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**PRIVILEGED ATTORNEY-CLIENT WORK PRODUCT**

TO: Boulder Mountain Bike Alliance

FROM: Davis Backer, Jordi Goodman, Student Attorneys

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RE: *The Concept of Carrying Capacity for Boulder's Open Space*

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**Introduction**

2017 is going to see the review and re-drafting of Boulder's Comprehensive Plan as well as the city's individual Master Plans. As part of that process, Open Space and Mountain Parks is responsible for conducting an analysis of Boulder's trail networks to get a sense for demand and the resulting effects on surrounding resources.

As Colorado's recent boom in population growth continues to swell, attracting nearly 60,000 people per year to the front range area alone, the state will be increasingly pressed to provide adequate open space to accommodate growing demand. In the interest of preserving our legendary trail systems for generations to come, adopting a regulatory framework that appreciates the need to balance both ecological and recreational interests will be crucial.

As one of Boulder's major recreational support groups, Boulder Mountainbike Alliance (BMA) is in an ideal position to advocate for this kind of balance, encouraging Boulder Open Space and Mountain Parks to adopt a more holistic account of the concerns facing our local trail networks. From the OSMP Visitor Master Plan, we know that one concept that will be important in the planning process is the concept of "carrying capacity."<sup>1</sup> It is our hope that what follows may provide some insight for BMA going forward as it navigates the comprehensive planning process.

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<sup>1</sup> City of Boulder Open Space and Mountain Parks Visitor Master Plan (Approved April 2005)  
<https://bouldercolorado.gov/osmp/visitor-master-plan>.

## Theoretical Framework

Understanding the role that carrying capacity will have in the regulation of open space begins with an examination of the city's governing documents themselves. In the city's Open Space and Mountain Parks Visitor Master Plan, the term is mentioned just once in connection with the generally accepted goal of "preserving the environment."<sup>2</sup> Noticeably absent is any stated reliance on the concept for planning purposes. From an interpretive standpoint, this could be due to poor drafting but it could also indicate flexibility in the concept's application.

While the concept of carrying capacity has been used as a proxy for sustainability for decades, it is not entirely clear where it originated. What is clear, however, is that the concept has gained wide acceptance within the realms of both scientific ecology and public land management.

The evolutionary development of the notion that our natural resources have some finite ability to accommodate human interaction begins with ecology. In 1889, carrying capacity had become a measure of rangeland productivity. For example, an article in *Science* framed appropriate levels of sheep grazing in Australia as follows:

[R]ecords show that land favored with less than ten inches of rain per year is quite valueless without irrigation. In such regions only one sheep per square mile can be carried for each inch of rainfall. For from nine to thirteen inches, however, the increase is about twenty sheep per square mile, and from thirteen to twenty inches of rainfall the increased carrying capacity is about seventy sheep per square mile.<sup>3</sup>

Australia and New Zealand established notable examples of regulating carrying capacity which coincided with a period of widespread overgrazing in the American West. In contrast with the American West, the Australian government instituted a system of grazing leases on rangelands with fees and taxes based on the number of supportable livestock. Describing a similar system in New Zealand, it was said that "the stock carrying capacity of the land and the wealth of the country was therefore by this process made seven or eight times what it was before."<sup>4</sup>

With the exception of a few instances in particular journals, ecology was the dominant framework from which carrying capacity was derived for much of the 20<sup>th</sup> century. Up until the 1970s, definitions of carrying capacity strongly resembled what we understand today as "sustainability" – use that does not result in long-term impairment. Today, however, carrying capacity has been further developed by academics and natural resource experts like Robert Manning, leading to an expansive incorporation of factors such as social experience and quality of life.

In fact, most of those reading this will be far more familiar with the concept of carrying capacity as emphasized by Manning than the simpler ecological model. Anyone who frequents national or state parks is likely familiar with the litany of crowding-related

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<sup>2</sup> *Visitor Master Plan* at 26. City of Boulder. <https://bouldercolorado.gov/osmp/visitor-master-plan>.

<sup>3</sup> The Rainfall of the Pacific Slope. [No authors listed] *Science* 13 (332), 1889, p.458.

