. Because Alternative 2 continues to authorize domestic sheep grazing in areas of overlap with bighorn CHHR and does not apply additional management options designed to prevent physical contact, it is not in conformance with Standard 2.3.39.

Standard 2.3.40 **Bighorn Sheep:** Grazing permit administration in occupied bighorn sheep habitat must utilize measures to prevent physical contact between domestic sheep and bighorn sheep. Permit administration actions may include but are not limited to use of guard dogs, grazing rotation adjustments, or relocation of salting and bed grounds.

This standard is met by Alternative 4 and Alternative 3. Selecting the Preferred Alternative (Alternative 4) in its entirety is consistent with this standard because it eliminates all areas of overlap between authorized domestic sheep allotments and bighorn CHHR. Because Alternative 4 and Alternative 3 each eliminate all areas of overlap with bighorn CHHR they do not authorize grazing in occupied bighorn sheep habitat and thus they are consistent with Standard 2.3.40. Because Alternative 2 continues to authorize domestic sheep grazing in areas of overlap with bighorn CHHR and does not apply additional management options designed to prevent physical contact, it is not in conformance with Standard 2.3.39.

Standard 2.3.41 **Bighorn Sheep:** Management of recreational pack goats and other domestic goats (*Capra aegagrus hircus*) must utilize measures to prevent physical contact with bighorn sheep.

This standard does not apply to this project because the use of recreational pack goats is outside the scope of this project-level decision.

Standard 2.3.42 **Bighorn Sheep:** Domestic goats used for invasive plant control must be veterinarian certified as free of pathogens transmissible to bighorn sheep, except in areas where there is no risk of contact with bighorn sheep.

This standard does not apply to this project because the use of domestic goats for invasive plant control is outside the scope of this project-level decision.

Guideline 2.3.64 **Bighorn Sheep:** Projects or activities that adversely impact bighorn sheep production areas by reducing habitat effectiveness should be limited or avoided, using access restrictions during the following periods (see Figure 2.3.3):

- Rocky Mountain bighorn sheep (*Ovis Canadensis Canadensis*): April 15-June 30.
- Desert bighorn sheep (*O.c. nelsoni*): February 1-May 1.

This guideline is met by administrative allotment boundary adjustments completed under Alternative 4 and Alternative 3 that remove all bighorn sheep production areas from active and forage reserve allotments, thereby maintaining habitat effectiveness within these areas. The removal of all bighorn production areas from active and forage reserve allotments under Alternative 4 and Alternative 3 maintains habitat effectiveness in bighorn production areas and therefore no access restrictions are necessary. For this reason, Alternative 4 and Alternative 3 are in conformance with Guideline 2.3.64. Although Alternative 2 continues to authorize domestic sheep grazing in areas of overlap with bighorn production areas, domestic sheep do not arrive in bighorn production areas until well after the June 30 date shown in this guideline. For this reason, Alternative 2 is in conformance with Guideline 2.3.64.

Guideline 2.3.65 **Bighorn Sheep:** Projects or activities that adversely impact bighorn sheep severe winter range and winter concentration areas by reducing habitat effectiveness should be limited or avoided using access restrictions during the following periods:

- Rocky Mountain bighorn sheep: November 1-April 15
- Desert bighorn sheep: December 1-April 15.

This guideline is met by administrative allotment boundary adjustments completed under Alternative 4 and Alternative 3 that remove all bighorn sheep severe winter range and winter concentration areas from active and forage reserve allotments, thereby maintaining habitat effectiveness within these areas. The removal of all bighorn severe winter range and winter concentration areas from active and forage reserve allotments under Alternative 4 and Alternative 3 maintains habitat effectiveness in bighorn severe winter range and winter concentration areas and therefore no access restrictions are necessary. For this reason, Alternative 4 and Alternative 3 are in conformance with Guideline 2.3.65. Although Alternative 2 continues to authorize domestic sheep grazing in areas of overlap with bighorn severe winter range and winter concentration areas, domestic sheep are not authorized to be in NFS allotments during the season date ranges shown in this guideline. For this reason, Alternative 2 is in conformance with Guideline 2.3.65.

FOREST PLAN RESOURCE DIRECTION FOR LIVESTOCK AND RANGELAND MANAGEMENT

Standard 2.7.11 Grazing permit administration in occupied bighorn sheep habitat must utilize measures to prevent physical contact between domestic sheep and bighorn sheep. Permit administration actions may include but are not limited to use of guard dogs, grazing rotation adjustments, or relocation of salting and bed grounds.

This standard is met by Alternative 4 and Alternative 3. Selecting the Preferred Alternative (Alternative 4) in its entirety is consistent with this standard because it eliminates all areas of overlap between authorized domestic sheep allotments and bighorn CHHR. Because Alternative 4 and Alternative 3 each eliminate all areas of overlap with bighorn CHHR they do not authorize grazing in occupied bighorn sheep habitat and thus they are consistent with Standard 2.7.11. Because Alternative 2 continues to authorize domestic sheep grazing in areas of overlap with bighorn CHHR and does not apply additional management measures designed to prevent physical contact, it is not in conformance with Standard 2.7.11.

Standard 2.7.12 Management of domestic sheep must utilize measures to prevent physical contact with bighorn sheep.

This standard is met, in part, by Alternative 4 and Alternative 3. Selecting the Preferred Alternative (Alternative 4) in its entirety is consistent with part of this standard because it eliminates all areas of overlap between authorized domestic sheep allotments and bighorn CHHR. Because Alternative 4 and Alternative 3 each eliminate all areas of overlap with bighorn CHHR they do not authorize grazing in occupied bighorn sheep habitat and thus they prevent physical contact between the species in the closed areas and therefore are in conformance with part of Standard 2.7.12.

In those areas where domestic sheep grazing is authorized under Alternative 4 and Alternative 3, a wide array of design criteria (EIS Tables 2-3 and 2-4) are applied and administrative allotment boundary adjustments completed that enhance the effectiveness of separation between the species. These management measures are applied with the intent of preventing physical contact between the species in the areas

they are applied. However, given the lack of information, both anecdotal and in the published literature, on the effectiveness of the design criteria to prevent contact, there is uncertainty if this part of Standard 2.7.12 is met or not met.

Because Alternative 2 continues to authorize domestic sheep grazing in areas of overlap with bighorn CHHR and does not apply additional management measures designed to prevent physical contact, it is not in conformance with Standard 2.7.12.

BIGHORN VIABILITY

The National Forest Management Act (NFMA), and the 1982 planning rule implementing that act, requires National Forests to provide habitat in order "to maintain viable populations of existing native and desired non-native species in the planning area" (36 CFR 219.19). The NFMA regulations further define a viable population as "one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area" (36 CFR 219.19). The regulations direct that "In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area". The planning area is defined as the NFS lands included in the Land and Resource Management Plan, the Forest Plan, and thus in this case the planning area is the entire San Juan NF.

The regulations require that conditions be provided to support the species in a "well distributed" pattern throughout the species' range within the planning area. The requirement for a "well distributed" pattern refers to "the geographic distribution of the species and its habitat, and to the biological interactions allowed by that distribution" (Holthausen 2002). Given the meta-population context within which bighorn populations on the San Juan NF are thought to be currently functioning, meeting the "well distributed" requirement includes maintaining the biological interactions among bighorn subgroups that is believed to currently exist across the administrative unit.

The concept of a "well distributed" population should be based on the species' natural history and historical distribution, the potential and actual distribution of its habitat across the planning area, and the fact that the distribution of habitats and populations are likely to be dynamic over time (Holthausen 2002). For the San Juan NF planning area, bighorn sheep summer source habitats have been and remain well distributed in a relatively uniform and interconnected pattern across the eastern, central and some western portions of the planning area. Substantial amounts and distribution of summer source habitats occur across the planning area that are not known or thought likely to be used by bighorn sheep. In essence, bighorn population characteristics and distribution on the Forest cannot be inferred from habitat conditions alone.

Historically, bighorn sheep distribution across the planning area contracted substantially in the early and mid-1900's, especially in the western and northern portions of the planning area. Bighorn distribution has recently (since the late 1990's) expanded and appears to be filling in gaps between CHHRs, especially in the eastern and central portions of the planning area. Overall and across the planning area, bighorn populations have gradually increased and somewhat expanded over the life of the previous Forest Plan. Recent declines in estimated size of two subgroups (S-28 and S-71) may represent normal population fluctuations in response to a dynamic and variable environment. There is some concern

however, that recent estimated declines in S-28 may represent a cause for conservation concern for this subgroup (GMU).

As stated previously, bighorn sheep summer source habitats are well distributed in a relatively uniform and interconnected pattern across the eastern, central and some western portions of the planning area. Given the relatively broadly distributed and interconnected nature of bighorn habitat across the planning area, a well distributed bighorn population is one in which dispersal of individuals among subgroups is maintained and the current pattern of interconnected subgroups well distributed across the eastern and central portions of the planning area is maintained. Retaining the currently interconnected nature of bighorn meta-populations on the planning area is integral to maintaining bighorn sheep as an important species diversity component highlighted within the current Forest Plan's ecological sustainability framework (Andelman et al. 2001). Loss of the current structure of biological connections among subgroups, or of the majority of members of a subgroup (GMU) itself, may cause impairment of ecological function and thus not meet ecological sustainability goals.

Genetic interchange and biological connections among the subgroups that make up a meta-population structure, especially through movements and exchanges of rams, is an important characteristic of bighorn sheep ecology and population structure (George et al. 2009, Beecham et al. 2007). CPW believes that greater attention to population- and meta-population-level management will be the most effective long-term approach to bighorn sheep management in Colorado (USDA Forest Service 2013a, George et al. 2009). Meta-population structure in bighorn sheep typically involves little exchange of ewes among subgroups that comprise relatively discrete herds with separate winter ranges (GMUs), but considerable commingling and exchange of rams representing frequently interacting herd complexes (DAUs)(Beecham et al. 2007). Maintaining the interaction of subgroups that is an intrinsic component of bighorn sheep meta-population function is part of meeting the "well distributed" requirement of NFMA (Holthausen 2002).

There is disagreement over what a minimum population size for bighorn sheep might be. Because of the range of disagreement over what value to place on a minimum population size for bighorn sheep, a determination of the viability of bighorn populations will not be based solely on population size. Holthausen (2002) states that there is no single size at which a population is considered viable and below which it will inevitably become extinct. Beecham et al. (2007) state that although population size alone may not be an accurate predictor of bighorn sheep persistence in any given area, smaller populations and those limited to restricted ranges are generally at greater risk of extirpation than larger populations occupying extended contiguous ranges. Carpenter et al. (2014) describe a minimum population size, the non-viable number, or NVN, as being that population size below which a bighorn sheep herd is "bound to inexorably decline." They used an NVN of 30 individuals and an associated negative growth rate of -16% as inputs for a bighorn sheep disease model. Some researchers have suggested that a minimum population size for bighorn sheep may be around 100 individuals with populations of less than 50 individuals being more likely to decline to extinction (Berger 1990). Others however note multiple incidents where populations smaller than 50 individuals maintained size over time or increased to over 100 individuals, or noted current bighorn populations that were estimated over 50 years ago to have numbered less than 50 individuals and thus should have been extinct (Wehausen 1999).

At present, bighorn sheep herds are distributed across roughly the eastern half of the San Juan NF. Apparently suitable bighorn habitat is well distributed across this same area and extends west to the far northwestern edge of the National Forest administrative unit. Apparently suitable bighorn habitat extends much further to the west across the administrative unit than does habitat known to be currently occupied by bighorn sheep. At this time, bighorn distribution on the administrative unit is not thought to be limited by the availability of suitable habitat.

Currently, habitat believed to be occupied by bighorn sheep (i.e. CPW mapped summer range) extends in a somewhat disjunct fashion from the South San Juan Wilderness in the southeastern portion of the Forest, north to the Wolf Creek Pass area, and west through the central Weminuche Wilderness to west of the Animas River canyon in the West Needle Mountains north of Durango. Within this range, CPW recognizes two separate groups of interacting meta-populations, the Weminuche Population (DAU RBS 20) comprised of GMUs S-15, S-16 and S-28 (the Sheep Mountain, Cimarrona Peak and Vallecito Creek Herds, respectively), and the San Juan Population (DAU RBS 24) comprised of GMUs S-29, S-30 and S-31 (the Alamosa Canyon, Conejos River and Blanco River Herds, respectively). At present, S-71, the West Needles Herd, is thought to be an isolated subgroup (GMU) that is unlikely to regularly interact with other bighorn subgroups (GMUs).

The Weminuche Population (DAU RBS-20) is classified by CPW as a Tier 1 population numbering about 425 animals (Figure 3, below), which is about 73% of the San Juan NF's estimated total bighorn population of 585 animals. A management plan was developed by CPW for the Weminuche population (Weinmeister 2012). The Weminuche Population is believed to be one of only three herds statewide that has received little or no augmentation of individuals. For that reason the Weminuche Population may represent important historic genetic material for the San Juan Mountains and for the state of Colorado. The Weminuche Population, as a Tier 1 population, is placed in the top priority state-wide for inventory and monitoring, habitat protection and improvement, disease prevention, and research (Weinmeister 2012).

At present, the Weminuche Population appears to be performing well as evidenced by continued growth, lamb production, and recruitment. Bighorns are being observed in new areas as they reoccupy historic ranges and fill gaps between CHHR's (USDA Forest Service 2013a). CPW's current population objective is to allow the Weminuche Population to expand to 4.4 bighorns per square kilometer from its current density estimate of 2.2 bighorns per square kilometer (Weinmeister 2012).

CPW believes the Weminuche Population is performing well enough to sustain annual hunter harvest. Each season, CPW issues 12 hunting licenses for the population (4 ram and 2 ewe licenses in S-15, 3 ram and 2 ewe licenses in S-16, and 1 ram license in S-28). There is no disease testing data for the Weminuche Population from which historic disease exposure inferences could be drawn. CPW's existing monitoring data for the population does not indicate the presence of disease in the population or any of its subgroups (GMUs).

Domestic sheep grazing activities in proximity to S-15 are managed by the Pagosa Ranger District, and by the Divide Ranger District of the Rio Grande National Forest (RGNF). There are no active domestic sheep grazing allotments on NFS lands managed by the Pagosa Ranger District in S-15. A 2010 NEPA decision closed all vacant allotments in S-15 on the Pagosa Ranger District due to concerns for the high risk of contact between domestic and

bighorn sheep. Two forage reserve allotments remain available on the Pagosa RD in or immediately adjacent to S-15 (Bonito Crater and Treasure) but intensive surveys would be required before stocking would be permitted. In another recent NEPA decision, the Divide Ranger District on the Rio Grande National Forest vacated the Fisher/Ivy/Goose Allotment in S-15, with concurrence from the permittee, due to concerns for high risk of contact between domestic and bighorn sheep.

