A CSU STUDY

INVESTING IN COLORADO

Colorado's Return on Investments in Conservation Easements:
Conservation Easement Tax Credit Program and Great Outdoors Colorado

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Photo by Michael Menefee

SUMMARY

Why did we do this?

To understand the ecological and real economic benefits the Conservation Easement Tax Credit program and GOCO-funded conservation easements provide to the people of Colorado.

Executive Summary

Colorado is famous for its iconic landscapes. These diverse lands constitute the natural and agricultural heritage of the state and fuel the economy through the sale of farm and ranch products, outdoor recreation, and tourism. Given the role these landscapes play in shaping the identity of the State, it is not surprising that Colorado has repeatedly identified conservation of the State's natural and agricultural resources as sound public policy and invested significant resources in conservation efforts to maintain these lands into the future. Conservation easements are one of the primary tools to achieve this goal. Conservation easements are voluntary, legally binding agreements between private landowners and nonprofit land trusts or governmental entities to protect specific conservation values of a property, such as fish and wildlife habitat, working farms and ranches, scenic views, and outdoor education and recreation.

The State of Colorado has invested substantial financial resources assisting state agencies, local governments, and private nonprofit land trusts in the voluntary acquisition of conservation easements from willing landowners. Two of the State's principal efforts to incentivize the acquisition of conservation easements are the Conservation Easement Tax Credit program and Great Outdoors Colorado (GOCO). Although these programs have funded acquisitions for over 22 years, there is little quantitative information about the benefits Colorado residents receive from the State's investments. This study examines the ecological and economic benefits to the public from the Conservation Easement Tax Credit program and GOCO-funded conservation easements.

Approach

We used data on about 2.1 million acres of Colorado's lands with conservation easements that have received GOCO funding or a state tax credit. To assess the ecological benefits, we calculated the acreage or miles of conserved lands that overlapped with mapped conservation values of priority to the State of Colorado. To assess the economic benefits, we adapted and re-estimated previous studies (Sargent-Michaud, J. 2009; Glenn, E. 2014; TPL 2016b) of the per-acre economic benefits of 11 ecosystem types present in Colorado. These benefits, known as ecosystem services, include the filtration and purification of water, protection of wildlife habitat, and soil retention, for example. We then calculated the total number of acres of the 11 ecosystem types conserved by conservation easements and the total annual economic benefits provided by conserved land in Colorado in 2017 dollars. With this total annual value and the annual amount the State of Colorado invested in conservation easements through the Conservation Easement Tax Credit program and GOCO a real Return on Investment (ROI), net present value, benefit-cost ratios and related measures of investment value can be derived.

Results

State investments in conservation easements have conserved nearly 1.5 million acres of mapped Crucial Habitat in Ranks 1-3. Additionally, these investments have conserved nearly 300,000 acres of prime farmland, 270,000 acres of elk severe winter range, 4,100 miles of stream, creek, or river frontage, and 19% of the Gunnison Sage-Grouse Production Areas that occur on private land.

Residents of Colorado have received an estimated $5.5-$13.7 billion (US$2017) of economic benefits from land conserved by conservation easements while the State has invested roughly $1.1 billion (US$2017)– through approximately $280 million from GOCO and $772 million from the Conservation Easement Tax Credit program on these efforts since 1995. This represents roughly $4-$12 of public benefits provided by conserved land for each $1 invested by the State and a benefit per acre of about $2,700-$6,600 against an investment of about $500 in real 2017 dollars. GOCO investments have also been matched by over $760 million in local government and federal funding and real estate value donated by landowners.

CONCLUSIONS

Land conservation efforts in Colorado target ecologically important areas and provide a significant economic stimulus to the State's economy and tangible benefits to its residents. Given the perpetual nature of conservation easements, these benefits are expected to continue to accrue into the future and increase on a per-acre basis due to Colorado's increasing population and wealth and decreasing supply of open lands. **These findings suggest past and current land conservation efforts are sound economic investments benefiting current and future Colorado residents.**

Moonrise over Soapstone Prairie

Photos, above and cover, by Michael Menefee

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Acknowledgements
The authors would like to acknowledge the insights, time, feedback, and efforts of the following individuals and organizations without whom this report would not have come to fruition: Amanda Barker, Tony Caligiuri, Colorado Cattlemen's Agricultural Land Trust, Colorado Coalition of Land Trusts, Colorado Parks and Wildlife, Beth Conover, Chris Castilian, Peter Ericson, Michele Frishman, Gates Family Foundation, Great Outdoors Colorado, Erik Glenn, Michelle Haefele, Rick Knight, Amanda Nims, James Petterson, Jessica Sargent, Russell Schnitzer, Jim Spaanstra, Jordan Vana, Mark Weston, and Chris Yuan-Farrell. Jamie McBryde and Cierra Carrigan provided research assistance. Errors remain our responsibility.

Funding for this study was made possible through a generous gift from Robert L. Tate to Colorado State University.

Photo by Michael Menefee

INTRODUCTION

Colorado is famous for its iconic landscapes. These diverse lands constitute the natural and agricultural heritage of the state and fuel the economy through the sale of farm and ranch products, outdoor recreation, and tourism. Given the role these landscapes play in shaping the identity of the State, it is not surprising that Colorado has repeatedly identified conservation of the state's natural and agricultural resources as sound public policy and invested significant resources in conservation efforts to maintain these lands into the future. **Conservation easements are one of the primary tools to achieve this goal.**

Conservation easements are voluntary, legally binding agreements between private landowners and nonprofit land trusts or governmental entities to protect specific conservation values of a property, such as agricultural viability, habitat for plants and animals, scenic views, and outdoor education and recreation. Conservation easements are typically permanent agreements that become part of the property's chain of title, yet the property itself remains in private ownership and management, and the underlying fee interest can be sold to new landowners. Colorado has funded the acquisition of conservation easements by nonprofit land trusts and government entities through two major efforts: (1) the Conservation Easement Tax Credit program, and (2) Great Outdoors Colorado (GOCO). Due to the State's substantial investments, providing information about the public benefits conservation easements protect and enhance is desirable (OSA 2016).

Here, we report the ecological and economic benefits the State of Colorado receives in return for its investments in conservation easements through the Conservation Easement Tax Credit program and GOCO (references to the State's investments in the remainder of the report refer to these two programs). We begin by providing a brief overview of Colorado's main conservation easement funding programs followed by an overview of our methods including how we calculated the State's investments, the economic benefits of conserved land, (net) present value of the investments, and the real return on investment (ROI). We then present the main findings of our analysis.

Photo by Michael Menefee

Conservation Easement Tax Credit Program

Colorado created the Conservation Easement Tax Credit program in 2000 [Section 39-22-522, C.R.S.]. Through this program, landowners that donate a conservation easement on their property can claim a state tax credit – a dollar-for-dollar reduction of state income tax liability – which can be sold in full or in part to a third-party if the landowner is unable to take advantage of the state income tax benefits. To the extent that state income tax liability is reduced by this program, the tax revenue collected by the state is reduced relative to what it would otherwise be. This unrecovered potential tax revenue is the cost of the program to the state. The value of the tax credit is a proportion of the fair market value of the donated conservation easement up to a capped maximum value per conservation easement donation. An annual program cap on the total value of tax credits issued was instituted in 2011. The specific proportion of the fair market value, the credit cap per donation, and the annual program cap have changed several times since the program began (Table 1).

Table 1. Formulae and caps for Colorado's Conservation Easement Tax Credit Program

Tax Years	Formula for Calculating Fair Market Value (FMV) of the Conservation Easement	Tax Credit Cap Per Donated Conservation Easement	Annual Program Cap
2000 to 2002	100% of the FMV	$100,000	No cap
2003 to 2006	100% of the first $100,000 of FMV plus 40% of any additional FMV	$260,000	No cap
2007 to 2010	50% of FMV	$375,000	No cap
2011 to 2012	50% of FMV	$375,000	$22,000,000
2013	50% of FMV	$375,000	$34,000,000
2014	50% of FMV	$375,000	$45,000,000
2015 to 2016	75% of the first $100,000 of FMV plus 50% of any additional FMV	$1,500,000	$45,000,000

Source: Adapted from OSA (2016)

To claim a tax credit, the conservation easement donation (or partial donation through a qualified "bargain sale" – where the landowner receives a cash payment for a portion of the appraised fair market value of the conservation easement and donates the remaining value) must meet several criteria. First, the conservation easement must be established to meet one or more of four conservation purposes established in federal statute [26 USC 170(h)(4)]:

- the preservation of land for public outdoor recreation or education
- the protection of ecosystems or fish and wildlife habitat
- the preservation of open space (including farmland and forest land) for scenic enjoyment or pursuing governmental conservation policies
- the preservation of historically important land or structures.

The conservation easement must also be perpetual and held by a qualified organization, defined to include nonprofit land trusts or governmental entities certified by the Colorado Division of Real Estate (DRE). The calculation of the tax credit value must be based on an appraisal conducted by a qualified appraiser certified by the DRE and reviewed and approved by DRE staff. Appraisal values are not connected to the public benefits of the parcel in its current or potential alternative use, some of which are highlighted in this study.

Great Outdoors Colorado (GOCO)

GOCO was established by constitutional amendment in 1992 after receiving 58% approval from state voters (GOCO 2017). The Great Outdoors Colorado Amendment redirected Colorado Lottery proceeds – GOCO's sole funding source – to the Great Outdoors Colorado Trust Fund to fund parks, trails, and projects that conserve wildlife and open space throughout the state. GOCO made its first grants for the acquisition of conservation easements in 1995 and has done so every year since. GOCO currently maintains several competitive grant programs including the Open Space program, which funds land conservation projects through conservation easements and fee simple acquisitions. GOCO investments in conservation easements are typically through bargain sales.

BACKGROUND

GOCO's Open Space program requires a cash match to leverage GOCO investments with financial support from local, federal, or private sources. The Open Space program currently requires at least a 25% match of GOCO funds, although projects with larger matches are viewed favorably and may be more competitive. Applicants for grant programs that fund acquisitions of conservation easements include nonprofit land trusts and local governmental entities. All applications for the acquisition of conservation easements are peer-reviewed by land conservation professionals in the state and receive due diligence reviews by GOCO staff, who make funding recommendations to the GOCO Board of Trustees. The Board of Trustees ultimately makes funding decisions about conservation easement projects.

