

The Economic Benefits of San Francisco's Park and Recreation System



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The Trust for Public Land

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Executive summary

This economic value study is the 12th undertaken by the Center for City Park Excellence since 2007 using a set of core criteria agreed upon by an independent panel of experts.

Seven major factors are enumerated: property value, tourism, direct use, health, community cohesion, clean water, and clean air. While the science of city park economics is still immature, these values have proved useful; the numbers reported here have been carefully tabulated, considered, and analyzed for the most recent year available at the time of this study. The analysis includes the economic impact of San Francisco's entire park and recreation system—from destination icons to trails, natural areas, neighborhood and community parks, and even hardscape downtown squares.¹

While the results in this document are consistent with our research in other cities, they suggest that San Francisco's park system plays a particularly outsized role in the city's economy.

San Francisco is a city of great and diverse parks. Found in its more than 5,500 acres are countless amenities—25 recreation centers, 150 ball fields, 151 tennis courts, 24 miles of park bike trails, 9 swimming pools, 6 golf courses, 132 playgrounds, a music grove, a Japanese tea garden, a carousel, and much more. Beginning with San Francisco's first public park, Portsmouth Square, to the unparalleled experience of Golden Gate Park, this vast legacy has great economic value.

San Francisco's park system started taking shape soon after the gold rush days (Golden Gate Park was begun in 1868), and it has developed hand in hand with the houses, apartment buildings, and office towers that are squeezed into this compact, second-most-densely-populated city in the country. In fact, many people feel that the parks are what enable San Franciscans to psychically survive and economically thrive in their crowded surroundings. Yet this is the first study to measure the economic value of what is arguably the City's largest asset. Having data that shows how San Francisco parks contribute to rather than burden the local economy can help city planners, business leaders, and policymakers recognize and better manage the role the parks play.

Two factors provide San Francisco with direct income to the city's treasury. The first is increased property and transfer tax from the increase in assessed and sales value of residences that are close to parks. This came to nearly \$25 million. The second consists of sales tax receipts from tourism spending by out-of-towners who came to San Francisco primarily because of its parks. This value came to nearly \$47 million for the city of San Francisco.

Beyond increased tax money, these same factors also bolstered the collective wealth of San Franciscans—by more than \$122 million in total property value and by more than \$431 million in net income from tourist spending.

Two factors provided San Francisco residents with direct savings. The larger by far stems from San Franciscans using the city's public parks, recreation centers, trails, and facilities instead of purchasing these items in the private marketplace. This value came to nearly \$212 million. Second

¹ The study does not include every potential value aspect of a park system. 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.

is the health benefit—savings in medical costs—from getting physical activity in the parks. This came to more than \$49 million.

The last three factors also provided savings, but to city government rather than to individuals. The first is water pollution reduction—the fact that the trees and soil of San Francisco’s parks retain rainfall and cut the cost of treating stormwater. This value came to just over \$1.9 million. The second concerns air pollution—the fact that park trees and shrubs absorb a variety of air pollutants. This value came to \$3.1 million. 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 exactly, helps ward off all kinds of antisocial problems that would otherwise cost the city more in police, fire, prison, counseling, and rehabilitation costs. We estimate this value at over \$66 million.

The park system of San Francisco thus has provided the city annual revenue of \$72 million, municipal cost savings of \$72 million, resident savings of \$261 million, and a collective increase of resident wealth of \$554 million. Although economists generally do not mix revenues with savings or combine public and private financial benefits, the total dollar amount of San Francisco parks’ economic value comes to an impressive \$959 million a year.