There are several domestic sheep and goat grazing allotments on the Divide Ranger District of the Rio Grande NF that overlap or lie adjacent to S-16, but all are currently vacant due in part to concerns for potential for contact with domestic sheep. All domestic sheep allotments on the portions of S-16 and S-28 managed by the Pagosa Ranger District were closed to domestic sheep grazing in 2010 (USDA Forest Service 2010b). Only one sheep allotment in the Weminuche Landscape overlaps S-16 (see Figure 5 at the end of this document, and EIS Figure 1-4), the Pine River Allotment, which has remained vacant since it was last grazed by domestic sheep in 1980.

All allotments that overlap with or are immediately adjacent to S-28 are managed by the Columbine Ranger District, and all of those allotments are being analyzed in this NEPA decision.

The San Juan Population (DAU RBS 24) occurs primarily in the South San Juan Wilderness and adjacent canyons on both sides of the Continental Divide. It is classified by CPW as a Tier 2 population numbering about 210 animals. As a Tier 2 population, CPW still places this population as a priority for inventory and monitoring, habitat protection and improvement, disease prevention, and research over populations that are not considered primary core populations (such as S-71). A DAU management plan has not been completed by CPW for this population. Of the three subgroups (GMUs) that comprise this population, only S-31, the Blanco River Herd, occurs on the San Juan NF and it numbers about 100 animals. The two other subgroups that comprise this interacting meta-population (S-29 and S-30) occur on the Rio Grande NF. Because of the biological connections among subgroups, decisions made by the San Juan NF that affect S-31 have potential to affect the status and viability of two bighorn herds on the Rio Grande NF. CPW believes the San Juan Population is performing well enough to sustain annual hunter harvest. Recently, CPW has issued 5 hunting licenses for the population (1 ram license in S-29, 1 ram license in S-30, and 3 ram licenses in S-31).

Disease testing has recently been completed on samples obtained from the San Juan Population (S. Wait pers. comm.). This data was obtained in conjunction with a project to place GPS tracking collars on bighorn sheep on the Rio Grande NF. These results document the presence of *Mycoplasma ovipneumoniae* and *Mannheimia haemolytica* within subgroups (GMUs) that comprise the San Juan Population. *M. ovipneumoniae* is a bacterium that is strongly associated with bronchopneumonia in bighorn sheep and likely plays a primary role in bighorn sheep pneumonia outbreaks (Besser 2013, Besser et al. 2012b). *M. haemolytica* frequently causes severe bronchopneumonia and the rapid death of bighorn sheep under experimental conditions (Lawrence et al. 2010).

This data documents a history of exposure in the San Juan Population to pathogens known to cause disease in bighorn sheep and indicates the population may be predisposed to the outbreak of disease with potential for a future mortality event. However, CPW's existing monitoring data does not suggest that a disease-based mortality event is currently occurring in the population or any of its subgroups (GMUs). The data confirms the death of individual

animals that tested positive for the presence of pathogens known to cause disease in bighorn sheep but does not document the cause of death of those individuals. It is possible that the disease testing data documents the presence of background levels of pathogens that remain in the population from a disease-based mortality event that occurred in the early 1990's but does not indicate a future disease outbreak event is imminent. At the least, this disease testing data documents the presence in the San Juan Population of pathogens known to cause disease in bighorn sheep and thus is cause for concern about the potential for a future disease outbreak within the population or one of its subgroups (GMUs).

S-71, the West Needles Herd, is an introduced herd that does not meet CPW's criteria for either a Tier 1 or Tier 2 population. For that reason, S-71 is referred to as an "unclassified" population (USDA Forest Service 2013a). CPW does not intend to develop management plans for unclassified herds until after plans have been completed for all Tier 1 and Tier 2 populations. At present, S-71 numbers about 60 animals and appears to be performing well as evidenced by continued population growth, lamb production, and expansion in occupied area. CPW believes the population is performing well enough to sustain annual hunter harvest and issues one ram hunting license per year for the GMU. There is no disease testing data for S-71 from which historic disease exposure inferences could be drawn. CPW's existing monitoring data for S-71 does not indicate the presence of disease in the GMU.

Given the definition of viability presented above, to maintain viability there is a need to maintain sufficient amounts of bighorn habitats well distributed within their current range across the Columbine and Pagosa Ranger Districts of the San Juan NF, and those habitats should be maintained in sufficient condition to support sufficient numbers of animals to retain the meta-population interactions and biological linkages of bighorn subgroups (GMUs) that play a key role in bighorn population function. If the geographic distribution or numbers of individual subgroups (GMUs) contract to the point where biological connections with other subgroups is lost then biological function of the overall meta-population could be lost and viability across the planning area could be reduced.

The overall distribution of bighorns across the planning area has contracted greatly from that postulated in the late 1800's, and somewhat contracted from that known in the 1970's. For example, bighorns have disappeared from wintering areas in the Animas River valley north of the town of Durango known to have been used as recently as the early 1980's and this is presumed to indicate the loss of a sub-group of animals summering in the La Plata Mountains (S. Wait pers. comm.). Also for example, bighorn subgroups were assumed to have occupied the San Juan NF portion of the Lizard Head Wilderness and the Rico Mountains, areas where bighorns have not been known to regularly occur for decades. This again indicates a presumed loss of subgroups. Also for example, the Grenadier Mountains was labelled on a 1908 Forest Service map as being "mountain sheep game refuge" and counts of bighorns in this area were listed as late as 1954 (USDA Forest Service 2013a). Bighorns have not been known to occur in the Grenadier Mountains north of Needle Creek for decades.

As previously described, in the first half of the 20th century as domestic sheep stocking rates were increasing in the San Juan Mountains, bighorn sheep populations were decreasing. Much of the decrease in bighorn populations is thought likely due to the effects of unregulated hunting (Weinmeister pers. comm.). As remnant bighorn herds became smaller and more isolated from each other and more separated from domestic sheep, the potential for physical contact and potential for subsequent disease outbreaks in remnant bighorn herds was also likely reduced. In addition, both black and grizzly bears were present in this area

during this time and thought responsible for substantial losses of domestic sheep. For this reason, domestic sheep herders typically used close herding techniques to reduce losses, which likely further reduced the potential for stray domestic sheep coming into contact with the much smaller and more isolated bighorn herds that remained in the landscape (Weinmeister pers. comm.).

Through the timeframe of the mid-1900's when bighorn populations were at their lowest numbers and distribution across the San Juan NF was at its most restricted and disjunct, the small isolated subgroups of bighorns that remained were almost certainly too small and too disjunct to retain the biological connections and interactions that characterize and maintain the current meta-population structure (Weinmeister pers. comm.). Bighorn sheep were extirpated throughout much of the San Juan Mountains from the late 1800's through the 1960's (Weinmeister 2012). Because of the substantial range contraction that occurred by the mid 1900's, the very low population numbers, highly disjunct nature of their distribution, and presumed loss of biological connections between isolated subgroups, it is unlikely that bighorn populations on the planning unit at that time would have met the definition of viability as it is described in the paragraphs above. Although bighorn sheep persisted within the Landscape across the decades to the present time, the components of a "well distributed" and viable population as described above are unlikely to have been retained during the mid 1900's. For bighorn populations to remain viable there is a need to maintain the biologically interconnected population functions that characterizes their meta-population structure, and retain, for the most part, their geographic distribution across the planning area. For this reason, a population structured similar to that which existed in the mid 1900's, comprised of small numbers restricted to disjunct and isolated subgroups, is unlikely to be considered viable under the definition described above.

Because the Weminuche Population represents nearly three quarters (73%) of the bighorn population and geographic distribution across the planning area, viability across the planning area is closely related to the status and function of the Weminuche Population. A disease event involving the population that represents 73% of the bighorn population on the planning area and roughly half of the geographic distribution across the planning area has potential for being a significant event for viability of bighorn sheep Forest-wide. Of the two herds remaining across the San Juan NF administrative unit, one (the Blanco River Herd S-31) recently tested positive for two pathogens known to cause disease in bighorn sheep and indicates the population may be predisposed to the outbreak of disease with potential for a future mortality event. The second herd (the West Needles Herd S-71) was created within the past 15 years by animals released into historic and apparently suitable habitat. Recent CPW population estimates show this population to be stable but having declined slightly from previously higher numbers (see figure 3, below). Given the status of these two remaining herds, the importance of the Weminuche Population to viability of bighorn sheep across the planning area is high.

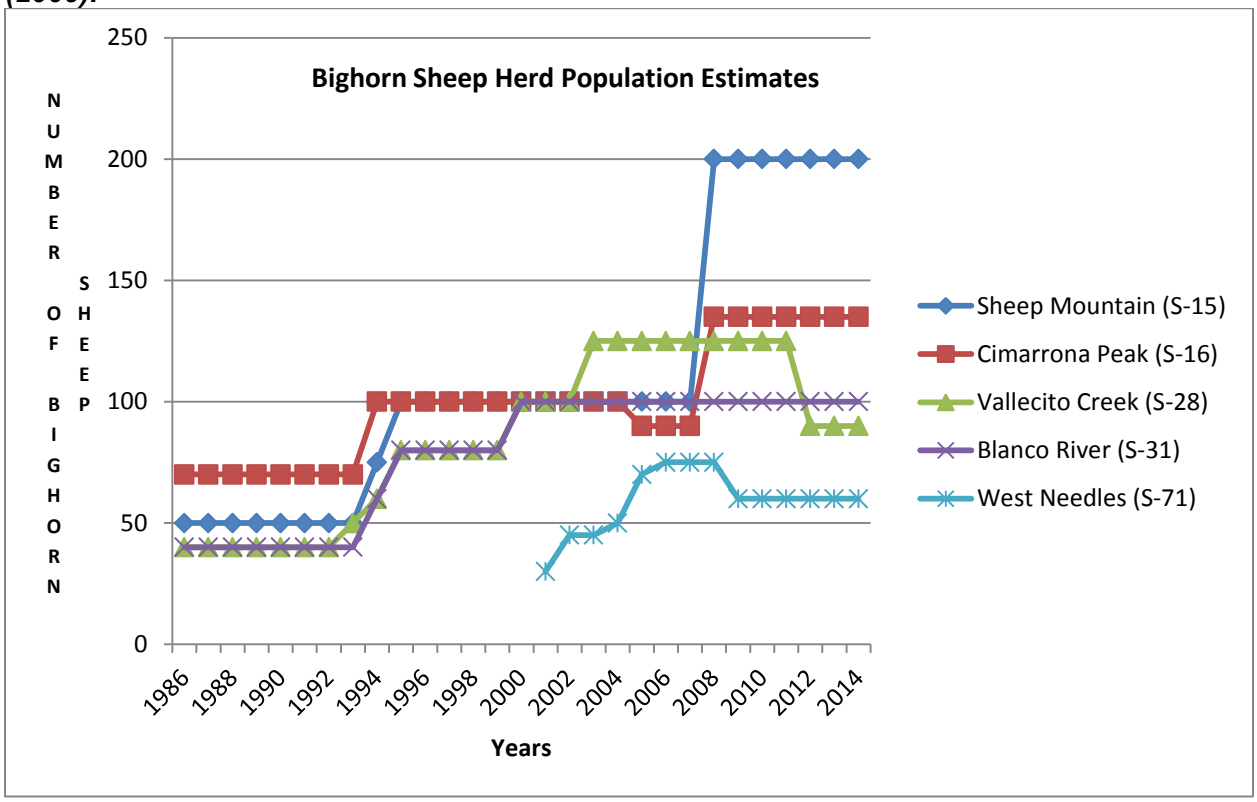
As a result of the range contractions and population declines throughout the early and mid-1900's, the range of bighorn sheep across the planning area remains somewhat reduced from previous decades, particularly in western and northern portions of the planning area. In the past several decades bighorn numbers and distribution have expanded somewhat, but many areas thought to have been formerly occupied appear to remain vacant, and total numbers of animals across the planning area likely remain well below what they were prior to 1900 (Weinmeister pers. comm.).

Bighorn sheep populations on the San Juan NF planning area are believed to be currently viable, as viability is defined in the paragraphs above. Since 1986, the forest-wide estimated number of bighorn sheep has increased from about 200 animals to about 585 animals (Figure 3, below). The number of bighorn herds on the San Juan NF has expanded from four to five after CPW translocations established the S-71 herd in 2003. The extent of the planning area occupied by bighorns has expanded since 1986, and the area thought to be occupied by members of individual herds has expanded for at least three of the five herds on the Forest, S-15, S-16 and S-28 (USDA Forest Service 2013a). Biological connections between subgroups within the Weminuche Population and within the San Juan Population appear to be functioning, and subgroup population sizes appear to be sufficient to maintain meta-population interaction. The one possible exception may be the perception of a recent decline in the total population size of the Vallecito Creek Herd S-28. At present, there is uncertainty whether the recent perceived decline in population estimates for S-28 indicates an extended declining trend that is cause for conservation concern, or if it simply represents a short-term fluctuation that is normal for most populations. For all these reasons, at present, bighorn populations on the San Juan NF planning area appear to be currently viable, as viability is defined under NFMA in the paragraphs above.

Numbers of bighorn sheep within and immediately adjacent to the Weminuche Landscape are believed to have increased during the time span of the current and previous Land and Resource Management Plan (since 1983; see Figure 3, below). CPW's population estimates for GMUs S-15, S-16, S-28 and S-71 increased from a low of 160 animals in 1986 to a high of 535 in 2008. Numbers have declined somewhat since then to 485 animals in 2014. The decline is due to CPW's lowered estimates of numbers of animals in the S-28 and S-71 herds. CPW's population estimates for S-71 declined by 20% after peaking in 2008, and CPW's estimates for S-28 declined by 28% after peaking in 2011. It is unknown if these declining estimates represent cause for conservation concern or reflect normal population fluctuations that are inherent to most biological populations.