Other Funding Sources for Conservation Easements in Colorado

In addition to the Conservation Easement Tax Credit program and GOCO, several other programs fund the acquisition of conservation easements in Colorado. Currently, 20 identified county and municipal governments in Colorado maintain local land conservation programs funded through voter-approved sales taxes, property taxes, and bonds (TPL 2016a). Colorado Parks and Wildlife (CPW) also provides significant funding for conservation easement acquisitions by CPW through its Colorado Wildlife Habitat Protection Program (CWHPP) – averaging several million dollars annually.

The federal government also offers several programs that fund the acquisition of conservation easements. The most commonly used program in Colorado is the Agricultural Conservation Easement Program (ACEP) offered through the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) (USDA 2017). Under the ACEP program, NRCS may contribute up to 50% of the fair market value of the conservation easement or in certain cases, where the project protects especially unique or vulnerable resources, 75% of the fair market value. Finally, several private foundations provide support for the purchase of conservation easements, often in foundation-identified priority regions of the state. Funds from local, federal, and private sources are often used for GOCO cash-matching requirements and the donated portion of bargain-sale conservation easements, the portion of the fair market value of the easement that is not covered by cash payments, is also typically eligible for a state tax credit.

Public benefits of conserved lands

Conserved lands provide numerous public benefits. These benefits, sometimes referred to as ecosystem services, include the natural filtration and purification of water supplies, groundwater recharge, flood control, and habitat for fish and wildlife, among many others. These ecosystem services benefit the public even if the property itself remains in private ownership without public access. While ecosystem services often have significant intrinsic values, many are also economically valuable and economists have developed techniques to estimate these values at different geographic scales.

In a landmark study published in 1997, researchers estimated that the (gross) global value of ecosystem services was $33 trillion per year – nearly twice the $18 trillion global gross national product at the time (Costanza et al., 1997) and more than $50 trillion in 2017 dollars. Costanza et al. (2014) re-estimated the (gross) value of the world's natural wealth at about US$125 trillion per year, reflecting not only improvements in economic valuation techniques, but also the effect of increases in population and wealth and the role of scarcity in determining economic value. For perspective, the cumulative global Gross Domestic Product (GDP) stood at US$73 trillion in 2015[1]. A recent study examined the ecosystem services provided by national parks in the United States and found they generate $92 billion annually in public benefits (Haefele et al., 2016). Similar studies have been conducted in many locations around the world to understand the material benefits that people receive from nature.

Economic valuation methods have also been used to estimate the net returns of conservation programs. In these analyses, the total ecosystem service benefits are weighed against the public investment in the conservation program. For example, a study on the net returns from 20 years of the Minnesota Department of Natural Resources' land acquisitions for conservation (fee and easements) determined that Return on Investment (ROI) ranged from $0.21 to $5.28 per dollar invested depending on various assumptions in the analysis (Kovacs et al., 2013). The study, however, did not consider flood control, pollination, or air quality improvements provided by conserved lands – which would increase the ROI estimate.

In an analysis published in 2009, economists with The Trust for Public Land (TPL) estimated the ROI for Colorado's investments in conservation easements through GOCO and the Conservation Easement Tax Credit program from 1994 to 2008 (Sargent-Michaud, 2009). This study concluded that, on average, Colorado residents receive roughly $6 in benefits in return for each $1 invested in conservation easements. Glenn (2014) expanded the 2009 study and found a return of about 8 to 1 across over 1.6 million acres of protected private lands. In the time since TPL's 2009 report was published, TPL has refined their approach to measuring the return to land conservation spending and found that in over a dozen states, every dollar invested returns between $4 and $11 in natural goods and services. For example, TPL (2016b) found that Virginia's investments in land conservation resulted in a $4 return in natural goods and services. We adapt and re-estimate TPL's 2009 and 2016 approaches to examine the returns to Colorado's Conservation Easement Tax Credit program and GOCO-funded conservation easements through 2016.

[1]World Bank national accounts data. Available from: http://data.worldbank.org/indicator/NY.GDP.MKTP.CD

Our approach estimates the public returns to investments in conservation easements in Colorado. In simplest terms, we calculate the total public benefits provided by conserved land, less the State of Colorado's investments in easements (i.e., the numerator), divided by the investments (i.e., the denominator). Specifically, we used the following equation for our analysis:

$$\mathbf{ROI} = \Sigma\left[\left(\left(\$_{i,t} \times \#_{i,t}\right) - i_t\right) / i_t\right];$$

Where,

ROI = Economic Return on Investment;

$\$_{i,t}$ = Value or returns of preserved ecosystem type i in time t per acre;

$\#_{i,t}$ = Number of acres preserved of ecosystem type i in year t;

i_t = Colorado's annual investment in the Conservation Easement Tax Credit program and GOCO's annual net investments in conservation easements.

We elaborate on the steps used to estimate the values for each variable within the ROI equation below.

Benefits

The benefits of the estimate approximate the economic returns, or benefits, from the ecosystem services provided from parcels with conservation easements. A benefits transfer approach is adopted for these estimates. According to Brander (2013), there are three general categories of benefits transfer approaches: Unit value transfer, value function transfer, and meta-analytic function transfer[2]. Unit transfer is the most commonly used and is the least complicated and expensive approach. Here, following previous studies (Sargent-Michaud, 2009; TPL, 2017), we use the unit value transfer approach to borrow ecosystem service values from the literature converted to a per-acre, per-year basis and applied to 11 ecosystem service types selected for analysis in parcels protected through the Colorado Conservation Easement Tax Credit program and GOCO-funded conservation easements.

Conservation easement parcels were extracted from the Colorado Ownership, Management and Protection database (COMaP), the State's most comprehensive map of protected lands. Overall, COMaP documents roughly 2.5 million acres of land held under conservation easement in Colorado. Of these 2.5 million acres, we identified 2.1 million acres conserved with GOCO funding or likely to have claimed a tax credit (see below and Appendix 3 for further explanation of our selection criteria). When compared to the 2015 Land Trust Alliance (LTA) census which reports the total acreage of conservation easements in Colorado held by certified land trusts, COMaP has 98% complete acreage of privately held conservation easements through 2015 (Christoph Nolte, personal communication, June 2017). We do not have census data to quantify the completeness of conservation easements established in 2016, or privately owned conservation easements held by government agencies or non-certified land trusts and other nonprofit organizations that do not report to LTA, thus we cannot assess overall completeness for these groups.

A call for data preceded this study and over 400,000 acres of conservation easements were added to COMaP before the analysis – representing an 18.8% change in documented conservation easement acreage between COMaP Version 10 (April 7th 2016) and COMaP Version 10 (May 5th 2017). We selected two distinct lists of conservation easements from COMaP: conservation easements that received financial support from GOCO and conservation easements that likely received a tax credit but did not receive support from GOCO. Since the donated portion of bargain-sale easements supported by GOCO may quality for tax credits, this selection criteria prevented double counting. For the first list, we worked with GOCO to identify over 800,000 acres of privately owned conservation easements established

[2]"Unit value transfer uses values for ecosystem services at a study site, expressed as a value per unit (usually per unit of area or per beneficiary). Unit values from the study site are multiplied by the number of units at the policy site. Value function transfer uses a value function estimated for an individual study site in conjunction with information on parameter values for the policy site to calculate the value of an ecosystem service at the policy site. Value functions can be estimated from a number of primary valuation methods including hedonic pricing, travel cost, production function, contingent valuation and choice experiments.
Meta-analytic function transfer uses a value function estimated from the results of multiple primary studies representing multiple study sites in conjunction with information on parameter values for the policy site to calculate the value of an ecosystem service at the policy site. Since the value function is estimated from the results of multiple studies it is able to represent and control for greater variation in the characteristics of ecosystems, beneficiaries and other contextual characteristics." Brander, 2013, p 23.

with financial support from GOCO. Developing the second list proved more difficult as information on specific properties claiming a tax credit through the Colorado Conservation Easement Tax Credit program is not publicly available. Rules for the Colorado Conservation Easement Tax Credit program provide for landowners to claim tax credits for the donated portion of a permanent conservation easement established since 2000. In COMaP, over 1.25 million acres of land meet these criteria and were included in the Conservation Easement Tax Credit portion of our analysis. Collectively, the 800,000 acres supported by GOCO and the 1.25 million acres likely to have claimed a tax credit resulted in a total of roughly 2.1 million acres included in the analysis (Figure 1). Appendix 3 further details the selection criteria used for identifying conservation easements to include in this analysis.