<sup>4</sup> Notes on the Progress of New Zealand for Twenty Years, 1864-84, by Robert Stout. *Journal of the Statistical Society of London* 49(3), 1886, p.574.

problems ranging from automobile congestion and full parking lots to long lines for service, overtaxed rangers and staff, more stringent rules and regulations, higher fees, mandatory use permits, conflicts among visitors, and degraded park resources.<sup>5</sup> Accordingly, most of us are familiar with the idea that carrying capacity is based on the notion that the use of parks and similar areas has *both* resource and social impacts and that these impacts may ultimately cause unacceptable change to resource *and* social conditions.

As Manning notes, as the concept of carrying capacity evolved, it emphasized the relationship between visitor use and environmental conditions. The working hypothesis was that increasing visitor use causes greater environmental impact, which could be measured by soil compaction, destruction of vegetation, and related variables.<sup>6</sup> Those already were common metrics to assess carrying capacity, to which experts added considerations related to human experiences. As an early report on the application of carrying capacity to outdoor recreation described the evolution: It “was initiated with the view that the carrying capacity of recreation lands could be determined primarily in terms of ecology and the deterioration of areas. However, it soon became obvious that the resource-oriented point of view must be augmented by consideration of human values.”<sup>7</sup>

Empirically, however, investigating those preferences is not an easy task. To clarify, some researchers have suggested distinguishing between *descriptive* and *prescriptive* components of any determination of social carrying capacity.<sup>8</sup> The descriptive component focuses on factual, objective data such as a demonstrated correlation between visitor use and percentage of visitors feeling crowded. What does the relationship between the amount of visitor use and visitor perceptions of crowding look like? In contrast, the prescriptive component concerns the seemingly more subjective issue of how much impact or change in the recreation experience is acceptable. For example, what level of perceived crowding should be allowed before management intervention is appropriate?<sup>9</sup>

Manning touches on a few rudimentary approaches to measuring this prescriptive component including a basic numerical system. For example, survey respondents can be asked to judge the acceptability of alternative levels of social impacts, such as a range of encounters with other groups over the course of a day along trails. “Resulting data can be aggregated and graphed to produce a norm curve from which social norms can be derived.”<sup>10</sup> With the advent of GIS technology, visual approaches to measuring visitor norms have been developed using computer software to manipulate photographs to depict various levels of use. Survey respondents then can be asked to evaluate and rate the

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<sup>5</sup> Lime, D. W. (1971). *Factors influencing campground use in the Superior National Forest of Minnesota*. St. Paul, MN: USDA Forest Service Northcentral Forest Experiment Station.

<sup>6</sup> Manning, Robert. *Crowding and Carrying Capacity in Outdoor Recreation: From Normative Standards to Standards of Quality*, University of Vermont at 327.

<sup>7</sup> Wagar, J. (1964). *The carrying capacity of wild lands for recreation* (Forest Science Monograph 7). Washington D.C.: Society of American Forests.

<sup>8</sup> Shelby, B. & Heberlein, T. (1986) *Carrying capacity in recreation settings*. Corvallis, OR. Oregon State University Press.

<sup>9</sup> Manning, *supra* note 5 at 328.

<sup>10</sup> *Id.* at 330.

acceptability of each in a series of photographs, attempting to get at the upper bounds of acceptable impact.<sup>11</sup>

One important consideration that Manning and others stress is that how survey questions are formulated and worded can have subtle, yet profound, effects on respondents. For example, questions often use the word “acceptability,” without understanding how that word is interpreted by different individual respondents. The survey results might reveal particular preferences of respondents while also revealing their absolute level of tolerance or possibly something else entirely. Similarly, it is important to understand whether respondents are prone to expressing different norms if they’re under the impression that what they say will lead to management actions that exclude or regulate more visitors (or vice versa).

### **Carrying Capacity Applied – Alternative Frameworks for Recreational Planning**

There have been some recent recreational planning efforts in British Columbia in which the idea of carrying capacity has been further refined, and in ways that appear useful to the issues here in Boulder. In December 2000, the British Columbia Ministry of Forests revised its manual for recreation trail management. In doing so, it reconsidered its use of carrying capacity and thoroughly examined authorities on recreational trail management.

