The Economic Benefits of Denver's Park and Recreation System

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Cover Photos: Darcy Kiefel

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A Report by The Trust for Public Land's
Center for City Park Excellence
for the City and County of Denver

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Executive Summary

With more than 6,200 acres of parkland, 29 recreation centers, 309 athletic fields, great streamside trails and myriad other amenities spread across town, Denver's park and recreation system is a significant reason to live in or visit the Mile-High City. From the historic parks and parkways laid out by planner George Kessler and supported by legendary Mayor Robert Speer to the "City Beautiful" designs laid out for Civic Center Park by Frederick Law Olmsted, Jr., to the recent additions of the South Platte River Greenway, Commons Park and the green spaces of Stapleton, this enduring legacy has great economic value.

Even when it was originally created, Denver's park system was thought of partly as an economic development tool to help put the city on the map. Yet the actual economic value of this asset has never been measured, and now this study provides it. Knowing this number can help planners and policymakers recognize the role of parks not just in buzzwords such as "quality of life" and "livability" but in terms of the real economic development of the city, informing the legacy of and prospect for future investments and budgetary decisions.

Seven major factors are enumerated in this study: property value, tourism, direct use, health, community cohesion, clean air, and clean water. While the science of city park economics is in its infancy, the numbers reported here have been carefully tabulated, considered and analyzed for the most recent year available at the time of this study. The valuation includes Denver's entire park and recreation system—its trails, natural areas, neighborhood and community parks, and parkways. The study does not include every aspect of a park system with potential value—for instance, the dollar value of the mental health benefit of a walk in the woods has not yet been documented and is not counted here.

Two of the factors provide Denver with *direct income* to the city's treasury. The first factor is increased property tax from the increase in value of certain residences because of their proximity to parks. This came to nearly $4.1 million. The second consists of sales tax receipts from tourism spending by out-of-towners who came to Denver primarily because of its parks. This value came to over $3 million for the city of Denver, with additional value not counted going to the state of Colorado and the Regional Transportation District.

Beyond the tax money, these factors also bolstered the *collective wealth* of Denverites—by $30.7 million in total property value and by $18 million in net income from tourist spending.

A telephone survey on park use of 600 randomly selected city residents revealed two other factors that provided Denver residents with *direct savings*. By far the largest savings is from the value of using the city's parks, recreation centers, and trails as public resources instead of having to purchase these items in the marketplace. This value came to $452 million. Second is the health benefit—savings in medical costs—from the beneficial aspects of physical activity in the parks. This came to nearly $65 million.

The last three factors also provided *savings*, but to *city government*. Two are of the environmental sort. The first involves water pollution reduction—the fact that the trees and soil of Denver's parks retain rainfall and thus cut the cost of treating stormwater. This value came to just under $804,000. The second concerns air pollution—the fact that park trees and shrubs absorb a variety of air pollutants. This value came to nearly $129,000. And third is the community cohesion benefit of people banding together to save and improve their neighborhood parks. This "know-your-neighbor" social capital, while hard to tabulate, helps ward off all kinds of antisocial problems that would otherwise cost the city more in police, fire, prison, counseling, and rehabilitation costs. This value came to approximately $2.7 million.

The park system of Denver thus has provided the city an annual revenue of $7.1 million, municipal savings of $3.6 million, resident savings of $517 million, and a collective increase of resident wealth of $48.7 million.

Summary Table. The Estimated Annual Value of the Denver Park and Recreation System

Revenue-Producing Factors for City Government		
Tax receipts from increased property value		$4,081,302
Tax receipts from increased tourism value		$3,048,861
	Total	**$7,130,163**
Cost-Saving Factors for City Government		
Stormwater management value		$804,187
Air pollution mitigation value		$128,914
Community cohesion value		$2,674,422
	Total	**$3,607,523**
Cost-Saving Factors to Citizens		
Direct use value		$452,014,285
Health value		$64,955,500
	Total	**$516,969,785**
Wealth-Increasing Factors to Citizens		
Property value from park proximity		$30,690,771
Net profit from tourism		$18,027,542
	Total	**$48,718,313**

Background

Cities are economic entities. They are made up of structures entwined with open space. Successful communities have a sufficient number of private homes and commercial and retail establishments to house their inhabitants and give them places to produce and consume goods. Cities also have public buildings—libraries, hospitals, arenas, city halls—for culture, health, and public discourse. They have linear corridors—streets and sidewalks—for transportation. And they have a range of other public spaces—parks, plazas, and trails, sometimes natural, sometimes almost fully paved—for recreation, health provision, tourism, sunlight, rainwater retention, air pollution removal, natural beauty, and views.