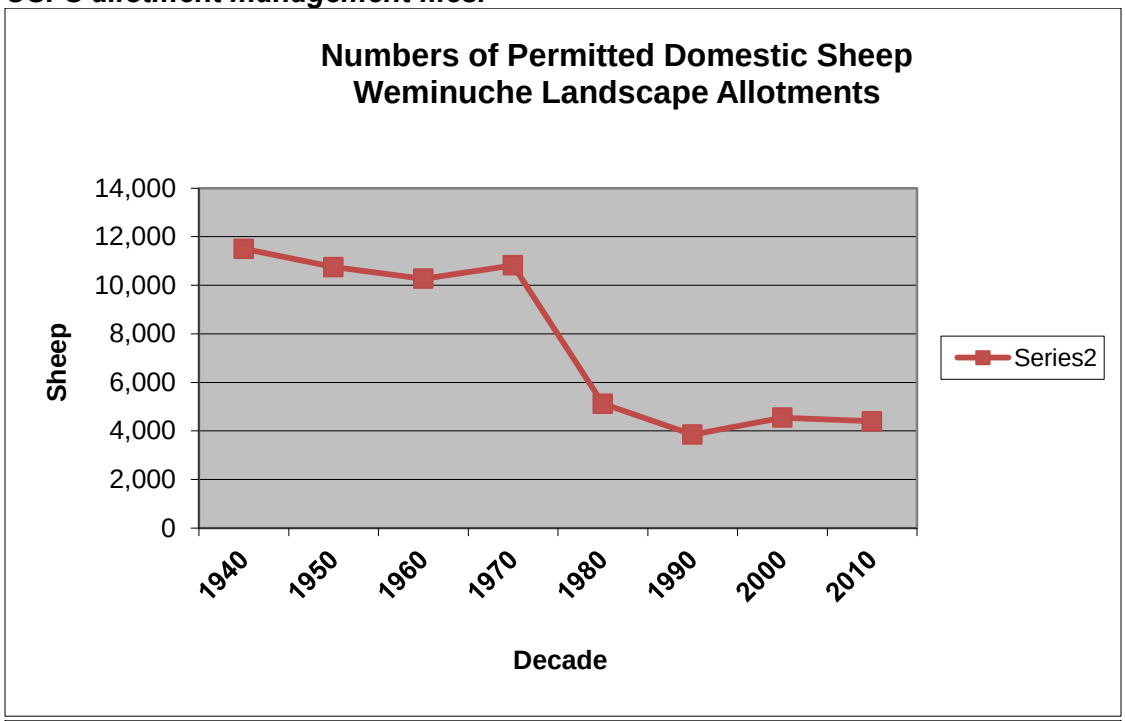
During this same time frame (since 1986) the numbers of domestic sheep permitted to graze allotments within the Weminuche Landscape, and the extent of area within active allotments has remained stable or has slightly declined (see Figure 4, below). Within the Weminuche Landscape, since the early 1980's there has been an essentially stable configuration of active domestic sheep grazing allotments and stocking rates, and bighorn sheep core herd home ranges, with the exception of the introduction of the West Needles bighorn herd beginning in 2000.

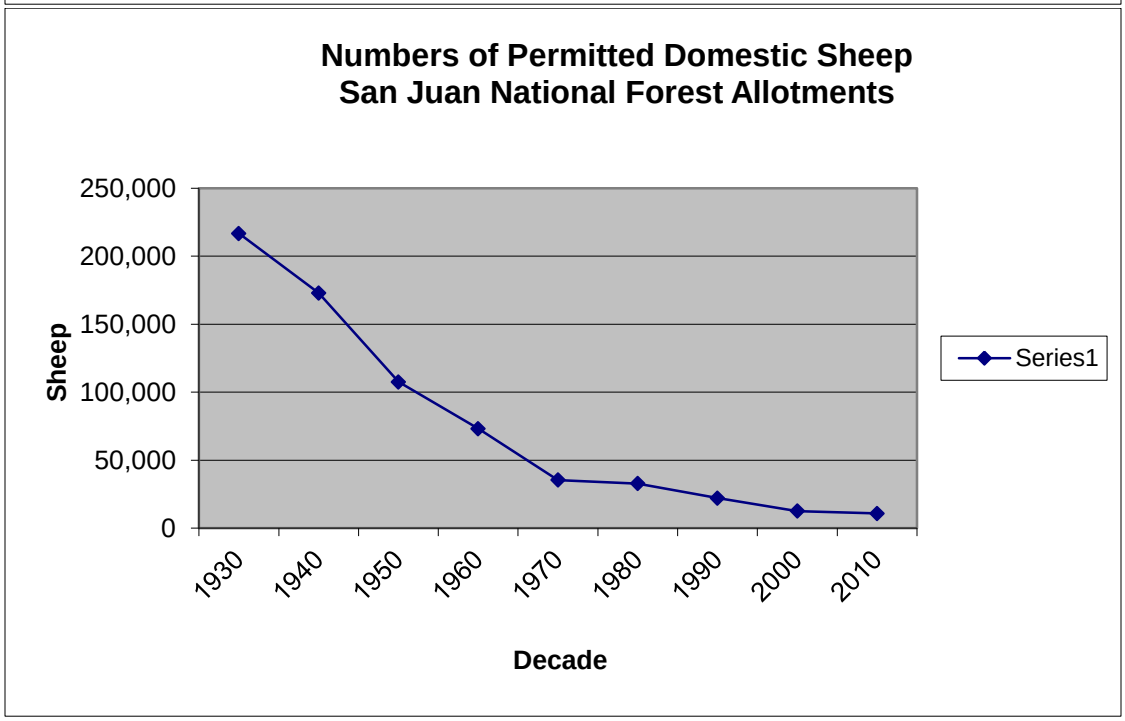
Figure 3. Population estimates, by year since 1986, for bighorn sheep herds that occur on the San Juan National Forest, based on Colorado Parks and Wildlife survey data and George et al. (2009).



Habitat conditions for bighorn sheep are expected to continue to gradually improve under all alternatives, assuming the historic trend of reduced numbers of domestic sheep grazed in the Weminuche Landscape and on the San Juan NF as a whole over the past 40+ years continues (see Figure 4, below). Numbers of domestic sheep permitted to graze in the Weminuche Landscape have dropped about 62% from a high of between about 10,300 and 11,500 animals from the 1940's through the 1970's, down to about 4,400 currently. In addition, numbers of sheep grazed on the San Juan National Forest have dropped about 95% from a high of about 216,600 animals in the 1930's to about 10,800 currently. As numbers of permitted domestic sheep on the San Juan NF and in the Weminuche Landscape have declined, habitat conditions for bighorn sheep have improved and the potential for contact and risk of subsequent disease transmission between the species has declined. Even if numbers of domestic sheep remain relatively stable over the next few (5+) years, a continued gradual improvement in vegetation conditions for bighorn sheep would be expected to continue under all alternatives. This is because even at current domestic sheep stocking levels, the gradual improvement in alpine plant communities observed over the past 40+ years is expected to continue. For the reason of expected continued gradual improvement in vegetation conditions over time, vegetation conditions anticipated under all alternatives are expected to have a neutral to slightly beneficial effect on the currently viable status of bighorn sheep on the San Juan NF planning area.

Figure 4. Numbers of domestic sheep permitted to graze livestock allotments within the Weminuche Landscape and on the San Juan National Forest, by decade since 1940, based on USFS allotment management files.





Domestic sheep grazing activities authorized by the Columbine Ranger District in the Weminuche Landscape since the 1980's has maintained bighorn sheep viability on the planning area. As stated previously in this document, the arrangement of active domestic sheep allotments and bighorn sheep herds (except S-71 which was created by translocations beginning in 2000) has been stable since the 1980's. There is no evidence of a disease-related

mortality event in the bighorn CHHR's of the Weminuche Landscape or anywhere on the San Juan NF, except for the unique Cave Basin event described earlier that did not involve the S-28 CHHR. Every bighorn herd in the Weminuche Landscape has increased in size since the 1980's and is thought to have also expanded somewhat in occupied area. Given the historic presence of domestic sheep grazing activities within the Weminuche Landscape (Figure 4, above), bighorn sheep herds on the San Juan NF planning area have met the definition of viability for greater than the past 30+ years.

Colorado Parks and Wildlife (CPW) appears to believe bighorn sheep herds on the San Juan NF planning area are viable. CPW has issued annual hunting harvest licenses for many years for four of the five herds on the Forest (USDA Forest Service 2013a), excluding S-71 which was created by translocations beginning in 2000. In CPW's judgement, the Forest's bighorn populations are of sufficient size and are performing sufficiently well to sustain some level of annual hunter harvest. By permitting annual bighorn harvest CPW demonstrates they believe the Forest's bighorn herds are viable and capable of supporting limited annual hunter harvest without jeopardizing herd size or population structure.

There have been no documented or hypothesized disease outbreaks within a bighorn CHHR on the San Juan NF (USDA Forest Service 2013a) during the time span of the current and previous Land and Resource Management Plan (since 1983). This covers the entire time span of the NFMA viability requirement. The loss of the introduced bighorns in the Cave Basin Allotment to a disease outbreak in 1988 was a unique event that did not involve the S-28 CHHR and its occurrence did not alter the viability status of bighorn herds on the San Juan NF planning area. All of CPW's monitoring data for S-28 since the incident indicates lamb survival has remained within expected parameters and no consistent population performance indicators have been detected that suggests disease might be resident in any of the Forest's bighorn populations (Weinmeister pers. comm.).

It should be noted however that CPW has conducted little disease testing of bighorns on the San Juan NF. The only known samples from the San Juan NF, taken years ago from S-28, were lost before they could be analyzed. However, as described above, disease testing of samples taken recently (within the past two years) on the Rio Grande NF involving individual animals known to have travelled through S-31 demonstrates the presence of pathogens known to cause respiratory disease in bighorn sheep. Current CPW monitoring data shows no indication of disease in S-31 on the San Juan NF and the herd has no known or hypothesized history of disease outbreaks. Therefore, at this time there is no evidence indicating the recent pathogen detections in animals known to have travelled through S-31 is cause for immediate concern for the viability of the S-31 bighorn herd.

A Forest-wide risk assessment (USDA Forest Service 2013a) conducted for the 2013 Forest Plan revision concluded that after application of Forest Plan resource direction, and in consideration of those factors within the administrative control and jurisdiction of the San Juan NF, it is likely that Forest Plan resource direction will provide for the viability of bighorn sheep populations on the San Juan NF administrative unit during the life of the Plan. The Forest-wide risk assessment concluded that "the potential interaction between bighorn sheep and domestic sheep and goats is the most influential factor that is likely to affect bighorn sheep on the SJNF. Physical contact between bighorn sheep and domestic sheep and goats, with the potential for subsequent disease transmission and a bighorn sheep mortality event, is the primary concern for LRMP implementation."

As stated in the Forest Plan conformance section above, it is concluded that Alternatives 1, 3 and 4 as proposed in the EIS are in conformance with Forest Plan resource direction, Standards and Guidelines and therefore have the potential to maintain bighorn sheep viability on the planning area. Alternative 2 however does not appear to be in conformance with some Forest Plan resource direction and therefore might not maintain bighorn sheep viability on the planning area.

The Forest-wide risk assessment recognized, however, that uncertainty exists due to the potential for activities conducted on adjacent land ownerships and jurisdictions outside the administrative control or jurisdiction of the San Juan NF might affect bighorn populations on the San Juan NF through biological connections within and among bighorn herds shared across administrative boundaries. Therefore potential for direct physical contact between domestic and bighorn sheep still exists in the Weminuche Landscape, even under Alternative 1.

For the reasons stated above, the potential for a disease outbreak still exists in the Weminuche Landscape even in the absence of domestic sheep grazing authorized by the Columbine Ranger District (Alternative 1). This potential for a bighorn disease outbreak exists even under Alternative 1 due to factors outside control of the Columbine Ranger District or from contact that could occur off NFS lands. For these reasons, even selection of Alternative 1, the no grazing alternative, would not guarantee long-term viability of bighorn sheep herds on the San Juan NF administrative unit.

Based on the information presented in the alternative comparisons section above, selecting Alternative 1 provides the greatest likelihood of maintaining bighorn viability across the planning area over the long term (next 10+ years). Considering the action alternatives analyzed in this EIS, Alternative 4 gives the next best chance of maintaining viability across the planning area in the future, compared to the other action alternatives (Alternative 3 and Alternative 2). If Alternative 4 (the preferred alternative) was not selected, Alternative 3 gives a better chance of maintaining bighorn viability in the future than does selecting Alternative 2. Given the information presented above, Alternative 2 does not appear to meet the project's purpose and need, and does not appear to be in conformance with some Forest Plan resource direction, Standards and Guidelines, and has the lowest likelihood of maintaining bighorn sheep viability on the planning area in the future.

Results from the Risk of Contact Tool are discussed below in the context of each alternative's potential to maintain bighorn sheep viability on the planning area. It should be noted that the results of the Risk of Contact Tool do not alter conclusions drawn from other lines of reasoning about bighorn viability on the planning area. If the results from the Risk of Contact Tool are completely disregarded the general conclusions about the potential for maintaining bighorn viability under each of the alternatives analyzed in the EIS would not change in any substantive way.

Results from the Risk of Contact Tool predict Alternative 4 as having the highest potential for maintaining long-term (greater than 10+ years) viability across the planning area, compared to Alternatives 3 and 2. The Risk of Contact Tool predicts Alternative 3 provides a better chance of maintaining bighorn sheep viability than does selecting Alternative 2. The Tool predicts Alternative 2 as having the lowest potential for maintaining viability across the planning area, compared to the other alternatives.

To account for the uncertainties in the science of disease transmission from contact, the Risk of Contact Tool results are presented as years to allotment contact at a 100% disease transmission probability (i.e. every contact results in a disease transmission event), a 25% disease transmission probability (one in four contacts, 25%, results in a disease transmission event), and a 10% disease transmission probability (one in ten contacts, 10%, results in a disease transmission event).

As stated previously, there has been no evidence of a disease transmission event within the bighorn CHHRs of the Weminuche Landscape over the past 40+ years despite a relatively stable configuration of active domestic sheep allotments and bighorn herds. Therefore, based on the past history of the Weminuche Landscape the best correspondence with the Risk of Contact Tool results and monitoring data from the Weminuche Landscape appears to be with the 10% disease transmission rate.

An analysis of bighorn sheep disease outbreak intervals on the Payette NF (USDA Forest Service 2010d) concluded that using a moderate probability of disease transmission given contact (25% of contacts result in a disease transmission event), disease return intervals greater than about every 46 years (total contact rate less than about 0.08) had a high probability of maintaining long-term herd viability. Slightly higher contact rates were predicted to be likely to maintain long-term viability, but disease return intervals more frequent than about every 46 years could produce a low probability but high consequence event. Disease return intervals more frequent than about every 31 years were increasingly less likely to maintain long-term herd viability.

A recent analysis on the Rio Grande NF (USDA Forest Service 2015) stated that disease outbreaks more frequent than about every 32 years would likely eventually extirpate a bighorn herd as a result of regular exposure to disease over time. The analysis concluded that disease events occurring more frequently than every 32 years would result in a “high risk” to bighorn sheep long term viability and a “low probability of population persistence and viability, as evidenced from several local herds”.

In almost all cases, the total herd contact rates predicted by the Risk of Contact Tool for the Vallecito Creek Herd S-28 were higher than those for the West Needles Herd S-71, and much higher than those for the Cimarrona Peak Herd S-16. The total herd contact rates for S-28 indicate that even under the allotment configuration proposed in Alternative 4 there is concern for the potential for physical contact with the Endlich Mesa and Virginia Gulch allotments (Table 41, above). The total herd contact rates for these two allotments exceed the levels thought likely to maintain long-term bighorn herd persistence (one disease event every 46 years), even under an assumption of moderate (25%) and low (10%) disease transmission probability (USDA Forest Service 2013c, USDA Forest Service 2010a, 2010c and 2010d).

For all alternatives, the Vallecito Creek Herd S-28 is predicted by the Risk of Contact Tool to be subject to the highest contact rates of the three bighorn CHHR’s in the landscape, due to the combination of its larger population size and closer proximity to more of the allotments in the landscape. Consistently across all three action alternatives, the S-28 herd had high probability of contact even when the probability of disease transmission is assumed to be low (10%) (see Tables 41, 42 and 43, below).

