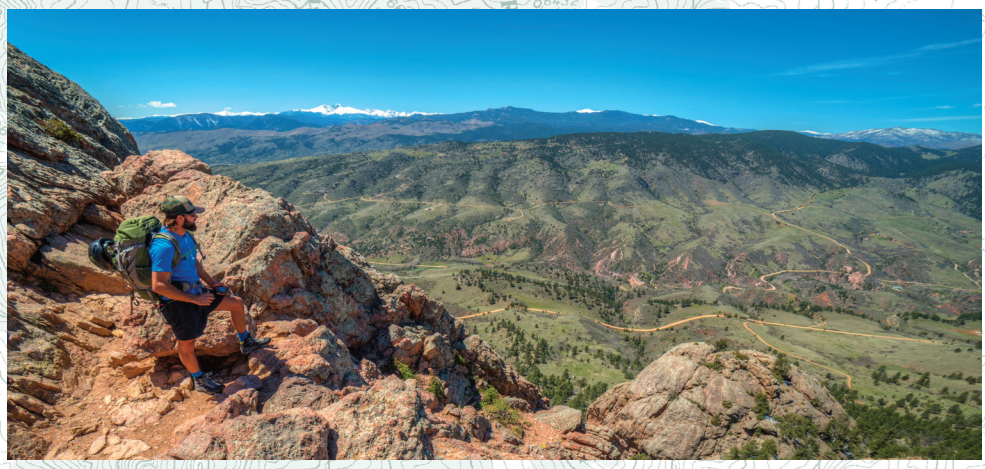



Final Report

Understanding Our Visitors

2017-18 Larimer County Visitor Use Study

Horsetooth Mountain and Red Mountain Open Spaces
and Horsetooth Reservoir

April 2019

Larimer County
Department of Natural Resources

Colorado State University
Human Dimensions of Natural Resources Department

LARIMER COUNTY
NATURAL RESOURCES

CONSERVATION AND RECREATION EXCELLENCE SINCE 1954

Colorado State University

Understanding Our Visitors
2017-18 Larimer County Visitor Use Study

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Cover photos provided by Brendan Bombaci, Harry Strharsky, and Herb Saperstone

Executive Summary

Over the past decade, visitation has steadily increased at Larimer County's Department of Natural Resources (LCDNR) open space and reservoir park properties, with increased episodes of visitor capacity especially near urban areas. The Department prioritized the need to better understand visitation and launched a visitor study to take place at several locations. Primary objectives of the study are to gain accurate visitor numbers as well as better understand who is visiting and what type of experience is taking place. The data collected and methods used from this study will serve as a model for future visitor studies managed by LCDNR.

Three locations were selected to be a part of the 2017-18 Visitor Study. As an extremely popular destination for hikers, bikers, and equestrians, **Horsetooth Mountain Open Space (HTMOS)** was selected because of increased episodes of visitor capacity, as well as a pending management plan update that will incorporate newly acquired land. **Red Mountain Open Space (RMOS)**, a more remote destination for visitors who prefer a less crowded outdoor experience, was selected because it will also undergo an updated management planning process. Third, as the busiest property in the entire Department's system, **Horsetooth Reservoir** was included to better understand annual visitation figures.

Visitor Count Data: This component of the study sought to accurately estimate the total number of annual visitors, better understand where and distance traveled within the trail systems with approximate percentages of each user type, estimate the number of vehicles frequenting each property, determine how often trailhead parking spaces turn over, and how often parking areas reach capacity. Industry standard tools including vehicle counters, webcams, wildlife cameras, and human observations were used to collect this information.

Visitor Surveys: Exit surveys were conducted at the two open space properties from June 2017 to May 2018. This component aimed to better understand visitors' overall experience, satisfaction of services, and their various preferences. The surveys were administered at three locations; the Main and Soderberg trailheads at HTMOS and the RMOS trailhead. To achieve a random sampling of visitors, a stratified-cluster sampling method was used to determine the sampling proportions at all three locations during weekdays and weekends. A total of 1,466 visitors completed the survey; 1,002 surveys were collected at HTMOS and 464 at RMOS. The survey results focus on indicators of standards of quality for visitor satisfaction, perceived conflict, perceived crowding, and norm tolerances.

Key Findings

Estimated Annual Person Visits

- Horsetooth Mountain Open Space - From November 2017 to October 2018 visitation was estimated between **213,000 and 235,000-person visits** (Table 2). This estimate included the two parking areas (Main and Soderberg) and 24,000 trail walk-ins from Lory State Park adjacent to HTMOS.
- Red Mountain Open Space - From September 2017 to August 2018, visitation was estimated between **19,700 to 22,300-person visits** (Table 8).
- Horsetooth Reservoir - From October 2017 to September 2018, visitation was estimated between **789,000 to 918,000-person visits** (Table 11). This included all six parking areas: Inlet Bay, South Bay, Rotary, Satanka, Skyline, and Sunrise.

Parking Lot Capacity

Parking lots were determined to be full (at capacity) defined by the Department when five or fewer parking spaces remained open within a given lot. Observations of the parking lots were recorded at Inlet Bay, Satanka Bay and South Bay at Horsetooth Reservoir during the peak season (May-September). At Horsetooth Mountain Open Space, observations were recorded at the Main and Soderberg trailheads over a twelve-month period.

- Horsetooth Mountain Open Space: On average, parking at the Main trailhead was at capacity 17% of the time and at Soderberg trailhead 8% of the time. On weekends, the Main trailhead (7 a.m. to 4:00 p.m.) was at capacity 43-48% and Soderberg 19% -24% (5 a.m. to 9:00 p.m.) of the time. (Table 12).
- Horsetooth Reservoir: On average, between May and September 2018, Inlet Bay (7 a.m. to 8:00 p.m.) was at capacity 1.6% of the time, Satanka was at capacity 5.5% of the time, and South Bay was at capacity 3.2% of the time. On weekends, Inlet Bay was at capacity 4.7% of the time, Satanka was at capacity 17.9% of the time, and South Bay was at 9.8% of the time.

Demographics

- HTMOS visitors were on average younger than RMOS visitors (36.61 vs. 48.52 years) (Table 14).
- At HTMOS, 50% of the respondents were male and 50% were female. At RMOS the distribution was 52% male and 48% female.
- HTMOS self-identified as White (93%), had a Bachelor's (42%) or a Master's (21%) degree, and had a household income of $50,000 to $149,999 (66%). At RMOS, visitors also self-identified as White (96%), had a Bachelor's (37%) or a Master's (22%) degree, and had a household income of $50,000 to $149,999 (74%).
- Visitors to the Main and Soderberg trails at HTMOS differed in terms of gender and age (Table 15). At the Main trail, the average visitor was slightly more likely to be female (53%) than male (47%) with an average age of 35 years. At the Soderberg trail, the average visitor was slightly more like to be male (58%) than female (42%) with an average age of 40 years.
- Over two thirds (69%) of HTMOS visitors were residents of Larimer County; 31% were non-residents. Similarly, 71% of visitors to RMOS are residents of Larimer County and 29% are non-residents. There was a difference between the amount of years HTMOS visitors have lived in Larimer County (11 years) compared to RMOS visitors (15 years). (Table 17).
- Fifty-two percent (52%) of HTMOS visitors and 45% of RMOS visitors live in Fort Collins. The remaining five primary residences of open space visitors include Loveland, Greeley, Cheyenne, Denver, and Berthoud. (Table 18).

Visitation

- When asked, 19% of visitors reported going to HTMOS for the first time in comparison to 45% for Red Mountain visitors (Table 19). There was a significant difference between the frequency of visits (in the past 12 months) at HTMOS at 17.5 visits compared with 3 visits to RMOS.
- Forty-three percent (43%) of non-residents were making their first visit to HTMOS, compared to only 7% of the residents (Table 20). Larimer County residents reported more visits, on average, to HTMOS (25.44) than non-residents (1.72).The majority (54%) of non-residents were on their first visit to Red Mountain Open Space; 41% of the residents were making their first visit (Table 21).
- At HTMOS, visitors (76%) reported exercise as their reason for visiting, followed by experiencing nature (65%) and the open space's location (55%) (Table 40).
- At RMOS, "Less crowded" was the most common response for visiting (61%), followed by "Other" comments (49%), which typically mentioned scenery or visiting the open space for the first time (Table 41)
- Nearly all (98%) of HTMOS visitors and 94% of RMOS visitors responded there are no Larimer County properties or open spaces they avoid (Table 43).

Activities

- Fifty-five percent (55%) of HTMOS and RMOS visitors listed hiking as their primary activity on the day they completed the survey (Table 22). Mountain biking was listed as the primary activity by 15% of

HTMOS visitors and 11% of RMOS visitors. Eleven percent (11%) listed horseback riding and wildlife viewing (19%) as their primary activity at RMOS, but, not HTMOS (< 1% and 0%, respectively).

- When overall use at HTMOS was separated by trailhead, hiking was the primary activity (65%) and mountain biking was only (5%) at Main. At Soderberg, mountain biking was the primary activity (44%) and less than a quarter (24%) listed hiking as the primary activity. These percentages are based upon 746 completed surveys at Main and 256 completed surveys at Soderberg.
- At HTMOS, 27% of hikers reported their first visit in comparison with only 4% of mountain bikers (Table 25). At RMOS, 51% of hikers reported this was their first visit than 36% of mountain bikers.
- In the past 12 months, the median (middle of the scale), hikers visited HTMOS 2 times and mountain bikers visited 30 times (Table 26). At RMOS, the median was less than 1 time (hikers) and 1 time (mountain bikers).
- At the Main trailhead, the median (middle of the scale) number of visits in the past 12 months for hikers was 2 times compared to mountain bikers at 10 times. At Soderberg, the median was 2 times (hikers) and 30 times (mountain bikers).
- Horsetooth Falls Trail and Horsetooth Rock Trail were the most used trails at HTMOS, representing 48% of visitors who reported the specific trail(s) they used during their visit (Table 31).

Group Characteristics

- At both properties, visitors are most likely to visit with a group (70% at HTMOS and 87% at RMOS). At HTMOS, the average group size was 2.5 visitors while Red Mountain yielded an average of 3.5 visitors per group. On average, these groups reported 2.13 adults at HTMOS and 3.07 adults at RMOS. At both locations, the number of children in attendance were less than 0.5 during the weekdays and weekends.
- Hiking was reported as the primary activity for those who visited alone (40%) and with a group (60%) (Table 33). Mountain biking was the second most reported activity for visitors by themselves (25%) while walking dog(s) was the second most reported activity of groups (14%).

Parking Area Capacity

- Less than a third of visitors (31% $n = 319$) reported being turned away from HTMOS at some point because the parking lot was full (Table 35). Of those that reported being turned away, 25% of visitors reported 3 times or less in the past 12 months.
- Mountain bikers reported being turned away more often (43%) than hikers (26%) at HTMOS (Table 37). In the past 12 months, 31% of mountain bikers and 23% of hikers reported being turned away 1-3 times.

Checked Conditions

- Respondents were more likely to check parking and trail conditions before visiting RMOS (38%) than HTMOS (22%) (Table 38). Of those that did check conditions, Larimer County's website was the most used source, followed by the NoCo Trail Report. Social media was the least utilized source to check conditions.
- At HTMOS and RMOS, mountain bikers (27%) were more likely to check conditions than hikers (22%) (Table 39). Sixty-nine percent (69%) of mountain bikers reported checking the NoCo Trail Report as their primary source while 59% of hikers checked the Larimer County website as their primary source.

Visited other Larimer County Properties

- Horsetooth Reservoir was reported as the most visited LCNR property over the last 12 months by both HTMOS visitors (72%) and RMOS visitors (60%) (Table 40). The second most visited property was Devil's Backbone Open Space (45% and 42%, respectively).

Indicators and Standards

This study worked within a framework recommended by Colorado State University (CSU) to identify and establish quantitative impact outcomes and standards for visitor experience. Outcomes are specific measurable variables that reflect the visitor's responses to the current situation at the open space. A standard of quality, the minimum acceptable condition for each outcome, was provided by CSU. These standards identify conditions that are desirable to visitors (e.g., clean restrooms), as well as conditions that managers do not want to exceed (e.g., conflicts on the trail between user groups). As such, comparing the existing conditions against the standards provides a quantitative estimate of whether or not the visitor experiences are within the standards' limits. CSU considered four sets of indicators and standards that have been used extensively in previous literature (research) as follows:

1. Visitor satisfaction
2. Perceived conflict
3. Perceived crowding
4. Norm tolerances

Visitor Satisfaction: The standard for Larimer County Open Space properties was set at **80% or more** of visitors should be satisfied with their experience or the services they received.