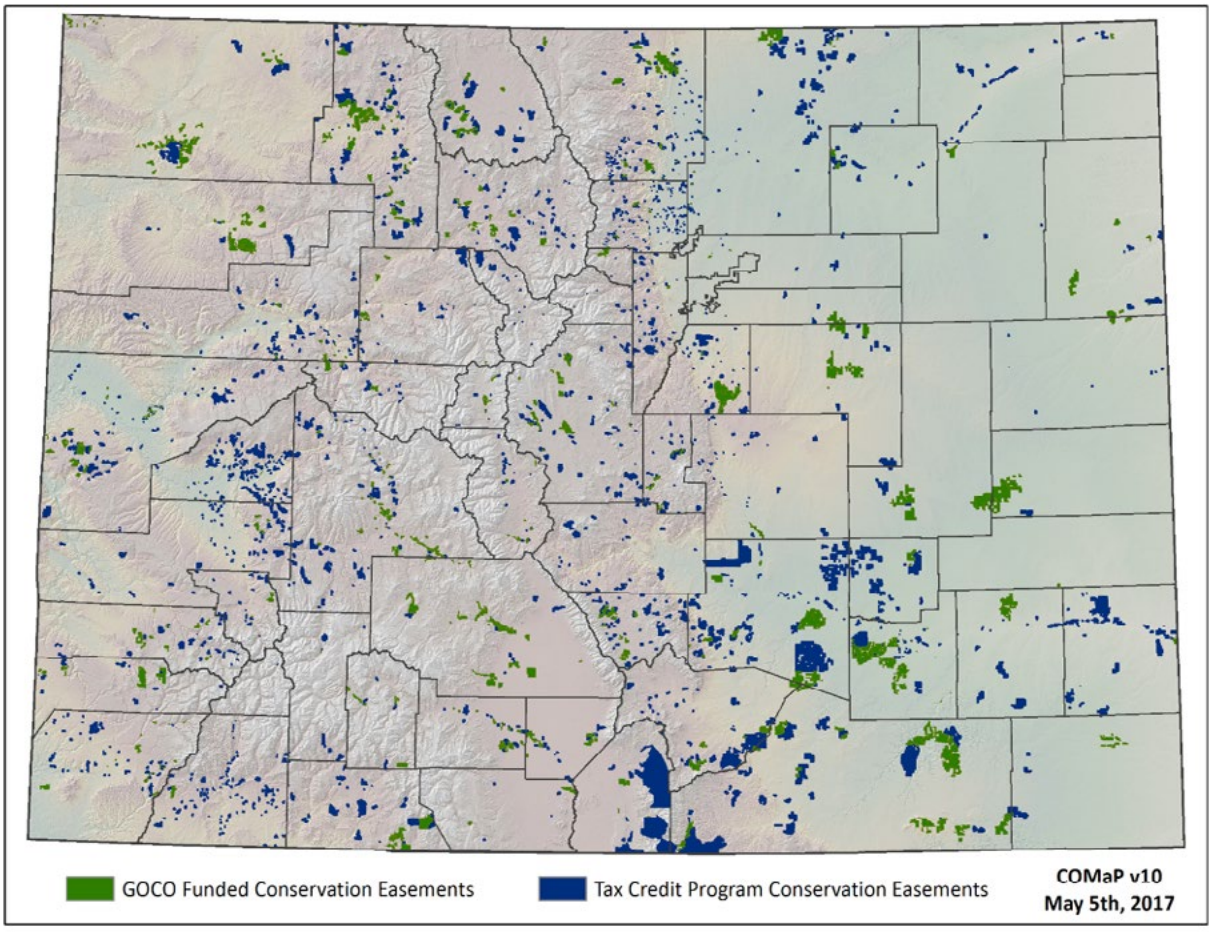

Figure 1. Locations of conservation easements included in the analysis.

Ecosystems were derived from the 2011 federal National Land Cover Database (NLCD), the most recent national land cover product based on 2011 Landsat satellite data. Conservation easements and ecosystems were overlaid in GIS to tabulate acres of each ecosystem type conserved through GOCO and the Conservation Easement Tax Credit Program. This number was, in turn, multiplied by the appropriate economic value estimate for the ecosystem type to derive an estimated economic value of each protected ecosystem to Coloradans.

We use Sargent-Michaud (2009) and TPL (2016b) as the basis for our analysis (Table 2). In all cases, we brought all benefits estimates used to comparable January 2017 US dollars based on US Bureau of Labor Statistics (2017), Consumer Price Index. A review of the literature revealed a large range of potentially applicable per acre values for the 11 ecosystem service types due to differences in approach, geography, scale, demographics, and other factors. As a result, we choose to adapt, re-estimate, merge and compare the TPL (2016b) to the Sargent-Michaud (2009) estimates or categorizations of ecosystem services to illustrate our best first estimate of the returns to public investments in private lands conservation in Colorado.

Table 2. Estimated Annual Per-Acre Value of Ecosystem Services by Ecosystem Type.

Ecosystem Type	*Ecosystem service(s)*	**Sargent-Michaud *(2009) in 2017$***	***TPL (2016b) Values in 2017$***
1) Emergent Herbaceous Wetland	Water quality and habitat	902	1361
2) Woody Wetland	Water quality and habitat	902	1361
3) Deciduous Forest	Air pollution removal, carbon sequestration, carbon storage, water quality protection/erosion control	1,011	447
4) Evergreen Forest	Air pollution removal, carbon sequestration, carbon storage, water quality protection/erosion control	1,011	445
5) Mixed Forest	Air pollution removal, carbon sequestration, carbon storage, water quality protection/erosion control	1,012	445
6) Scrub/Shrub	Biodiversity/habitat, Carbon sequestration	702	17
7) Grassland/ Herbaceous	Carbon sequestration, biodiversity/habitat, and pollination services	98	158
8) Open Water	Fresh water regulation and supply; habitat provision	307	248
9) Developed - Low Intensity Urban/Open Space	Air pollution removal, carbon sequestration, stormwater management	223	1870
10) Developed - High Intensity Urban	No natural goods and services provided	223	N/A
11) Agriculture	Primarily pasture/hay; carbon sequestration, biodiversity/habitat, livestock/livestock products and pollination services.	326	132.24

Note: Sources for benefit transfer values are: The Trust for Public Land. 2016b. Virginia's Return on Investment in Land Conservation. 39 pp and The Trust for Public Land. 2009. A Return on Investment: The Economic Value of Colorado's Conservation Easements. See page 31 TPL (2016b) for a discussion of the benefit transfer methodology and derivation of the unit values to transfer. Inflation adjustment: US Bureau of Labor Statistics, Consumer Price Index (use Jan of $ year, adj. to Jan 2017) https://www.bls.gov/data/inflation_calculator.htm The calculated price inflator from Jan 2008 to Jan 2017 was 1.15. From Jan 2015 to Jan 2017 it was 1.04.

Several ecosystem service categories are not strictly comparable across the two studies, as the methodology has evolved. For example, the two 'developed' land categories in Sargent-Michaud (2009) were further refined in the TPL (2016b) analysis. In TPL (2016b), urban open space becomes 'developed open space' generating substantial natural goods and services and the high intensity urban development category becomes simply 'developed' and is assumed not to generate any natural goods and services. In addition, in TPL (2016b) agricultural practices from Sargent-Michaud (2009) are divided into "pasture/hay" ($42 per acre) and "cultivated crops" ($172 per acre). We constructed a weighted average value ($127.27) for agricultural acreages based on these values and Colorado's enrolled acreages, which were overall 65.6% pasture/hay (81% of GOCO and 55% of Tax Credit) and 34.4% cultivated crops (18% of GOCO and 45% of Tax Credit), and then adjusted this value to 2017 dollars. This allows us to re-estimate the 2009 study by preserving its categorization, as well as appropriately represent the evolution of the methodological categories in 2016. It does not allow us to examine each of the subcategories separately, however.

Historical benefits and costs were adjusted to January 2017 values. The benefits of enrolled parcels were assumed to begin in the year of enrollment and extend to the present. Future benefits of current and past investments were, like TPL (2016b), extrapolated to 2024 to facilitate comparisons with that study at a discount rate of 5%.

The data did not allow us to determine the date of enrollment of the parcel in the program for about 7% of the acreage. However, it was possible to establish the ecosystem types of these parcels. As a result, we conservatively assigned the acreage benefits as if they had been enrolled in 2017, so no cumulative benefits of the acreage enrolled over time were calculated. The investment costs did not change as they were already included in the annual cost estimates.

We assumed that ecosystem service values did not otherwise grow and that protection by conservation easement implies full ecosystem service values for each ecosystem area on the parcel. We did not adjust for other factors that might affect supply (growth, land conversion pressure) and demand (income, population), and, therefore, value of the benefits over time. Nor did we include, potentially sizeable, off site values, due to a lack of data compatibility at this juncture. A more advanced benefits-transfer modelling approach and more locally derived values would improve the accuracy and precision of our estimates. The likely direction and magnitude of these omitted values is discussed in Appendix 2.

Investment

The investment portion of the ROI calculation represents the State of Colorado's financial investments in conservation easements through: the Conservation Easement Tax Credit Program and GOCO. We used the Colorado Department of Revenue's Annual Reports, which list the total value of conservation easement tax credits claimed during the calendar year, to estimate the Conservation Easement Tax Credit program's annual investment. GOCO staff provided data on all conservation easement investments GOCO has made since 1995. We excluded conservation easements on publically owned land that GOCO required to be held by a third party as part of grants that funded fee title acquisitions since the funding was for the fee interest and not the conservation easement. Conservation easements held by third parties are common requirements for many GOCO grants for fee title acquisition and ensures that properties cannot be sold off later and used for purposes other than the original granting purpose.

For the investment calculation, we adjusted the State's cost by the estimated income tax revenue the State was likely to collect for the different investments (e.g., 4.63% in 2016). For the Conservation Easement Tax Credit program, the portion of the tax credit that is sold to a third party is subject to Colorado income tax. Based on conversations with tax credit brokers, we assumed that 85% of the value of tax credits claimed were subject to state income tax and would contribute to state revenue (i.e., 85% of claimed tax credits multiplied by Colorado's income tax rate in that year). We also assumed that all purchased portions of conservation easements that GOCO funded would be subject to state income tax at the rate in place when the grant was made. The value of estimated state tax revenue for both programs was deducted from the State's overall investment. Finally, we assume the conservation easement has no other income effects, either positive or negative, on the landowner resulting from land management and economic activity changes required or enabled by the conservation easement. All investment costs were brought to 2017$ equivalents using the US Bureau of Labor Statistics (2017), Consumer Price Index.

The Conservation Easement Tax Credit program and GOCO have collectively supported the conservation of nearly 2.1 million acres spanning the state (Figure 1) and portions of all 11 ecosystem types considered in this analysis (Table 3). **Lands protected under conservation easement maintain important conservation values for Colorado residents, such as working lands and important wildlife habitat, beyond their economic value.**

Table 3. Acres of each ecosystem type conserved by GOCO and the Conservation Easement Tax Credit program.