The British Columbia Ministry of Forests Recreation Manual (the “Manual”) provides a good example of balancing the importance of conservation and trail character with recreational use.<sup>12</sup> In doing so, the Manual incorporates principles of carrying capacity and a more modern framework called limits of acceptable change (“LAC”).<sup>13</sup> The Manual, and several of its precedent planning documents, also emphasize recreational use and recreational trail development in ways that may apply to Boulder’s planning efforts.

#### *Issues with carrying capacity*

The Manual defines carrying capacity as “the amount of use an area can sustain without undue environmental degradation.”<sup>14</sup> The historical focus of carrying capacity has been on the amount of use and has tried to search for the maximum number of people before use becomes problematic. That has led land managers to use rationing and to search for a “single, magic, carrying capacity number.”<sup>15</sup> The reality facing managers, however, is that carrying capacity depends on management objectives, use characteristics, and land characteristics. For example, managers may have usage goals for an acre of city parkland that are substantially different from the goals related to an acre of wilderness area. Further, assessing adverse impact by the blunt tool of “too much use,” hides important information that comes from more focused questions that look at the

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<sup>11</sup> *Id.*

<sup>12</sup> *Recreation Manual*, British Columbia Ministry of Forests (2000).  
<https://www.for.gov.bc.ca/hfp/publications/00201/chap10/chap10.htm>

<sup>13</sup> *Id.* at Section 10.2.3

<sup>14</sup> *Id.*

<sup>15</sup> *Id.*

kinds of use, visitor behavior, and the timing and distribution of use.<sup>16</sup> The Manual also notes that carrying capacity misdirects the attention of land managers to numbers instead of trying to correct specific problems on the ground.<sup>17</sup>

#### *Limits of acceptable change (LAC) planning*

The Manual uses the LAC concept, which reframes the traditional carrying capacity of “how much use is too much?” to “how much change is acceptable?”<sup>18</sup> LAC acknowledges that both natural and human-caused changes to environments will occur, and seeks to focus on the types of environmental conditions that are desirable, as opposed to limiting use as a starting point.

The goal of LAC is to keep the character and rate of change due to human factors within acceptable levels. Based on what environmental and social conditions are acceptable, LAC proposes prescribing actions to protect or achieve those conditions. LAC focuses on the *effects* of use, rather than *how much* use is occurring. LAC is comprised of four major components, as follows:

1. Specifications of acceptable and achievable resource and social conditions;
2. Analysis of the relationship between existing conditions and those judged acceptable;
3. Identification of management actions judged to best achieve desired conditions; and,
4. A program of evaluating management effectiveness.

The LAC planning system relies on land managers to evaluate conditions and to determine actions that can achieve desired conditions. Acceptance of the premise that changes to environments will occur due to both natural and human factors allows managers to focus on the effects of use and the actual change that is occurring on the ground, rather than on a rigid analysis of trail volume and a numerical analysis of carrying capacity.

In line with the LAC planning system, the Canadian Parks Service *Trail Manual* suggests that prior to trail development, planners consider the following questions:

1. What is the desired level of use?
2. What will be the extent of detrimental impact upon the environment? And
3. Is this level of impact acceptable?<sup>19</sup>

Adopting portions of an LAC framework may allow recreational language to be more prominent in planning documents. The Manual refers to the U.S. Forest Service *Trails Management Handbook* in order to frame planning discussions with big-picture consideration of recreational opportunities.<sup>20</sup> The *Trails Management Handbook*

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<sup>16</sup> *Id.*

<sup>17</sup> *Id.*

<sup>18</sup> *Id.*

<sup>19</sup> *Id.*

<sup>20</sup> *Trails Management Handbook*, United States Forest Service (2008).

[https://www.fs.usda.gov/Internet/FSE\\_DOCUMENTS/stelprdb5403600.pdf](https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5403600.pdf)

encourages considering recreational opportunities at the first phase of trail development. It suggests considering recreational trail planning “relative to the existing types of trail opportunities present.”<sup>21</sup> Applying a strict capacity regime to trail planning will likely not allow for an optimal discussion of recreation in planning documents, because the focus will be on the amount of use rather than the use itself.