- Findings indicated positive responses of the overall perceived quality at HTMOS and RMOS; 98% of HTMOS respondents and 99% of RMOS respondents reported a "good" or "excellent" for the overall perceived quality (Table 47).
- Visitors rated the quality of facilities at HTMOS and RMOS was rated as "good" or "very good" ranging between 88-99% (Table 45). The exception was "restrooms" at HTMOS at 68%.
- Visitor satisfaction was above 80% on both peak (weekend) and off-peak days (weekdays).

Interpersonal Conflict: The standard for interpersonal conflict (one user group interferes with another person's efforts at achieving a goal) was set at **no more than 25%, or that if less than 25% respondents reported interpersonal conflict, then that is an acceptable level.**

- For both HTMOS and RMOS, between 58% and 84% of visitors reported no conflict. Between 16% and 33% expressed interpersonal conflict. Less than 10% noted interpersonal safety of discourteous conflicts with hikers, bikers, or horseback riders. These findings are within the standard of no more than 25% of visitors reporting interpersonal conflict.

Perceived Crowding

The standard for perceived crowding was set at **no more than 35% visitors** should feel any level of crowding.

- At HTMOS, the percentage visitors reporting any level of crowding ranged from 7% to 30% (Table 53). At HTMOS, At RMOS, these percentages ranged from 1% to 4%. All of the percentages at HTMOS and RMOS were within the standard of no more than 35% of visitors should feel any level of crowding.
- To put the crowding scores in perspective, Appendix B ranks perceived crowding scores from 82 studies in Colorado. RMOS visitors had among the lowest crowding evaluations.

Norm Tolerances *(HTMOS Survey Only)*

The standard for the Larimer County open spaces was set at **80% or more** of visitors should encounter fewer other visitors than their norm or what they would expect to encounter.

- Nearly half of hikers (49%) and mountain bikers (47%) at HTMOS reported it didn't matter how many other visitors they saw on the trail (Table 55).
- On average, respondents indicated that they could tolerate seeing up to 26 hikers and 11 mountain bikers while visiting HTMOS (Table 55).

- The standard was met for hiker's evaluations of mountain bikers (88%) and mountain bikers evaluations of other bikers (92%) as they exceeded the 80% standard (Table 56).
- The standard was **not met** for hikers' evaluations of other hikers (73%) or for mountain bikers of hikers (75%) at the Main trailhead at Horsetooth Mountain Open Space. These findings likely reflect the higher number of hikers as the larger user group.

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Introduction

The Larimer County Department of Natural Resource (LCDNR) mission is to establish, protect, and manage significant regional parks and open spaces providing quality outdoor recreational opportunities and stewardship of natural resource values. Three and a half decades later in 2017, the Department reached a significant milestone of 50,000-acres of land conserved in the county. These acres consist of land purchased outright by Larimer County, placed under a conservation easement held by the county, or conserved by a partner with financial or other support from the county. In 2018, the county conserved an additional 2,500 acres of land surrounding Horsetooth Mountain Open Space and an 800-acre private inholding at Red Mountain Open Space.

Visitation has steadily increased at Larimer County open space and reservoir park properties, with increased episodes of visitor capacity especially near urban areas. The Colorado State Demography Office predicts that the population northern Front Range (i.e., Weld and Larimer counties) will double by 2050. LCDNR conducted a visitor study in 2005 and installed trail counters at several of the County's open space properties from 2013-2015. Trail counting efforts have been made in some areas but not in others. In 2017, LCDNR prioritized the need to better understand open space visitors and launched a visitor study.

Three locations were selected to be a part of the 2017-18 Visitor Study. As an extremely popular destination for hikers, bikers, and equestrians, Horsetooth Mountain Open Space was selected because of increased episodes of visitor capacity, as well as a pending management plan update that will include newly acquired land. Red Mountain Open Space, a more remote destination for visitors who prefer a less crowded outdoor experience, was selected because it will also undergo an updated management plan. Third, as the busiest property in the entire Department's system, Horsetooth Reservoir was included to better understand annual visitation figures.

Study Objectives

This project sought to estimate the annual number of visitors to LCDNR properties and to better understand visitors to Horsetooth Mountain and Red Mountain open spaces. The objectives for the two primary components, visitor counts and visitor surveys, of the study are identified below. The intent was to; (a) provide LCDNR with baseline information against which future research results can be compared and (b) to inform management decisions.

Visitor Counts

1. Annual Visitation Estimate
2. Parking Lot Use (HTMOS and Horsetooth Reservoir only)
3. Frontcountry and Backcountry Trail Visits & User Types
4. Backcountry Camping (HTMOS only)

Visitor Surveys

1. Demographic characteristics (e.g., gender, age, place of residence)
2. User types and their preferences (e.g. group size, frequency of visits)
3. Prior visitation rates and trip characteristics (e.g., trip duration, activity participation, reasons for visiting, transportation)
4. Visitation to other county properties, if they are being avoided and why
5. Visitor satisfaction of trailhead and trail facilities
6. Perceived conflicts with other visitors
7. Perceived crowding
8. Norm tolerances for seeing other visitors

Visitor Survey Planning Framework and Background

Natural resource management agencies like LCDNR strive to provide high quality recreation experiences (Decker, Brown & Siemer, 2001). Not all visitors, however, share the same set of preferences for setting attributes, facilities, and services offered. Some individuals, for example, may desire nothing more than the opportunity to enjoy nature, hike, and watch wildlife; activities that require only a natural setting with minimal agency provided facilities or services. Other visitors are more demanding in the services they believe should be offered (Donnelly, Vaske, DeRuiter, & King, 1996).

Recognizing this diversity of desires found among recreationists, researchers and managers have attempted to differentiate users into more homogeneous groups (Bryan, 1977). Segmentation strategies have been developed that evaluate the benefits sought by individuals in a variety of situations or occasions. For example, several studies highlight the importance of segmenting visitors based on geographic location (e.g., Donnelly et al., 1996; Vaske, 2019, Vaske, Beaman, Stanley, & Grenier, 1996). This report compared visitors to Horsetooth Mountain and Red Mountain open spaces.

Most planning frameworks recommend identifying and establishing quantitative impact indicators and standards (e.g., Visitor Impact Management, Graefe, Kuss, & Vaske, 1990; Visitor Experience and Resource Protection, National Park Service, 1997; Limits of Acceptable Change, Stankey, Cole, Lucas, Petersen, & Frissell, 1985). Indicators are specific, measurable variables that reflect the current situation. A standard of quality is the minimum acceptable condition for each indicator. Standards identify conditions that are desirable (e.g., no litter), as well as conditions that managers do not want to exceed (e.g., encounters with other people). Comparing existing conditions against the standards provides a quantitative estimate of whether the experiences provided are within the limits specified by the standard (Vaske, Whittaker, Shelby, & Manfredo, 2002).

This report considered four sets of indicators and standards that have been used extensively in the literature:

1. Visitor satisfaction
2. Perceived conflict
3. Perceived crowding
4. Norm tolerances

Satisfaction Indicator and Standard

Satisfaction has been defined as the congruence between expectations and outcomes (Manning, 2011) and is one of the most commonly used indicators of visitor experience or perceived quality of service received (Vaske et al., 2002). Satisfaction from a recreation experience reflects visitor expectations and management goals. People who experience conditions or services in line with what they expected are likely to be satisfied. From a manager's perspective, providing satisfactory experiences or services to at least "X" percent of the visiting public reflects a standard for this indicator.

At least two methodologies for investigating satisfaction are evident in the literature. One theory has focused on a multiple satisfactions approach, which assumes that each individual brings his or her own expectations to an experience and these influence the kinds of satisfaction that he or she receives (Hendee, 1974). This framework recognizes the diversity of experiences that visitors seek, and a quality experience for a recreationist involves achieving the particular satisfactions in which he or she is interested or expects (Manfredo, Fix, Teel, Smeltzer, & Kahn, 2004). The concern is with identifying variables that affect satisfaction and that are susceptible to management or manipulation. If such variables can be identified and monitored, the potential for changing circumstances to create better recreation opportunities is enhanced. To facilitate this applied focus, a report card was developed in the late 1970's for tracking visitor satisfaction (LaPage & Bevins, 1981). The instrument included items that could be influenced by management actions (e.g., restrooms, parking areas, trash receptacles) This applied approach was adopted for this study and incorporated in both of the HTMOS and RMOS surveys.

Second, researchers (e.g., Vaske, Donnelly, Heberlein, & Shelby, 1982; Vaske & Roemer, 2013) have defined satisfaction as an overall rating of a recreation experience or service as good or bad. Satisfaction is viewed as a composite of the particular expectations and needs, expressed as a single numerical rating. Defined this way, satisfaction has been operationalized with a single question, such as "Overall, how would you rate the quality of the visitor services provided to you and your group?" The percentage of individuals reporting a given level of satisfaction can be calculated for all participants in an activity and the activities can be compared directly.

There are advantages and disadvantages to both multiple-item and single-item indicators of a concept. Multiple-item indicators can contribute to a more sophisticated understanding of concepts and often have good psychometric properties (e.g., reliability, validity). Measurement reliability means that the multiple items measure the same construct (i.e., the items intercorrelate with each other). Measurement validity means that the scale measures what it was intended to measure. Unfortunately, multiple-item indicators also have disadvantages: (a) they increase respondent burden, (b) they challenge comparisons of findings among studies because different items are used, and (c) they do not necessarily yield clear management standards (Vaske, 2008).

Vaske and Roemer (2013) have been analyzing differences in overall satisfaction by consumptive and nonconsumptive recreationists over a 30-year period. Based on theory and previous research, two hypotheses were advanced: (a) consumptive recreationists (e.g., hunters, anglers) will report significantly lower satisfaction than will nonconsumptive recreationists (e.g., kayakers, hikers), and (b) this pattern will remain consistent over time. Data were obtained from published and unpublished studies in 57 consumptive and 45 nonconsumptive recreation contexts. Each study used the same question measuring overall satisfaction (i.e., "overall, how would you rate your day / trip / experience"). Following previous research (Vaske et al., 1982), responses were collapsed into three categories (i.e., "poor / fair," "good / very good," "excellent / perfect"). The independent variables were activity type and year. Consistent with the hypotheses and the previous article, consumptive recreationists reported lower satisfaction than did nonconsumptive recreationists, and this pattern of findings generally remained consistent over time.

Visitor Satisfaction Standard. Based on the previous meta-analyses (Vaske & Roemer, 2013; Vaske et al., 1982), the standard for the Larimer County natural areas was set at 80% or more of visitors should be satisfied with their experience or the services they received. Comparing existing satisfaction ratings against the 80% standard provides a quantitative estimate of whether any experiential changes are within the limits specified by the standard (Vaske et al., 2002).

Perceived Conflict Indicator and Standard. Conflict has been a theme in the outdoor recreation literature for decades (e.g., Lucas, 1964). Recreation conflict generally falls into two main categories (Graefe & Thapa, 2004). First, interpersonal conflict (a.k.a., goal-interference) occurs when the physical presence or behavior of an individual or group interferes with the goals of another individual or group (Jacob & Schreyer, 1980). Interpersonal conflict can occur directly via a face-to-face encounter (e.g., between a backcountry skier and a snowmobiler on a shared route), or indirectly where evidence of one group's behavior is sufficient to cause conflict (e.g., a skier smells the exhaust of a snowmobiler). Different groups may share the same goal (e.g., experiencing untracked snow), but have different means of achieving that goal (e.g., skiing vs. snowmobiling), which can influence goal-interference conflict (Graefe & Thapa, 2004).

Second, social values conflict occurs between groups who may not share similar norms or values about an activity (Vaske, Donnelly, Wittmann, & Laidlaw, 1995). Unlike interpersonal conflict, social values conflict can occur even when there is no direct contact between the groups (Carothers, Vaske, & Donnelly, 2001; Vaske, Needham, & Cline, 2007). For example, although encounters with llama packing trips may be rare, individuals may philosophically disagree about the appropriateness of using these animals in the backcountry (Blahna, Smith, & Anderson, 1995).