Ecosystem Type	*GOCO Conserved Acres*	*Tax Credit Program Conserved Acres*	*Acres Conserved by Both Programs**
Emergent Herbaceous Wetland	12,118	12,872	24,990
Woody Wetland	15,336	26,239	41,575
Deciduous Forest	66,093	110,647	176,740
Evergreen Forest	68,587	233,214	301,801
Mixed Forest	4,244	9,280	13,523
Scrub/Shrub	206,937	264,981	471,918
Grassland/ Herbaceous	370,725	471,345	842,070
Open Water	933	2,981	3,914
Developed - Low Intensity Urban/Open Space	11,025	12,894	23,918
Developed - High Intensity Urban	43	123	166
Agriculture	68,640	102,943	171,583
Total Acres Conserved	**826,515**	**1,254,525**	**2,081,040**

*We developed our inclusion criteria to prevent double counting of acres. Therefore, acres included in the GOCO summaries would not also be included in the Colorado State Tax Credit program summaries even if the donated portion of a GOCO supported project qualified for a tax credit.

In-depth analyses to assess the full complement of other conservation values are outside the purview of this report, but are still important to highlight. Here we summarize a concise analysis comparing conservation easements conserved through GOCO and the Conservation Easement Tax Credit program with Crucial Habitat as delineated in the Western Association of Fish and Wildlife Agencies Crucial Habitat Assessment Tool (WAFWA's CHAT) and several other conservation values. Per WAFWA, Crucial Habitat is defined as "places that are likely to provide the natural resources important to aquatic and terrestrial wildlife, including species of concern, as well as hunting and fishing species" and is ranked from 1-6 with 1 being most crucial and 6 least crucial. Appendix 3 provides additional information on CHAT and the data sources for the other conservation values considered.

According to COMaP, almost 38 million acres of land are privately owned, or owned by nonprofit organizations, such as land trusts, in Colorado. This represents all land available for protection under conservation easements through the two programs. Of these available lands, 5.5% is currently protected with the help of the Conservation Easement Tax Credit program or GOCO. Thus, while these conservation easements only constitute 5.5% of all private lands, they protect 10% of all private land acres in Rank 1 Crucial Habitat, 9% of all private land acres in Rank 2 Crucial Habitat, and 6% of all private land acres in Rank 3 Crucial Habitat (Table 4).

Table 4. Acres of conservation easements (CEs) within each Crucial Habitat Rank compared to private land acres in Colorado (ranked from 1 = most crucial to 6 = least crucial).

Crucial Habitat Rank	Total Acres of GOCO Funded CEs and Tax Credit CEs in each Rank	Total Acres of Private Lands Statewide in each Rank	% of Private Land Acres Statewide Protected under GOCO Funded CEs and Tax Credit CEs in each Rank
1	81,034	850,273	10%
2	519,238	5,722,715	9%
3	896,511	14,091,799	6%
4	552,137	16,098,434	3%
5	32,091	1,181,567	3%
6	0	0	0%
	2,081,012	37,944,788	

Additionally, land conserved with support from GOCO and the Conservation Easement Tax Credit conserve numerous other agricultural, scenic, and natural values (Table 5). For instance, these efforts have conserved over 290,000 acres of designated prime farmland, over 4,100 miles of stream, creek, or river frontage throughout the state, and roughly 9% and 19% of Greater Sage-Grouse and Gunnison Sage-Grouse Production Areas, respectively (see Appendix 3 for information on the datasets used to calculate these statistics). These numbers provide a coarse and preliminary snapshot of the wildlife habitat values afforded to Coloradans by conservation easements with state assistance. To truly capture the broad diversity of conservation and agricultural benefits, finer scale analyses would be needed that consider conservation priorities at multiple spatial and temporal scales. While the primary emphasis of this study is to demonstrate the return on investment for the Conservation Easement Tax Credit Program, future studies could help identify the full suite of conservation priorities supported by private conservation easements across Colorado.

Table 5. Other conservation values conserved with conservation easements (CEs) through GOCO and the Conservation Easement Tax Credit Program.

Conservation Value	Acres Conserved	Miles Adjacent to CEs	Percentage of Private Land Acres or Miles Conserved*
CNHP Potential Conservation Areas (CNHP 2017)	893,241		7%
Prime Farmland (USDA 2014)	293,332		3%
Preliminary Priority Habitat for Greater Sage-Grouse (CPW 2017b)	114,457		10%
Greater Sage-Grouse Production Areas (CPW 2017b)	124,189		9%
Gunnison Sage-Grouse Critical Habitat (USFWS 2014)**	9,876		Unable to estimate
Gunnison Sage-Grouse Production Areas (CPW 2017b)	76,287		19%
Designated Scenic Byways within 250 meters of Conserved Property (CDOT 2013)		250	10%
Gold Medal Streams (CPW 2017a)		20	6%
Streams, Creeks, and Rivers Mapped in the National Hydrography Dataset (USEPA and USGS 2012)		4,132	7%
Elk Winter Range (CPW 2017b)	796,749		Not Calculated
Elk Severe Winter Range (CPW 2017b)	270,585		Not Calculated
Mule Deer Winter Range (CPW 2017b)	805,079		Not Calculated
Mule Deer Severe Winter Range (CPW 2017b)	232,870		Not Calculated
Whitetail Deer Winter Range (CPW 2017b)	52,872		Not Calculated
Black Bear Fall Concentration Range (CPW 2017b)	431,470		Not Calculated
Pronghorn Winter Range (CPW 2017b)	238,107		Not Calculated
Pronghorn Severe Winter Range (CPW 2017b)	47,461		Not Calculated
Big Horn Sheep Winter Range (CPW 2017b)	51,111		Not Calculated

*The percentage of mileage conserved along scenic byways, gold medal streams, and all mapped streams, creeks, and rivers includes all mileage in the state – not just mileage along private lands.

** This analysis only includes conservation easements established after November 2014. Land placed under permanent conservation easement prior to formal designation of critical habitat in November 2014 is excluded from Critical Habitat designation due to inherent conservation protections. The excluded easements all likely include Gunnison Sage-Grouse habitat, please compare this number with Gunnison Sage-Grouse Production Areas to get a better sense of the overall conservation benefits that easements are providing for the species.

Value of ecosystem service benefits

Using data on about 2.1 million of Colorado's estimated 2.5 million acres of lands with conservation easements, residents of Colorado have received an estimated $5.5-$13.7 billion (US$2017) of economic benefits from land conserved by conservation easements (Table 6) while the State has invested roughly $1.1 billion (US$2017) on these efforts since 1995 (Table 7) – through approximately $280 million from GOCO and $772 million from the Conservation Easement Tax Credit program (Figure 2). This represents roughly $4-$12 of public benefits provided by conserved land for each $1 invested by the State and a benefit per acre of about $2,700-$6,600 against an investment of about $500 in real 2017 dollars.

GOCO investments have also been matched by over $760 million from local government and federal funding and real estate value donated by landowners ($378 million from local and federal match and $382 million in donated value) - representing leverage of nearly $3 to every $1 of GOCO investments in conservation easements. Due to the formulas for determining tax credits (Table 1), we assume that the Conservation Easement Tax Credit program also leveraged significant landowner donations of appraised real estate value, but we were unable to estimate this value due to a lack of publicly available data on appraised real estate value donated by landowners relative to tax credits claimed.

Table 6: Summary measures of public returns to investment in ecosystem services in Colorado.

	Re-estimate of 2009 Study (2017$)	Re-estimate of 2016 Study (2017$)	Low value estimate (2017$)
Present value	13,672,703,600	7,181,010,064	5,505,384,779
Net present value	12,620,935,663	6,129,242,127	4,485,394,092
Real Return on Investment	12:1	6:1	4:1
Real benefits per acre	6,570	3,451	2,661
Real investment costs per acre	505	505	505
Benefit-Cost Ratio	13:1	7:1	5:1

Notes: It was not possible to assign 136,287 acres by year of enrollment, though ecosystem service types were possible to assign. Total acres accounted for in the analysis includes these acres bringing the total to: 2,080,551 acres. All costs are assigned to the year of enrollment. Benefits begin the year of enrollment, occur annually, and are extended from 2017 through 2024 at a 5% rate of discount.

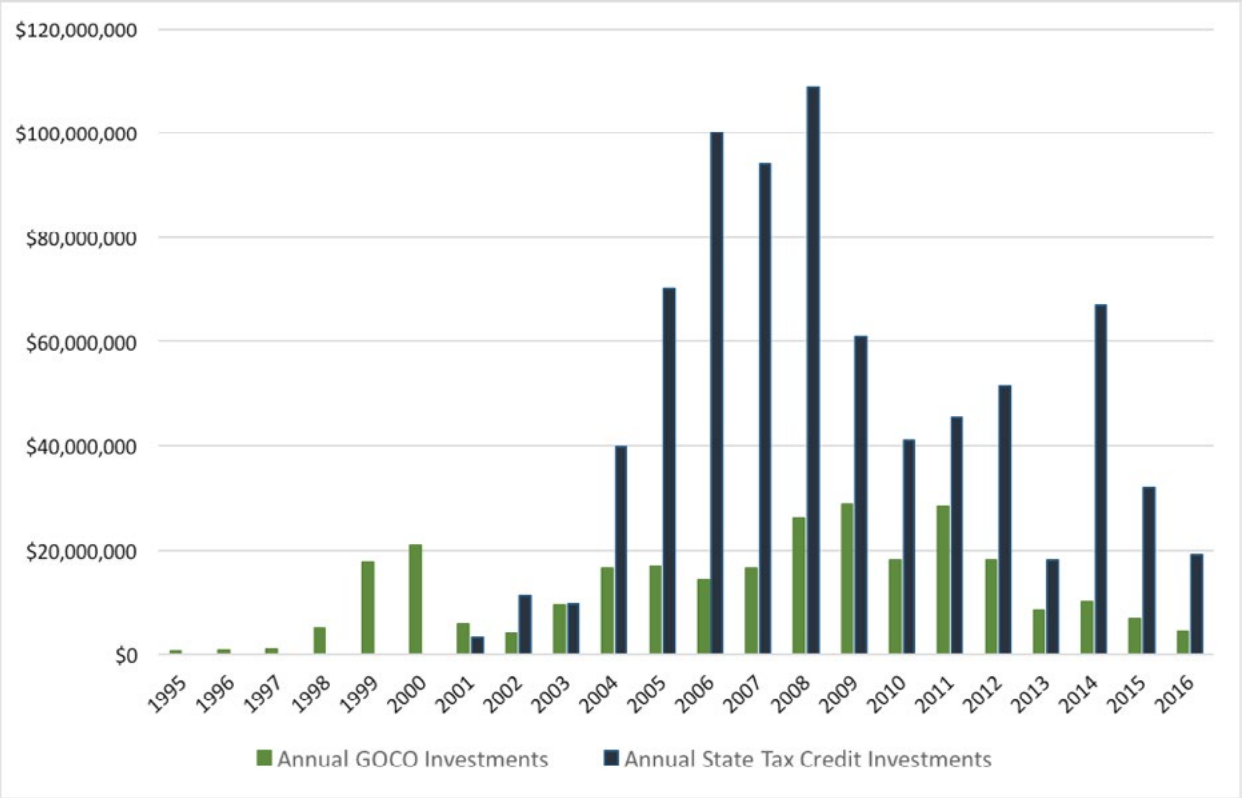

Figure 2. Colorado's investments in conservation easements through GOCO and the Conservation Easement Tax Credit program, 1995-2016.