In successful cities the equation works. Private and public spaces animate each other with the sum greatly surpassing the parts. In unsuccessful communities, some aspect of the relationship is awry: production, retail, or transportation may be inadequate; housing may be insufficient; or the public realm might be too small or too uninspiring.

A city's park system is integral to this equation, but research on the topic has largely been absent in cities even though the economic impact of stadia, convention centers, and museums has been promoted widely. Based on a two-day colloquium of park experts and economists held in October,

2003 (see Appendix II), the Center for City Park Excellence believes that there are seven attributes of a city's park system that are measurable and that provide economic benefits to the city. (For a listing of studies done on these issues by participants in the colloquium as well as others, see Appendix III.)

What follows are a description of each attribute and an estimate of the specific economic value it provides. The numerical calculation sheets can be obtained from The Trust for Public Land, or they can be accessed online at this address: www.tpl.org/denverparkvalue/.

1. Hedonic (Property) Value

Numerous studies have consistently shown that parks and open space have a positive impact on nearby residential property values. The evidence has shown that most people are willing to pay more for a home close to a nice park. Economists call this phenomenon "hedonic value." (Hedonic value also comes into play with other amenities such as schools, libraries, police stations and transit stops. Commercial office space near parks may also command increased value, but no study has yet been able to quantify it.) Incidentally, property value goes up even if the resident never goes into the park; simply the view of Commons Park from Lower Downtown in Denver, for example, can be worth extra value for some.

Property value near parks is affected primarily by two factors: distance and the quality of the space. While proximate value (i.e., the "nearness" factor) has been documented for up to 2,000 feet from a large park, most of the value has been found by studies to be within the first 500 feet. To be conservative, we have limited our measurement to this shorter distance. As for park quality, beautiful natural resource parks with great trees, trails, meadows, and gardens are markedly valuable to surrounding homes. Excellent recreational facilities are also desirable (with some reductions due to issues of noise, nighttime lighting, and parking). Less attractive or poorly maintained parks, however, are only marginally valuable. And parks with dangerous or frightening aspects can reduce nearby property values.

Determining a park-by-park, house-by-house property value for a city is technically feasible, but it is prohibitively time-consuming and costly. Thus we formulated an extrapolative methodology to arrive at a reasonable estimate. Using computer-based mapping, we identified all residential properties within 500 feet of every significant park and recreation area in Denver. (We defined "significant" as parks of one acre or more that are publicly owned within the city's boundaries and parkways with medians consisting of at least ten acres and significant width, such as Monaco Parkway.) According to property records of the Denver Assessor's Office, there are 47,085 residential properties within 500 feet of parks in the city of Denver. (A residential property is defined as a unit that is owned and taxed; a single-family house is one property, a 100-unit rental building is one property, and a 100-unit condominium building is 100 properties.) These properties when measured in 2009 had a combined market value of $14.5 billion.

Despite interviews with park professionals, park users, real estate agents, assessors and law enforcement officials, we determined that there is no simple methodology to measure park quality and its effect on value. Instead, we chose to assign the conservative value of 5 percent as the amount that parkland adds to the assessed value of all dwellings within 500 feet of parks. This number is an average of the high, medium and low values of 15 percent, 5 percent, and negative 5 percent that will be used if specific park quality can be established in the future. Using this, we calculated that the property value attributable to parks in Denver is $724 million.

We then tallied the amount of tax revenue generated from the additional park value. Using data provided by the Assessor's Office, we calculated that a total of $81.6 million of property tax was collected from properties within 500 feet of parks, and that 5 percent of this, or $4.08 million, was due to parks. We also determined that based on the assessor's data, for the 1,893 homes sold in 2008 (the last complete year of residential sales available at the time of this study), the proximate park value realized at the time of sale was $30.7 million.

Ben Welle

Parks have been found to enhance property values around their edges, which also helps bring in additional tax revenue. Seen here is Denver's Cheesman Park.

We consider this a conservative estimate for three reasons. First, it does not include the effects of small parks (under an acre), although it is known that even minor green spaces have a property value effect. Second, it leaves out all the value of dwellings located between 500 feet and 2,000 feet from a park. Third, it does not include the potentially very significant property value for commercial offices located near parks.