Estimated annual value of the San Francisco park and recreation system

Revenue producing factors for city government	
Tax receipts from increased property value	\$24,674,897
Tax receipts from increased tourism value	\$46,909,727
Estimated total, municipal revenue-producing factors	\$71,584,624
Cost-saving factors for city government	
Stormwater management value	\$1,916,937
Air pollution mitigation value	\$3,117,747
Community cohesion value	\$66,567,569
Estimated total, municipal cost-saving factors	\$71,602,253
Cost-saving factors to citizens	
Direct use value	\$211,904,399
Health value	\$49,221,673
Estimated total, citizen cost-saving factors	\$261,126,072
Wealth-increasing factors to citizens	
Additional property sales value from park proximity	\$122,522,833
Profit from park-related tourism	\$431,083,800
Estimated total, wealth-increasing factors	\$553,606,633

Calculations are based on data from the Center for City Park Excellence, The Trust for Public Land, April 2014.

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 may 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 stadiums, convention centers, and museums has been promoted widely. Based on a two-day colloquium of park experts and economists held in Philadelphia in October 2003 (see Appendix II), the Center for City Park Excellence believes there are seven attributes of a city's park system that are measurable and provide economic benefits to the city. (For a listing of studies done on these issues by participants in the colloquium, as well as other studies, 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 www.tpl.org/SanFranciscoParkValue.



Alamo Square Park. Parks enhance property values around their edges, which results in additional tax revenue.

Hedonic (property) value

Numerous studies have consistently shown that parks and open space have a positive impact on nearby residential property values. The evidence reveals 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 a view of a park can be worth extra value for some.

Property value near parks is affected primarily by two factors: distance and quality. 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 that are perceived as dangerous or frightening 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 San Francisco. (We defined “significant” as parks of one-half acre or more that are publicly owned within the city limits, excluding water areas outside the city’s land boundary.) According to the U.S. Census, as of 2010, there are about 377,942 residential properties in the city. (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.)

After reviewing available data and discussing methods of analyzing it with resource economists, we determined that there is no straightforward 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 San Francisco is \$2 billion. We then applied the park-effect coefficient in two ways—to determine additional property tax income to the city in 2013 and to determine additional personal income to those homeowners who sold their dwellings in 2013.

Using data provided by the San Francisco Office of the Assessor-Recorder, we calculated that approximately \$473 million in property and transfer taxes was collected from properties within 500 feet of parks. Since 5 percent of this was due to parks, the increment came to more than \$24 million. We also determined that based on 2013 sales data for city residences from the U.S. Department of Housing and Urban Development (HUD) and an estimate of sales for park-proximate properties, the proximate park value realized at the time of sale was more than \$122 million.

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

Table 1. Economic benefits of parks to residential property values, San Francisco

Market value of properties within 500 feet of parks	\$40,410,965,916
Market value attributable to parks (5%)	\$2,020,548,296
Property tax revenue from properties within 500 feet of parks	\$472,444,603
Property tax revenue attributable to parks (5%)	\$23,622,230
Transfer tax revenue from properties sold in 2013 within 500 feet of parks	\$21,053,337
Transfer tax revenue attributable to parks (5%)	\$1,052,667
Value of properties sold in 2013 within 500 feet of parks	\$2,450,056,662
Value of properties sold attributable to parks (5%)	\$122,502,833

Calculations are based on data provided by the San Francisco Office of the Assessor-Recorder and the U.S. Department of Housing and Urban Development.

Tourism value

San Francisco's place as a city on the sea with spectacular views from its hills and waterfront, combined with its cultural offerings, nightlife, and heritage, make it popular to visit. A significant portion of the city's tourism can be attributed to its park system, visitors either coming to see specific parks or taking part in park-based events.² The evidence can be found in travel writing alone. For instance, noting San Francisco's great outdoor opportunities, Fodor's lists Golden Gate Park among the city's top attractions and of course also spotlights Alcatraz, now a national park. The New York Times' "36 Hours" column describes Crissy Field as "San Francisco's de facto outdoor gym" and recommends that golfers try the course on the western end of Golden Gate Park. Wikitravel's contributors tout Twin Peaks for its views and Mission Dolores Park for its playground and people watching. When it comes to large outdoor events, people naturally flock to parks to attend the following: the annual San Francisco Pride Festival at Civic Center Plaza, the Hardly Strictly Bluegrass Festival, the Yerba Buena Gardens Festival, the Biodiversity Festival in Golden Gate Park, the Escape from Alcatraz Triathlon, the Northern California Cherry Blossom Festival at Japantown Peace Plaza, and many others.