Value estimates are highly dependent upon the per-acre values used in the benefits transfer exercise (Table 2). All per-acre values are expressed in 2017 dollars to correct for when the values were estimated and published. TPL's policy is to select the lower bound value of the best available information at the time of the study and we have re-estimated using the values they assumed and then a composite of the lowest values across the two studies and still have arrived at robust public returns to investment. However, many of these estimates have substantial variability in the literature, so assuming lower or higher values would have a large influence on a total estimate spread across more than 2 million acres and more than two decades.

ROI estimates are sensitive to assumptions on key variables including benefits, costs, continued enrollments, rates of discount or time preference, and duration of program benefits after the investment is made. Sensitivity analysis explores assumptions and ranges around these baseline estimates. For example, if our value estimates were overstated by ten times, more or less, the return on investment would evaporate. If we were to assume the programs continue to enroll new acreage at a similar rate and of a similar type as they have in the past, then an average of 88,000 acres at an average annual value of $340 million against an average annual investment of $45 million might be expected. If we were to assume that Colorado's conservation easement programs ended today and all enrolled acres immediately lost their public values (highly unlikely), the return on investment would be substantially lower. On the other hand, if our assumed discount rate was lower or the time over which benefits accrue were increased beyond 2024, the net present value and ROI calculation would increase.

Table 7. Estimated Return on Ecosystem Services Investments by State of Colorado.

Year	*Acres Enrolled*		*Investment*		*Net present value: 2009 study re-estimate*	*Net present value: 2016 study re-estimate*	*Net present value: Low value estimate*
	Annual	Cumulative	2017$	Cumulative 2017$	2017$	2017$	2017$
1995	32	32	662,906	662,906	-658,494	-653,497	-659,560
1996	1,781	1,813	724,664	1,387,570	605,824	35,750	-124,454
1997	803	2,616	941,241	2,328,811	745,679	-69,629	-253,570
1998	9,893	12,509	5,167,484	7,496,295	1,370,690	-1,540,348	-2,653,238
1999	23,700	36,209	17,821,880	25,318,175	2,055,434	-7,243,649	-10,384,466
2000	39,960	76,169	20,891,668	46,209,843	19,343,096	-747,952	-6,073,748
2001	122,975	199,144	9,058,009	55,267,852	96,553,731	36,258,208	26,153,875
2002	75,064	274,208	15,436,208	70,704,060	138,347,305	55,084,845	41,155,309
2003	68,241	342,449	19,047,141	89,751,201	171,947,912	70,259,595	51,625,405
2004	131,645	474,094	56,390,302	146,141,503	189,379,894	66,530,275	37,860,709
2005	204,300	678,394	87,094,947	233,236,450	282,072,300	100,897,202	62,225,642
2006	132,923	811,317	114,250,025	347,486,475	316,399,856	106,630,308	59,367,782
2007	131,558	942,875	110,508,356	457,994,831	380,488,768	140,380,666	86,085,088
2008	216,404	1,159,279	134,893,215	592,888,046	454,701,074	168,252,615	100,218,671
2009	104,927	1,264,206	89,680,247	682,568,293	546,754,038	241,240,883	165,844,565
2010	142,037	1,406,243	59,161,528	741,729,821	634,049,290	304,021,561	219,246,482
2011	90,229	1,496,472	73,926,820	815,656,641	673,816,413	312,749,219	224,289,877
2012	101,471	1,597,943	69,842,275	885,498,916	728,933,570	339,375,104	244,881,232
2013	82,768	1,680,711	26,596,228	912,095,144	815,710,150	400,381,467	302,266,645
2014	102,037	1,782,748	76,947,472	989,042,616	824,713,689	366,843,838	265,594,695
2015	80,109	1,862,857	38,770,475	1,027,813,091	887,719,103	421,210,376	315,613,614
2016	43,971	1,906,828	23,587,824	1,051,400,915	918,169,021	446,131,133	337,372,902
2017	37,435	1,944,263	367,022	1,051,767,937	955,499,261	478,254,688	366,581,099
Total	1,944,264		1,051,767,93		9,038,717,605	4,044,282,658	2,886,234,558

Photo by Michael Menefee

CONCLUSIONS

Given the perpetual requirements of conservation easements, the benefits they provide are expected to continue to accrue into the future and increase on a per-acre basis due to Colorado's increasing population and wealth and decreasing supply of open lands. The cost of making such investments is lower now than it will be in the future. **These findings suggest past and current land conservation efforts are sound economic investments benefiting current and future Colorado residents.**

Land conservation efforts in Colorado target ecologically important areas, provide a significant economic stimulus to the State's economy, and tangible benefits to its residents. State investments in conservation easements have conserved nearly 1.5 million acres of mapped crucial habitat in ranks 1-3, as well as nearly 300,000 acres of prime farmland, 270,000 acres of elk severe winter range, 4,100 miles of stream, creek, or river frontage, and almost 1/5 of the Gunnison Sage-Grouse Production Areas that occur on private land. Using a benefits transfer approach, we find a $4-$12 return on investment to Colorado taxpayers for the tax credit and GOCO conservation easement programs on more than 2 million acres of Colorado private lands. These estimated returns-on-investment are broadly in line with earlier findings from the TPL and broader literature. The differences are mostly explained by the differences in the year of analysis (more enrolled acreage and more value accumulated over time). The return on investment could be different by employing reasonable assumptions and the precision of these estimates could be improved using primary analyses specifically designed for the needs and uses of the people and communities of Colorado.

Given the perpetual requirements of conservation easements, the benefits they provide are expected to continue to accrue into the future and increase on a per-acre basis due to Colorado's increasing population and wealth and decreasing supply of open lands. The cost of making such investments is lower now than it will be in the future. These findings suggest past and current land conservation efforts are sound economic investments benefiting current and future Colorado residents.

Photo by Michael Menefee

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Photos by Michael Menefee

APPENDICES

Appendix 1. Acronyms and Abbreviations

ACEP – Agricultural Conservation Easement Program
CEs – Conservation Easements
CHAT – Crucial Habitat Assessment Tool
COMaP - Colorado Ownership, Management and Protection Database
CNHP – Colorado Natural Heritage Program
CPW – Colorado Parks and Wildlife
CWHPP – Colorado Wildlife Habitat Protection Program
DRE – Colorado Division of Real Estate
GOCO – Great Outdoors Colorado
LTA – Land Trust Alliance
NLCD – National Land Cover Database
NRCS – Natural Resources Conservation Service
ROI – Return on Investment
TPL – The Trust for Public Land
WAFWA – Western Association of Fish and Wildlife Agencies

Photo by Michael Menefee

APPENDIX 2. Ecological-Economic Values We Did Not Count

Our analysis isolates an estimate of the value of ecosystem services found on a particular parcel to society at large without specific regard to the social, economic and ecological context within which the parcel is found. In this section we discuss the likely implications of excluding this contextual information on the values reported.

Threshold, neighborhood, spillover, or scaling effects

Smaller parcels are ecologically more vulnerable than larger parcels, all other things equal. That is, ecosystem function and ecosystem services created over time are probably not simply a multiplicative manipulation of per-acre values. Rather there is likely a minimum size (threshold) for robust ecosystem function, a range over which increases in parcel size increase the production of ecosystem services, and a size beyond which more ecosystem service provision is no longer valuable (scaling). Moreover, it may be that ecosystem services are produced in a nonlinear manner over a relevant range of parcel sizes.

Although this level of precision would be expensive and perhaps not particularly policy-relevant to reveal, the implications for this current study are that we assign 100 one-acre parcels as ecologically equivalent to one 100-acre parcel. To the extent that we have relatively small parcels in an ecological sense, we over estimate their ecological and, therefore, economic value.

However, (relatively small) private parcels may be located adjacent to compatible private or public land uses or may even create an important wildlife corridor or link between protected or extensively managed lands. This location specificity of any particular parcel, then, may have important neighborhood or spillover effects on other parcels that we have not taken into consideration. In this sense, we underestimate the ecological importance, and therefore economic value, of some parcels in our dataset.

Similarly, there may be purely economic neighborhood, spillover and scaling effects of working landscape preservation. For example, parcel size may contribute in a nonlinear manner to outdoor recreation opportunities. We don't capture outdoor recreation values in this analysis, much less the role of scale in those values.

All other things equal, residences adjacent to protected lands and working landscapes have higher values than those adjacent to other residences or commercial properties. In part, this can be due to the visual perception of 'access' to a larger property than you actually own, the perception of increased privacy by not having a 'back door' neighbor, and, perhaps, the moderating (most notable cooling) effect of green spaces on nearby temperature variation.

For example, 80% of people who live on golf courses do not golf. Houses located on greenways and trails and adjacent to public parks similarly enjoy a bump in market value.[3] These values are captured by the owner of the residence, not the owner of the protected land, so are not captured by our analysis. Residences adjacent to protected lands are also more likely to have valuable views, which are also captured in the value of the residential parcel, not by the protected landscape manager, so are not reflected in our estimates. The failure to account for these purely economic scaling, spillover and neighborhood effects clearly under-counts the economic value of working landscapes and investments in preserving them.