## Data Collection and Planning Process

*VMP recognizes need for best available data*

Boulder’s visitor master plan (VMP) espouses many principles that align with best practices for recreational trail management. As a guiding principle, Boulder’s VMP calls for a “best information” standard.<sup>22</sup> The Best Information Standard is intended to provide guidelines for decision-making based on “all relevant factors, needs, and values.”<sup>23</sup> The relevant portions of the Best Information Standard are inset below:

**Elements of a Best Information Standard**

- *Use the best information available without unreasonable cost, effort, or time.*
- *Use diverse and inclusive information sources as applied to a particular circumstance. These may include biological/ecological concepts and data, visitor desires and use patterns, information generated by Open Space and Mountain Parks staff, values of the community, socio-economic information, and other sources.*
- *Use the most relevant, high-quality, and up-to-date scientific information—research studies, monitoring results, analyses, impact assessments, public opinion surveys, “expert” knowledge, and other types of information.*
- *Use both quantitative and qualitative information.*
- *Consider the quality, reliability, and limitations of the information.*
- *Assess trade-offs in outcomes, interests, and values.*
- *Evaluate alternatives that represent a spectrum of decisions or approaches.*

The VMP has a clear history of encouraging that local data collection happen in ways that are consistent with best practices in place in other municipalities. The VMP also states, “When key information gaps exist, OSMP shall take reasonable measures [...] to generate or obtain new or improved information that will reduce uncertainty and improve decision making.”<sup>24</sup>

*Best practices for data collection*

Because the Boulder VMP calls for a best information standard, it is important to examine what optimal data collection looks like. In 2012, the City of Portland, in conjunction with Portland State University, undertook a recreation survey (the “Survey”) of Forest Park, a 5158-acre park area located entirely within Portland. The Survey was

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<sup>21</sup> *Id.*

<sup>22</sup> *Visitor Master Plan* at 29. City of Boulder. <https://bouldercolorado.gov/osmp/visitor-master-plan>

<sup>23</sup> *Id.*

<sup>24</sup> *Id.*

conducted to better understand “preferences, motivations, frequency of use, and satisfaction of users.”

The Survey paid special attention to account for recreational and non-recreational uses. It was conducted over a 15-month period, in person, from nine locations in the park. The 2,277 survey respondents were asked a wide variety of questions with a wide variety of possible answers. Some of the inquiries included: length of visit, frequency of visit, or primary activity. Additional inquiries included ratings of park facilities and ideas for proposed improvements. There are undoubtedly other locales that have produced high quality recreation surveys, and Portland is just named as one. A best practice example that could be applied to OSMP’s process would be to include qualitative and quantitative means of collecting data, as well as professional controls to reduce bias and to take into account variations in seasonality, use types, and an assessment of current conditions.

#### *Some starting thoughts on strategy*

Understanding that additional perspectives beyond ecology should be included and measured is just the first step. Further, applying what Manning refers to as “social carrying capacity” is admittedly easier said than done. How much social impact, such as crowding, is too much? Given the substantial demand for outdoor recreation, some decline or change in the quality of the visitor experience (e.g. some perceived crowding) is inevitable. But how much decline or change is appropriate or acceptable? In other words, what is the limit of acceptable change?

Looking ahead, it would be wise to determine what kind of recreational surveying has been done and how it was memorialized. If Boulder is failing to collect ideal data or collecting it in outdated ways then it would be informative to see where the gaps exist. Anecdotally, Portland found during their recreational survey that mountain bike access was the most requested area for improvement. Better information may allow the City of Boulder to examine this type of use (and others) in greater detail.

One last notion worthy of consideration here is the balance required to motivate locals to advocate for their open space. Allowing unfettered access to our local trail systems could potentially result in severe ecological degradation in addition to a crowded social experience. However, opting towards the other extreme of *too much* access restriction could result in not enough locals having the benefit of understanding what’s in their backyard. Ensuring that locals and visitors alike have the opportunity to sufficiently enjoy open space amenities is crucial to building grassroots advocacy for those resources. And without that grassroots support, it’s unlikely that communities like Boulder would be able to ensure that open space areas survive in perpetuity.