Determining the contribution of parks to the tourism economy requires knowledge of tourist activities, the number of visits, and the level of spending. In San Francisco, while attendance at some events is known, there is no comprehensive survey regarding tourism due primarily to parks. Nevertheless, the San Francisco convention and visitors bureau known as San Francisco Travel does have data on visits to the city, the level of spending, and a limited variety of reasons for the trip. This data, supplemented by interviews with local tourism experts, enabled us to estimate the economic value of park visitation by tourists.

We estimated that approximately 15 percent of tourists visit San Francisco primarily because of the city's parks. This is a broad group that includes, for instance, a suburban day visitor to the San Francisco Maritime National Historic Park, an overnight traveler to the Outside Lands Music and Arts Festival in Golden Gate Park, and a family traveling to visit Alcatraz.



FLICKR/JIM BAHN

Hardly Strictly Bluegrass Festival in Golden Gate Park. Parks contribute to San Francisco's tourism economy—both as event venues and as attractions in their own right.

² By definition, local users are not tourists—any spending they do at or near the park is money not spent locally somewhere else, such as in their immediate neighborhood.

The level of tourist spending ranges considerably, from the high level of overnight hotel guests to the mid-level of overnighers staying with family and friends, to the lower level of day visitors who may only eat lunch or a snack and make fewer other purchases. We thus calculated that park-based tourists who stayed overnight in hotels spent \$723 million, those who stayed with family and friends spent \$117 million, and those who came for the day spent \$392 million in 2010. We then factored the sales tax rate for the city of San Francisco—2 percent for food and other purchases and 15 percent for hotel rooms. The resulting tax revenue gain to the city came to \$47 million in 2010.

In addition, since economists consider about 35 percent of every tourist dollar to be profit (the rest of the income being pass-through to pay for expenses), the San Francisco citizenry's collective increase in wealth from park-based tourism was just over \$431 million.

Table 2. Tourist spending by visitors to parks, San Francisco

Overnight visitors in hotels	
Spending of overnight visitors staying in hotels	\$4,819,293,000
Spending of overnight visitors whose primary reason to visit is parks (15 percent)	\$722,893,950
Overnight visitors staying with family and friends	
Spending of overnight visitors staying with family and friends	\$780,572,000
Spending of overnight visitors whose primary reason to visit is parks (15 percent)	\$117,085,800
Day visitors	
Spending of day visitors	\$2,611,255,000
Spending of day visitors whose primary reason to visit is parks (15 percent)	\$391,688,250
Total spending of all park visitors	\$1,231,688,000
Tax receipts	
Hotel tax collection by the city	\$243,000,000
Hotel tax collected by the city from park visitors (15%)	\$36,450,000
Sales tax collected for the city	\$69,731,514
Sales tax collected for the city from park visitors (15%)	\$10,459,727
Total hotel and sales tax receipts from park-related tourism	\$46,909,727
Profits to citizenry	
Collective profit to the citizens of San Francisco from park visitors who came because of parks (35 percent of total spending)	\$431,083,800

Calculations are based on data from reports published by the San Francisco Travel Association: *San Francisco Visitor Study*; *2010 Segmentation Profiles*; *San Francisco Visitor Profile Research Final Report 2011*; and *San Francisco Visitor Industry Economic Impact Estimates, 2012*.

Direct use value

Just as important as their indirect value for property and tourism, San Francisco parks provide huge direct benefit to residents: scores of playgrounds, nature trails in Golden Gate Park, basketball and tennis courts in Mission Creek Park, gyms in numerous community centers, Lincoln Park Golf Course, over two dozen dog parks, and much more. Economists call activities on these facilities “direct uses.”