Table 1. Economic Benefits of Parks to Residential Property Values, Denver

Market value of properties within 500 feet of parks	$14,487,661,644
Market value attributable to parks (5%)	**$724,383,082**
Assessed taxable value of properties near parks	$1,159,736,040
Property tax revenue from properties within 500 feet of parks	$81,626,050
Tax revenue attributable to parks (5%)	**$4,081,302**
Value of properties sold in 2008 within 500 feet of parks	$613,815,418
Value of properties sold attributable to parks (5%)	**$30,690,771**

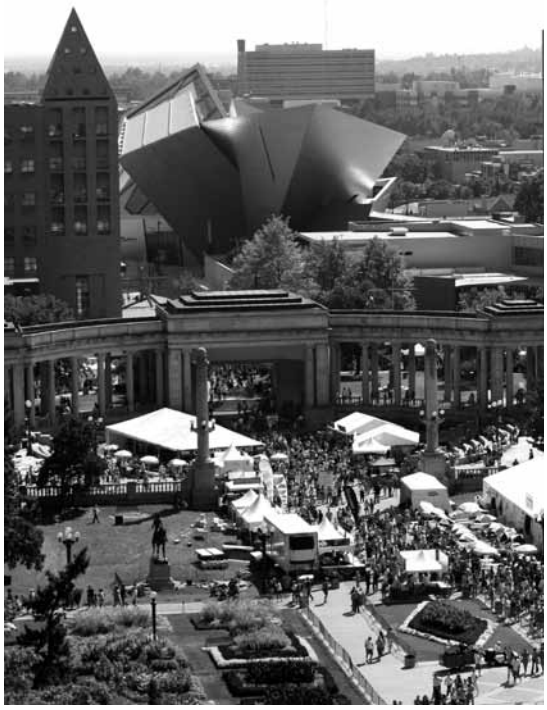
2. Tourism Value

The parks of Denver attract two kinds of users—residents and out-of-towners. When calculating income from tourists, residents are not counted. While locals may spend money in and around parks, economists treat that as merely a shift in spending from one neighborhood within the city to another. Only the "new" revenue brought to the city from elsewhere is counted here; the value to residents is counted under direct use (see page 8).

The features that encourage people to visit Denver for leisure include cultural offerings, nightlife, heritage places, and parks as well as special events that take place there, such as festivals and sports contests. Over 500,000 people attended the Taste of Colorado and 250,000 attended the People's Fair in Civic Center Park. When travel writers talk about Denver, they nearly always mention some aspect of the park system. *The New York Times*' "36 Hours" series, noting that "even in the city, being in Colorado means being outdoors," focused on parks and trail activities. Fodor's travel guide highlights the South Platte River Greenway. And Wikitravel users write that the city is "full of beautiful parks." There is no question that a significant portion of Denver's tourism can be attributed to these green features.

Determining the park system's precise contribution to the tourism economy requires knowledge of the number of tourists, their activities, and their spending. In Denver, as elsewhere, although the attendance at some events is known, there is no specific data point on the amount of tourism that is due primarily to parks. Nevertheless, based on a report provided by Visit Denver, the local organization devoted to tourism in the metropolitan area, we were able to make educated estimates using its data on visitor spending and reason for visit.

First, reducing counts from the entire metro area, we estimated the number of visitors to the city itself as one-third of all trips. More than 13.5 million tourists visited Denver in 2008, most staying overnight, some coming for just the day. Based on percentages of those visiting for special events, touring, an urban experience, and the outdoors, we assume a percentage of each of these is coming because of parks. We estimate that in total 5.25 percent of them, 711,376, came significantly because of parks—either because of a specific event in a park or more generally because of the simple beauty or sporting value of using a park. (The percent does not include an approximation of those visiting Denver for other purposes but who also happen to visit a park.) Of that number, approximately 344,593 stayed overnight in a hotel, 249,533 stayed overnight with friends or relatives, and 117,250 came just for the day.



City of Denver

Civic Center Park. Parks contribute to a city's tourism economy from events in them and as attractions themselves, both of which can be found in Civic Center Park.

Converting this into spending from food, lodging and incidentals, again using data from Visit Denver, we estimate that overnight park visitors in hotels spent $33.08 million, overnight visitors with friends and family spent $11.98 million, and day visitors spent $6.45 million in 2008. We then applied the sales tax rate of 3.62 percent to the day visitors and to the overnight visitors staying with friends and relatives. For the overnight visitors staying in hotels, we applied an average of the sales and hotel taxes of 7.2 percent. (This is an average of the regular local sales tax rate of 3.62 percent and the local lodger's tax of 10.75 percent.) Combined, the total 2008 tax revenue to the city from park-based tourism was $3,048,860.

In addition, since 35 percent of every tourist dollar is considered "profit" to the city economy (the rest of the income is merely pass-through to pay for expenses), the citizenry's collective increase in wealth from park-based tourism was $18,027,542.