Interpersonal Conflict. Research on recreational conflict has traditionally focused on the asymmetrical relationships that occur when different activity groups interact (Kuss, Graefe, & Vaske, 1990). Studies, for example, have shown the presence of a one-way conflict between paddling canoeists and motorboaters

(Adelman, Heberlein, & Bonnicksen, 1982). Paddling canoeists disliked motorboaters, but the people using motor-powered craft were not bothered by, and often enjoyed seeing and interacting with paddlers. This one-way type of conflict has also been shown between hikers and mountain bikers, oar-powered and motor-powered whitewater rafters, cross-country skiers and snowmobilers, backpackers and horsepackers, water skiers and anglers, and hunters and non-hunters. In general, the research has shown that for those recreationists for whom the interaction has negative consequences (e.g., disrupts the solitude of the experience, or inhibits one's ability to catch fish or hunt game), conflict increases.

Hikers and mountain bikers differ in their method of experiencing the environment, but the participants share similar characteristics. Research has profiled mountain bikers as "30 something" white males, from a range of income levels, who believe the activity is important to their identity (Chavez, 1999). Similarly, many hikers are over 30, white males, from a range of income levels and who identify with the sport (Wellner, 1997). Individuals in both activities tend to participate frequently (Ruibal, 1996) and many pursue both activities (Chavez, 1999). Such similarities suggest that conflict, to the extent it exists between hikers and mountain bikers, is likely to reflect interpersonal problems rather than differences in social values. Interpersonal conflict between hikers and mountain bikers may be related to speed, lack of courtesy, crowding, or safety concerns (Moore, 1994). Safety issues, for example, have been linked to trail design (blind corners) and the behaviors of some mountain bikers who ride too fast for existing conditions (Hoger & Chavez, 1998).

Social Values Conflict. The importance of social acceptability judgments in conflict management is relatively new to the recreation literature (Blahna et al., 1995). McShea, Wemmer, and Stuwe (1993), for example, describe the social conflicts that erupted between hunters and anti-hunters when the National Zoo's Conservation and Research Center (CRC) attempted to open the area to hunting to reduce the size of a controversial deer herd. The conflict was primarily based on differences in values held by the CRC and animal rights groups. The CRC was concerned with protecting exotic hoofed animals from disease caused by the deer, whereas the animal rights groups advocated a position favoring the rights of individual deer. These findings reflect broader societal value differences toward consumptive versus non-consumptive uses of wildlife.

Social value differences between hikers and mountain bikers may reflect anticipated threats. Existing research (Hoger & Chavez, 1998; Moore, 1994), for example, suggests that some hikers believe mountain bikers increase safety concerns (i.e., riding irresponsibly), degrade the natural resource (i.e., creating informal trails), and lower the quality of the experience (i.e., lack of user etiquette). Similar to the controversy over allowing hunting in certain locations (Vaske et al., 1995), these reactions suggest that, for at least some individuals, mountain biking is not a socially acceptable activity and should not be allowed on trails traditionally used by hikers. Such value judgments are reinforced when mountain bikers are stereotyped as "crazy kids out for an adrenaline rush" (Hoger & Chavez, 1998).

Hiking represents a traditional activity on most trails whereas mountain biking is a relatively new sport. Past research has repeatedly demonstrated that traditional users frequently question the social acceptability of any non-traditional activity in natural resource settings (Blahna et al., 1995). As the number of individuals participating in non-traditional activities like mountain biking increases (Ruibal, 1996), hikers' tolerance levels for bikers may decrease and the potential for social values conflict can increase.

Interpersonnel versus Social Values Conflict. Vaske et al. (1995) examined the magnitude of interpersonal and social values conflict for two general classes of events. Hunting-associated events included seeing an animal being shot, seeing people hunting, and hearing guns being fired. Human-wildlife interaction events were represented by evaluations of people disturbing, harassing, and feeding wildlife. Comparisons were made between hunters and non-hunters and between frequent and infrequent visitors to Mt. Evans, a 14,150-foot mountain located about 70 miles west of Denver. Results indicated that interpersonal conflicts between hunters and non-hunters on Mt. Evans were minimized due to the mountain's natural visual barriers and the Colorado Division of Wildlife's regulations that prohibit hunting near the road where most non-hunters are found. To the extent that conflict existed for hunting

associated events, much of the problem was associated with differences in social values held by the non-hunting public. Conflict in social values remained relatively constant across frequency of visitation; findings that supported the argument that a visitor's value orientation is independent of the number of prior visits to an area.

Carothers et al. (2001) examined social values and interpersonal conflict reported by hikers, mountain bikers, and those who participate in both activities. Across all three groups, less conflict was reported for hiking than for mountain biking. To the extent that conflict did exist for hiking, mountain bikers and dual-sport participants were more likely than hikers to report unacceptable behaviors. For evaluations of mountain biking behavior, hikers were more likely than mountain bikers to experience conflict, whereas dual-sport participants fell in between these two extremes. All three groups reported more interpersonal than social values conflict.

Both interpersonal and social values conflict can be influenced by recreationists' lifestyle tolerance; the tendency to accept or reject lifestyles different than one's own (Jacob & Schreyer, 1980). As noted by Ivy, Stewart, and Lue (1992), tolerance is typically associated with beliefs about a particular group, rather than reactions to specific behaviors. When recreationists encounter others, a cognitive processing of information occurs. This action often results in the categorization of others according to some group membership, which helps to simplify and order environmental stimuli. Differences in lifestyles are often communicated via visual cues such as the equipment used by recreationists engaged in different activities (e.g., guns for hunting versus binoculars for wildlife viewing, Vaske et al., 1995). Recreation in-groups and out-groups represent categories an individual establishes on the basis of perceived or imagined lifestyle similarities and differences (Jacob & Schreyer, 1980). Though useful for maintaining a view of the world, it can also lead to unjustified generalizations about other groups (Ramthun, 1995). Those who demonstrate low tolerance for persons with differing lifestyles will be more likely to experience conflict.

Out-group versus in-group lifestyle tolerance differences have been noted for several recreation activities. Research (Vaske, Carothers, Donnelly, & Baird, 2000; Williams, Dossa, & Fulton, 1994), for example, has indicated that skiers and snowboarders have differing views of each other. Skiers felt threatened by the snowboarders' different approach; evaluated the language, clothes, and on-slope behavior of snowboarders as intimidating; and had the perception that snowboarders purposely created conflict situations. Snowboarders, on the other hand, perceived skiers as predictable and showed less concern for their presence on the slopes. Watson, Williams, and Daigle (1991) found that mountain bikers were more likely than hikers to perceive the two groups as similar in terms of socio-demographic characteristics, as well as their relationship to the resource (attitudes about the environment, values of the area). Hikers perceived more differences between the two groups. Other research has shown that hikers view mountain biking as intrusive and are concerned with the impact mountain biking has on the environment and safety issues related to multiple use trails (Hoger & Chavez, 1998).

Simple classifications of individuals into groups (e.g., skier vs. snowboarder, or hiker vs. biker), however, can introduce problems when attempting to understand conflict (Watson, Zaglauer, & Stewart, 1996). Many recreationists participate in multiple activities (i.e., both hiking and biking) and consequently, their tolerance for others may be altered. Analyses should distinguish these dual sport participants from individuals who pursue only one activity.

There are a variety of ways to operationalize interpersonal versus social values conflict. Vaske et al. (1995) suggests combining the frequency (observed vs. not observed) of seeing different events with corresponding perceived problem (problem vs. not a problem) variables (Figure 1). Individuals who have not observed a given event, or who have observed it (e.g., bikers riding fast) yet do not perceive it to be a problem, are considered a no conflict group (either in terms of interpersonal or social values conflicts). Those who have never seen a particular event, but believe a problem exists for that event, are expressing a

conflict in social values. Conversely, those who witness a particular situation and believe that the event has caused a problem are indicating an interpersonal conflict.

Figure 1. Conflict evaluation figure

		Perceived Problem: No	Perceived Problem: Yes
Observed	No	No Conflict	Social Values Conflict
	Yes	No Conflict	Interpersonal Conflict

Source: Vaske et al. 1995

Conflict Standard. Unlike the other indicators and standards considered here (i.e., satisfaction, perceived crowding), standards for acceptable levels conflict are more variable. The existing research suggests that the magnitude of conflict depends on the characteristics of the:

1) Activity (e.g., consumptive vs. non-consumptive, traditional vs. non-traditional),
2) Visitors (e.g., tolerances for other user groups, perceived similarities between the groups),
3) Environment (e.g., unpaved vs. paved trails that allow for faster speeds),
4) Management (e.g., zoning to separate potentially incompatible activities).

As a starting point, the researcher recommends that **no <u>more than 25%</u>** of the respondents should report interpersonal conflict.

Crowding Indicator and Standard

Researchers have recognized the difference between density and crowding, but even scientists sometimes use the word "crowding" inappropriately when referring to high density (Shelby & Heberlein, 1986). Density is a descriptive term that refers to the number of people per unit area. It is measured by counting the number of people and measuring the space they occupy, and it can be determined objectively. Crowding, on the other hand, is a negative evaluation of density; it involves a value judgment that the specified number is too many. The term ***perceived crowding*** is often used to emphasize the subjective or evaluative nature of the concept.

Heberlein and Vaske (1977) developed a relatively simple measure of perceived crowding that asks people to indicate how crowded the area was at the time of their visit. Responses are given on the scale below:

Figure 2. Example of crowding response scale

1	2	3	4	5	6	7	8	9
Not at all Crowded		Slightly Crowded			Moderately Crowded			Extremely Crowded

In this item, two of the nine scale points label the situation as uncrowded, and the remaining seven points label it as crowded to some degree. The rationale is that people may be reluctant to say an area was crowded because crowding is an undesirable characteristic in a recreation setting. An item that asked, "Did you feel crowded?" might lead most people to say "No." The scale is designed to be sensitive enough to pick up even slight degrees of perceived crowding, just as measures of undesirable chemicals (e.g., pollutants or carcinogens) are sensitive to even low levels of these substances.

Crowding Standard. Shelby, Vaske, and Heberlein (1989) developed crowding standards based on this indicator. Their comparative analysis of 59 different settings and activities suggested five distinct categories of standards (suppressed crowding, low normal, high normal, over capacity, and greatly over capacity). When ≤ 35% of the visitors feel crowded, density levels in the area were not a problem. For locations where between 50 and 60% of visitors felt crowded, the setting was approaching its carrying capacity, and visitors started to experience access and displacement problems. Locations and activities where over 65% of the visitors felt crowded were considered over carrying capacity.

A subsequent meta-analysis (Vaske & Shelby, 2008) examined crowding ratings for 615 different settings and activities. These studies were conducted across the United States, Canada, New Zealand, Ecuador, Sweden, and Taiwan. The activities included hunting of many types, fishing of many types, rafting, kayaking, canoeing, floating, boating, rock climbing, mountain climbing, backpacking, day hiking, biking, sailing, photography, and driving for pleasure. The areas studied show considerable diversity, with some showing extremely high density and use impact problems, others showing low densities and no problems, and still others actively utilizing management strategies to control densities and use impacts. In total, 85,451 individuals have been asked the crowding question.

Both meta-analyses (Shelby et al., 1989; Vaske & Shelby, 2008) supported the five distinct categories of standards based on the 9-point perceived crowding scale (Table 1). The five categories were established based on the percent of visitors reporting any level of crowding (scale points 3 through 9).

The crowding standard was **no more than 35%** if visitors should feel any level of crowding.

Table 1. Carrying capacity standards based on levels of perceived crowding [1]

Percent feeling crowded	Capacity judgment	Comment	Total # of contexts (n = 615)	Percent of contexts
0-35%	Suppressed crowding	Crowding is likely limited by management, situational factors, or natural factors may offer unique low-density experiences.	245	40%
36-50%	Low normal	Access, displacement, or crowding problems are not likely to exist at this time. Similar to the above category, may offer unique low-density experiences.	111	18%
51-65%	High normal	These locations or activities probably have not exceeded carrying capacity but may be tending in that direction. Should be studied if increased use is expected, allowing management to anticipate problems.	107	17%
66-80%	Over capacity	These locations or activities are generally known to have overuse problems, and they are likely to be operating at more than their capacity. Studies and management necessary to preserve experiences.	99	16%
81-100%	Greatly over capacity	It is generally necessary to manage for high-density recreation. A crowding problem has typically been identified.	53	9%

1. Source: Vaske and Shelby (2008)

Normative Indicator and Standard. The concept of norms provides a theoretical framework for collecting and organizing information about users' evaluations of conditions and has proven to be sensitive to changing use conditions. As defined by one research tradition, norms are standards that people use to evaluate behavior or the conditions created by behavior as acceptable or unacceptable (see Shelby et al., 1996; Vaske et al., 1986; Vaske et al., 1993; for reviews). Norms thus define what behavior or conditions should be, and can apply to individuals, collective behavior, or management actions designed to constrain collective behavior. This normative approach allows researchers to define social norms, describe a range of acceptable behavior or conditions, and explore agreement about the norm.