Downstream effects, disaster and other risk reduction

Land management in Colorado's high country, or even simply a bit upstream, has important implications for downstream and instream users. Generally speaking, healthier, more intact ecosystems will absorb more water, release it more slowly and retain more soil and other organic matter than lands that are more intensively used, either in agriculture or in residential or commercial activities.

It is likely that cleaner water with less volumetric variation downstream of working landscapes are better for Colorado's recreational fisheries, boating and kayaking, and agricultural uses than are highly variable and less clean water flows. Sending cleaner water downstream reduces the cost of municipal water treatment and increases the useable life (or reduces the maintenance costs) of storage facilities.

Moreover, by retaining surface soil and foliage, more intact ecosystems upstream can reduce the risk and expected impact or magnitude of flood, fire, mudslides and the like downstream. Since all of these benefits occur offsite, they are not included in our estimates, creating an underestimate of the value of investment in (upstream) working landscape management.

Local and regional economic impact

Our analysis informs the question of what the State of Colorado's direct returns to investments in ecosystem services are, but for local communities that may not be the most appropriate question. It may be interesting to know, for example, whether

[3]See, for example: Racca, D.P. and A. Dhanju. 2006. Property value/desirability effects of bike paths adjacent to residential areas. Center for Applied Demography and Research, University of Delaware. 31 pp.
Asabere, P.K. and F.E. Huffman. 2009. The relative impacts of trails and greenbelts on home price. Journal of Real Estate and Financial Economics. 38: 408-419.

management of private agricultural and ranchlands without conservation easements has different local economic development effects than if they are managed with easements placed against them.

The effect of a conservation easement is to ensure to a large extent that the property will remain as a low-density, often 'working,' landscape for the foreseeable future. This assurance has predictable consequences in the broader community as well as to the landowner. For example, when a parcel's future use is largely known, it is less prone to speculatory investment, and community land use planning around protected parcels can be better targeted. Neighbors can be better assured that the views, lifestyle and recreation opportunities that are tied to more open land uses will be maintained relative to communities where such properties are potentially at risk (or opportunity) of conversion to higher-density uses.

Several Colorado studies have shown that community residents are willing to sponsor conservation easement programs in their communities, ostensibly arguing that they prefer the economic and lifestyle opportunities and implications when key lands are protected to when they are not. These effects could be measured in a number of ways that are not accounted for in this current study, including estimating differences in multiplier effects.

Every dollar spent on agricultural production, outdoor recreation, and tourism generates jobs, income, and tax base for the community. Agricultural production under conservation easement may reduce the agricultural output of the operation to a certain extent due to the conservation management plan often required to secure the easement. This potential loss in production on the ranch may be compensated directly by increases in other non-consumptive use enterprises (e.g., agri-tourism, hunting, mountain biking, snowmobiling) at the farm, or potentially in the broader community. If there is a net increase in economic activity, then either the rancher developed more profitable alternative enterprises (diversification) or the community captured more of the value of existing production (higher multipliers) or both.

The number of jobs and income created and relative tax burden by conservation easement programs has been studied from an economic development perspective in a number of Colorado communities typically indicating that such programs are helpful to meet community development objectives. [4]

Cost of community services and fiscal impacts

Strategic use of land use management tools, including conservation easements, to guide community growth and create community separators is not simply a matter of aesthetics. The amount of public investment, and therefore tax burden, required to support different land use patterns can vary substantially. As they say, cows don't go to school. Differential taxation is expected to address some of the public finance issues across various land uses. It also can create incentives for individuals to argue a parcel is agricultural and the tax appraiser to classify it as commercial.

Many public services costs increase with decreases in density. For example, physical infrastructure like water, sewer, electric lines and fiber optic cable clearly increase in costs with increases in distance covered and lower-density development implies greater distances to cover to serve the same population base. In addition, important emergency services (e.g., fire, police, ambulance), common public services (e.g., school bus, mail delivery), and necessary private services (e.g., garbage pickup) increase in cost (e.g., travel and response time) with increases in distance. Moreover, some public health concerns (e.g., commute times and weight gain, fossil fuel use and air quality, bedroom communities and a lack of volunteerism and civic dialogue) increase with increases in distance from a community core. [5]

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[4]See, for example, programs and analyses from Routt, Chaffee, and Gunnison Counties:
Cline, S. and A. Seidl. 2010. Combining non-market valuation and input-output analysis for community tourism planning: Open space and water quality values in Colorado, USA. Economic Systems Research. 22(4): 385-405.
Cline, S. and A. Seidl. 2009. Surf and Turf: Tourists' Values for Multifunctional Working Landscapes and Water Quality in Colorado. American Journal of Agricultural Economics 91(5): 1360-1367.
Ellingson, L. and A. Seidl. 2009. Tourists' and Residents' Values for Maintaining Working Landscapes of the 'Old West.' Journal of Rural Research & Policy. 4(1): 1-17.
Ellingson, L., Seidl, A., and J.B. Loomis. 2011. Comparing tourists' behavior and valuation of land use changes: A focus on ranchland open space in Colorado. 2011. Journal of Environmental Policy and Management. 54(1): 55-69.
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Orens, A. and A. Seidl. 2009. Working lands and winter tourists in the Rocky Mountain West: A travel cost, contingent behaviour and input-output analysis. Tourism Economics 15(1): 215-242.

[5]See for example, Colorado Cost of Community Services study, which also cites other similar studies nationwide:
Coupal R. and A. Seidl. 2003. Rural Land Use and Your Taxes: The Fiscal Impact of Rural Residential Development in Colorado. Agricultural and Resource Policy Report, Department of Agricultural and Resource Economics, Colorado State University, APR03-02. http://webdoc.agsci.colostate.edu/DARE/LUPR/LUPR%2003-02.pdf 25 pp.
Executive summary @ http://webdoc.agsci.colostate.edu/DARE/LUPR/LUPR%2003-03.pdf

Supply and demand trends

In our estimates, ecosystem service benefits were uncompensated but nonetheless provided prior to protection/investment and do not change over time due to the investment. This assumption is required due to a lack of information about ecosystem status, function, and growth due to protection by the conservation easement. Those benefits will also change (actually unambiguously increase) over time due to supply and demand considerations.

Economic value is reflected in the individual and collective demand for scarce goods and services. Since there is a fixed amount of private land, and commercial and residential land uses are largely irreversible, conversion of agricultural and ranch lands into higher intensity uses reduces the supply of agricultural and ranch lands. Less supply usually implies greater scarcity and upward pressure on land prices (values) from the supply side of the equation.

In addition, Colorado is getting wealthier by the day. The state ranks 9th in personal income growth per capita in the United States over the past decade. All other things equal, wealthier people are willing to pay more for valuable goods and services than less wealthy people, firstly because they have greater ability to pay to begin with, but also because people tend to spend a greater proportion of their income on non-food items the wealthier they become. So, if the parcel is preserved in a wealthier neighborhood, it will generate greater economic value than if it is in a less wealthy neighborhood. As the state gets wealthier, there is upward pressure on land prices (values) from the demand side.

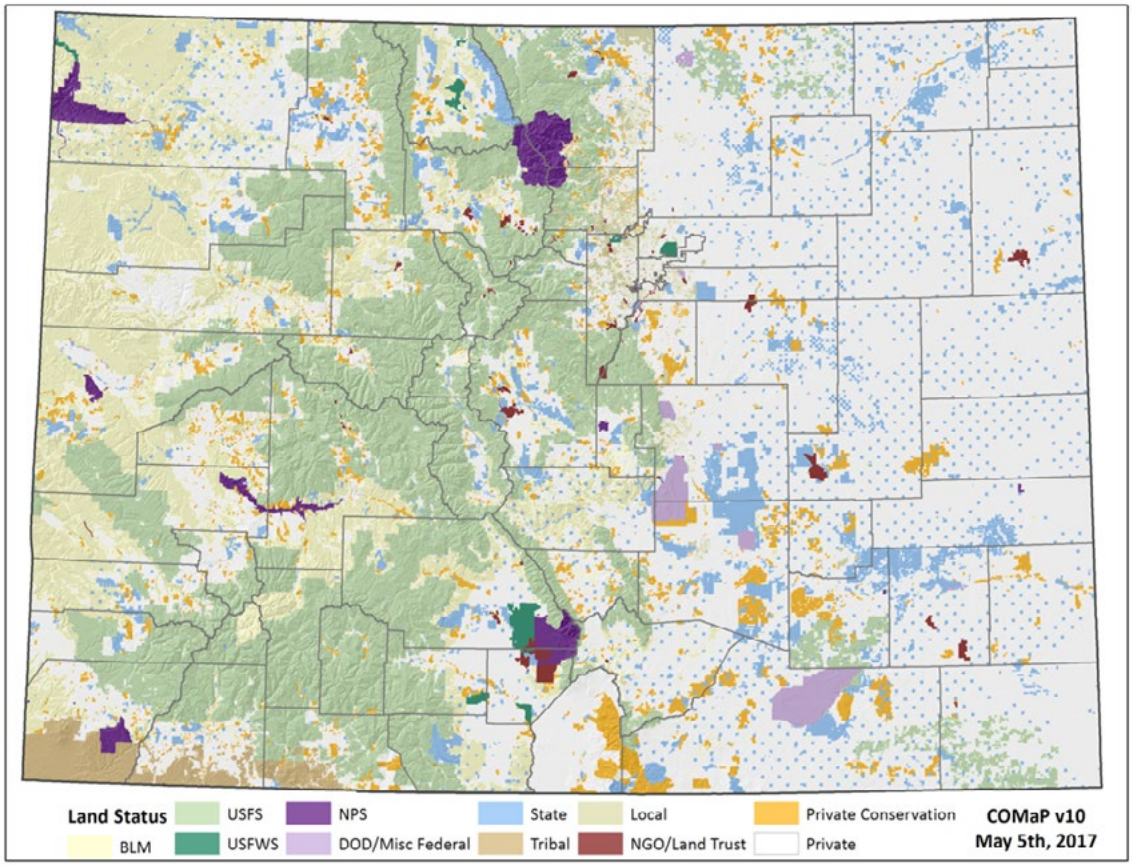
Coloradans are not only wealthier, but there are more and more of us. Colorado ranks 4th in percentage population growth and 8th in total population growth in the United States over the past decade. More people demanding both houses and working landscapes put upward pressure on land prices from both the supply and the demand side. Since we calculate total value based upon extrapolating individual per-acre values to the population of the state, supply and demand trends over time will increase the values of protected landscapes into the future. Although this does generate a larger number, the real take-home message is that there is no time like the present to invest in preserving landscapes since the price and the value of doing so are almost certain to increase in the future.