Table 2. Tourism Value from Parks

Overnight Visitors Staying in Hotels	
Number of overnight tourist days to Denver	6,563,667
Overnight visitors whose primary reason to visit is parks (5.25%*)	344,593
Spending per person, per day	$96
Spending of overnight visitors whose primary reason to visit is parks	$33,080,928
Sales/hotel tax paid by hotel visitors, attributable to parks** (approximately 7.2%)	**$2,381,827**
Overnight Visitors Staying with Friends/Relatives	
Number of overnight tourist days to Denver	4,753,000
Overnight visitors whose primary reason to visit is parks	249,533
Spending per person, per day	$48
Spending of overnight visitors whose primary reason to visit is parks	$11,977,584
Sales tax payments by friend/relative visitors, attributable to parks (3.62%)	**$433,589**
Day Visitors	
Number of day tourists to Denver	2,233,333
Day visitors whose primary reason to visit is parks	117,250
Spending per day visitor	$55
Spending of day visitors whose primary reason to visit is parks	$6,448,750
Sales tax payments by day visitors, attributable to parks (3.62%)	**$233,445**
Total spending (overnight and day visitors)	**$51,507,262**
Total tax payments by visitors attributable to parks*	**$3,048,861**
Collective profit to the citizens of Denver from park visitors who came because of parks (35% of total sales)	**$18,027,542**

**Estimate based on visitor data provided by Visit Denver. **Average sales tax and hotel tax, assumed as total taxes paid. Estimates based on data from Visit Denver.*

3. Direct Use Value

While Denver's park system provides much indirect value, its many components are community resources owned and available for use by residents. Economists call these activities—basketball and other team sports in Washington Park, bicycling to work on the Cherry Creek Trail, skateboarding in Denver's great skatepark, walking and picnicking in Cheesman Park, making use of fitness centers and recreation classes, and much more—"direct uses."

Most direct uses in public parks are free of charge, but economists can still calculate their value by determining the consumer's "willingness to pay" for the recreation experience in the private marketplace. In other words, if the park system was not available in Denver, how much would the resident (or "consumer") pay for similar experiences in commercial venues? Thus, rather than income, the direct use value represents the amount of money residents save by not having to pay market rates to indulge in the many park activities they enjoy.

The model for quantifying the benefits received by direct users is based on a professionally conducted random-digit-dialed telephone survey on park use of 600 residents within the city of Denver using the "Unit Day Value" method as documented in Water Resources Council recreation valuation procedures by the U.S. Army Corps of Engineers. The Unit Day Value model counts park visits by specific activity, assigning each activity a dollar value. For example, playing in a playground is worth $3.50 each time to each user. Running, walking or in-line skating on a park trail is worth $4, as is playing a game of tennis on a public court. For activities for which a fee is charged, such as golf or visiting an arboretum, only the "extra value" (if any) is assigned; that is, if a round of golf costs $20 on a public course and $80 on a private course, the direct use value of the public course would be $60. Under the theory that the second and third repetitions of a park use in a given period are slightly less valuable than the first use (i.e., the value to a child of visiting a playground the seventh time in a week is somewhat lower than the first), we incorporated an estimated sliding scale of diminishing returns for heavy park users. For example, playground value diminishes from $3.50 for the first time to $2.25 for the sixth time in a week. As the weather in the Rockies has its warm and cold months, we also estimated a time span for different park uses to take into account reduced participation in different seasons, depending on the activity. (Although some people are active in parks 365 days a year, we chose to err on the side of conservatism and eliminated seasons when participation rates drop to low levels, though some activities, such as using an indoor recreation center, are year-round.) Finally, for the few activities that charge a fee, such as golf, use of weight rooms, and use of fields for league sports, we subtracted the per-person fee from the imputed value.

The phone survey, which had a widely accepted accuracy level of plus-or-minus 3 percent, determined the number of visits and the activities engaged in within the park system (from trails to natural areas to playing fields). Residents were asked to answer for themselves; a representative proportion of adults with children under the age of 18 were also asked to respond for one of their children. (The calculation includes only residents of Denver. The value from what out-of-town visitors spend because of park visitation is covered on page 6.)

City of Denver

Denver residents receive millions in economic benefit from their access to parks as public amenities, something they otherwise would have to purchase, including the beautiful flower gardens and recreational facilities of Washington Park seen here.

The result of the Direct Use Calculator was $452,014,285 for the year 2009.