Even though most direct uses in San Francisco parks are free of charge, economists can calculate their value by determining the consumer’s “willingness to pay” for the recreation experience in the private marketplace. In other words, if San Francisco’s park system were not available, 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 data for quantifying the benefits received by direct users stems from a detailed, professionally conducted, random-digit-dialed telephone survey on park use of 620 San Francisco residents. To accommodate San Francisco’s linguistically diverse population, the November 2013 survey was conducted in English, Spanish, Mandarin, and Cantonese.

The model used is based on 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 playing golf, using a weight room, or playing league sports, 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 sixth time in a week is less than the first), we incorporated diminishing returns for multiple uses within a week. For example, playground value diminishes from \$3.50 for the first time to \$2.25 for the sixth time in a week. We also estimated a seasonal length for different park uses to take into account reduced participation at certain times of the year. San Francisco’s mild climate allows participation in most activities year round.

The phone survey, which represents the population of San Francisco with an accuracy level of plus-or-minus 3 percent, revealed residents’ park activities and the number of times each activity was engaged in. 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.³ We made two modifications to the initial results. In order for the methodology to correspond to the requirements of the “Unit Day Value” protocol, we took into account those people who did more than one activity in the park on a given day. We also used a factor to correct for the known tendency of respondents to over-report desirable behavior, such as going to a park. The study of the use of parks, including type of physical activity and the duration of activity can be collected

3 The survey covered only San Francisco residents; the value from nonresident users is captured under tourism.

either through observational methods or self-reported methods. This analysis uses the self-reported method. The validity and reliability of this method has been tested in prior work, including a study by Evenson et al. (2012). The authors found that in five cities across the country the average number of park visits per week was 1.8 as measured by GPS. To control for over reporting in our analysis, the self-reported visits are weighted to reflect this five city average.

The result of the Direct Use Calculator was \$211,904,399 for 2013.

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 each had to be purchased, but San Francisco residents are unquestionably 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. Economic value of direct use of parks, San Francisco

FACILITY/ACTIVITY	PERSON-VISITS	AVERAGE VALUE PER VISIT	VALUE
General park use (playgrounds, trails, dog walking, picnicking, sitting, etc.)	52,876,548	\$1.92	\$101,657,864
Sports facilities uses (tennis, team sports, bicycling, running, etc.)	18,862,433	\$5.02	\$94,695,216
Special uses (fishing, kayaking, gardening, festivals, concerts, attractions, etc.)	3,631,015	\$4.28	\$15,551,319
Total			\$211,904,399

Calculations are based on a telephone survey conducted by The Trust for Public Land, November 2013.

Health value

There is increasing evidence from experts that obesity and physical inactivity have become a major public health problem that has expensive economic consequences. A report released in August 2009 by the U.S. Centers for Disease Control and Prevention (CDC) estimated that \$147 billion in added costs could be attributed to obesity the previous year. Experts have called for a more active lifestyle, and research suggests that nearby parks, programming at playgrounds, and a walkable urban landscape can help people increase their level of physical activity. From the Portola Trail to the tennis courts in Miraloma Park to the youth sports league, San Francisco's parks and programs help city residents become and stay healthier.

The Health Benefits Calculator measures the collective economic savings that San Francisco residents realized by their active use of parks. The key data input for determining medical cost savings is the number of people exercising in the park, using the CDC's definitions of exercise. The CDC defines and categorizes exercise according to the type of activity and the frequency and number of minutes (150 minutes per week for moderate-intensity activities and 75 minutes per week for vigorous-intensity activities) engaged in by the individual.

The same telephone survey that collected the direct use data (see page 11) also determined residents' physical activities and their frequency. (We modified the frequency of activity based on a 2012 study in New York City, which showed that the average amount of activity as measured with an accelerometer was 38 percent of the average amount that was self-reported.) The survey also



FLICKR/ANDREW BALLANTYNE

Golden Gate Park. Parks reduce healthcare costs by providing a place to exercise.

identified respondents by age because seniors typically incur two or more times the medical care costs of younger adults. In order to modify the results to serve the health benefits study, low-heart-rate uses such as picnicking, sitting, strolling, and birdwatching were not included in our calculation of health care cost savings.