The effect of open land supply and demand conditions over time could be estimated in a number of ways. For example, we could assume Coloradans' income elasticity is unitary with respect to their willingness to pay for working landscapes (a 1% change in income results in a 1% increase in willingness to pay). Colorado incomes have increased 2% in real terms over the past few decades. So, income-driven increases in working landscape benefits could be increased by 2%. Colorado's population has increased by 11-12% since 2008 to 5.5 million (2016). If the additions to Colorado's population (native-born and in-migrants) generally reflect the working landscape preferences of the current population, we might expect a population driven increase in the benefits by 11-12% relative to estimates that ignore these changes. Colorado State Parks visits have shown increases in visitation similar to the population growth rate over the past decade, reaching more than 57 million in 2016, potentially supporting the contention that Coloradans old and new share positive impressions of open lands.

Supply and demand conditions affect the housing market in a similar way as they would affect open landscape values. Colorado residential values increased by about 15% since 2008. If the benefits of working landscapes increased similarly, then our benefit calculation would increase and our baseline would be higher.

APPENDIX 3. Spatial Datasets and Selection Criteria

Several spatial datasets were central to our analysis and are described in more detail below.



Appendix Figure 1. Protected areas and public ownership data provided through COMaP.

Colorado Ownership, Management and Protection database

The Colorado Ownership, Management and Protection database (COMaP) is a map product managed by the Colorado Natural Heritage Program and Geospatial Centroid at Colorado State University. The conservation easement data used in this study were derived from COMaP. Currently in its 10th version, COMaP integrates protected lands from over 300 data sources into one seamless map (Appendix Figure 1). Source polygons are adjusted, or edge-matched, to create a topologically correct map with no overlaps or gaps. The scale of the data varies by source and is documented in the attribute table. Other attributes include land owner, land manager, easement holder, reception number, protection mechanism, public access, and more. To learn more about COMaP, visit https://comap.cnhp.colostate.edu A call for data preceded this report and many organizations responded with current data submissions to support our goal of a robust and comprehensive map. From March to April, 2017, we added over 400,000 acres of conservation easements in preparation for this study representing an 18.8% increase in acreage. This analysis used the May 5th, 2017 version of COMaP. Selection criteria for each of the two categories are described below.

GOCO List: We received a conservation investment list from GOCO and included all conservation easements matching GOCO log numbers in the list except publicly owned lands.

- Selected from GIS fields OWNER and GOCO_LOG

Colorado Conservation Easement Tax Credit Program List: If we definitively knew whether or not a tax credit was claimed (< 6% of conservation easements were known), we honored that information. Otherwise, we assumed that qualifying conservation easements received a tax credit and applied the following filters to identify qualifying conservation easements:

Included

- Privately owned conservation easements from 2000, the onset of the program, through 2016. (conservation easements with unknown dates were included, assuming the majority of privately owned conservation easements have been established since 2000)
  - Selected from GIS fields OWNER, PROTECTION_MECHANISM, and DATE_ESTABLISHED
- Conservation easements established in 2015 or later that are owned by Land Trusts or other nonprofit organizations. Beginning in 2015, a new rule allowed nonprofits to claim a tax credit (conservation easements with unknown dates were excluded, assuming the majority of nonprofit-owned conservation easements were established before 2015).
  - Selected from GIS fields OWNER, PROTECTION_MECHANISM, and DATE_ESTABLISHED

Excluded

- Conservation easements in public ownership.
- Term (i.e., less-than-perpetual) easements.
- Any conservation easement in the GOCO list above (to avoid double-counting).

Photo by Michael Menefee

National Land Cover Database

The National Land Cover Database (NLCD) is a nationwide dataset developed by a consortium of federal agencies. We used the 2011 version of the NLCD to identify ecosystems in Colorado. The NLCD is derived primarily from Landsat mosaics and is available at a spatial resolution of 30 meters. To learn more about the NLCD, visit https://www.mrlc.gov/nlcd2011.php

The NLCD raster was reclassified in GIS to match the ecosystem types used for valuation.

We applied the crosswalk in Appendix Table 1 to link NLCD ecosystems (Appendix Figure 2) to equivalent ecosystems types used for the economic valuation calculations.

Conservation easement polygons in each list were overlaid with the reclassed NLCD raster in GIS using the tabulate areas tool. This reported the square meters of each ecosystem type within each list of conservation easements. Square meters were converted to acres using Microsoft Excel conversion tools.

Appendix Table 1.

Crosswalk of ecosystem types used for valuing ecosystem services and the ecosystems used in NLCD.

Ecosystem Types Used for Valuation	NLCD Ecosystem Type
Agriculture	Cultivated Crops
Agriculture	Hay/Pasture
Deciduous Forest	Deciduous Forest
Developed - High Intensity Urban*	Developed, High Intensity
Developed - High Intensity Urban*	Developed, Medium Intensity
Developed - Low Intensity Urban/Open Space**	Developed, Low Intensity
Developed - Low Intensity Urban/Open Space**	Developed, Open Space
Emergent Herbaceous Wetland	Emergent Herbaceous Wetlands
Evergreen Forest	Evergreen Forest
Grassland/Herbaceous***	Herbaceous
Mixed Forest	Mixed Forest
Not valued in Study	Barren Land
Not valued in Study	Perennial Snow/Ice
Open Water	Open Water
Scrub/Shrub****	Shrub/Scrub
Woody Wetland	Woody Wetlands

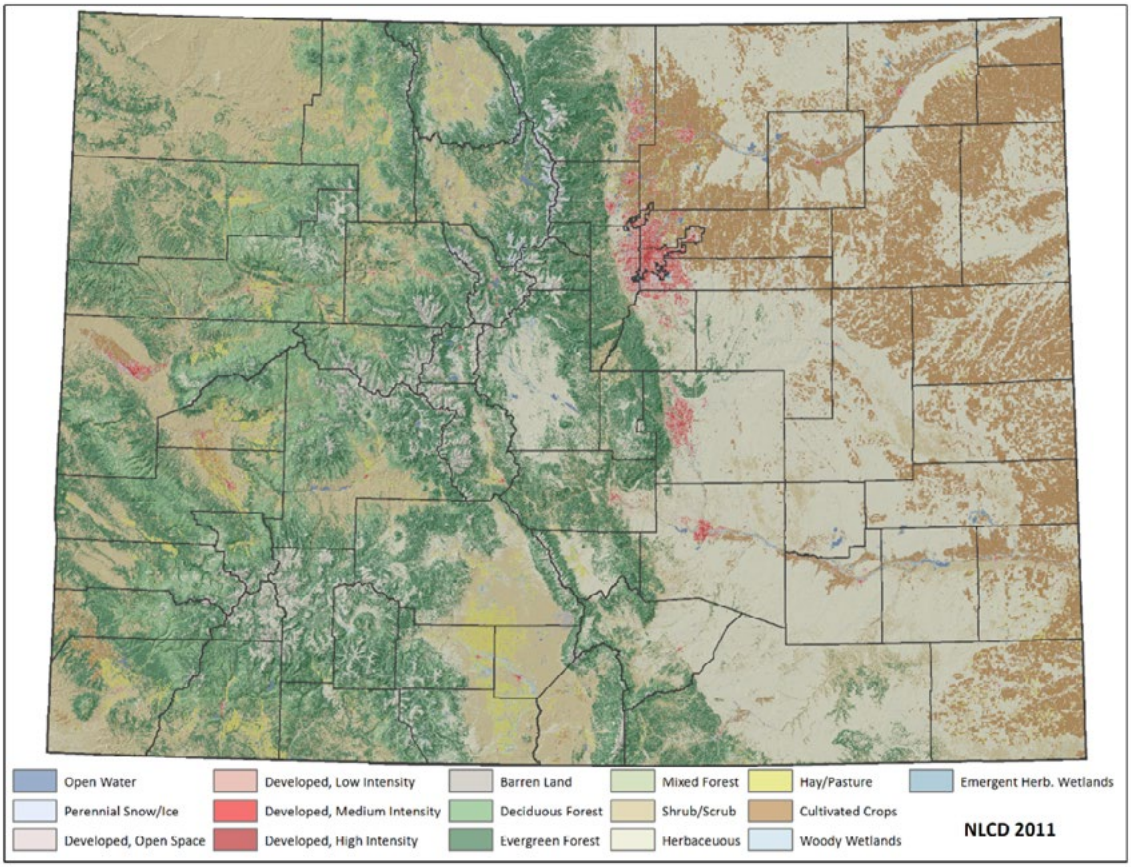
Notes comparing ecosystem types and associated NLCD categories used in this study with those used in Sargent-Michaud (2009) are provided below.

*Acreage for Developed - High Intensity Urban is based on NLCD ecosystem types Developed High Intensity lumped/added together with Developed Medium Intensity. Since there are no economic valuations for medium intensity, medium intensity was placed in high for a conservative approach.