While it can be claimed that this very large number is not as "real" as the numbers for tax or tourism revenue, it nevertheless has true meaning. Certainly, not all these activities would take place if they had to be purchased, but Denverites truly are getting pleasure and satisfaction from their use of the parks. If they had to pay and if they consequently reduced some of this use, they would be materially "poorer" from not doing some of the things they enjoy.

Table 3. The Economic Value of Direct Use of Parks in Denver

Facility/Activity	Person Uses	Average Value per Use*	Value
General use (playgrounds, trails, dog walking, picnicking, sitting, etc.)	119,746,050	$1.93	$231,109,876
Sports facilities uses (tennis, team sports, bicycling, running, etc.)	52,345,694	$3.65	$191,061,782
Special uses (fishing, kayaking, gardening, festivals, concerts, attractions, etc.)	4,949,026	$6.03	$29,842,627
Total			**$452,014,285**

**Rounded to two decimal points.*

4. Health Value

There is increasing evidence from experts that obesity and physical inactivity are becoming a major public health problem that, in addition to human misery, has expensive economic consequences. One recent report by the federal Centers for Disease Control and Prevention (CDC) estimates that in 2008, $147 billion in added costs could be attributed to obesity. Research suggests that nearby parks, accessible and safe bike trails, and programming at playgrounds can help people increase their level of physical activity and reduce their medical expenses.

The Health Benefits Calculator measures the collective economic savings that Denver residents realized by their use of parks. We created the calculator by identifying the common types of medical problems that are inversely related to physical activity, such as heart disease and diabetes. The model does not include an estimate specifically on the effect parks have shown to have in some research on mental health.

Based on studies that have been carried out in seven different states, we assigned a value of $351 as the cost difference in current dollars between those who exercise regularly and those who do not. For persons over the age of 65, that value has been doubled to $702 in today's dollars because seniors typically incur two or more times the medical care costs of younger adults. The calculator makes one additional computation, applying a small multiplier to reflect the differences in medical care costs between Colorado and the United States as a whole.

The key data input for determining medical cost savings is the number of park users indulging in a sufficient amount of physical activity to make a difference. The CDC defines this as at least 150 minutes of moderate activity, or at least 75 minutes of vigorous activity, per week.

Darcy Kiefel

Parks provide a place to exercise, as seen in the kayakers and bikers on the South Platte River Greenway, making residents healthier and reducing healthcare costs.

The same telephone survey that collected the direct use data (see page 8) also determined residents' physical activities and their frequency, dividing respondents by age. In order to modify the results to serve the health benefits study, low-heart-rate uses such as picnicking, sitting, strolling and birdwatching were eliminated. Also, all respondents who engaged in strenuous activities fewer than three times per week were dropped as not being active enough for health benefit, in accordance with CDC guidelines. Likewise, for less-vigorous activity, respondents were not valued if they did not engage in activities at least four times per week.

In Denver, we estimated that 171,363 residents—158,954 younger than 65 and 12,409 older than 65—engaged actively enough in parks to cut their health costs. The combined health savings due to park use for the residents of Denver in 2009 was $64,955,500.

Table 4. Health Care Cost Benefits of Denver's Parks

Adults Younger Than 65 Years of Age	
Average annual medical care cost difference between active and inactive persons over 65 years of age	$351
Physically active in parks*	**158,954**
Subtotal of health care benefits	$55,792,854
Adults 65 Years of Age and Older	
Average annual medical care cost difference between active and inactive persons	$702
Physically active in parks*	**12,409**
Subtotal of health care benefits	$8,711,118
Subtotals combined	$64,503,972
Regional multiplier for health costs	**1.007**
Total annual value of health benefits from parks	**$64,955,500**

**Calculations based on persons engaging in moderate or vigorous activity as defined by the CDC.*

5. Community Cohesion Value

Along with schools, churches and other social gathering places, parks are key sources of community. As several studies have shown, the institutions that make up this web of human relationships can make a neighborhood stronger, safer and more successful. Aside from the great social value in people caring about their communities, there is monetary value that is benefiting neighborhoods and the entire city.

This human web, for which famous urbanist Jane Jacobs coined the term "social capital," is strengthened in some communities by parks. From playgrounds to sports fields to park benches to chessboards to swimming pools to ice skating rinks to flower gardens, parks offer opportunities for people of all ages to communicate, compete, interact, learn and grow. For example, a group that provides free concerts in City Park not only brings those individuals together, but also enlivens the park and gives quality of life to the city. Perhaps more significantly, the acts of improving, renewing, or even saving a park can build extraordinary levels of social capital in a neighborhood that may well be suffering from fear and alienation partially owing to the lack of safe public spaces. Groups such as the Civic Center Conservancy and The Park People have garnered support for parks and gathered neighbors for their cause.