Table 41. Disease outbreak intervals (in years) for Alternative 2, the current management alternative, based on modeled contact probabilities from the Risk of Contact Tool in the Weminuche Landscape for three levels of disease transmission probability

Disease Transmission Probabilities from Contact: Low (1 in 10; 10%); Moderate (1 in 4; 25%); High (1 in 1; 100%)

Alternative 2	Disease Transmission Rates via Foray (1 Transmission/X Years)								
	Cimarrona Peak S-16			**Vallecito Creek S-28**			**West Needles S-71**		
Allotment	**10%**	**25%**	**100%**	**10%**	**25%**	**100%**	**10%**	**25%**	**100%**
Burnt Timber	4,881	1,952	488	118	47	12	203	81	20
Canyon Creek	24,401	9,760	2,440	456	183	46	10	4	1
Cave Basin	23	9	2	10	4	1	121	49	12
Endlich Mesa	193	77	19	20	8	2	83	33	8
Fall Creek	126	50	13	13	5	1	127	51	13
Flint Creek	14	5	1	10	4	1	231	92	23
Johnson Creek	77	31	8	15	6	1	88	35	9
Leviathan	85	34	9	20	8	2	89	35	9
Pine River	10	4	1	10	4	1	292	117	29
Rock Creek	58	23	6	10	4	1	120	48	12
Spring Gulch				610	244	61	1,935	774	193
Tank Creek	1,307	523	131	90	36	9	10	4	1
Virginia Gulch	212	85	21	34	14	3	55	22	5
Total	4	1	0	1	1	0	3	1	0

CHHR Intersects With Allotment

N/A: Allotment Proposed Closed

N/A: Too Far From Allotment

Active Sheep Allotment

*Maintain Herd Viability

(CHHR = Bighorn Core Herd Home Range)

*Based on USDA Forest Service 2010c

Table 42. Disease outbreak intervals (in years) for Alternative 3, the forage reserves alternative, based on modeled contact probabilities from the Risk of Contact Tool in the Weminuche Landscape for three levels of disease transmission probability

Disease Transmission Probabilities from Contact: Low (1 in 10; 10%); Moderate (1 in 4; 25%); High (1 in 1; 100%)

Alternative 3	Disease Transmission Rates via Foray (1 Transmission/X Years)								
	Cimarrona Peak S-16			**Vallecito Creek S-28**			**West Needles S-71**		
Allotment	**10%**	**25%**	**100%**	**10%**	**25%**	**100%**	**10%**	**25%**	**100%**
Burnt Timber	4,893	1,957	489	118	47	12	204	82	20
Canyon Creek	24,330	9,732	2,433	451	180	45	111	44	11
Cave Basin	Allotment Proposed Closed								
Endlich Mesa	193	77	19	20	8	2	83	33	8
Fall Creek	Allotment Proposed Closed								
Flint Creek	Allotment Proposed Closed								

Johnson Creek	91	36	9	17	7	2	89	36	9
Leviathan	85	34	9	20	8	2	88	35	9
Pine River	Allotment Proposed Closed								
Rock Creek	75	30	8	28	11	3	140	56	14
Spring Gulch				631	253	63	1,969	788	197
Tank Creek	1,124	450	112	80	32	8	50	20	5
Virginia Gulch	211	84	21	34	13	3	55	22	5
Total	21.2	8.5	2.1	4.1	1.6	0.4	10.6	4.2	1.1

Table 43. Disease outbreak intervals (in years) for Alternative 4, the preferred alternative, based on modeled contact probabilities from the Risk of Contact Tool in the Weminuche Landscape for three levels of disease transmission probability

Disease Transmission Probabilities from Contact: Low (1 in 10; 10%); Moderate (1 in 4; 25%); High (1 in 1; 100%)

Alternative 4	Disease Transmission Rates via Foray (1 Transmission/X Years)								
	Cimarrona Peak S-16			**Vallecito Creek S-28**			**West Needles S-71**		
Allotment	**10%**	**25%**	**100%**	**10%**	**25%**	**100%**	**10%**	**25%**	**100%**
Burnt Timber	4,893	1,957	489	118	47	12	204	82	20
Canyon Creek	24,330	9,732	2,433	451	180	45	111	44	11
Cave Basin	Allotment Proposed Closed								
Endlich Mesa	193	77	19	20	8	2	83	33	8
Fall Creek	Allotment Proposed Closed								
Flint Creek	Allotment Proposed Closed								
Johnson Creek	Allotment Proposed Closed								
Leviathan	Allotment Proposed Closed								
Pine River	Allotment Proposed Closed								
Rock Creek	Allotment Proposed Closed								
Spring Gulch				631	253	63	1,969	788	197
Tank Creek	1,124	450	112	80	32	8	50	20	5
Virginia Gulch	211	84	21	34	13	3	55	22	5
Total	90.4	36.1	9.0	9.6	3.9	1.0	15.5	6.2	1.5

Given the presumed biological interaction between members of the S-28 herd and other herds in the Weminuche Population, a disease outbreak in S-28 has potential to spread to other herds in the meta-population, potentially affecting effecting 73% of the Forest's bighorn population. If a mortality event occurred that reduced the size of any of the three herds to the point that subgroup interactions were lost then overall meta-population function within the Weminuche Population could be compromised, potentially reducing bighorn viability on the planning area. Retaining the biological interactions presumed to currently exist among the subgroups plays an important role in maintaining a "well distributed" population in the context of a viable population described above.

For the West Needles Herd S-71, all total herd contact rates for active allotments in Alternative 4 were within the levels thought likely to maintain long-term bighorn herd persistence (one event every 46 years or longer), assuming a low (10%) probability of disease

transmission from contact (see Table 41, above). Under an assumption of moderate disease transmission probability (25%), two out of six allotment contact rates were greater than about every 46 years and thus were within the levels thought likely to maintain long-term bighorn herd persistence (USDA Forest Service 2013c, USDA Forest Service 2010a, 2010c and 2010d). The remaining four allotment contact rates were at levels well below that thought to ensure long-term herd persistence (USDA Forest Service 2013c, USDA Forest Service 2010a, 2010c and 2010d).

For the Cimarrona Peak Herd S-16, all total herd contact rates for active allotments in Alternative 4 were well below the levels thought likely to maintain long-term bighorn herd persistence (one event every 46 years), assuming moderate (25%) and low (10%) disease transmission probabilities.

Therefore, under Alternative 4, the action alternative most likely to maintain bighorn herd persistence in the long term, concern remains for the potential for a disease transmission event in the Weminuche Landscape due to a number of allotment/bighorn herd combinations having predicted total herd contact rates more frequent than the levels thought necessary to maintain herd persistence for the long term. These concerns are greatest for the Vallecito Creek Herd S-28 (39% of allotment/disease transmission probability combinations; see Table 41, above), which is believed to be connected biologically with the Cimarrona Peak Herd S-16 and Sheep Mountain Herd S-15 as members of the interconnected Weminuche Population. For this reason, a disease event involving the Vallecito Creek Herd S-28 is predicted in 39% of allotment/disease transmission probability combinations and could also involve bighorn herds S-16 and S-15 through biological connections among these three herds.

As a sensitive species, individual bighorn sheep and habitats for bighorn sheep may be impacted, but actions should not contribute to a trend towards federal listing or a loss of viability on the planning area. A preponderance of the scientific literature supports the potential for disease to be transmitted from domestic sheep to bighorn sheep to which bighorns have little resistance. There is uncertainty however regarding the precise mechanisms of disease transmission, and uncertainty regarding the rate of physical contact that results in actual disease transmission in the wild. Because of these uncertainties, most management recommendations include physical separation as a best management practice at least until such time as these uncertainties have been further clarified by additional research.

Extensive peer-reviewed scientific literature supports the relationship between disease in bighorn sheep populations and contact with domestic sheep. There is an increasing body of evidence that overwhelmingly demonstrates bighorn sheep near domestic sheep are at risk for disease transmission, even though physical contact between the species may not have been proven. The majority of literature supports the potential for disease transmission between the species, documents bighorn die-offs near domestic sheep, and supports the management goal of separating the species to prevent disease transmission. Providing for effective separation between bighorn and domestic sheep for the purpose of preventing disease transmission and the potential for a subsequent bighorn mortality event meets conservation objectives for sensitive species to provide habitats necessary to provide for long term persistence of bighorn sheep on the administrative unit.

There are a total of five bighorn sheep herds that overlap with the San Juan National Forest (S-15, S-16, S-28, S-31 and S-71), totaling about 585 individuals (USDA Forest Service 2013a). The Weminuche Herd RBS-20 (S-15, S-16 and S-28) totals about 425 individuals, about 73% of the bighorn population on the San Juan NF. If a disease event involved S-28 and was to spread to S-16 and S-15 through the interconnected meta-population structure of the Weminuche Population, there is potential for a disease event to involve a population that comprises about 73% of the bighorn population on the Forest and is recognized to be of high value state-wide. A bighorn mortality event involving about three quarters of the Forest's bighorn population would be a significant event for the administrative unit, though is unlikely to contribute to a trend towards federal listing.

Alternative 4 is consistent with the conservation of a designated sensitive species. Alternative 4 removes all direct overlap between bighorn CHHR and domestic sheep allotments. It removes 77% of bighorn summer source habitats in the Weminuche Landscape from domestic sheep grazing opportunities. In addition, 51% of bighorn source habitat that overlaps with suitable domestic sheep range would be removed from domestic sheep grazing opportunities. Therefore Alternative 4 provides a greater degree of separation between bighorn sheep and domestic sheep grazing opportunities, while also having little effect (about 1% loss) on the amount of domestic sheep grazing acres in currently active allotments. Alternative 4 increases by about half the average distance from bighorn CHHR to allotments, compared to Alternatives 2 and 3. Alternative 4 also reduces the number of allotments ranked "High Risk" for physical contact between bighorn and domestic sheep by about 75%, compared to Alternative 2. Each of these factors demonstrates how Alternative 4 provides greater separation between the species, compared to Alternatives 2 or 3, thereby improving the conservation status of a designated sensitive species on the Columbine Ranger District.

Annual rates of contact calculated by the Risk of Contact Tool in Alternative 4 predict total herd contact rates for all allotments combined for S-16, S-28 and S-71 at 0.12, 1.09 and 0.56, respectively. The lower the probability of contact, the more likely a bighorn sheep population will persist. Assuming a low probability of disease transmission given contact (one in ten, or 10%), S-16 has a high likelihood of long term persistence (greater than 46 years) thereby maintaining viability. S-28 and S-71 have lower likelihoods of long term persistence with predicted disease transmission intervals approximately every 10 years and 20 years, respectively. Because these intervals are predicted to result in multiple disease exposures with potential for multiple bighorn mortality events within a 46 year period, they are predicted to be less likely to maintain long term bighorn herd persistence. S-28 is predicted to have a low probability of long term persistence, and S-71 is predicted to have a moderate probability of long term persistence.

When the probability of disease transmission given contact is assumed to be moderate (one in four, or 25%), S-16 shows a moderate probability of long term persistence in Alternative 4, but S-28 and S-71 are predicted to have low probabilities of long term persistence. At disease transmission rates greater than 25%, such as 100%, the probability of long term persistence for S-16 is also low. The probability of long-term herd persistence is lower for all three bighorn herds under Alternative 3 than under Alternative 4, and lower under Alternative 2 than under Alternative 3.

UNCERTAINTIES

There is uncertainty regarding the applicability of the default values suggested for use with the Risk of Contact Tool to the bighorn sheep herds of the Southern Rocky Mountains. In contrast to Hells Canyon, bighorn habitat in the Weminuche Landscape is dominated by rugged alpine terrain above timberline and is generally not associated with discrete river systems. There is uncertainty about the applicability of foray rates, distances, and probability assumptions in the Risk of Contact Tool developed generally in river and canyon settings compared to the generally high elevation alpine terrain typical of the Weminuche Landscape. There is no data from the Weminuche Landscape by which to test the model's assumptions, especially those related to foraying rates and distances. For this reason, the appropriate level of confidence that should be placed on the total herd contact rates generated by the model is not known. However, this uncertainty is unlikely to vary by alternative and thus there is no reason to believe that the uncertainty associated with the model's default foray values would favor one alternative over another. For this reason, the Tool is unlikely to bias the selection of one alternative versus another.

There is uncertainty how the Risk of Contact Tool predictions for bighorn foray contact rates with an allotment might relate to or potentially equate to predicted rates of physical contact between individual bighorn and domestic sheep within the allotment. If domestic sheep are not grazed equally across the entire allotment, there could be portions of the allotment where the potential for physical contact between the species is less than, or more than, the allotment contact rates predicted by the Risk of Contact Tool. Because the allotment contact rates from the Risk of Contact Tool are based on the point at which the allotment is in closest proximity to the bighorn CHHR the Tool does not account for variations within the allotment in how domestic sheep are distributed across the allotment or how bighorn summer source habitat is distributed within the allotment. For this reason it is not known with certainty how the Tool outputs relate to rates of physical contact between animals within the allotment.

There is additional uncertainty resulting from the potential that an infected bighorn may not survive to return to its CHHR and infect other members of its home herd. It is possible that the rugged nature of the Weminuche Landscape may result in infected bighorns dying from their disease before being able to return and spread the infection to other members of their home herd. Following is additional uncertainty about the intensity of a subsequent mortality event within the bighorn home herd.

To account for these interdependent uncertainties, the total herd contact rates were displayed as interacting with three levels of disease transmission probabilities. A "low" disease transmission probability was considered to be one in ten predicted allotment contacts resulting in a disease transmission event (i.e., a 10% disease transmission probability). The 10% probability was used as the 'low' value because it was felt that a 5% value did not account for the behavioral attractiveness of bighorn and domestic sheep and thus was likely too low (C. Obrien pers. comm., USDA Forest Service 2010a, 2010c, 2010d). A "moderate" disease transmission probability was considered to be one in four contacts resulting in a disease transmission event (25% disease transmission probability). A "high" disease transmission probability was considered to be every contact resulting in a disease transmission event (100% disease transmission probability).

There is uncertainty around interpretation of model results when extrapolating those results to the mountains of southwestern Colorado which has different ecological characteristics and is distant from Idaho where the model was developed. For this reason, it is not known with certainty how much confidence, or conversely the degree of uncertainty, that should be

placed on the precise actual total herd contact values produced by the Risk of Contact Tool for the Weminuche Landscape. Also for this reason, the Risk of Contact Tool is assumed to be of highest value in terms of demonstrating the relative degree of risk of contact among the alternatives being evaluated by the Weminuche EIS.