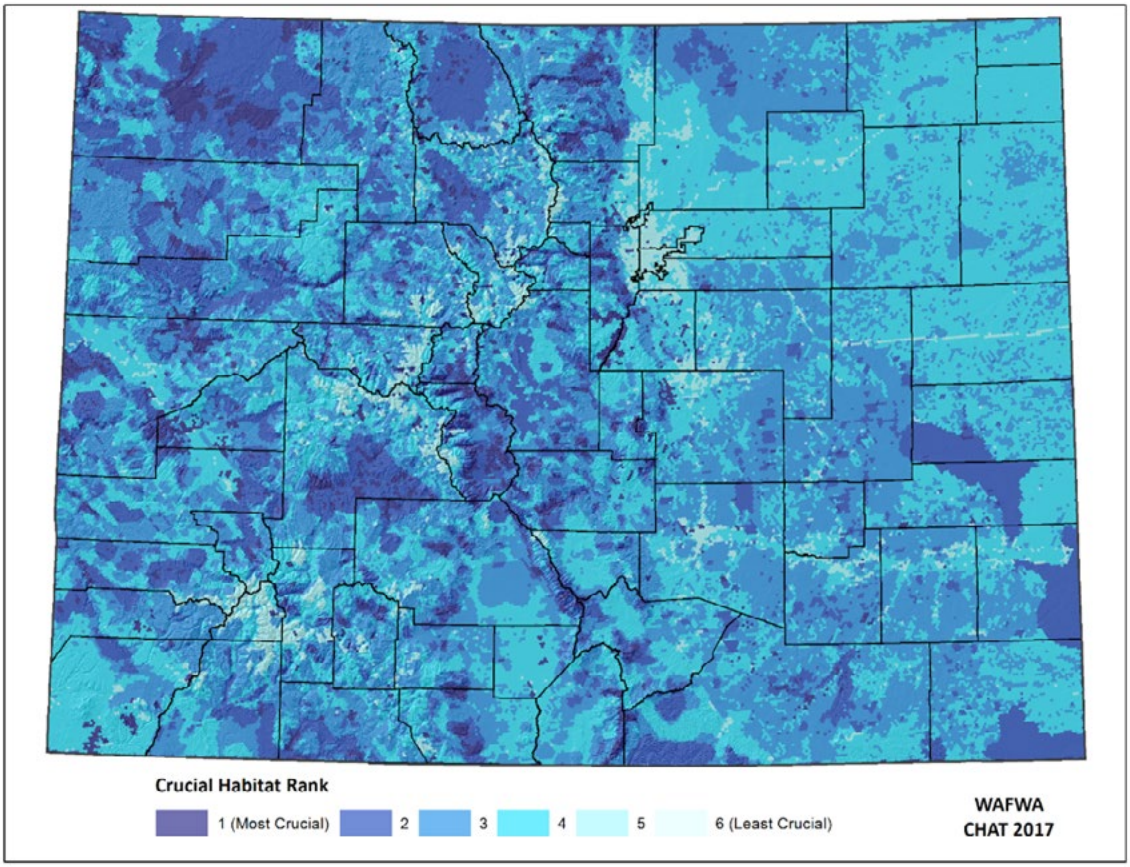
**Acreage for Developed - Low Intensity Urban/Open Space is based on NLCD ecosystem types Developed Low Intensity lumped/added together with Developed Open Space.

***Acreages for Shortgrass Prairie are not included with NLCD but are mostly subsumed/included with the NLCD ecosystem type Grassland/Herbaceous. We did not include independent valuation for Shortgrass Prairie as it is already being counted under Grassland/Herbaceous.

****Acreages for Sagebrush are not included with NLCD but are mostly subsumed/included with the NLCD ecosystem type Scrub/Shrub. We did not include independent valuation for Sagebrush as it is already being counted under Scrub/Shrub.



Appendix Figure 2. National Land Cover Database 2011.



Appendix Figure 3. Crucial Habitat Assessment Tool.

Crucial Habitat Assessment Tool

The Crucial Habitat Assessment Tool (CHAT) is a map detailing crucial wildlife habitat in 16 Western states. Launched in 2013 by Western Governors, and currently managed by the Western Association of Fish and Wildlife Agencies (WAFWA), CHAT is a non-regulatory tool designed to better incorporate wildlife values into large-scale planning. Crucial Habitat in Colorado is coarsely mapped as hexagons with a resolution of one square mile. For more information, visit http://www.wafwachat.org/.

We selected Colorado crucial habitat data from CHAT (Appendix Figure 3), and intersected it with conservation easements in each list to determine total acres of conservation easements within each Crucial Habitat Rank.

Colorado Parks and Wildlife Species Activity Mapping

The Species Activity Mapping (SAM) provides information on wildlife distributions to public and private agencies and individuals, for environmental assessment, land management resource planning and general scientific reference. This is a layer package created by the Colorado Parks and Wildlife GIS Unit in 2017 for distributing Colorado wildlife GIS data in shapefile format for public distribution. This information was used extensively on Table 5 to illustrate conservation priorities conserved through GOCO and the Conservation Easement Tax Credit Program.

Gridded Soil Survey Geographic (gSSURGO) Database

Gridded SSURGO (gSSURGO) was used for calculating Prime Farmland acres. USDA provides the following description: The gridded SSURGO (gSSURGO) dataset was created for use in national, regional, and statewide resource planning and analysis of soils data. The raster map layer data can be readily combined with other national, regional, and local raster layers, including the National Land Cover Database (NLCD), the National Agricultural Statistics Service (NASS) Crop Data Layer (CDL), and the National Elevation Dataset (NED).

The gSSURGO Database is derived from the official Soil Survey Geographic (SSURGO) Database. SSURGO generally has the most detailed level of soil geographic data developed by the National Cooperative Soil Survey (NCSS) in accordance with NCSS mapping standards. The tabular data represent the soil attributes and are derived from properties and characteristics stored in the National Soil Information System (NASIS).

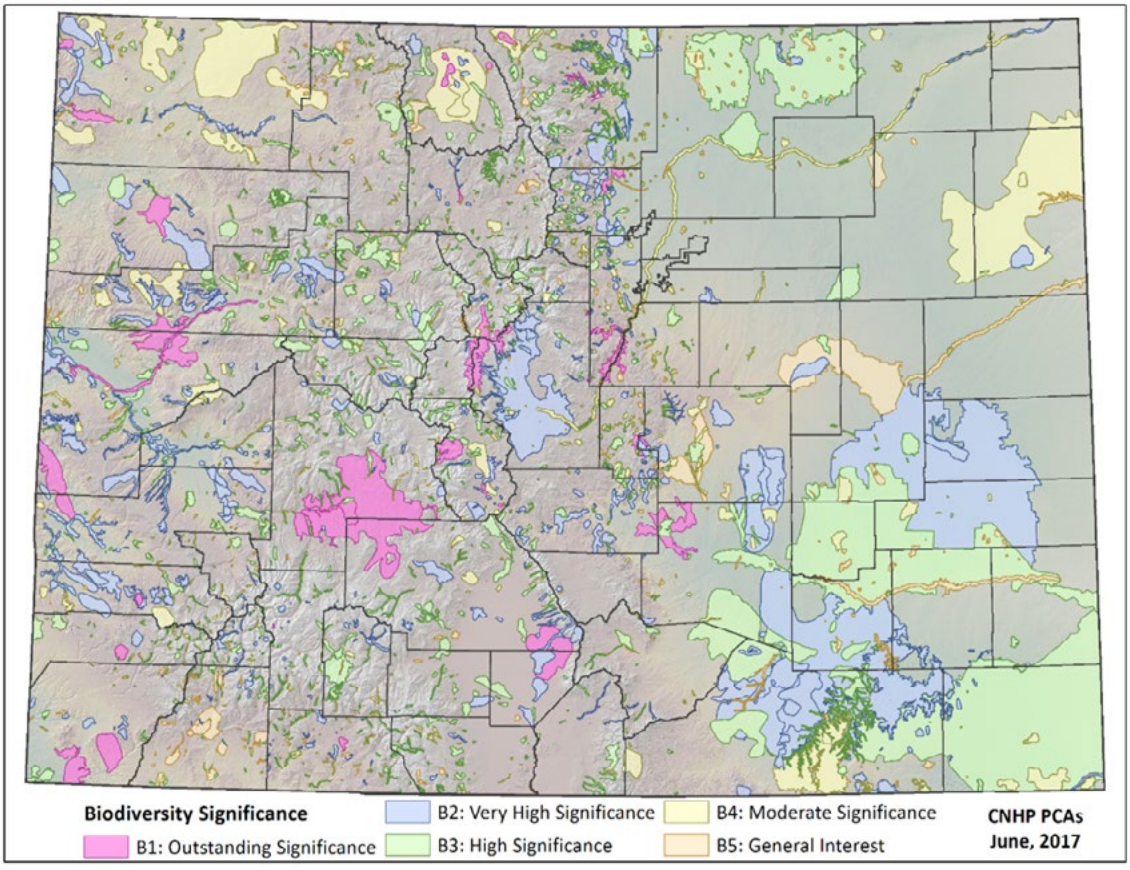
For the purposes of this study we included the following categories of Prime Farmland from gSSURGO:

- Farmland of local importance
- Farmland of statewide importance
- Farmland of statewide importance, if warm enough, and either drained or either protected from flooding or not frequently flooded during the growing season
- Farmland of unique importance
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if protected from flooding or not frequently flooded during the growing season

CNHP Potential Conservation Areas

The Potential Conservation Areas (PCA) map layer shows CNHP's best estimate of the primary area required to support the long-term survival of targeted species or natural communities (Appendix Figure 4).
In order to successfully protect populations or occurrences, it is necessary to delineate conservation areas. These potential conservation areas focus on capturing the ecological processes that are necessary to support the continued existence of a particular element of natural heritage significance. Potential conservation areas may include a single occurrence of a rare element or a suite of rare elements or significant features.

The goal of the process is to identify a land area that can provide the habitat and ecological processes upon which a particular element or suite of elements depends for their continued existence. The best available knowledge of each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features, vegetative cover, as well as current and potential land uses. The proposed boundary does not automatically exclude all activity. It is hypothesized that some activities will cause degradation to the element or the process on which they depend, while others will not. Consideration of specific activities or land use changes proposed within or adjacent to the preliminary conservation planning boundary should be carefully considered and evaluated for their consequences to the element on which the conservation unit is based.



Appendix Figure 4. CNHP Potential Conservation Areas.

Why did we do this?

To understand the ecological and real economic benefits the Conservation Easement Tax Credit program and GOCO- funded conservation easements provide to the people of Colorado.

Suggested Citation

Seidl, A., Anderson, D., Bennett, D., Greenwell, A., and M. Menefee. 2017. Colorado's return on investments in conservation easements: Conservation Easement Tax Credit program and Great Outdoors Colorado. Colorado State University, Fort Collins, Colorado.

Photo by Michael Menefee

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