The economic value of social capital is not entirely identifiable and is in some ways priceless, but it is possible to tally up a proxy based on real numbers—the amount of time and money that residents donate to their parks. Denver has thousands of park volunteers who do everything from picking up trash and pulling weeds to planting flowers, raising playgrounds, teaching about the environment, educating public officials, and contributing dollars toward a better city.

To arrive at the proxy number, we tallied all the financial contributions made to "friends of parks" groups, community organizations, nonprofits, and foundations, using the most recent data available, 2008. We also included all the hours of volunteer time donated directly to the city's adopt-a-park and other volunteer programs as well as to park organizations; we then multiplied the hours by the value assigned to volunteerism in 2008—$19.51—by the Washington, D.C.-based organization Independent Sector.

City of Denver

People come together in parks, and this social capital can be measured economically in volunteer hours and the contributions of non-profit groups.

The result of the Social Capital Calculator for the city of Denver is $2,674,422.

Table 5. Community Cohesion Value: Park Supporters in Denver

	Volunteer Hours	Value of Volunteer Hours*	Financial Contributions	Total
City volunteer programs and events	26,559	$518,166	--	$518,166
Greenway Foundation (in Denver)	5,000	$97,550	$431,745	$529,295
Park People	1,500	$29,265	$750,387	$779,652
Other park groups**	12,184	$237,710	$609,599	$847,309
Total	**45,243**	**$882,691**	**$1,791,731**	**$2,674,422**

**Source of value of volunteer hour in Denver is from Independent Sector, at $19.51 per hour.*
***Includes City Park Alliance, Cheesman Park Advocacy Group, Friends and Neighbors of Washington Park, Civic Center Conservancy, and others.*

6. Stormwater Retention Value

Stormwater runoff is a significant problem in cities. When rainwater flows off roads, sidewalks, and other impervious surfaces, it carries pollutants with it. Unfiltered rainwater can flow directly into waterways, causing significant ecological problems.

Denver's parks, from the trees and vegetation of City Park to the filtering and buffer effect of Commons Park's lawns, reduce stormwater management costs by capturing precipitation and/or slowing its runoff. Large pervious (absorbent) surface areas allow precipitation to infiltrate and recharge the groundwater. Also, vegetation provides considerable surface area that intercepts and stores rainwater, allowing some to evaporate before it ever reaches the ground. In effect, urban green spaces function like mini storage reservoirs and are the original form of green infrastructure.

The Western Research Station of the U.S. Forest Service in Davis, California, has developed a model to estimate the value of retained stormwater runoff due to this public green space. Inputs to the model consist of geographic location, climate region, surface permeability index, park size, land cover percentages, and types of vegetation. The model, while excellent, is not perfect; because of numerous data challenges, it thus far gives only a preliminary indication of the stormwater control value of Denver's park system.

First, we studied land cover—trees, open grassy areas, impervious surface, and so on— through analysis of data obtained from the City of Denver. This analysis by computer mapping (known as GIS) revealed the perviousness of Denver parks. The impervious portion consists of roadways, asphalt trails, parking areas, buildings, hard courts, and also water surface. (While the model was developed with the sensitivity to distinguish between the different vegetation down to palms and shrubs, this study was limited to deciduous, coniferous, and grassy areas because of the limitations of the land cover data.)

Next, we analyzed the same data for the amount of perviousness of the *rest* of Denver—in other words, the city without its parkland. The pervious land consists largely of residential front and backyards, private natural areas such as cemeteries, institutional grounds, and office campuses. Naturally, the city as a whole has a higher percentage of hardscape than its parks. Our calculation methodology compares actual runoff with parks against the theoretical runoff that would occur if there were no parks.

Third, we calculated the amount and characteristics of precipitation from U.S. weather data. Denver's typical weather pattern consists of general dryness, occasional showers, and snow in winter. On average the city receives 15.65 inches per year.

The model, which combines aspects of two other models developed by researchers with the U.S. Forest Service, uses hourly annual precipitation data to estimate annual runoff. We then calculated the reduction in runoff by comparing the modeled runoff with the runoff that would leave a hypothetical site of the same size but with land cover that is typical of surrounding urban development (i.e., with streets, rooftops, parking lots, etc.). In other words, it is not the entire amount of water held back by parks, but the additional amount compared to the surrounding city development pattern. This number is 78,076,400 cubic feet.

City of Denver

Parks are green infrastructure, filtering and absorbing stormwater otherwise bound for the city's gutters and sewer system.