Normative concepts in natural-resource settings were initially applied to encounter impacts in backcountry settings (encounter norms measure tolerances for the number of contacts with other users). The focus on encounters in backcountry worked because encounter levels were generally low, survey respondents could count and remember them, and encounters have important effects on the quality of experiences when solitude is a feature. Most studies showed that encounter norms across these backcountry settings were stable and strongly agreed upon, usually averaging about four encounters per day (Vaske et al., 1986).

More recently, norm concepts and methods have been applied to a greater diversity of impacts and settings (Shelby & Vaske, 1991; Shelby et al., 1996). Research on encounter norms in higher-density frontcountry settings, for example, has demonstrated more variation in visitors' tolerances for others as well as lower levels of agreement (Donnelly et al., 2000; Manning et al., 1996; Vaske and Donnelly 1998; Vaske et al. 1996). This led some researchers to examine norms for interaction impacts other than encounters (Martinson and Shelby 1992; Shelby et al. 1987; Whittaker & Shelby 1993; Whittaker, 1992). Norms for recreationist proximity, percentage of time within sight of others, incidents of discourteous behavior, competition for specific resources, and waiting times at access areas have all been examined. These alternative interaction impacts are often more salient than encounters in higher-use settings (Basman et al. 1996; Whittaker and Shelby 1996). Taken together, this work suggests that normative data are sensitive to changing use conditions, can facilitate understanding visitors' evaluations of social and environmental conditions, and have proven helpful to managers.

Normative Standard. Consistent with previous research, the normative standard was based on the relationship between the number of encounters with others an individual experienced and the person's normative tolerances for see others. The standard for the Larimer County Department of Natural Resources open spaces was set at **80% or more of visitors should encounter fewer other visitors than their norm**.

VISITOR COUNT RESULTS

Estimates for annual visitation, with 80% confidence intervals, for Horsetooth Mountain Open Space (HTMOS), Red Mountain Open Space (RMOS) and Horsetooth Reservoir were analyzed by Dr. Jay Beaman with CSU. The estimates were calculated using vehicle and parking observational data supplied by the Department as well as information supplied from the visitor surveys. Cut-off values were determined for each of the properties in order to eliminate counter readings that were excessive. The data was then processed through a customized statistical software program which was developed by CSU specifically for this study.

Horsetooth Mountain Open Space

Estimated Annual Visitation

For HTMOS, confidence intervals were based on the number of vehicles entering the parking areas and trail counters placed at certain access points into the trail system. The HTMOS vehicle counters and the trail counters were corrected for days when counters did not function properly by not recording or over counting. For the trail counters, estimates were based on one half the count as it was assumed that people pass the counter as they enter and leave.

Visitor estimates for the Main and Soderberg trailheads were calculated for both weekends and weekdays. The initial multipliers, based on human observational data collected by LCDNR, for visitors per car were 1.95 for Main and 1.63 for Soderberg. It was determined by CSU that the multipliers might be too high because sampling data cannot be linked to traffic counts. The compromise solution was a multiplier of 1.9 for Main and 1.6 for Soderberg. For the combined two parking areas at HTMOS the multiplier was 1.8.

During the study period, the Main trailhead had 140,634-person visits and the Soderberg trailhead had 83,238-person visits (Table 2). This translates to an estimated annual visitation of 134,000 to 147,000-person visits. At Soderberg, the range was 79,000 to 87,000-person visits. Taken together, including 23,947 walk-in trail visits from Lory State Park (measured by two trail counters near the property line), HTMOS had between 213,000 and 235,000-person visits.

Table 2. Visitation estimates for Horsetooth Mountain Open Space

		Uncertainty		
Location	Person Visits	Percent	Number	Visitation Estimate
Main	140,634	± 4.6	± 6,469	134,000 to 147,000
Soderberg *	83,238	± 4.9	± 4,079	79,000 to 87,000
HTMOS	223,872	± 4.8	± 10,746	213,000 to 235,000

* Includes 23,947 walk-in trail visits from Lory State Park

Parking Lot Capacity Analysis: Main and Soderberg Trailhead Parking Lots

LCDNR defines capacity as five or fewer parking spots in each trailhead parking lot. Observations of the lots were recorded throughout the study at Main and Soderberg trailheads which had a total of 88 and 39 regular parking spots respectively. Parking capacity was recorded at Main (7 a.m. – 4:00 p.m.) and Soderberg (5 a.m. – 8:00 p.m.) by reviewing webcam footage each hour by trained staff and volunteers. The data was then analyzed using SPSS statistical software program.

On average, parking lots at the Main trailhead were at capacity 17% of the time and at Soderberg trailhead 8% of the time (Table 3). Weekdays were at capacity 4% of the time and weekends reached capacity 31% of the time over the course of the study period.

Table 3. HTMOS Parking Lot Capacity Estimates

	Parking Lot at Capacity	
	No %	Yes %
Location		
Main	83	17
Soderberg	92	8
Day of Week		
Weekday	96	4
Weekend	69	31

At the Main lot, key findings indicate that March, May, June, and July exceeded capacity more often than the other months of the year. The Main parking lot is most likely to hit capacity on Sunday (48%), Saturday (43%), and Friday (12%). Soderberg is most likely to hit capacity on Saturday (19%) and Sunday (24%).

Table 4. Percent of Time HTMOS Exceeded Parking Lot Capacity

	Parking Lot at Capacity	
	Main %	Soderberg %
Month		
January	10	7
February	8	3
March	25	8
April	15	9
May	23	13
June	24	10
July	23	10
August	19	6
September	13	6
October	18	10
November	12	7
December	5	5
Day of Week		
Monday	7	1
Tuesday	4	2

Wednesday	2	4
Thursday	5	3
Friday	12	1
Saturday	43	19
Sunday	48	24
Weekday vs. Weekend		
Weekday	6	2
Weekend	45	21

Frontcountry and Backcountry Visits and User Type Comparison

This component of the study aimed to better understand where and how deep visitors go within the trail systems at HTMOS approximate percentages of user types, but specifically: hikers, mountain bikers and horseback riders. At HTMOS, frontcountry refers to trails at or near the trailheads and backcountry locations refer to more remote trails.

Trail Counters to Determine Use: Eighteen (18) trail counters were installed at HTMOS in August 2017. The counters were placed along the frontcountry and backcountry trails (Appendix F) and intended to measure (a) annual visitation and (b) backcountry trail use. The devices were programmed to collect visitor data, triggered by motion, over the course of twelve months. Count data was reviewed by trained employees and volunteers. However, excluding trail counters #11 and #16, the trail counter totals were not included as part of the annual visitation counts. This can be attributed primarily to the complex trail system at HTMOS and that visitors can use multiple trails during their visit thus creating a higher level of data uncertainty. Therefore, the study utilized the exit vehicle counters for total annual estimates and used the trail counters to understand the relative or proportional use of each trail.

Table 5. HTMOS Trail Counter Data Estimates. The listed trails below refer to the locations of the trail counters and may differ slightly from the standard HTMOS trail nomenclature. (For the specific placement of the trail counters and cameras refer to Appendix F).

South Ridge Trail (Near Main Trailhead)	Horsetooth Falls Trail (Near Main Trailhead)	Swan Johnson Trail (Near Soderberg Trailhead)	Towers Trail	Sawmill Trail	Loggers Trail	Carey Springs Trail	Mill Creek West Trail	Spring Creek Trail
TC #2	TC #3	TC #4	TC #5	TC #6	TC #7	TC #8	TC #9	TC #10
12%	24.8%	10%	5%	2%	1.8%	1.5%	1%	0.7%

Shoreline Trail (near Lory property)	Horsetooth Falls Trail (at the terminus)	Wathen Trail	West Ridge Trail	HT Rock Trail (at terminus)	Mill Creek Trail (near Lory property)	Stout Trail	Herrington Trail
TC #11	TC #12	TC #13	TC #14	TC #15	TC #16	TC #17	TC #18
9.5%	13%	1.8%	0.7%	13%	1%	1.4%	0.8%

Trail Cameras to Delineate User Types: A total of four Bushnell trail cameras were installed in September 2017 at HTMOS and strategically placed to best capture frontcountry and backcountry user types (Appendix F), specifically, hikers, bikers, and horseback riders. Devices were programmed to collect images, triggered by motion, over the course of one year. The photos were reviewed by trained employees and volunteers. The results capture twelve months of data and summarized below.

According to the camera data, South Ridge Trail had the highest percentage of hikers at HTMOS compared with the other cameras. Biker ratios stayed relatively the same during weekdays and weekends and no horseback riders were recorded. The Swan Johnson Trail had more hikers and fewer mountain bikers during the spring and winter months. User type ratios didn't change significantly during the weekday and weekends. Horseback riders on this trail were very low.

Table 6. HTMOS Frontcountry Trail Camera User Types (Estimate)

South Ridge Trail	% of Hikers	% of Bikers	% of Equestrians
Summer	90	10	0
Fall	89	11	0
Winter	92	8	0
Spring	89	11	0
Average	**90**	**10**	**0**
Swan Johnson Trail	% of Hikers	% of Bikers	% of Equestrians
Summer	54	45	1
Fall	56	43	1
Winter	72	27	1
Spring	64	35	1
Average	**64**	**37**	**1**

According to the camera data, Sawmill Trail had the highest percentage of horseback riders of all trails reviewed; however, their numbers were still lower compared with other users across all seasons. In winter months, this trail had an increase in hikers and a decrease of mountain bikers. During the spring and summer months the percentage of hikers increased on weekends by 15-20%. The Mill Creek West Trail had an increase of hikers on weekends during the spring and winter months. Mountain bike use increased on weekdays versus weekends during the spring and winter months. Horseback riders were seen along this trail but were very low compared to the other user types.

Table 7. HTMOS Backcountry Trail Camera User Types (Estimate)

Sawmill Trail	% of Hikers	% of Bikers	% of Equestrians
Summer	51	33	16
Fall	54	41	5
Winter	80	17	3
Spring	70	28	2
Average	**64**	**29**	**7**
Mill Creek Trail	% of Hikers	% of Bikers	% of Equestrians
Summer	38	61	1
Fall	38	61	1
Winter	70	29	1
Spring	67	33	0
Average	**53**	**46**	**1**

Backcountry Camping

The Department offers three backcountry camping sites at HTMOS to visitors. This amenity is not advertised, except at the trailhead and is on a first-come-first-serve basis. Over the span of twelve months, 70 visitors and their guests stayed at the backcountry camping sites, totaling 129 people. The average group size was 1.89 and over 95% stayed for only one night.

Estimated Annual Visitation

The confidence interval for RMOS based on vehicle count data and the RMOS satisfaction survey. Based on the RMOS visitor survey the multiplier was 2.37 people/vehicle with a standard deviation of 0.95. This amounts to a percent uncertainty of 6.2%. During the study period, which includes the seasonal closure between December and February, RMOS had a visitation estimate of **19,700 to 22,300-person** visits. (Table 8).

Table 8. Visitation estimates for Red Mountain Open Space

		Uncertainty		
Location	Person Visits	Percent	Number	Visitation Estimate
Red Mountain	20,818	± 6.2	± 1,291	19,700 to 22,300

Front Country and Backcountry Visits and User Type Comparison

This component of the study aimed better understand where and how deep visitors go within the trail systems at RMOS with approximate percentages of user types, but specifically: hikers, mountain bikers and horseback riders.

Trail Counters to Determine Use: Eight (8) trail counters were installed at RMOS in August 2017. The counters were placed along the frontcountry and backcountry trails (Appendix F) and intended to measure (a) annual visitation and (b) backcountry trail use. The devices were carefully programmed to collect visitor data each month, triggered by motion, over the course of twelve months. Count data was reviewed by trained employees and volunteers. The trail counter data presented below was not included as part of the annual visitation counts. This can be attributed primarily to the fact that visitors can use multiple trails during their visit thus creating a higher level of data uncertainty. Instead, the study utilized the exit vehicle counters for the annual estimates.