There is uncertainty in how the Risk of Contact Tool functions in an environment where mountain goats are present in bighorn sheep historic range that is incorporated in the model as bighorn summer source habitat. Mountain goats and bighorn sheep have large overlap in habitat use and diet, and mountain goats are thought to be behaviorally dominant over bighorn sheep (George et al. 2009, Beecham et al. 2007). If so, it is possible that the presence of mountain goats could alter the pattern and prevalence of bighorn foray movements through areas that the model considers to otherwise be suitable for bighorns. There is a strong introduced population of mountain goats in the Grenadier Mountains that borders the northern edge of the Weminuche Landscape inhabiting areas thought to be bighorn historic range and identified as bighorn summer source habitat. CPW has determined this goat population is performing well and sets annual goat harvest seasons. Mountain goats do not occur in the area in which the Risk of Contact Tool was developed. The potential for the presence of mountain goats to alter the manner in which the Tool predicts bighorn foray movements occurring across the landscape creates an unknown degree of uncertainty in the foray-based allotment contact rates generated by the Tool.

Uncertainty regarding the level of confidence that should be placed on the total herd contact values produced by the Risk of Contact Tool is derived from the past history of domestic sheep grazing and presumed bighorn sheep distribution and abundance patterns within the Weminuche Landscape. There is a history of apparent stability over the past 30 to 45+ years of most of the current bighorn sheep herd and domestic sheep allotment configuration in this landscape without evidence of a bighorn disease outbreak. Results from the Risk of Contact Tool predict that multiple contacts with active domestic sheep allotments, and the likelihood of multiple disease transmission events, should have occurred in this landscape during the past 30 to 45+ years. The currently active allotments and the S-28 and S-16 bighorn herds have been in essentially a stable state in their current configurations for decades with no evidence of a mortality event within the landscape's bighorn herds. As stated previously, the unique Cave Basin event in 1988 did not appear to involve the S-28 herd and all evidence today suggests even low-level disease effects are not resident in the S-28 herd.

For example, in 1973 Bear and Jones (1973) stated "there appears to have been very little change in the [S-16] population during the last 27 years" (about 1945-1972), which is a time when there were higher domestic sheep stocking rates and more active allotments than exist in the same area today. Because of the apparent contrast between a past history without evidence of the presence of disease and the strength of the Risk of Contact Tool predictions for contact and disease transmission happening somewhere in the landscape multiple times per decade, there is some uncertainty about the efficacy of the Tool's total herd contact rate predictions.

There may be many reasons for this apparent contrast between a 30 to 45+ year past history of no apparent disease outbreaks, and Risk of Contact Tool predictions for multiple contacts and disease transmission events per decade. The high alpine and extremely rugged nature of many parts of the Weminuche Landscape may result in the presence of unrecognized terrain features or geographic barriers to bighorn sheep movements that alter the foray probabilities from those predicted by the Risk of Contact Tool. The natural tendency for bighorn sheep to

remain in their CHHR may be especially strong in these herds, given the nature of the landscape within which they occur. It is also possible that straying domestic sheep that might pose substantial risks for physical contact in other landscapes have lower survival rates wandering in the rugged terrain of the Weminuche Landscape, thereby reducing the potential for contact that might have otherwise occurred in other areas. The Weminuche Landscape has a suite of predators that can pose a substantial predation risk to straying domestic sheep. Black bear and coyotes are common in the Weminuche Landscape, and mountain lion, bobcat and Canada lynx are also present, though generally less common. Grizzly bear was also found in the Landscape prior to about the 1960's. It is possible that straying domestic sheep are quickly taken by predators, thereby reducing the potential for contact with bighorn sheep.

It is also possible that the random nature of a very few foraying bighorn sheep on a very large and rugged landscape has produced few physical contacts; in essence, bighorns have been lucky enough to not encounter domestic sheep for no other reason than random chance alone over the past 30 to 45 years.

Nonetheless, this contrast between a past history lacking evidence of a disease event and consistent predictions by the Risk of Contact Tool for multiple physical contacts with potential for disease transmission events, especially involving the Vallecito Creek Herd S-28, is not readily explained. This apparent contrast remains a source of uncertainty about how much confidence to place on the precision of the total herd contact values generated by the Tool.

There is uncertainty regarding the pathogen profiles carried by the domestic sheep that are permitted to graze within the Weminuche Landscape, and how those profiles relate to a mix that could cause an all-age mortality event or prolonged periods of reduced lamb survival in bighorn sheep. There are numerous pathogens, some of which are more virulent to bighorn sheep than others (Drew et al. 2014, Besser et al. 2012b). It is possible that contact with domestic sheep has occurred but contact has not yet occurred with a pathogen mix "hot" enough to cause a detectible die off. It is possible that contact with what is known as a "hot" domestic ewe simply hasn't occurred, by chance alone.

It is also unknown how domestic sheep disease profiles might change from year to year. If the pathogen profiles of the domestic sheep bands grazed in the Weminuche Landscape have been relatively consistent over the past three to four decades and the particular mix of pathogens they have carried has been relatively benign to bighorn sheep (Drew et al. 2014, Besser et al. 2012b) then it is possible contact between bighorn and domestic sheep has occurred but that contact has not resulted in a detectible bighorn mortality event. In this case, local bighorn herds may have been regularly exposed to a consistent and relatively mild domestic sheep pathogen profile that has had little population-level effect. In essence, it is possible the Weminuche Landscape has had a consistent history of contact between bighorn and domestic sheep, consistent with the predictions of the Risk of Contact Tool, but that contact has not resulted in chronic reduced lamb survival or a detectible all-age mortality event (e.g., see Group Two research recommendations contained in American Sheep Industry Association 2011).

Consistent with this possibility is the fact that there have been few domestic sheep permittees actively grazing sheep in the Weminuche Landscape over the past 30 to 45 years, primarily two permittees whose sheep bands were linked. There is some evidence these

permittees managed their bands in a relatively closed fashion and this tendency might have reduced the potential for their bands to be introduced to new or "hot" pathogen mixes. If true, there may be greater correspondence between the Risk of Contact Tool predictions and past history than first appears. In essence, there may be regular contact with the active allotments by foraying bighorns, as predicted by the Risk of Contact Tool, and regular physical contact between the species within the active allotments, but bighorn disease outbreaks have not occurred because the pathogen mix carried by the domestic sheep bands is of relatively low virility and has remained relatively consistent for the past 30 to 45 years. Despite the speculative nature of this factor, it is unlikely that questions about domestic sheep pathogen profiles would suggest the selection of one alternative over another.

There is uncertainty regarding the successful implementation of design criteria (BMPs derived primarily from the WAFWA Guidelines) meant to prevent physical contact between the species, and how effective they might be even when fully implemented. It must be recognized that the effectiveness of most individual design criteria have not been tested or verified using a rigorous scientific approach (Highland pers comm. 2014, Western Association of Fish and Wildlife Agencies 2012, American Sheep Industry Association 2011) and their effectiveness remains largely undocumented. There is also little anecdotal evidence available from the Weminuche Landscape, or elsewhere, that we have been able to locate that would suggest the effectiveness of the design criteria to prevent contact. For this reason, the effectiveness of design criteria (BMPs) at preventing contact between the species is difficult to ascertain or describe. The uncertainty about the effectiveness of design criteria makes it difficult to state what degree of risk reduction benefit would be achieved by the application of these measures.

A Forest-wide risk assessment (USDA Forest Service 2013a) conducted for the Forest Plan revision concluded "there is uncertainty about the effectiveness of some WAFWA guidelines. Because of uncertainty about the effectiveness of certain WAFWA Guidelines, application of those guidelines at the project-level must be accompanied by project-level monitoring as part of an adaptive management strategy to document the effectiveness of project design criteria within individual project areas."

The uncertainty about design criteria effectiveness is problematic when design criteria are relied on in large measure to prevent contact within allotments where there is recognized high risk for physical contact, such as Endlich Mesa and Virginia Gulch, that are in close proximity to bighorn CHHR and well connected by bighorn summer source habitat.

The effectiveness of design criteria may become more important over time due to the continuing population increases and presumed range expansions by the S-16 and S-71 bighorn herds. CPW's population objective is to allow the Weminuche Population to increase in size from its current estimate of 2.2 bighorns/square kilometer to the population objective of 4.4 bighorns/square kilometer (Weinmeister 2012). Because foray rates are directly related to bighorn population size (Carpenter et al. 2014, O'Brien et al. 2014), as the Weminuche Population and the West Needles Herd S-71 continue to increase in size and fill in gaps between core herd areas an increase in allotment contacts by foraying bighorns is also expected to occur. As the number of forays reaching active domestic sheep allotments increases, the importance of determining and documenting design criteria effectiveness will also increase.

Although there is uncertainty regarding their effectiveness, it is logical to expect that full and complete implementation of all design criteria has the potential to provide more effective separation between the species (Western Association of Fish and Wildlife Agencies 2012). By extension, it also logical to expect that more effective separation between the species would also reduce the potential for disease transmission between the species and the potential for a subsequent bighorn mortality event. These management measures are applied with the intent of preventing physical contact between the species, and in the areas they are applied there is a presumption that separation effectiveness will be improved by their application. The difficulty in describing their level of effectiveness should not be perceived as disqualifying the generally recognized benefits of their application.

Because of uncertainty about the effectiveness of design criteria, application of project-level monitoring is an important part of the adaptive management strategy to document the general assumption that design criteria enhance separation effectiveness within individual project areas. Failure to apply, monitor, and adjust management practices in an adaptive management context may result in unrealistic confidence being placed in the effectiveness of management practices, with potential for negative consequences to bighorn sheep. The rugged and remote nature of much of the Weminuche Landscape could make monitoring activities more difficult and time consuming, as compared to other landscapes with more accessible and gentle terrain.

Discussions with the permittees concluded that the design criteria included as part of Alternatives 3 and 4 (EIS Tables 2-2 and 2-3) are reasonable and feasible. It is generally agreed that these design criteria are expected to enhance the effectiveness of separation in the Weminuche Landscape.

There is uncertainty regarding how the known behavioral attraction between domestic and bighorn sheep could increase the risk of contact within the landscape, above that predicted by the Risk of Contact Tool. The tool does not consider or attempt to model the natural attractive instincts of bighorn and domestic sheep (Wehausen et al. 2011, Beecham et al. 2009). While on forays, because of this mutual attraction, bighorns are more likely to come into contact with domestic sheep bands. Also, domestic sheep strays are more likely to contact bighorn sheep bands while traveling across the landscape. The effect of this mutual attraction is likely to increase potential for physical contact between the species, if they are present in the same area at the same time. However, the degree of increased potential for contact is not known. Because there should be equal risk under all three action alternatives from this factor, behavioral attraction is unlikely to suggest the selection of one alternative versus another.

Given the known behavioral attraction between bighorn and domestic sheep, it is important to note that the domestic sheep permittees report they have not seen bighorn sheep in their allotments during the decades they have operated their grazing permits. It must be recognized that their combined observational experience across multiple allotments and spanning decades of time is extensive, and has resulted in no reported bighorn observations. This extensive history with a lack of bighorn observations indicates that if bighorn forays are occurring within the active allotments they may be very rare and/or difficult to detect.

It must also be acknowledged however, that during the summer of 2015 a Forest Service employee speaking Spanish with several herders was told that bighorn sheep were occasionally seen near the domestic bands. The herders stated that bighorns were not seen

to comingle with domestics, but instead were seen at higher elevations on neighboring peaks. The herders specifically differentiated between bighorn sheep, deer and elk observations. These statements appear to confirm the occasional presence of foraying bighorn sheep in proximity to domestic sheep bands within the Weminuche Landscape.

There is uncertainty regarding stray domestic sheep and the risk of physical contact with bighorn sheep posed by strays outside their permitted allotment. By definition, a domestic sheep must leave its permitted allotment before being classified as a stray. The tool does not consider or attempt to model the movements (i.e. forays) of domestic sheep straying away from their home bands and outside their permitted allotment. Straying domestic sheep are more likely to seek out and comingle with bighorn sheep while they are straying than are domestics that remain within their permitted allotments due to the natural behavioral attraction of bighorn and domestic sheep (Shannon et al. 2014, Wehausen et al. 2011, Beecham et al. 2009). For this reason, straying domestic sheep increase the likelihood of physical contact occurring between the species especially when trailing in or near bighorn CHHR. The presence of strays on the landscape is likely to increase the risk of physical contact between the species. However, the rate of domestic sheep strays in the Weminuche Landscape is not known and thus it is not possible to determine with certainty to what degree strays might increase the risk of physical contact between domestic and bighorn sheep. Design criteria have been developed that address domestic sheep strays, but the effectiveness of these measures are not known. Despite the best efforts of permittees and their herders stray domestic sheep are known to occur often from trailing to and from summer ranges. The effect the rugged Weminuche Landscape might have on reducing and/or containing strays is also unknown.

There is uncertainty regarding bighorn sheep foraying from herds in the Weminuche Landscape coming into contact with domestic sheep off NFS lands. There are risk factors outside the scope of the Forest's authority or control which may influence bighorn sheep populations in the Weminuche Landscape. For example, domestic sheep on private lands or adjacent jurisdictions may be contacted by foraying bighorns, which then return to their home herd in the landscape, potentially introducing disease to the herd and thereby affecting bighorn populations in the landscape. In some cases, adjacent private landowners or jurisdictions do not manage their lands to prevent circumstances that could lead to disease transmission to bighorn herds that share a common landscape with the SJNF. How the risk of contact between bighorn and domestic sheep is managed off NFS lands is beyond the control of the Forest. We are not aware of bands of domestic sheep on non-NFS lands within about 10 miles of the bighorn herds in the Weminuche Landscape. Further, there should be equal risk under all three action alternatives from this factor and therefore this uncertainty is unlikely to suggest selection of one alternative over another. In addition, the presence of factors that are outside the control of the Agency does not reduce the obligation the agency has to analyze and address those factors that are within the agency's discretion and management authority.

There is uncertainty regarding the connectedness of subgroups within the Weminuche Population itself, and outside the population with other adjacent bighorn herds. The individual herds within the Weminuche Population are grouped into a single meta-population due to their presumed regular interaction and biological connections. The level of interaction and rate of genetic interchange, primarily through exchange of rams, is not known with certainty but is presumed to be regular and consistent. Additionally, it is not known how much interaction there is between the population and adjacent bighorn herds such as S-71,

S-33, and S-53, or with the San Juan Population (DAU RBS-24). In the case of a disease event occurring within one herd of the Weminuche Population, it is not known what the potential rate of spread might be within the population, or what the potential is for disease to spread beyond the Weminuche Population and impact other adjacent herds outside the Weminuche Landscape. Bighorn sheep collaring projects involving animals on the nearby Rio Grande National Forest has shown movement more than expected from one herd unit into another (USDA Forest Service 2015).

There is uncertainty regarding changes in bighorn sheep movement patterns across the Weminuche Landscape in response to habitat changes produced by a spruce beetle (*Dendroctonus rufipennis*) epidemic that is rapidly expanding from northern and eastern portions of the Landscape towards southern and western portions of the Landscape. Large stands of Engelmann spruce has either died or is dying, causing extensive openings in the overstory forest canopy. For example, within the past five years, the upper third of the Pine River and Vallecito Creek drainages have had extensive areas of mortality of mature Engelmann spruce trees, in some areas exceeding 80% to 90% of mature overstory trees. Within stands affected by spruce beetles, there is a high probability that most spruce trees over five inches diameter will die. Within the next five years the beetle outbreak is expected to expand down the Pine River and Vallecito Creek drainages, and is expected to increase in the upper Florida River and Missionary Ridge portions of the Weminuche Landscape.