The final step in determining the economic value of a park system's contribution to clean water is calculating what it costs to manage stormwater using "hard" infrastructure (e.g., concrete pipes, sewers and the like). This is not a generally known number and, in fact, is difficult to ascertain. Therefore, to obtain an estimate, we divided spending on stormwater facilities for 2008 by an estimate of the total amount of water conveyed by the city's system (i.e., the rain falling on the developed areas of the city). This works out to a cost for stormwater conveyance of $0.0103 per cubic foot.*

Overall, by considering the rainfall, parkland, imperviousness and treatment cost factors, we obtained a total annual Stormwater Retention Value of $804,187 million for the park system of Denver.

* This is likely a low number because it does not fully account for the far greater costs of the initial system that have been paid off since pipes were laid down.

Table 6. Stormwater Cost Savings Due to Parks in Denver

Typical Year	Inches	Cubic Feet
Rainfall	15.65	357,104,517
Runoff with parks		24,413,590
Runoff without parks		102,489,990
Runoff reduction due to parks		78,076,400
Runoff reduction rate	76%	
Cost of treating stormwater ($ per cubic foot)		$0.0103
Total savings due to park runoff reduction		**$804,187**

7. Air Pollution Removal Value

Air pollution in cities can injure health and damage structures, creating both an environmental and an economic problem. Human cardiovascular and respiratory systems can be affected with broad consequences for health costs and productivity. In addition, acid deposition, smog, and ozone increase the need to clean, repair, or repaint buildings, bridges, and other costly infrastructure.

The many trees and shrubs in Denver's parks have the ability to remove air pollutants such as nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone, and some particulate matter. Leaves absorb gases, and particulates adhere to the plant surface. The vegetation present in city parks plays a role in improving air quality, helping urban residents avoid costs associated with pollution.

In order to quantify the contribution of park vegetation to air quality, the Northeast Research Station of the U.S. Forest Service in Syracuse, New York, designed a calculator to estimate pollution removal and value for urban trees. This program, which is based on the Urban Forest Effects (UFORE) model of the U.S. Forest Service, is location-specific, taking into account the air pollution characteristics of the city of Denver. (Different cities can generate different results based on differences in ambient air quality.)

First, we obtained land cover information for all of Denver's parks through analysis of the city's tree canopy, using computerized mapping based on a digitized assessment of aerial photography. While Denver has many trees on streets and private property, this study measured only the economic value of trees on public parkland and parkways. Based on this, we found that 775 acres, or 12.3 percent of the city's 6,286 acres of parks, are covered with trees.

Then we considered the pollutant flow through the area within a given time period (known as "pollutant flux"), taking into account the concentration of pollutants and the velocity of pollutant deposition. (The calculator uses 1994 Environmental Protection Agency hourly pollution concentration data.) We also took into account the resistance of the tree canopy to the air, the behavior of different types of trees and other vegetation, and seasonal leaf variation. We then multiplied the total pollutant flux by tree-canopy coverage to estimate total pollutant removal by trees in the

study area. Finally, we estimated the monetary value of pollution removal by trees, using the median U.S. externality values for each pollutant. (The externality value refers to the amount it would otherwise cost to prevent a unit of that pollutant from entering the atmosphere. For instance, the externality value of preventing the emission of a short ton of carbon monoxide is $870; the externality value of the same amount of sulfur dioxide is $1,500.)

City of Denver

Vegetation in Denver's parks helps clear the air of pollutants.

The result of the Air Quality Calculator for the park system of Denver in 2009 was an economic savings of $128,914.

Table 7. The Role of Parks in Cutting Air Pollution Costs in Denver

	Tons Removed	Dollars Saved per Ton Removed	Pollutant Removal Value
Carbon dioxide	0.7359	$870	$640
Nitrogen dioxide	6.0486	$6,127	$37,060
Ozone	7.1057	$6,127	$43,536
Particular matter	10.7184	$4,091	$43,849
Sulfur dioxide	2.5524	$1,500	$3,829
Total			**$128,914**

Conclusion

While reams of urban research have been carried out on the economics of housing, manufacturing, retail, and even the arts, there has been until now no comprehensive study in Denver on the worth of the city's park system. The Trust for Public Land believes that answering this question—"How much value does a city park system bring to a city?"—can be profoundly helpful and useful. For the first time, parks can be assigned the kind of numerical underpinning long associated with transportation, trade, housing, and other sectors. Urban analysts will be able to obtain a major piece of missing information about how cities work and how parks fit into the equation. Housing proponents and other urban constituencies will potentially be able to find a new ally in city park advocates. And mayors, city councils, and chambers of commerce may uncover the solid, numerical motivation to strategically acquire parkland in balance with community development projects.