Table 9. RMOS Trail Counter Data

Rising Sun Trail	Sinking Sun Trail	Bent Rock Trail	Cheyenne Rim Trail	Ruby Wash Trail	Salt Lick Trail	K-Lynn Cameron Trail	Big Hole Wash Trail	Fort Collins SS Canyon Trail (near Soapstone boundary)
TC #1	TC #2	TC #3	TC #4	TC #5	TC #6	TC #7	TC #8	SS
13.4%	16.6%	24%	8.2%	6.4%	7.7%	13.6%	6.7%	3.4%

Backcountry Visits and User Types

Two Bushnell trail cameras were installed in September 2017 at RMOS and strategically placed to best capture backcountry user types (Appendix F), but specifically, hikers, bikers, and horseback riders. Devices were programmed to collect images, triggered by motion, over the course of one year. The photos were reviewed by trained employees and volunteers. The results capture nine months (the property is closed in the winter) of data and summarized below.

According to the camera data, hiker ratios were lower in fall on the Cheyenne Rim Trail but increased in the spring. Mountain bikers were more likely to be seen during the weekdays in the spring but reversed in the summer months to weekends. This trail saw the most horseback riders in the fall months, with the lowest in the spring months. Hiker ratios on Big Hole and Sinking Sun trails were the most consistent of

all user types, across summer, fall, and spring. Mountain bike users tapered off in the spring and in the fall. The highest equestrian use was in the fall.

Table 10. RMOS Backcountry Trail Camera User Types

Cheyenne Rim Trail	% of Hikers	% of Bikers	% of Equestrians
Spring	51	41	8
Summer	32	46	22
Fall	19	57	24
Average	**34**	**48**	**18**
Big Hole/Sinking Sun Trail	% of Hikers	% of Bikers	% of Equestrians
Spring	71	11	18
Summer	58	18	24
Fall	60	8	32
Average	**63**	**12**	**25**

Horsetooth Reservoir

Estimated Annual Visitation

For Horsetooth Reservoir, confidence intervals were provided using the counts from vehicle counters at each of the parking areas, six in total. Analyses corrected counter data to adjust for days with missing counts and days when counters did not function properly. The confidence intervals were based on approximately 2% statistical error.

The table below (Table 11) shows the visitation estimates for six locations at Horsetooth Reservoir. Inlet Bay had 129,104 person visits, South Bay had 197,851 person visits, and Satanka had 117,039 person visits. The remaining three locations at Horsetooth Reservoir were day use areas. Person visits at these areas ranged from 209,224 at Rotary, 143,301 at Skyline, 257,338 at Sunrise. Visitation at the three-day use areas combined ranged from 378,000 to 442,000. Overall, when all six locations at Horsetooth Reservoir were considered together, the visitation estimate ranged from 789,000 to 918,000-person visits.

Table 11. Visitation estimates for Horsetooth Reservoir (*Day use area)

		Uncertainty		
Location	Person Visits	Percent	Number	Visitation Estimate
Inlet Bay	129,104	± 8.2	± 13,551	116,000 to 143,000
South Bay	197,851	± 6.3	± 15,955	182,000 to 214,000
Rotary *	209,224	± 6.9	± 18,479	191,000 to 228,000
Satanka	117,039	± 8.2	± 12,284	105,000 to 129,000
Skyline *	71,651	± 10.5	± 9,630	62,000 to 81,000
Sunrise *	128,669	± 7.6	± 12,517	116,000 to 141,000
3 Day Use Areas	409,544	± 6.0	± 31,977	378,000 to 442,000
All 6 areas	853,538	± 5.9	± 64,459	789,000 to 918,000

The visitor estimates at Horsetooth Reservoir were calculated based on visitors per car during peak off-peak months. The multipliers were based in part on the human observational data collected by LCDNR and through statistical analysis provided by CSU. The non-peak multiplier for Inlet Bay is 3.9, Rotary is 3.4, Satanka is 4.7, Skyline is 5.9, South Bay is 3.4, and Sunrise is 4.0. The peak multiplier for Inlet Bay is 5.4, Rotary is 4.6, Satanka is 4.9, Skyline is 7.9, South Bay is 3.4, and Sunrise is 4.7.

Parking Lot Capacity: Inlet Bay, South Bay, and Satanka Bay Parking Lots

LCDNR defines capacity as five or fewer parking spots in each lot. Observations of the parking lots were recorded throughout the study. At Horsetooth Reservoir, parking capacity measurements were recorded by trained staff using the same full or not full indicators by recording the start and end times of all six parking areas at capacity. The data was then analyzed using SPSS statistical software program.

On average, between May and September 2018, Inlet Bay was at capacity 1.6% of the time, Satanka was at capacity 5.5% of the time, and South Bay was at capacity 3.2% of the time. Satanka Bay exceeded capacity 18% of the time on weekends.

Table 12. Parking Lot Capacity Estimates at Horsetooth Reservoir

	Horsetooth Reservoir		
	Inlet Bay %	Satanka Bay %	South Bay %
Peak Months (May-September)	1.6	5.5	3.2
Weekday vs. Weekend			
Weekday	< 1	1	1
Weekend	5	18	10

User Types

A trail camera was strategically placed along the Foothills Trail to best capture trail users on the east side of Horsetooth Reservoir, but specifically, hikers and mountain bikers. Devices were programmed to collect images and triggered by motion. The photos were reviewed by trained staff and volunteers. In spring and summer months, hikers overwhelmingly yielded the highest ratio of all user types on both weekdays and weekends. Mountain bikers visited this trail more during the weekdays and no horseback riders were seen riding on this trail.

Table 13. Foothills Trail Camera User Types

Foothills Trail	% of Hikers	% of Bikers	% of Equestrians
Spring	85	15	0
Summer	86	15	0
Fall	86	14	0
Spring	85	15	0
Average	**85.5**	**14.5**	**0**

VISITOR SURVEY RESULTS

A total of 1,466 visitors completed the survey (Table 14). A total of 1,002 surveys were collected at HTMOS and 464 at RMOS. Due to higher visitation, visitors completed more surveys during the spring and summer seasons. Surveys were administered during the weekdays and weekends and during each of the shifts. Refer to Appendix E for information related to the survey design and survey methods used for this study.

Table 14. Visitor survey data collection effort (1 year)

	Larimer County Open Spaces	
	Horsetooth Mountain (*n* = 1002) %	Red Mountain (*n* = 464) %
Year		
2017	66	48
2018	34	52
Month		
January to March	15	20
April to June	36	43
July to September	30	32
October to December	18	6
Day of Week		
Weekday	51	40
Weekend	49	60
Shift		
Morning	38	9
Afternoon	48	62
Early evening	24	29

Demographics

The only significant difference in demographics between the two properties was the average age between HTMOS visitors (36.61 years) and RMOS visitors (48.52 years) (Table 15). The average HTMOS visitor is equally likely to be male (50%) or female (50%), self-identifies as White (93%), has a Bachelor's (42%) or a Master's (21%) degree, and has a household income of $50,000 to $149,999 (66%). At RMOS, the average visitor is slightly more likely to be male (52%) than female (48%), self-identifies as White (96%), has a Bachelor's (37%) or a Master's (22%) degree, and has a household income of $50,000 to $149,999 (58%).

Table 15. Demographic profile of Horsetooth Mountain and Red Mountain Open Spaces visitors

	Open Space [1]				
	Horsetooth Mountain %	Red Mountain %	Test statistic χ^2 or *t*-value	*p*-value	Effect size *V* or η
Gender			0.49	.503	.018
Male	50	52			
Female	50	48			
Age			173.76	< .001	.359
< 20	7	4			
21 to 25	20	5			
26 to 35	28	20			
36 to 45	18	14			
46 to 55	13	19			
56 to 65	11	22			
66 +	3	18			
Mean age	36.61	48.52	13.25	< .001	.357
Ethnicity			5.81	.016	.06
Hispanic or Latino	6	3			
Not Hispanic or Latino	94	97			
Race					
White	93	96	5.66	.017	.061
Black	1	< 1	1.52	.218	.031
Asian	3	1	9.66	.002	.074
American Indian	2	1	0.52	.473	.019
Native Hawaiian	< 1	< 1	0.77	.385	.022
Other	2	1	0.42	.515	.017
Don't know	1	1	0.64	.424	.020
Highest Level of Education			9.58	.088	.083
Some high school or less	2	1			
High school	14	14			
Associate's degree	13	11			
Bachelor's degree	42	37			
Master's degree	21	22			
Professional / Ph.D.	9	14			
Household Income			16.97	.018	.111
Less than $24,999	15	9			
$25,000 – $34,999	9	5			
$35,000 – $49,999	11	12			
$50,000 – $74,999	16	18			
$75,000 – $99,999	15	18			
$100,000 – $149,999	19	22			
$150,000 – $199,999	8	9			
$200,000+	8	7			

1 Cell entries are either percentages or means

Visitors to the Main and Soderberg trailheads at HTMOS differed statistically in terms of gender and age (Table 16). At the Main trailhead, the average visitor was slightly more likely to be female (53%) than male (47%) with an average age of 35 years. At the Soderberg trailhead, the average visitor was slightly more like to be male (58%) than female (42%) with an average age of 40 years. Over 90% of visitors at both trailhead locations were not Hispanic or Latino and similar percentages were white. Two-thirds of the visitors at the Main trailhead held a bachelor's degree or higher; 80% of the visitors to the Soderberg trailhead had achieved these education levels. A third (34%) of the Main trailhead visitors and 39% of the Soderberg trailhead visitors made $100,000 or more.

Table 16. Demographic profile of visitors to Horsetooth Mountain trailheads

	Trailhead [1]				
	Main %	Soderberg %	Test statistic χ^2 or *t*-value	*p*-value	Effect size *V* or η
Gender			7.85	.005	.092
Male	47	58			
Female	53	42			
Age			37.57	< .001	.210
< 20	8	3			
21 to 25	22	14			
26 to 35	30	22			
36 to 45	16	27			
46 to 55	10	20			
56 to 65	10	12			
66 +	4	3			
Mean age	35.42	40.17	4.74	< .001	.146
Ethnicity			0.46	.497	.022
Hispanic or Latino	7	6			
Not Hispanic or Latino	93	94			
Race					
White	92	94	1.30	.254	.036
Black	1	1	0.15	.695	.013
Asian	3	3	0.25	.616	.016
American Indian	2	1	1.18	.277	.033
Native Hawaiian	1	0	0.58	.448	.041
Other	2	1	0.92	.338	.040
Don't know	1	1	0.02	.900	.004
Highest Level of Education			19.71	.003	.135
Some high school or less	2	< 1			
High school	16	8			
Associate's degree	14	10			
Bachelor's degree	41	44			
Master's degree	19	26			
Professional / Ph.D.	9	10			
Household Income			17.49	.014	.140
Less than $24,999	16	10			
$25,000 – $34,999	9	7			
$35,000 – $49,999	12	8			
$50,000 – $74,999	15	16			
$75,000 – $99,999	14	19			
$100,000 – $149,999	20	17			

$150,000 – $199,999	7	11
$200,000+	7	11

Over two thirds (69%) of HTMOS visitors were residents of Larimer County; 31% were non-residents (Table 17). Similarly, 71% of visitors to RMOS are residents of Larimer County and 29% are non-residents. There was a difference between the amount of years HTMOS visitors have lived in Larimer County (11 years) versus RMOS visitors (15 years).

Table 17. Residence of Horsetooth Mountain and Red Mountain Open Space visitors

	Open Space				
	Horsetooth Mountain %	Red Mountain %	χ^2 or *t*-value	*p*-value	Effect size *V* or η
Resident of Larimer County			0.48	.488	.018
Yes	69	71			
No	31	29			
Years lived in Larimer County			39.02	< .001	.202
1 year or less	19	10			
2 – 3	16	15			
4 – 5	11	12			
6 – 10	15	14			
11 – 20	21	21			
21 – 30	12	11			
31+	6	18			
Range	1 to 58	1 to 62			
Mean	11.24	15.82	4.84	< .001	.167

Fifty-two percent of HTMOS visitors and 45% of RMOS visitors live in Fort Collins (Table 18). The remaining five primary residences of open space visitors include Loveland, Greeley, Cheyenne, Denver, and Berthoud.

Table 18. Top five specific primary residences of Horsetooth Mountain and Red Mountain Open Space visitors

	Open Space	
	Horsetooth Mountain %	Red Mountain %
Fort Collins	52	45
Loveland	8	8
Greeley	7	6
Denver	3	1
Berthoud	1	< 1

Visitation

When asked, 19% of visitors reported going to HTMOS for the first time in comparison to 45% for Red Mountain visitors (Table 19). There was a significant difference between the frequency of visits (in the past 12 months) at HTMOS (17.5 visits) compared with RMOS (3 visits).