Spruce mortality resulting from this beetle epidemic is expected to increase forbs and grasses in the understory of previously closed-canopy stands. For this reason, the beetle epidemic has the potential to substantially alter habitat conditions for bighorn sheep, likely improving habitat connectivity for bighorn sheep in the most heavily affected areas. Beetle epidemics have the potential to substantially open the canopy of mature closed-canopy stands, potentially greatly improving bighorn forage and travel habitats. Most forests in the landscape are mature closed-canopy spruce-fir stands that are at risk to beetles. In northern and eastern portions of the landscape that have many already heavily affected forest stands, bighorn mobility across the landscape could be enhanced, thereby increasing the potential for foraying bighorns to contact active allotments and come into physical contact with domestic sheep. Spruce beetle impacts could also improve forage availability for domestic sheep in heavily affected stands, thereby increasing the amount of time domestic sheep spend in areas that were previously unsuitable due to lack of forage. In this case, future rates of allotment contact by foraying bighorns could be greater than those predicted today by the Risk of Contact Tool under conditions of closed-canopy spruce-fir stands dominating the landscape. However, because there should be equal risk under all three action alternatives from this factor, the uncertainty associated with this factor is unlikely to suggest selection of one alternative over another.

LITERATURE CITED

American Sheep Industry Association. 2011. Bighorn working session recommendations, June 14, 2011. Unpublished document. 2 pp. Available on the internet at: *http://amhealthmaster.http.internapcdn.net/AMHealthMaster/DOCUMENT/SheepUSA/bighorn_working_sessions.pdf*

Andelman, S. J., S. Beissinger, J. F. Cochrane, L. Gerber, P. Gomez-Priego, C. Groves, J. Hofler, R. Holthausen, D. Lee, L. Maguire, B. Noon, K. Ralls, and H. Regan. 2001. Scientific standards for conducting viability assessments under the National Forest

Management Act: report and recommendations of the NCEAS working group. Unpublished report, National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, CA.160 pp. Available on the internet at: *http://www.treesearch.fs.fed.us/pubs/3467*

Aune, K., N. Anderson, D. Worley, L. Stackhouse, J. Henderson, and J. Daniel. 1998. A comparison of population and health histories among seven Montana bighorn sheep populations. Biennial Symposium of the Northern Wild Sheep and goat Council. 11:46-69.

Bear, G.D., and G.W. Jones, 1973. History and distribution of bighorn sheep in Colorado. Colorado Division of Wildlife Game Research Report. 232pp.

Beecham, J. J., C. P. Collins, and T. D. Reynolds 2007. Rocky Mountain bighorn sheep (*ovis canadensis*): a technical conservation assessment. [Online]. USDA Forest Service, Rocky Mountain Region. Available on the internet at: *http://www.fs.fed.us/r2/projects/scp/assessments/rockymountainbighornsheep.pdf.*

Berger, J. 1990. Persistence of different-sized populations: an empirical assessment of rapid extinctions in bighorn sheep. Conservation Biology 4:91-98.

Besser, T. E. 2013. Whodunit: what causes pneumonia outbreaks in bighorn sheep? Wild Sheep: Fall 2013.

Besser, T. E., E. F. Cassirer, C. Yamada, K. A. Potter, C. Herndon, W. J. Foreyt, D. P. Knowles, and S. Srikumaran. 2012a. Survival of bighorn sheep (*Ovis canadensis*) commingled with domestic sheep (*Ovis aries*) in the absence of *Mycoplasma ovipneumoniae*. Journal of Wildlife Diseases 48:168-172.

Besser, T. E., M. A. Highland, K. Baker, E. F. Cassirer, N. J. Anderson, J. M. Ramsey, K. Mansfield, D. L. Bruning, P. Wolff, J. B. Smith, and J. A. Jenks. 2012b. Causes of pneumonia epizootics among bighorn sheep, Western United States, 2008-2010. Emerging Infectious Diseases 18:406-414.

Besser, T. E., E. F. Cassirer, M. A. Highland, P. Wolff, A. Justice-Allen, K. Mansfield, M. A. Davis, and W. Foreyt. 2012c. Bighorn sheep pneumonia: sorting out the cause of a polymicrobial disease. Preventive Veterniary Medicine 108:85-93.

Besser, T. E., E. F. Cassirer, M C. Yamada, K. A. Potter, C. Herndon, W. Foreyt, and D. P. Knowles. 2012d. Survival of bighorn sheep (*Ovis canadensis*) commingled with domestic sheep (*Ovis aries*) in the absence of *Mycoplasma ovipneumoniae*. Journal of Wildlife Diseases 48:000-000.

Besser, T. E., E. F. Cassirer, K. A. Potter, K. Lahmers, J. L. Oaks, S. Shanthalingam, S. Srikumaran, and W. J. Foreyt. 2014. Epizootic pheumonia of bighorn sheep following experimental exposure to *Mycoplasma ovipneumoniae*. PLoS One 9:e110039.

Cahn, M. L., M. M. Conner, O. J. Schmitz, T. R. Stephenson, J. D. Wehausen, and H. E. Johnson. 2011. Disease, population viability, and recovery of endangered Sierra Nevada bighorn sheep. Journal of Wildlife Management 75:1753-1766.

Carpenter, T. E., V. L. Coggins, C. McCarthy, C. S. O'Brien, J. M. O'Brien, and J. J. Schommer. 2014. A spatial risk assessment of bighorn sheep extirpation by grazing domestic sheep on public lands. Preventive Veterniary Medicine 114:3-10.

Cassirer, E. F., R. K. Plowright, K. R. Manlove, P. C. Cross, A. P. Dobson, K. A. Potter, and P. J. Hudson. 2013. Spatio—temporal dynamics of pheumonia in bighorn sheep. Journal of Animal Ecology 82:518-528.

Colorado Parks and Wildlife. 2013a. Memorandum of understanding for management of domestic sheep and bighorn sheep. October 14, 2013. 4 pp.

Colorado Parks and Wildlife. 2013b. Memorandum of understandingbetween the Ute Mountain Ute Tribe and the State of Colorado concerning wildlife management and enforcement in the Brunot area. January 2013. 10 pp. Available on the internet at: *http://cpw.state.co.us/Documents/Commission/2013/Jan/January2013Minutes.pdf*

Council for Agricultural Science and Technology (CAST). 2008. Pasteurellosis transmissino risks between domestic and wild sheep. CAST Commentary QTA 2008-1. CAST, Aimes, IA. 8 pp.

Diamond, B. 2005. Abbreviated summary for Unit S-33, the Pole Mountain/Upper Lake Fork bighorn sheep herd. Unpublished report, Colorado Division of Wildlife, Fort Collins, CO. 6 pp.

Drew, M. L., K. M. Rudolph, A. C. S. Ward, and G. C. Weiser. 2014. Health status and microbial (Pasteurellaceae) flora of free-ranging bighorn sheep following contact with domestic ruminants. Wildlife Society Bulletin 38:332-340.

DuBois, C. 1903. Report on the proposed San Juan Forest Reserve, Colorado. Unpublished Report, on file at San Juan National Forest Supervisor's Office, 15 Burnett Court, Durango, CO 81301.

Eichhoff, K., B. Dreher, S. Huwer, S. McClean, J. Stiver, S. Steinhoff, and J. George. 2012. Bighorn sheep suitable habitat modeling in Colorado – 22 Jan 2012. Unpublished Report, prepared by Colorado Parks and Wildlife, Denver, CO. 18 pp.

George, J. L., D.J. Martin, P.M. Lukacs and M.W. Miller. 2008. Epidemic Pasteurellosis in a bighorn sheep population coinciding with the appearance of a domestic sheep. Journal of Wildlife Diseases 44:388-403

George, J. L., R. Kahn, M.W. Miller, and B. Watkins. 2009. Colorado Bighorn Sheep Management Plan 2009 – 2019. Colorado Division of Wildlife Special Report 81. Colorado Division of Wildlife, 6060 Broadway, Denver, CO, 80216. 88 pp.

Holthausen, R. S. 2002. White paper on managing for population viabiliy, draft July 2002. Unpublishied report, prepared for USDA Forest Service, 37 pp. Available on the internet at: *http://fsweb.r2.fs.fed.us/rr/ecology/viability-sustainability/index.shtml*

Jeffress, J. 2008. Transmission of *Pasteurella haemolytica* between domestic sheep and a

free-ranging bighorn ewe. Bienn. Symp. North. Wildl. Sheep. And goat Council 16:160.

Krausman, P. R., R. C. Etchberger, and R. M. Lee. 1996. Persistence of mountain sheep populations in Arizona. Southwestern Naturalist 41:399-402.

Lawrence, P. K., S. Shanthlingam, R. P. Dassanayake, R. Subramianam, C. N. Herndon, D. P. Knowles, F. R. Rurangirwa, W. J. Foreyt, G. Wayman, A. M. Marciel, S. K. Highlander, and S. Srikumaran. 2010. Transmission of Mannheimia haemolytica from domestic sheep (Ovis aries) to bighorn sheep (Ovis canadensis): unequivocal demonstration with green flourescent protein-tagged organisms. Journal of Wildlife Diseases 46:706-717.

Martin, K. D., T. J. Schommer, and V. L. Coggins. 1996. Literature review regarding the compatibility between bighorn and domestic sheep. Proceedings of the Tenth Biennial Symposium of the Northern Wild Sheep and Goat Council 10:72-77.

Miller, M. W. 2011. Update on bighorn sheep vaccines. Unpublished document. 8 pp. Available on the internet at: *http://amhealthmaster.http.internapcdn.net/AMHealthMaster/DOCUMENT/SheepUSA/update-on-bighorn-sheep.pdf*

Onderka, D. K., and W. D. Wishart. 1984. A major bighorn sheep die-off from pneumonia in southern Alberta. Proceedings of the Fourth Biennial Symposium of the Northern Wild Sheep and Goat Council 4:356-363.

Quimby, C. 2005. A practical approach to adaptive management with a special focus on livestock management NEPA based decisions. Unpublished Report. USDA Forest Service, 740 Simms St, Golden, CO, 80401. 28 pp.

O'Brien, J. M., C. S. O'Brien, C. McCarthy, and T. E. Carpenter. 2014. Incorporating foray behavior into models estimating contact risk between bighorn sheep and areas occupied by domestic sheep. Wildlife Society Bulletin 38:321-331.

Roberts, Paul H. 1963. Hoof prints on forest ranges: the early years of National Forest range administration. The Naylor Company. San Antonio, Texas.

Rudolph, K. M., D. L. Hunter, W. J. Foreyt, E. F. Cassirer, R. B. Rimler, and A. C. S. Ward. 2003. Sharing of *Pasteurella* spp. between free-ranging bighorn sheep and feral goats. Journal of Wildlife Diseases 39:897-903.

Schommer, T., and M. Woolever. 2001. A process for finding management solutions to the incompatibility between domestic and bighorn sheep. USDA Forest Service, Washington, DC. 62 pp.

Scott, M. R. 1932. History of the San Juan National Forest. On File. Pagosa Ranger District, San Juan National Forest.

Sells, S. N, M. S. Mitchell, J. J. Nowak, P. M. Lukacs, N. J. Anderson, J. M. Ramsey, J. A. Gude, and P. R. Krausman. 2015. Modeling risk of pneumonia epizootics in bighorn sheep. Journal of Wildlife Management 79:195-210.

Shannon, J. M., J. C. Whiting, R. T. Larsen, D. D. Olson, J. T. Flinders, T. S. Smith, and R. T. Bowyer. 2014. Population response of reintroduced bighorn sheep after observed commingling with domestic sheep. European Journal of Wildlife Research 60:737-748.

Singer, F.J., L.C. Zeigenfuss, and L. Spicer. 2001. Role of patch size, disease, and movement in rapid extinction of bighorn sheep. Conservation Biology 15:1347-1354.

Srikumaran, S. 2011. Letter to Wild Sheep Foundation regarding the development of a vaccine against pneumonia for use in bighorn sheep in the field. Unpublished Letter, Washington State University, Pullman, WA 99164. 1 pp.

Subramaniam, R., S. Shanthalingam, J. Bavananthasivam, A. Kugadas, K. A. Potter, W. J. Foreyt, D. C. Hodgins, P. E. Shewen, G. M. Barrington, D. P. Knowles, and S. Srikumaran. 2011. A multivalent *Mannheimia-Bibersteinia* vaccine protects bighorn sheep against *Mannheimia haemolytica* challenge. Clinical and Vaccine Immunology 18:1689-1694.

The Wildlife Society. 2015. The Wildlife Society & American Association of Wildlife Veterinarians joint issue statement, domestic sheep and goats disease transmission risk to wild sheep, approved March 8, 2015. Available on the internet at: http://wildlife.org/wp-content/uploads/2015/03/WS-DS_DiseaseTransmission_TWS-AAWV_JointStatement_APPROVED.pdf. Accessed 4/23/2015.

Tucker, M. Personal communications with Mark Tucker, Range Program Manager, San Juan National Forest, Durango, CO.

USAHA Joint Working Group. 2009. Recommendations on best management practices for domestic sheep grazing on public land ranges shared with bighorn sheep. United States Animal Health Association Joint Working Group, Committee of Wildlife Diseases & Committee on Sheep and Goats, October 2009. Available on the internet at: http://www.bighornsheep.org/article_USAHA%20Joint%20Working%20Group%20FINAL2_091109.pdf

USDA Forest Service. 1954. Management – San Juan annual report, Durango, April 29, 1954, Colorado State Game Department figures on mountain sheep population, Paul G. Lundell, Assistant Forest Supervisor. Unpublished Report, 1 pp.

USDA Forest Service. 2010a. Record of Decision for the: Final Supplemental Environmental Impact Statement and forest plan amendment identifying suitable rangeland for domestic sheep and goat grazing to maintain habitat for viable bighorn sheep populations. Supplemented July 2010. Payette National Forest, 800 West Lakeside Ave, McCall, ID 83638. 38 pp. Available on the internet at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5238683.pdf

USDA Forest Service. 2010b. Environmental Assessment, Decision Notice and Finding of No Significant Impact, and Risk Assessment for the Pagosa Sheep Grazing Analysis. USDA Forest Service, San Juan National Forest, Pagosa Ranger District.