Denver is in a state known for its great offering of natural features, but the splendor of the great outdoors can be found right within the city's boundaries in its over 6,200 acres of parks, parkways and trails. From the open lawn of Cheesman Park to the car-free loop of Washington Park to the Cherry Creek Trail to the development-enhancing Commons Park in Lower Downtown, Denverites are fortunate to have such a wide variety of spaces that offer real economic benefits.

Research by economists Gerald Carlino and Albert Saiz has concluded that metropolitan areas rich in amenities such as parks, historic sites, museums, and beaches "disproportionately attracted highly educated individuals and experienced faster housing price appreciation." Additional research and writing by such academics such as Richard Florida, John Crompton and Hank Savitch have indicated that great parks, trails, and recreational amenities are key ingredients to attracting talent and distinguishing a city as good place to live.

This study has shown local benefits from Denver's parks on property values and taxes, increased economic development and tax revenue from tourism, improved quality of life from publicly available amenities, a healthier and more interconnected citizenry, and an enhanced ability to deal with the environmental challenges of stormwater management and air pollution.

Determining the economic value of a city park system is a science still in its infancy. More research and analysis are needed regarding park usership, park tourism, adjacent property transactions, water runoff and retention, and other measures. In fact, every aspect of city parks—from design to management to programming to funding to marketing—would benefit from much deeper investigation and analysis. This study is offered as a mechanism to begin a conversation about the present and future role of parks within the life—and economy—of Denver.

Appendix I
Acknowledgments

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David Chenoweth, Ph.D., Health Management Associates, New Bern, N.C.

John Crompton, Ph.D., Department of Park, Recreation, and Tourism Sciences, Texas A&M University

E. G. McPherson, Ph.D., U.S. Forest Service Western Research Station, Davis, Calif.

Sarah Nicholls, Ph.D., Department of Park, Recreation, and Tourism Resources, Michigan State University

David Nowak, Ph.D., U.S. Forest Service Northeast Research Station, Syracuse, N.Y.

Dan Stynes, Ph.D., Department of Park, Recreation, and Tourism Resources, Michigan State University

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Tim Wohlgenant, Colorado state director, The Trust for Public Land

Doug Woods, director of parks, Denver Parks and Recreation

Kim Yuan-Farrell, program manager, The Park People

Appendix II
Colloquium Attendees

The following individuals took part in the colloquium "How Much Value Does a Park System Bring to a City," in October, 2003.

Susan Baird, Denver Dept of Parks & Recreation, Denver, Colo.
Kathy Blaha, The Trust for Public Land, Washington D.C.
Blaine Bonham, Pennsylvania Horticultural Society, Philadelphia, Pa.
Glenn Brill, Ernst & Young, New York, N.Y.
Valerie Burns, Boston Natural Areas Network, Boston, Mass.
Patrice Carroll, Philadelphia Managing Director's Office, Philadelphia, Pa.
Donald Colvin, Indianapolis Dept of Parks and Recreation, Indianapolis, Ind.
Ernest Cook, The Trust for Public Land, Boston, Mass.
John Crompton, Texas A&M University, College Station, Tex.
Dick Dadey, City Parks Alliance, New York, N.Y.
Nancy Goldenberg, Philadelphia Center City Partners, Philadelphia, Pa.
Peter Harnik, The Trust for Public Land, Washington, D.C.
Nancy Kafka, The Trust for Public Land, Boston, Mass.
Alastair McFarlane, U.S. Dept of Housing & Urban Development, Washington, D.C.
Ken Meter, Crossroads Resource Center, Minneapolis, Minn.
Sarah Nicholls, Michigan State Univerisity, E. Lansing, Mich.
Joan Reilly, Pennsylvania Horticultural Society, Philadelphia, Pa.
Dan Stynes, Michigan State Univerisity, E. Lansing, Mich.
Patrice Todisco, Boston GreenSpace Alliance, Boston, Mass.
Susan Wachter, University of Pennsylvania, Philadelphia, Pa.
Guijing Wang, Centers for Disease Control, Atlanta, Ga.
Richard Weisskoff, Everglades Economics Group, N. Miami, Fla.
Wayne Weston, Mecklenburg Parks and Recreation Dept., Charlotte, N.C.
Jennifer Wolch, University of Southern California, Los Angeles, Calif.
Kathleen Wolf, University of Washington, Seattle, Wash.
Matt Zieper, The Trust for Public Land, Boston, Mass.

Appendix III
Resources Related to the Economic Value of Parks

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