Table 19. Visits to Horsetooth Mountain and Red Mountain Open Spaces in the past 12 months

	Open Space				
	Horsetooth Mountain %	Red Mountain %	Test statistic χ^2 or *t*-value	*p*-value	Effect Size *V* or η
Visits			173.60	< .001	.338
0 (first visit)	19	45			
1 – 2	26	29			
3 – 5	18	15			
6 – 10	11	6			
11 – 20	10	4			
21 – 50	10	2			
More than 50	7	< 1			
Range	0 to 365	0 to 150			
Mean	17.56	3.04	10.00	< .001	.189

Forty-three percent of non-residents were making their first visit to HTMOS, compared to only 7% of the residents (Table 20). Larimer County residents reported more visits, on average, to HTMOS (25.44) than non-residents (1.72).

Table 20. Number of visits to Horsetooth Mountain Open Space by Residents and Non-residents

	Resident of Larimer County				
	Non-Resident %	Resident %	Test statistic χ^2 or *t*-value	*p*-value	Effect Size *V* or η
Visits			336.40	< .001	.572
0 (first visit)	43	7			
1 – 2	40	19			
3 – 5	13	20			
6 – 10	3	15			
11 – 20	1	13			
21 – 50	0	15			
More than 50	0	11			
Range	0 to 50	0 to 365			
Mean	1.72	25.44	11.72	< .001	.256

Findings for primary activities on weekdays and weekends at HTMOS and RMOS yielded substantially significant differences (Table 23). Hiking was reported to be the primary activity on both weekdays and weekends at both properties. The second highest primary activity reported at HTMOS was walking dog(s) on both weekdays (18%) and weekends (24%). The second highest primary activity reported at RMOS was wildlife viewing on both weekdays (18%) and weekends (19%).

Table 23. Primary activities on weekdays and weekends

	Weekdays		Weekends	
	Horsetooth Mountain %	Red Mountain %	Horsetooth Mountain %	Red Mountain %
Hiking	55	52	55	57
Mountain biking	17	11	12	12
Walking dog(s)	18	0	24	0
Trail running	10	4	9	4
Horseback riding	0	14	< 1	9
Wildlife viewing	0	18	0	19
Chi-square	225.54		256.97	
p-value	< .001		< .001	
Cramer's *V*	.546		.513	

Differences between primary activity at the Main trailhead and Soderberg trailhead at HTMOS were substantial (Table 24). Hiking was the primary activity at the Main trailhead (65%), whereas less than a quarter (24%) listed this activity at Soderberg trailhead. Mountain biking was the primary activity at Soderberg trailhead (44%), compared to only 5% at Main trailhead.

Table 24. Primary activities at Horsetooth Mountain Open Space trailheads

	Trailhead [1]	
	Main n = 756 %	Soderberg n = 246 %
Hiking	65	24
Mountain biking	5	44
Walking dog(s)	23	15
Trail running	7	16
Horseback riding	0	1

$\chi^2 = 247.19$, $p < .001$. Cramer's $V = .522$.

Findings for primary activities on weekdays and weekends at HTMOS and RMOS yielded substantially significant differences (Table 23). Hiking was reported to be the primary activity on both weekdays and weekends at both properties. The second highest primary activity reported at HTMOS was walking dog(s) on both weekdays (18%) and weekends (24%). The second highest primary activity reported at RMOS was wildlife viewing on both weekdays (18%) and weekends (19%).

Table 23. Primary activities on weekdays and weekends

	Weekdays		Weekends	
	Horsetooth Mountain %	Red Mountain %	Horsetooth Mountain %	Red Mountain %
Hiking	55	52	55	57
Mountain biking	17	11	12	12
Walking dog(s)	18	0	24	0
Trail running	10	4	9	4
Horseback riding	0	14	< 1	9
Wildlife viewing	0	18	0	19
Chi-square	225.54		256.97	
p-value	< .001		< .001	
Cramer's *V*	.546		.513	

Differences between primary activity at the Main trailhead and Soderberg trailhead at HTMOS were substantial (Table 24). Hiking was the primary activity at the Main trailhead (65%), whereas less than a quarter (24%) listed this activity at Soderberg trailhead. Mountain biking was the primary activity at Soderberg trailhead (44%), compared to only 5% at Main trailhead.

Table 24. Primary activities at Horsetooth Mountain Open Space trailheads

	Trailhead [1]	
	Main %	Soderberg %
Hiking	65	24
Mountain biking	5	44
Walking dog(s)	23	15
Trail running	7	16
Horseback riding	0	1

$\chi^2 = 247.19$, $p < .001$. Cramer's $V = .522$.

At the combined HTMOS trailheads, 27% of hikers reported their first visit in comparison with only 4% of mountain bikers (Table 25). There is a substantial difference of frequency of visits between hikers and mountain bikers at HTMOS. At RMOS, 51% of hikers an 36% of mountain bikers reported this was their first visit. The difference between frequencies of hiking and mountain biking visits to Red Mountain was not as substantial.

Table 25. Hikers and mountain bikers visitation to Horsetooth Mountain and Red Mountain Open Spaces

	Horsetooth Mountain		Red Mountain	
	Hiking %	Mountain Biking %	Hiking %	Mountain Biking %
0 (first visit)	27	4	51	36
1 – 2	33	4	32	26
3 – 5	18	9	10	12
6 – 10	9	12	3	6
11 – 20	7	15	2	6
21 – 50	4	28	1	2
More than 50	2	28	0	2
Chi-square	229.29		12.82	
p-value	< .001		.046	
Cramer's *V*	.617		.232	

In the past 12 months, the median of hikers visited HTMOS 2 times and bikers visited an average of 30 times (Table 26). At RMOS, the median of hikers visited less than once in the last 12 months and mountain bikers visited one time. The range identified in the table below refers to the visitor days reported.

Table 26. Descriptive statistics for hikers and mountain bikers visitation to Horsetooth Mountain and Red Mountain Open Spaces

	Horsetooth Mountain		Red Mountain	
	Hiking	Mountain Biking	Hiking	Mountain Biking
Range (visitor days)	0 to 300	0 to 365	0 to 25	0 to 60
Median	**2**	**30**	**0**	**1**
Mean	6.96	49.53	1.69	5.21
t-value	7.76		2.04	
p-value	< .001		.047	
Eta	.441		.223	

At HTMOS Main trailhead, 27% of hikers reported their first visit compared to only 3% of mountain bikers (Table 27). At Soderberg trailhead, 24% of hikers reported their first visit compared to 4% of mountain bikers. Additionally, 55% of hikers have visited the Main trailhead within 2 years or less compared with 7% at Soderberg trailhead.

Table 27. Hikers and mountain bikers visitation Horsetooth Mountain Open Space trailheads

	Main Trailhead		Soderberg Trailhead	
	Hiking %	Mountain Biking %	Hiking %	Mountain Biking %
0 (first visit)	27	3	24	4
1 – 2	34	8	31	3
3 – 5	20	29	4	1
6 – 10	9	13	11	11
11 – 20	7	16	11	15
21 – 50	2	16	15	33
More than 50	2	16	6	33
Chi-square	53.23		52.87	
p-value	< .001		< .001	
Cramer's *V*	.369		.575	

The median (middle of scale) number of visits by hikers was 2 at both Main and Soderberg trailheads. The medians for number of visits by mountain bikers were 10 (Main) and 30 (Soderberg). The high means were being driven by some visitors at both trailheads reporting frequent visitation (see range in Table 28).

Table 28. Descriptive statistics for hikers and mountain bikers visitation to Horsetooth Mountain Open Space trailheads

	Main Trailhead		Soderberg Trailhead	
	Hiking	Mountain Biking	Hiking	Mountain Biking
Range (visitor days)	0 to 300	0 to 257	0 to 145	0 to 365
Median	**2**	**10**	**2**	**30**
Mean	6.16	30.95	13.62	56.73
t-value	2.94		5.76	
p-value	.006		< .001	
Eta	.246		.355	

Findings indicated statistical differences between HTMOS and RMOS in 6 of the 8 activities (hiking, trail running, horseback riding, picnicking, photography/art, and wildlife viewing) (Table 29). Trail running, horseback riding, and picnicking yielded the most significant activity type differences between the properties. The activities that did not yield significant differences were mountain biking and family gathering.

Table 29. All activities on day of interview Horsetooth Mountain and Red Mountain Open Spaces

	Open Space [1]				
	Horsetooth Mountain %	Red Mountain %	Chi-square	*p*-value	Phi
Hiking	84	77	9.83	.002	.083
Mountain biking	15	11	3.52	.061	.048
Trail running	16	5	44.83	<.001	.162
Family gathering	6	5	.01	.937	.002
Horseback riding	< 1	11	95.47	< .001	.259
Picnicking	6	12	18.68	< .001	.117
Photography / Art	14	21	10.12	.001	.085
Wildlife viewing	17	22	6.01	.014	.065

Most visitors at HTMOS reported using only 1 trail (62%) during their visit (Table 30). Twenty-one percent of visitors reported using two trails, 11% reported using three, and only 6% reporting using four trails during their visit.

Table 30. Reported number of trails used at Horsetooth Mountain Open Space on the day of the interview

	Visitors	
Number of Trails	Number	Percent
1	626	62
2	213	21
3	115	11
4	62	6
Total	1016	100%

Horsetooth Falls Trail and Horsetooth Rock Trail were the most used trails, representing 48% of visitors who reported the specific trails they used during their visit (Table 31). Overall, the backcountry trails were used less by visitors than frontcountry trails.

Table 31. Specific trail uses at Horsetooth Mountain Open Space on the day of the interview

	Visitors	
Trail	Number	Percent
Horsetooth Falls Trail	248	25
Horsetooth Rock Trail	232	23
South Ridge Trail	69	7
Towers Road	72	7
Soderberg Trail	58	6
Spring Creek Trail	58	6
Nomad Trail	36	4
Sawmill Trail	31	3
Shoreline Trail	30	3
Wathen Trail	27	3
Carey Springs Trail	18	2
Stout Trail	20	2
Herrington Trail	13	1
Loggers Trail	9	1
Mill Creek Trail	14	1
West Ridge Trail	13	1
Audra Culver Trail	14	1
Other	39	4
Total	1016	100

Group Characteristics

A group is defined as more than one individual. Findings indicated significant differences in group characteristics between HTMOS and RMOS (Table 32). At both properties, visitors are most likely to visit with a group (70% at HTMOS and 87% at RMOS). At HTMOS, the average group size was 2.5 visitors while Red Mountain yielded an average of 3.5 visitors per group. On average, these groups reported 2.13 adults at HTMOS and 3.07 adults at RMOS. At both locations, the number of children in attendance were less than 0.5.

Table 32. Group characteristics of Horsetooth Mountain and Red Mountain Open Spaces visitors

	Open Space				
	Horsetooth Mountain %	Red Mountain %	χ^2 or *t*-value	*p*-value	Effect size *V* or η
I visited the open space			50.87	< .001	.18
Alone	30	13			
With a group	70	87			
Number of people in group			69.90	< .001	.217
1	30	13			
2	41	45			
3	11	13			
4 – 5	13	15			
6+	5	13			
Range	1 to 30	1 to 27			
Mean	2.46	3.54			.179
Number of adults in group			87.02	< .001	.245
1	34	15			
2	47	53			
3	10	11			
4 – 5	7	11			
6+	3	11			
Range	1 to 30	1 to 19			
Mean	2.13	3.07			.198
Number of children in group			12.38	.030	.093
0	85	81			
1	6	9			
2	5	6			
3	3	1			
4 – 5	1	1			
6+	< 1	1			
Range	1 to 8	1 to 21			
Mean	.31	.49			.059

Hiking was reported as the primary activity for those who visited alone (40%) and with a group (60%) (Table 33). Mountain biking was the second most reported activity for visitors by themselves (25%) while walking dog(s) was the second most reported activity of groups (14%).

Table 33. Primary activity by visited alone or with a group

	Visited:		Visited:	
	Alone %	With Group %	Alone *n*	With Group *n*
Hiking	40	60	142	657
Mountain biking	25	10	91	107
Walking dog(s)	14	14	51	151
Trail running	18	4	63	46
Horseback riding	1	4	5	46
Wildlife viewing	3	8	6	82

$\chi^2 = 144.93$, $p < .001$. Cramer's $V = .323$.

Transportation

Over 90% of visitors at HTMOS (94%) and RMOS (97%) reported a car as their mode of transportation to the open spaces (Table 34).