USDA Forest Service. 2010c. Appendix M, occupancy,risk, and the potential for contact report. Payette National Forest, 800 West Lakeside Ave, McCall, ID 83638. 13 pp. Available on the internet at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5238661.pdf

USDA Forest Service. 2010d. Chapter 3. Affected environment and environmental consequences, terrestrial wildlife habitat and species. Payette National Forest, 800 West Lakeside Ave, McCall, ID 83638. 93 pp. Available on the internet at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5238679.pdf

USDA Forest Service. 2010e. Update to the draft supplemental to the final environmental impact statement for the southwest Idaho ecogroup land and resource management plans, January 2010. Appendix B, modeling and analysis technical report. Payette National Forest, 800 West Lakeside Ave, McCall, ID 83638. 69 pp. Available on the internet at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5238681.pdf

USDA Forest Service. 2011a. USDA Forest Service, bighorn sheep analysis for NEPA documents, letter R-1, 2, 3, 4, 5 and 6. Joel D. Holtrop, Deputy Chief, Washington Office, Washington D.C. (August 19, 2011).

USDA Forest Service. 2011b. USDA Forest Service, bighorn sheep analysis for NEPA documents letter, Glenn Casamassa, Action Deputy Regional Forester, Rocky Mountain Region, Denver, CO. (September 14, 2011).

USDA Forest Service. 2012. USDA Forest Service, bighorn sheep analysis for NEPA documents letter, Leslie A. C. Weldon, Deputy Chief, National Forest Sytem, Washington Office, Washington D.C. (June 11, 2012).

USDA Forest Service. 2013a. Risk Assessment and Viability Analysis for Rock Mountain Bighorn Sheep on the San Juan National Forest, August 21, 2013. 65 pp. Unpublished Report, on file at San Juan National Forest Supervisor's Office, 15 Burnett Court, Durango, CO 81301.

USDA Forest Service. 2013b. Bighorn sheep risk of contact tool users guide. USDA Forest Service, Intermountain Region, January 2013. Unpublished Document, prepared by USDA Forest Service Bighorn Sheep Working Group, and Critigen, Inc. 76 pp.

USDA Forest Service. 2013c. Bighorn sheep risk of contact tool, frequently asked questions, version 1.0. Unpublished Document, prepared by USDA Forest Service Bighorn Sheep Working Group. 12 pp.

USDA Forest Service 2013d. Region 2 Regional Forester's Sensitive Species List, FSM R2 Supplement 2600-2013-1, August 24, 2013.

USDA Forest Service 2013e. Volume II: Final San Juan National Forest and proposed Tres Rios Field Office land and resource management plan. USDA Forest Service, San Juan National Forest, 15 Burnet Court, Durango, CO 81301. 328 pp. Available on line at http://www.fs.usda.gov/goto/sanjuan/planning.

USDA Forest Service. 2014a. USDA Forest Service, bighorn sheep analysis for NEPA

documents letter, Leslie A. C. Weldon, Deputy Chief, National Forest Sytem, Washington Office, Washington D.C. (July 31, 2014).

USDA Forest Service. 2014b. USDA Forest Service, bighorn sheep analysis for NEPA documents letter, Jacqueline A. Buchanan, Director, Renewable Resources, Rocky Mountain Region, Denver, CO. (August 29, 2014).

USDA Forest Service. 2015. Assessment of risk of physical contact between Rocky Mountain bighorn sheep a domestic sheep in the Snow Mesa sheep allotment grazing landscape, Rio Grande National Forest, Divide Ranger District. Environmental Assessment for comment, Snow Mesa sheep allotments, USDA Forest Service, Rio Grande National Forest, Divide Ranger District, 13308 W. Highway 160, Del Norte, Colorado 81132, August 2015, 71 pp. Available on the internet at: http://www.fs.usda.gov/project/?project=42886

Wait, S. Personal communications with Scott Wait, Regional Terrestrial Biologist, Colorado Department of Parks and Wildlife, Southwest Regional Office, Durango, CO.

Wehausen, J. D. 1999. Rapid extinction of mountain sheep populations revisited. Conservation Biology 13:378-384.

Wehausen, J. D., S. T. Kelley, and R.R. Ramey II. 2011. Domestic sheep, bighorn sheep, and respiratory disease: a review of experimental evidence. California Fish and Game 97:7-24.

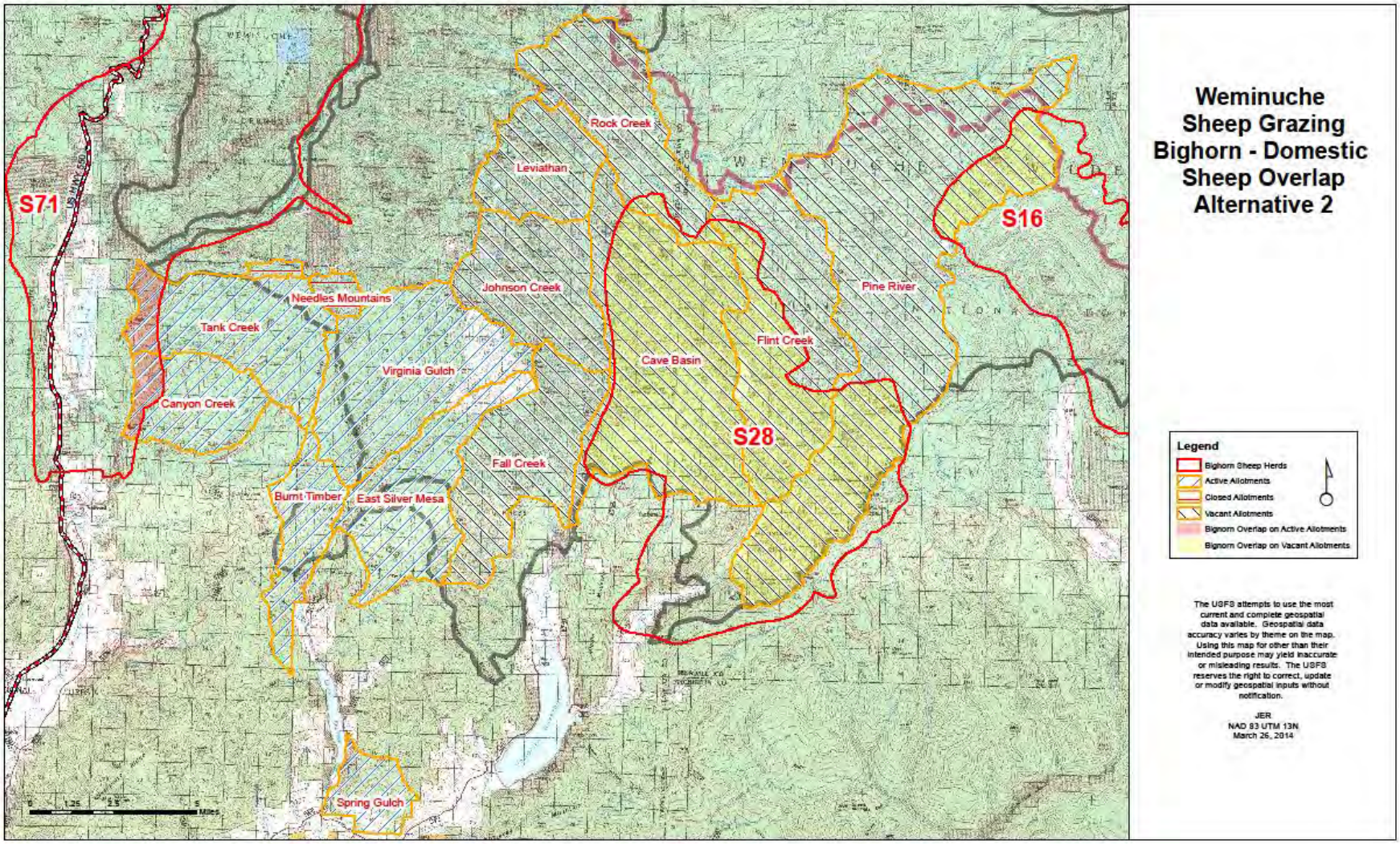
Weinmeister, B. 2012. Bighorn sheep management plan, data analysis unit RBS-20, Weminuche Herd. game management units S15 (Sheep Mountain), S16 (Cimarrona Peak), S28 (Vallecito). Colorado Parks and Wildlife. 67 pp. Available on the internet at: http://cpw.state.co.us/Documents/Hunting/BigGame/DAU/BighornSheep/RBS20DAUPlan.pdf

Weinmeister, B. Personal communications with Brad Weinmeister, Terrestrial Biologist, Durango Area Office, Colorado Department of Parks and Wildlife, Durango, CO.

Western Association of Fish and Wildlife Agencies. 2011. Colorado: domestic sheep & bighorn sheep distribution; draft copy. Revised November, 2011. Available on the internet at: http://www.fs.fed.us/biology/wildlife/curl.html.

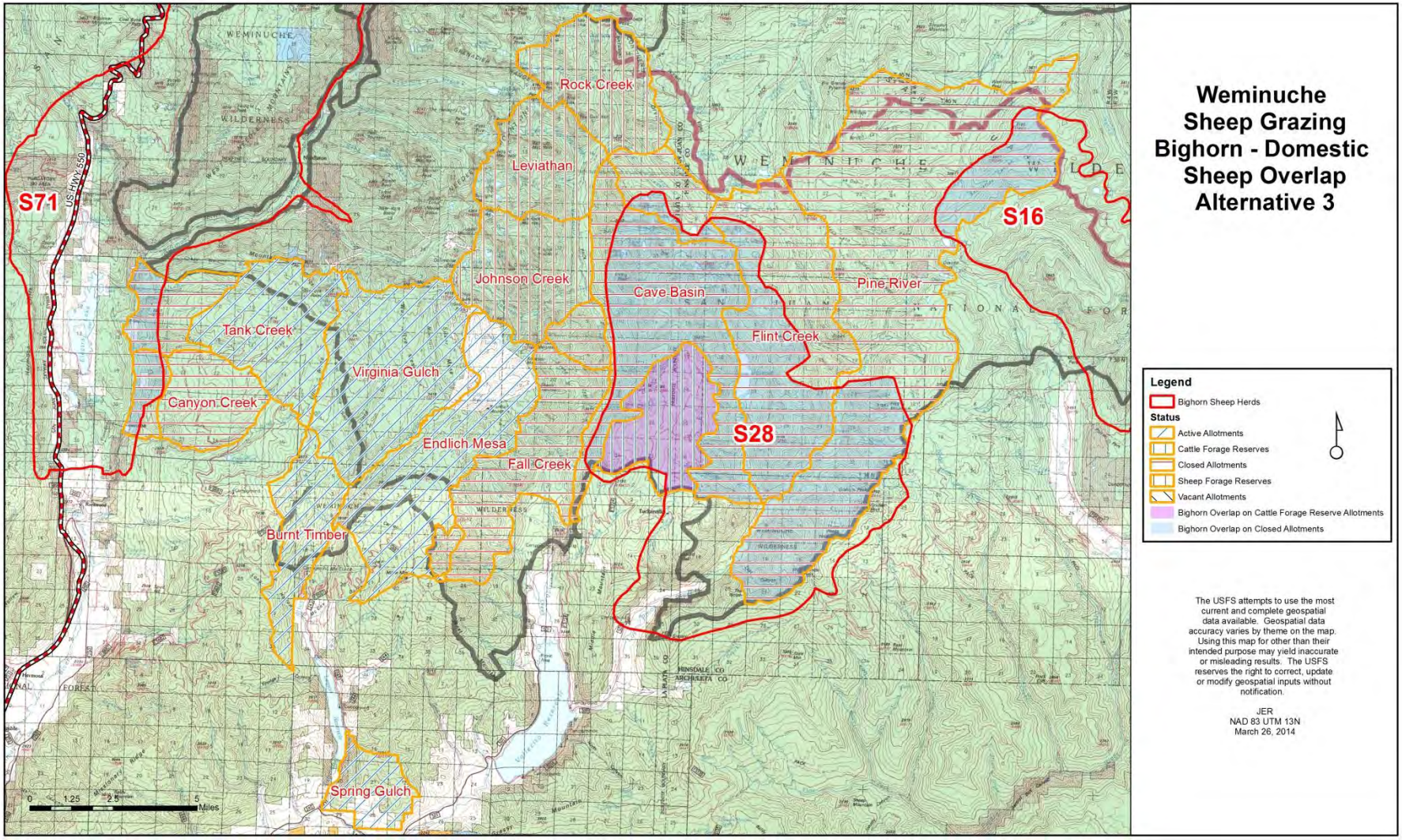
Western Association of Fish and Wildlife Agencies. 2012. Recommendations for domestic sheep and goat management in wild sheep habitat. Wild Sheep Working Group. 24 pp. Available on the internet at: http://www.wildsheepworkinggroup.com/resources/publications/ .

Figure 5. Domestic Sheep Overlap with Bighorn Summer Range* (Core Herd Home Range) in the Weminuche Grazing Analysis Landscape under Alternative 2 (current configuration).



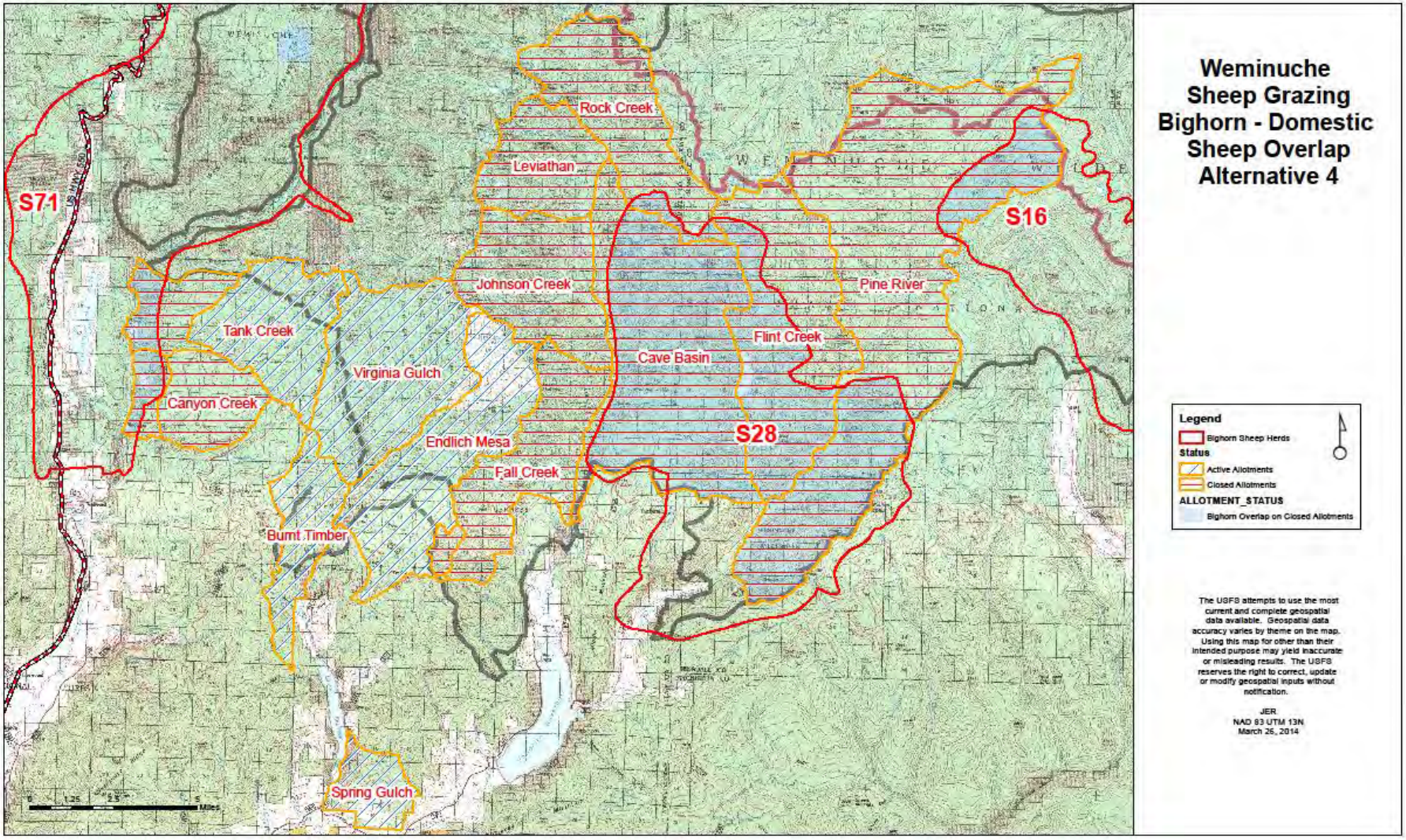
*Source: Bighorn Summer Range GIS layer, provided by Colorado Division of Parks and Wildlife. Summer range is that portion of the overall range where 90% of individual bighorn sheep are located between spring green-up and the first heavy snowfall.