Table 34. Transportation to Horsetooth Mountain and Red Mountain Open Spaces

	Open Space	
	Horsetooth Mountain %	Red Mountain %
Vehicle	94	97
Dropped off	< 1	0
Bicycle	2	< 1
Horseback	0	< 1
Run / Walk	3	< 1
Other	< 1	0

$\chi^2 = 37.71$, $p < .001$. Cramer's $V = .146$

Less than a third of visitors (31% *n* = 319) reported being turned away from HTMOS at some point because the parking lot was full (Table 35). Of those that reported being turned away, 25% of visitors reported 3 times or less in the past 12 months.

Table 35. Turned away from visiting Horsetooth Mountain Open Space because the parking was full

Turned away	Number	Percent
No	683	69
Yes	319	31
If yes, how many times in past 12 months		
1	153	15
2	74	7
3	29	3
4	10	1
5	16	2
6+	26	3

At HTMOS, 30% of visitors were turned away from the Main trailhead, while 35% of visitors were turned away from the Soderberg trailhead (Table 36). Sixteen percent of those who were turned away at Main and 16% at Soderberg were turned away once in the past 12 months.

Table 36. Turned away from visiting Horsetooth Mountain Open Space because the parking was full by trailhead location

	Trailhead	
Turned away	Main %	Soderberg %
No	70	65
Yes	30	35
If yes, how many times in the past 12 months		
1	15	16
2	7	10
3	3	3
4	1	1
5	1	3
6+	2	4

$\chi^2 = 5.59$, $p = .471$. Cramer's $V = .077$

Mountain bikers reported being turned away more often (43%) than hikers (26%) at HTMOS (Table 37). In the past 12 months, 31% of mountain bikers and 23% of hikers reported being turned away 1-3 times.

Table 37. Turned away from visiting Horsetooth Mountain Open Space because the parking was full by user type

	Primary Activity	
Turned away	Hiker %	Mountain Biker %
No	74	57
Yes	26	43
If yes, how many times in past 12 months		
1	15	14
2	6	13
3	2	4
4	< 1	1
5	1	4
6+	2	8

$\chi^2 = 30.58$, $p < .001$. Cramer's $V = .228$

Checked Conditions

Respondents were more likely to check open space conditions before visiting RMOS (38%) than HTMOS (22%) (Table 38). Of those that checked conditions, LCNDR's website was the most used source, followed by the NoCo Trail Report.

Table 38. Checked the conditions before visiting Horsetooth Mountain or Red Mountain Open Spaces on the day of the interview

	Open Space				
	Horsetooth Mountain %	Red Mountain %	Chi-square	*p*-value	Cramer's *V*
Did you check the conditions?			41.48	< .001	.172
No	78	61			
Yes	22	38			
How did you check [1]					
NoCo Trail Report	33	21	6.19	.013	.139
Social Media	20	6	14.36	< .001	.205
Website	53	80	24.49	< .001	.274

At HTMOS and RMOS, mountain bikers (27%) were more likely to check conditions than hikers (22%) (Table 39). Sixty-nine percent of mountain bikers reported checking the NoCo Trail Report as their primary source while 59% of hikers checked the LCDNR website as their primary source. Social media was the least utilized source to check conditions.

Table 39. Checked the conditions before visiting Horsetooth Mountain or Red Mountain Open Spaces on the day of the interview by hikers and mountain bikers

	Primary Activity				
	Hiking %	Mountain Biking %	Chi-square	*p*-value	Cramer's *V*
Did you check the conditions?			1.23	.318	.042
No	78	73			
Yes	22	27			
How did you check [1]					
NoCo Trail Report	23	69	23.87	<.001	.431
Social Media	21	19	0.04	.838	.018
Website	59	39	4.04	.045	.176

Reasons for Visiting

Most visitors (76%) reported exercise as their reason for visiting HTMOS, followed by nature (65%) and location (55%) (Table 40).

Table 40. Reasons for visiting Horsetooth Mountain Open Space on the day of the interview.

	Percent
Exercise	76
Nature	65
Location	55
Family time	28
Other	11

"Less crowded" was the most common response for visiting RMOS (61%), followed by "Other" comments (49%), which typically mentioned scenery or visiting the open space for the first time (Table 41).

Table 41. Reasons for visiting Red Mountain Open Space on the day of the interview.

	Percent
Less crowded	61
Variety of trails	40
Solitude	43
Other	49

Visited Other Larimer County Properties

Horsetooth Reservoir was reported as the most visited LCNR property over the last 12 months by both HTMOS visitors (72%) and RMOS visitors (60%) (Table 42). The second most visited property was Devil's Backbone Open Space (45% and 42%, respectively).

Table 42. Visited other Larimer County Natural Resource properties over the past 12 months.

	Open Space [1]				
	Horsetooth Mountain %	Red Mountain %	Chi-square	*p*-value	Phi
Carter Lake	24	17	8.35	.004	.080
Flatiron Reservoir	8	8	0.01	.938	.005
Horsetooth Reservoir	72	60	19.54	< .001	.120
Pinewood Reservoir	14	12	0.23	.629	.013
Devil Backbone OS	45	42	1.59	.208	.036
Eagle Nest OS	7	26	84.52	< .001	.255
Hermit Park OS	6	10	5.06	.024	.064
Lions OS	7	7	0.00	.996	.000
Ramsay Shockey OS	2	5	5.51	.019	.068
River Bluffs OS	2	6	9.53	.002	.086

1 Cell entries are the percentages of visitors to each location that visited other locations.

Nearly all (98%) of HTMOS visitors and 94% of RMOS visitors responded there are no Larimer County park/open spaces they avoid (Table 43).

Table 43. Larimer County Natural Resources properties respondents no longer visit

Do you avoid any particular Larimer County Natural Resources properties?	Open Space	
	Horsetooth Mountain %	Red Mountain %
No	98	94
Yes	2	6

$\chi^2 = 11.82$, $p = .001$. Phi = .098.

Of the HTMOS visitors (2%) and RMOS visitors (6%) indicated avoiding particular LCDNR properties, 16 visitors responded they avoid Devils Backbone Open Space, 8 responded they avoid Horsetooth Reservoir, and 4 responded they avoid Carter Lake (Table 44).

Table 44. Specific Larimer County Natural Resources properties respondents no longer visit

	Number
Devils Backbone OS	16
Horsetooth Reservoir	8
Carter Lake	4

Numbers less than 4 were not included on this list.

Visitor Satisfaction

With one exception, over 80% of visitors at HTMOS and RMOS rated the quality of facilities as "good" and "very good" (Table 45). The exception was the "restrooms" (68%) at HTMOS. Eleven of the 12 percentages in Table 45, exceed the 80% standard for satisfaction.

Table 45. Perceived quality of facilities at Horsetooth Mountain and Red Mountain Open Spaces

	Open Space [1]				
	Horsetooth Mountain %	Red Mountain %	Chi-square	*p*-value	Phi
Restrooms	68	88	50.34	< .001	.230
Parking areas	89	99	55.44	< .001	.174
Picnic areas	89	97	15.50	< .001	.153
Trash receptacles	83	96	24.03	< .001	.166
Kiosk information	87	96	19.27	< .001	.138
Trails	96	96	0.26	.610	.013

1. Cell entries are percentages for "good" and "very good" responses

Over three quarters (79%) of the comments provided by respondents about facilities at HTMOS were overwhelmingly positive. The less positive comments provided by 21% of respondents included smelly restrooms and need for more parking (Table 46).

Table 46. Constructive feedback given related to lower facility ratings at Horsetooth Mountain

Constructive Feedback Topics	Number	Percent
Smelly Restrooms	25	6
Need more parking	21	5
Update kiosk maps	15	3
Water fountain not working	13	3
Need more trash cans	14	3
Need hand sanitizer	10	2
Other comments were positive	358	79

Findings also indicated positive responses of the overall perceived quality at HTMOS and RMOS; 98% of HTMOS respondents and 99% of RMOS respondents reported a "good" or "excellent" for the overall perceived quality (Table 47). These findings exceed the 80% standard of quality.

Table 47. Overall perceived quality of Horsetooth Mountain and Red Mountain Open Spaces

	Open Space	
	Horsetooth Mountain %	Red Mountain %
1 Poor	0	0
2	0	0
3 Neutral	2	1
4	25	18
5 Excellent	73	81

$\chi^2 = 11.82$, $p = .008$, $V = .087$

The early recreation literature (e.g., Graefe et al. 1990; Heberlein & Vaske, 1977; Shelby & Heberlein, 1986) predicted that satisfaction should be lower during peak usage as compared to off-peak. Table 48 compares the reported satisfaction levels for seven specific facilities (e.g., restrooms, parking areas) and a measure of the overall quality of the experience at HTMOS during weekdays (off-peak) and weekends (peak use). The seven specific facilities were coded on a scale that ranged from (1) very poor to (5) very good. With the exception of restrooms, all of the means were greater than 4 (i.e., between good and very good) for both weekdays and weekends. For the restrooms the means were approaching good (3.96 for weekdays and 3.84 for weekends). Only 3 of the 7 *t*-values were statistically significant, and all eta values were minimal. Substantively, the satisfaction for these seven facilities were the same on weekdays and weekends, and in nearly all instances were approaching the high end of the scale.

A similar conclusion was evident for the overall measure of quality of the experience. The mean for weekdays was 4.74; the mean for weekends was 4.69. A high end of this scale was 5 (i.e., Excellent).

Table 48. Perceived quality of facilities and the overall experience at Horsetooth Mountain Open Space on weekdays and weekends

	Weekdays	Weekends	*t*-value	*p*-value	eta
Perceived quality of: [1]					
Restrooms	3.96	3.84	1.62	.105	.069
Parking Areas	4.45	4.33	2.50	.013	.082
Fountain	4.23	4.06	2.12	.037	.093
Picnic Areas	4.43	4.26	2.24	.023	.122
Trash Receptacles	4.32	4.22	1.36	.175	.060
Kiosk Information	4.36	4.28	1.29	.201	.055
Trails	4.65	4.57	2.11	.035	.068
Overall perceived quality 2	4.74	4.69	1.63	.103	.058

1. Scale: 1 = Very Poor, 2 = Poor, 3 = Average, 4 = Good , 5 = Very Good
2. Scale: 1 = Poor, 3 = Neutral, 5 = Excellent

Perceived Conflict

Ninety percent or more of all respondents "never" *observed* hikers, mountain bikers or equestrian riders behaving unsafely or discourteously (Table 49). When these behaviors were witnessed, the most reported reasons for unsafe and discourteous hiking were climbing illegally, off trail hiking, and playing loud music. Unsafe and discourteous biking was reported due to riding too fast and not yielding to other visitors. Unsafe and discourteous horseback riding was reported due to horse waste and riding off trail.

Table 49. Unsafe and discourteous behaviors witnessed at Horsetooth Mountain and Red Mountain Open Spaces on the day of the interview.

Percent of respondents who "never" observed the behavior.

	Open Space [1]				
	Horsetooth Mountain %	Red Mountain %	Chi-square	*p*-value	Phi
Saw hikers behaving unsafely	91	99	36.95	< .001	.142
Saw mountain bikers behaving unsafely	90	97	29.76	< .001	.131
Saw equestrian riders behaving unsafely	98	99	1.01	.314	.026
Witnessed hikers being discourteous	90	99	47.36	< .001	.157
Witnessed mountain bikers being discourteous	92	97	14.83	< .001	.095
Witnessed equestrian riders being discourteous	98	99	1.24	.266	.028

At both open space properties, 58-84% of visitors reported "never" experiencing problem behaviors with hikers, bikers, and equestrians (Table 50). Perceived problems with other visitors were reported more at HTMOS than RMOS.

Table 50. Perceived problems with other visitors at Horsetooth and Red Mountain Open Spaces.

Percent of respondents who "never" experienced the problem behavior

	Open Space [1]				
	Horsetooth Mountain %	Red Mountain %	Chi-square	*p*-value	Phi
Hikers hiking unsafely	64	81	46.09	< .001	.176
Mountain bikers riding unsafely	58	77	46.56	< .001	.178
Equestrian riders riding unsafely	74	82	11.88	< .001	.091
Hikers being discourteous	63	84	63.28	< .001	.205
Mountain bikers being discourteous	63	78	34.40	< .001	.153
Equestrian riders being discourteous	73	83	16.34	< .001	.106

Combining the observed behaviors in Table 49 with the corresponding perceived problem behaviors in Table 50 resulted in the distributions shown in Table 51. For both locations, between 58% and 84% reported no conflict. Between 16% and 33% expressed social values conflict. Less than 10% noted interpersonal safety of discourteous conflicts with hikers, bikers, or horseback riders. These findings are within the standard of no more than 25% of visitors reporting interpersonal conflict.

Table 51. Perceived conflict at Horsetooth Mountain and Red Mountain Open Spaces

	Open Space				
	Horsetooth Mountain %	Red Mountain %	Chi-square	*p*-value	Cramer's *V*
Hikers hiking unsafely			54.57	< .001	.186
No conflict	64	81			
Interpersonal conflict	7	1			
Social values conflict	29	18			
Mountain bikers riding unsafely			54.09	< .001	.189
No conflict	58	77			
Interpersonal conflict	9	2			
Social values conflict	33	21			
Equestrian riders riding unsafely			16.87	< .001	.103
No conflict	74	82			
Interpersonal conflict	2	< 1			
Social values conflict	24	18			
Hikers being discourteous			78.63	< .001	.218
No conflict	64	84			
Interpersonal conflict	8	< 1			
Social values conflict	28	28			
Mountain bikers being discourteous			37.37	< .001	.159
No conflict	63	78			
Interpersonal conflict	7	3			
Social values conflict	30	19			
Equestrian riders being discourteous			16.37	< .001	.106
No conflict	73	83			
Interpersonal conflict	2	1			
Social values conflict	25	16			

Encounters with Others and Perceived Crowding

On average, visitors to HTMOS reported seeing 13.52 hikers at the trailhead and 22.71 hikers on the trail (Table 52). Encounters with mountain bikers at HTMOS were substantially less (M = 1.99 at the trailhead and 4.17 on the trail). Seeing horseback riders at HTMOS rarely occurred. However, respondents did see an average of 3.50 dogs at the trailhead and 6.28 on the trail. The questions about dogs were not included on the RMOS because dogs are not allowed on that property.

Encounters with hikers (M = 3.63) and mountain bikers (M = 0.53) at RMOS were substantially lower when compared to HTMOS. However, seeing horseback riders at RMOS was slightly more common than at Horsetooth. In all cases, the differences in these means was statistically significant ($t \geq 6.12$, $p < .001$, in all cases) and effect sizes in the typical to substantial range.

Table 52. Reported number of other visitors seen at Horsetooth Mountain and Red Mountain Open Spaces

	Open Space [1]				
	Horsetooth Mountain	Red Mountain	*t*-test	*p*-value	Eta
Number seen at the trailhead					
Hikers	13.52	3.63	17.08	< .001	.346
Mountain bikers	1.99	0.53	9.88	< .001	.217
Horseback riders	0.11	0.78	7.84	< .001	.260
Dogs [2]	3.50				
Number seen on the trail					
Hikers	22.71	4.36	24.72	< .001	.473
Mountain bikers	4.17	0.68	14.78	< .001	.313
Horseback riders	0.22	0.76	6.12	< .001	.196
Dogs [2]	6.28			37	

1. Cell entries are means
2 This question was not included on the Red Mountain survey

The percent of HTMOS visitors reporting any level of crowding (scale points 3 thru 9) ranged from 7 to 30 (Table 53). At RMOS, these percentages were always < 5. All of the differences between HTMOS and RMOS percentages were statistically significant ($p < .001$). In addition, all of the percentages were within the standard of no more than 35% of visitors should feel any level of crowding.

Table 53. Perceived crowding at Horsetooth Mountain and Red Mountain Open Spaces

Did you feel crowded by:	Open Space [1]				
	Horsetooth Mountain % Crowded	Red Mountain % Crowded	Chi-square	*p*-value	Phi
Hikers					
At the trailhead	24	4	100.62	< .001	.240
On the trail	30	4	157.04	< .001	.296
Mountain bikers					
At the trailhead	7	1	23.90	< .001	.118
On the trail	11	2	42.31	< .001	.155

1. % crowded includes scale points 3 thru 9 in Figure 2

Norm Tolerances

Nearly half of hikers and mountain bikers at HTMOS reported that it did not matter how many other visitors they saw on the trail (Table 54). Twenty-one percent of both user groups were able to report an acceptable number of other users. These findings are consistent with other frontcountry locations.

Table 54. Encounter norms for seeing hikers and mountain bikers on the trail at Horsetooth Mountain Open Space [1]

	Acceptable number of ____ to see on the trails	
	Hikers %	Mountain bikers %
Reported a number (i.e., has a norm)	21	21
Number does not matter (does not have a norm)	49	47
Number matters to me, but I cannot specify a number	27	31

1. This question read:
   What is an acceptable number of **hikers** (or mountain bikers) to see while you are **on the trail**?
   (Please fill in a number or check one of the other two options)

   It is OK to see as many as _____ **Hikers on the trail**
   _____ It does not matter to me
   _____ It matters to me, but I cannot specify a number

On average, respondents indicated that they could tolerate seeing 26 other recreationists while visiting HTMOS (Table 55). The median (the middle) and mode (most frequent) for this distribution were both 20 other visitors and responses ranged from 0 to 100. Comparable values for seeing mountain bikers were 11 (Mean), 10 (Median), 10 (Mode) and 0 to 100 (range). This suggests that HTMOS visitors were more tolerant of seeing hikers than they were of encounters with mountain bikers.

Table 55. Encounter norm descriptive statistics for seeing hikers and mountain bikers on the trail at Horsetooth Mountain Open Space [1]

	Acceptable number of ____ to see on the trails	
	Hikers	Mountain bikers
Mean	26	11
Median	**20**	**10**
Mode	20	10
Minimum	0	0
Maximum	100	100

The normative standard for the Larimer County open spaces was set at 80% or more of visitors should encounter fewer other visitors than their norm. Hikers evaluations mountain bikers (88%) and mountain bikers evaluations of other bikers (92%) exceeded this standard (Table 56). However, this standard was **not met** for hikers evaluations of other hikers (73%) or for mountain bikers of hikers (75%). These findings probably reflect the higher densities of hikers at HTMOS.

Table 56. Reported encounters and norm tolerances at Horsetooth Mountain Open Space

Evaluation Context		Reported Encounters Compared to Norm	
Evaluation by:	Evaluation of:	% Fewer Encounters	% More Encounters
Hikers	Other hikers	73	**27**
	Mountain bikers	88	12
Mountain bikers	Hikers	75	**25**
	Other mountain bikers	92	8

Hikers evaluations of other hikers (29%) and mountain bikers evaluations of hikers (33%) norm tolerance standard that was not met both occurred at the Main trailhead. The 80% norm standard at Soderberg was exceeded by visitors as they encountered fewer visitors than their norm.

Table 57. Reported encounters and norm tolerances at Main and Soderberg trailheads

	Evaluation Context		Reported Encounters Compared to Norm	
Trailhead	Evaluation by:	Evaluation of:	% Fewer Encounters	% More Encounters
Main	Hikers	Other hikers	71	**29**
		Mountain bikers	89	11
	Mountain bikers	Hikers	67	**33**
		Other mountain bikers	100	0
Soderberg	Hikers	Other hikers	91	9
		Mountain bikers	80	20
	Mountain bikers	Hikers	81	19
		Other mountain bikers	88	12

The majority of visitors from HTMOS disagreed that there are too many large groups of mountain bikers (76%), hikers (70%), and equestrians (81%) (Table 58). Seventy-eight percent of respondents were neutral or disagreed hikers and mountain bikers should not be allowed on the same trails. Over three-quarters (77%) disagreed mountain bikers and equestrians should not be allowed on the same trails. Dogs at HTMOS did not interfere with visitors' enjoyment.

Table 58. Beliefs about hikers, mountain bikers and dogs at Horsetooth Mountain Open Space

	Disagree %	Neutral %	Agree %
There are too many large groups of *mountain bikers*	76	22	2
There are too many large groups of *hikers*	70	26	4
There are too many large groups of *equestrians*	81	18	1
Hikers and *mountain bikers* should not be allowed on the same trails	52	26	22
Mountain bikers and *horses* should not be allowed on the same trails.	48	29	23
Encounters with dogs interfered with my enjoyment	82	14	4

Dogs off leash interfered more with the enjoyment of Soderberg trailhead visitors than it did with visitors at Main trailhead (Table 59). "Other" comments were overwhelmingly positive dog experiences.

Table 59. Reasons dogs interfered with my enjoyment at Horsetooth Mountain Open Space

	Trailhead [1]	
	Main %	Soderberg %
Dogs off-leash	14	53
Dog waste	14	11
Other comments were positive responses about dogs	72	37

$\chi^2 = 11.21$, $p = .004$, Cramer's $V = .388$

Visitor Survey Conclusions

Visitor Survey

This report summarized the findings from a 2017-2018 survey of visitors to Horsetooth Mountain and Red Mountain open spaces. Visitors were described in terms of their (1) demographic characteristics, 2) user type preferences (3) prior visitation rates and trip characteristics, (4) visitation to other county properties and if they're being avoided and why, (5) visitor satisfaction of trailhead and trail facilities, (6) perceived conflicts with other visitors, (7) perceived crowding, and norm tolerances for seeing others while visiting. The intent was to provide LCDNR with baseline information against which future research results can be compared and to inform management decisions.

To better interpret the data, the results were expressed in terms of indicators and standards for visitor satisfaction, perceived conflict, and perceived crowding. An indicator is a specific variable that reflects the current situation. A standard of quality is the minimum acceptable condition for each indicator. Standards identify desirable conditions (e.g., no litter), and conditions that managers are trying to achieve. For example, at least X% of visitors should be satisfied with their experience at the natural area, or no more than Y% of recreationist should feel crowded. Selecting values for X and Y has always proven challenging for natural resource managers and researchers. This section (1) summarizes how the indicators and standards for the LCDNR were selected and what the results revealed. (2) presents more general criteria for choosing indicators and standards, and (3) discusses sources for selecting indicator and developing standards.

Larimer County Open Space Indicators and Standards

This report was based on indicators and standards for visitor satisfaction, perceived conflict, perceived crowding and normative tolerances. The four concepts were selected because they have received the most attention in the natural resource literature and previous research has suggested standards for their application. Meta-analyses of the satisfaction research (e.g., Vaske et al., 1982; Vaske & Roemer, 2013), for example, has consistently found that non-consumptive recreationists (e.g., hiker, mountain bikers) report higher levels of satisfaction than consumptive recreationists (e.g., hunters, anglers). This study focused on non-consumptive visitors. Based on the literature, the standard was set at 80% or more of the visitors should be satisfied with their experiences at Horsetooth Mountain and Red Mountain. Results for the quality of specific facilities indicated that with one exception (i.e., restrooms at Horsetooth) this standard was met or exceeded in both locations across all six facilities; parking areas, drinking fountain, picnic areas, trash receptacles, kiosk information, and trails. The standard was also achieved in both areas for the overall perceived quality of the experience. Nearly all respondents rated the perceived quality of their experience as "good" or "excellent:" Horsetooth Mountain (98%) and Red Mountain (99%).

For perceived conflict, the literature suggested that the magnitude of conflict depends on the characteristics of: (1) the activity (e.g., consumptive vs. non-consumptive, traditional vs. non-traditional), (2) the visitors (e.g., tolerances for other user groups, perceived similarities between the groups), (3) the environment (e.g., unpaved vs. paved trails that allow for faster speeds), and (4) management (e.g., zoning to separate potentially incompatible activities). Given the activities and conditions at the two open space properties, the standard was set at no more than 25% of the respondents should experience interpersonal conflict. This standard was met or exceeded for both areas, activities (hiking, mountain biking, horseback riding) and behaviors (i.e., acting unsafely or discourteous).

The perceived crowding literature (Shelby et al., 1989; Vaske & Shelby, 2008) has suggested a standard of $\leq$ 35% of visitors should feel any level of crowding (i.e., scale points 3 thru 9 on the crowding scale, Figure 2). This report examined this standard for hikers and mountain bikers at the trailhead and on the trail. The $\leq$ 35% perceived crowding standard was met or exceed in all contexts.

The normative standard for the Larimer County open spaces was set at 80% or more of visitors should encounter fewer other visitors than their norm. Hikers evaluations of mountain bikers (88%) and mountain bikers evaluations of other bikers (92%) exceeded this standard. The standard was not met for hikers evaluations of other hikers (73%) or for mountain bikers of hikers (75%).

Overall, the findings here suggest the standards of quality for visitor satisfaction, perceived conflict, perceived crowding, and normative tolerances **were met or exceeded** at both Horsetooth Mountain and Red Mountain open spaces with only a few minor exceptions. Appendix C provides general criteria for choosing additional indicators and standards if expanded research in the future is warranted.

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