Figure 6. Domestic Sheep Overlap with Bighorn Summer Range* (Core Herd Home Range) in the Weminuche Grazing Analysis Landscape under Alternative 3 (forage reserve alternative).



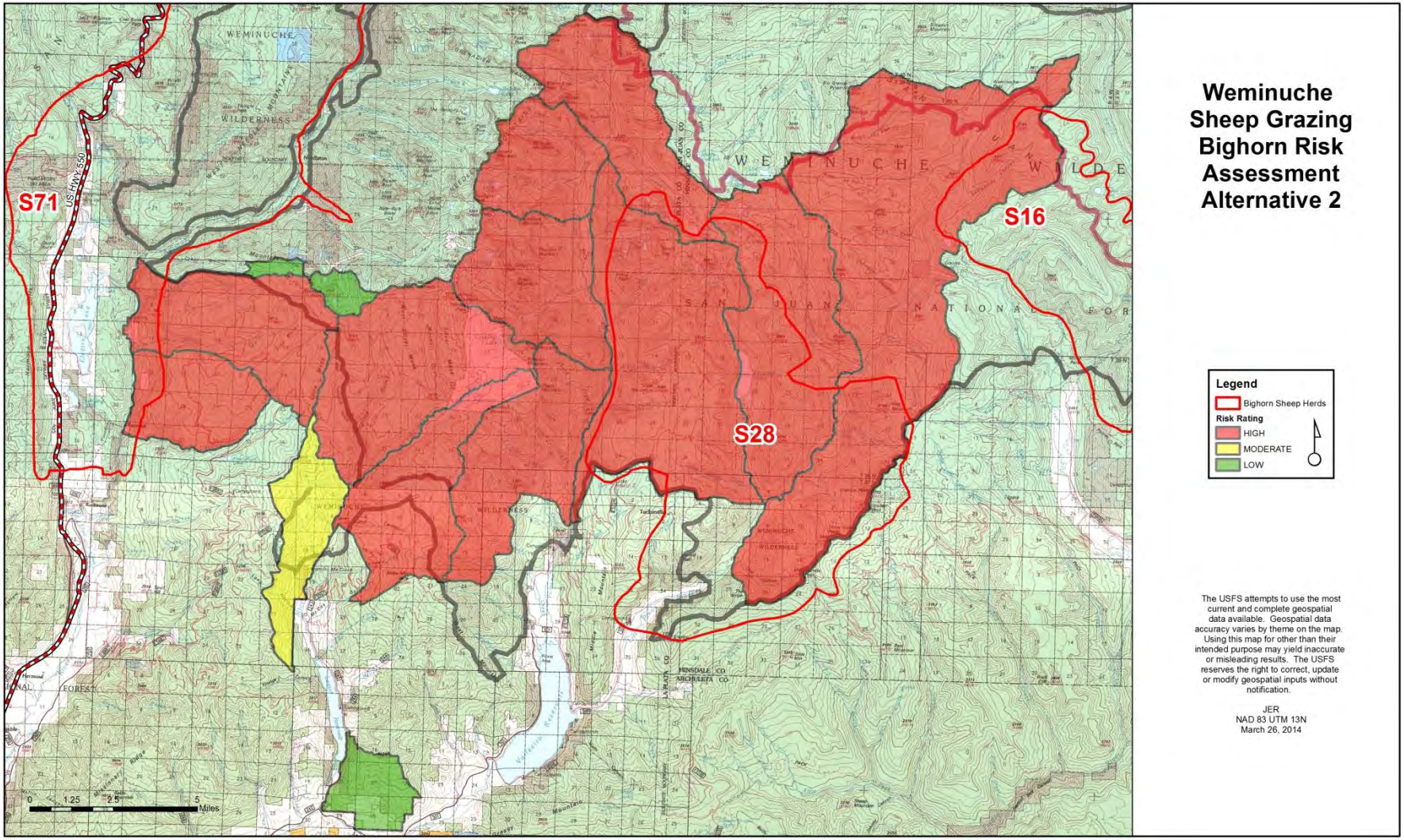
*Source: Bighorn Summer Range GIS layer, provided by Colorado Division of Parks and Wildlife. Summer range is that portion of the overall range where 90% of individual bighorn sheep are located between spring green-up and the first heavy snowfall.

Figure 7. Domestic Sheep Overlap with Bighorn Summer Range* (Core Herd Home Range) in the Weminuche Grazing Analysis Landscape under Alternative 4 (Preferred Alternative).



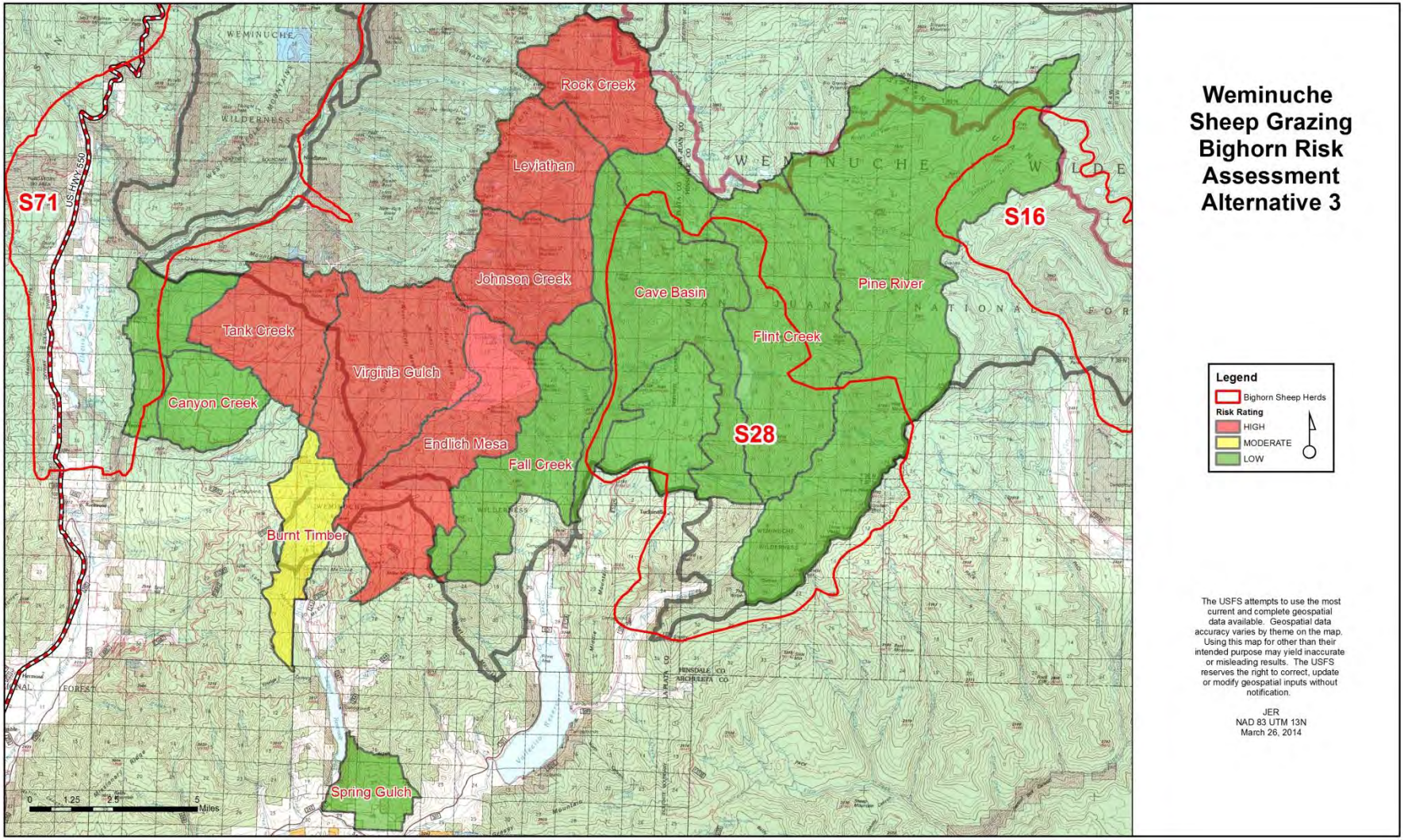
*Source: Bighorn Summer Range GIS layer, provided by Colorado Division of Parks and Wildlife. Summer range is that portion of the overall range where 90% of individual bighorn sheep are located between spring green-up and the first heavy snowfall.

Figure 8. Qualitative Ratings of Risk of Physical Contact between Bighorn Sheep and Domestic Sheep in the Weminuche Grazing Analysis Landscape under Alternative 2 (current configuration).



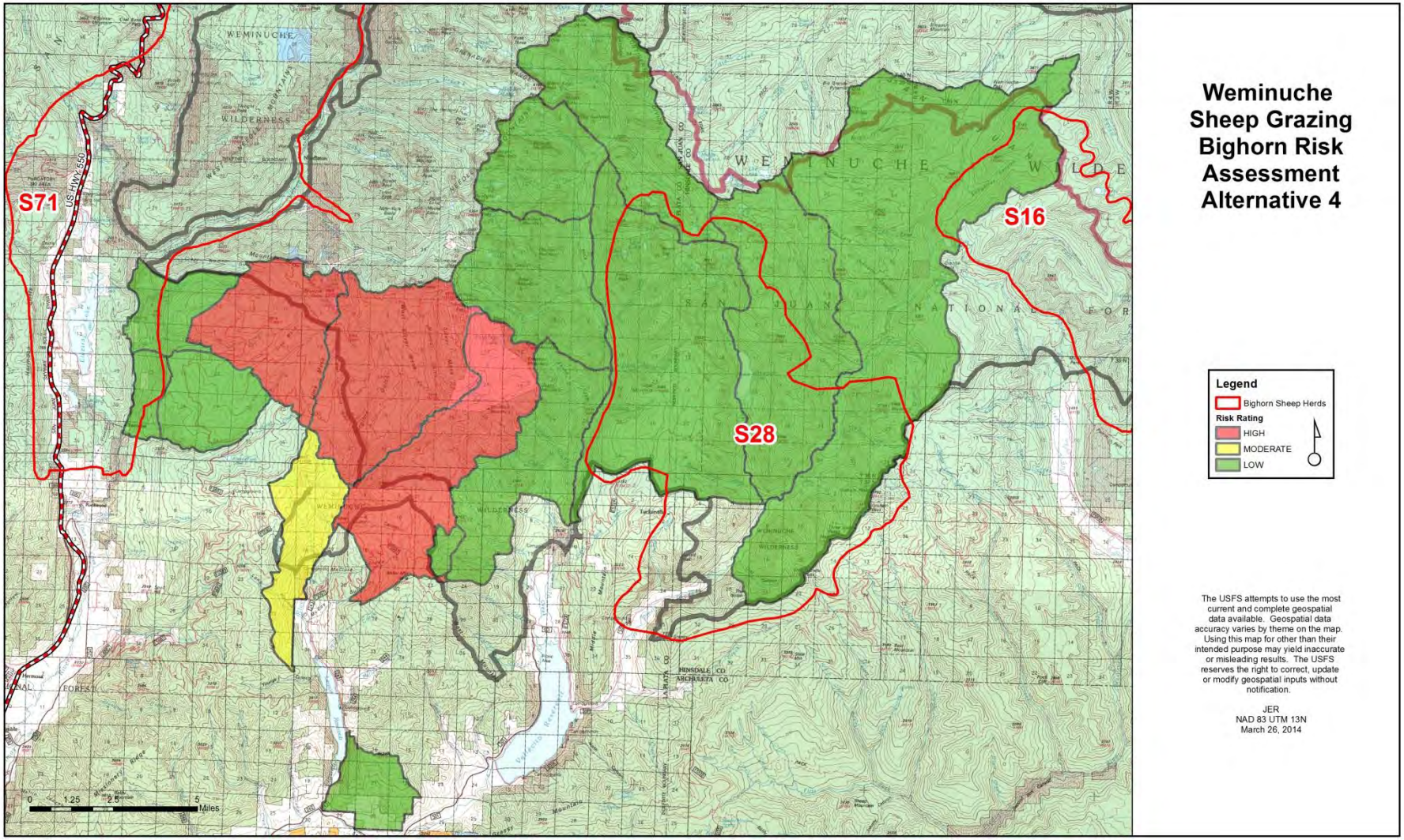
*Source: Bighorn Summer Range GIS layer, provided by Colorado Division of Parks and Wildlife. Summer range is that portion of the overall range where 90% of individual bighorn sheep are located between spring green-up and the first heavy snowfall.

Figure 9. Qualitative Ratings of Risk of Physical Contact between Bighorn Sheep and Domestic Sheep in the Weminuche Grazing Analysis Landscape under Alternative 3 (forage reserve alternative).



*Source: Bighorn Summer Range GIS layer, provided by Colorado Division of Parks and Wildlife. Summer range is that portion of the overall range where 90% of individual bighorn sheep are located between spring green-up and the first heavy snowfall.

Figure 10. Qualitative Ratings of Risk of Physical Contact between Bighorn Sheep and Domestic Sheep in the Weminuche Grazing Analysis Landscape under Alternative 4 (Preferred Alternative).



*Source: Bighorn Summer Range GIS layer, provided by Colorado Division of Parks and Wildlife. Summer range is that portion of the overall range where 90% of individual bighorn sheep are located between spring green-up and the first heavy snowfall.