Based on the results of studies from seven different states, and using the U.S. Bureau of Labor Statistics Consumer Price Index Detailed Reports for medical costs to adjust for inflation, we assigned a value of \$322 as the medical savings for those who exercise regularly. For persons over the age of 65, that value has been doubled to \$644. (The calculator incorporates a multiplier of 0.95 to reflect the fact that San Francisco's medical care costs are lower than those of the United States as a whole.)

In San Francisco, we estimated that 140,640 residents—128,472 younger than 65 and 12,168 older than 65—engaged actively enough in parks to cut their health costs. The combined health savings due to park use for 2014 was \$49,221,673.

Table 4. Health care cost benefits of parks, San Francisco

Adults younger than 65 years of age	
Average annual medical care cost difference between active and inactive persons	\$322
Physically active in parks*	128,472
Subtotal of health care benefits	\$41,382,714
Adults 65 years of age and older	
Average annual medical care cost difference between active and inactive persons over 65 years of age	\$644
Physically active in parks*	12,168
Subtotal of health care benefits	\$7,838,959
Total annual value of health benefits from parks	\$49,221,673

*Calculations are based on a telephone survey conducted by The Trust for Public Land of residents engaging in moderate or vigorous activity as defined by the U.S. Centers for Disease Control and Prevention.

Community cohesion value

Along with schools, churches, and other social gathering spaces, parks are key sources of community. Studies show that the institutions and places that make up this web of human relationships can make a neighborhood stronger, safer, and more successful. This network, for which 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. The acts of improving, renewing, or even saving a park can build extraordinary levels of social capital in a neighborhood that may be suffering from fear and alienation partially owing to the lack of safe public spaces. Groups such as the San Francisco Parks Alliance and the many groups under its umbrella, from Friends of Jefferson Square Park to community garden groups, to the Golden Gate National Parks Conservancy, 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. San Francisco 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 park organizations, nonprofits, and foundations in 2013, the most recent year available. 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 California in 2013—\$26.34—by the Washington, D.C.-based organization Independent Sector.

The result of the Social Capital Calculator for the city of San Francisco—financial contributions plus the dollar value of people’s time—was \$66,567,569.

Table 5. Community cohesion calculator, San Francisco

Dollars donated		\$54,915,570
Hours of time donated (51 organizations)	442,369	
Value of a volunteer hour, 2011	\$26.34	
Value of hours donated		\$11,651,999
Total		\$66,567,569

Calculations are based on data from Independent Sector and volunteer data provided by 51 San Francisco park organizations.

Stormwater retention value

Stormwater runoff is a significant problem in cities. When rain flows off roads, sidewalks, and other impervious surfaces, it carries pollutants with it, causing significant ecological problems.

The parks of San Francisco, from the Presidio in the north to McLaren in the south, reduce stormwater management costs by capturing precipitation and/or slowing its runoff. Large permeable surface areas allow precipitation to infiltrate and recharge the groundwater. Also, vegetation provides 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.

Our calculation methodology compares actual runoff with parks against the theoretical runoff that would occur if there were no parks. To determine the water retention value of San Francisco's parks, we compared the perviousness of the entire park system with the perviousness of the more built-up surrounding city as a whole. The parks are largely pervious, of course, although they also contain impervious roadways, asphalt trails, parking areas, buildings, and hard courts.

Next, we analyzed the same data for the amount of perviousness of the rest of San Francisco—in other words, the city without its parkland. The pervious land consists largely of residential front and backyards and 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.



FLICKR/SIMON GIBSON

Golden Gate Park Botanical Garden. Parks filter and absorb stormwater otherwise bound for the city's gutters and sewer system.

Third, we plugged in the amount and characteristics of rainfall for the city. (San Francisco receives just under 23 inches of precipitation per year, largely in the form of fall-winter-spring drizzle.)

The Western Research Station of the U.S. Forest Service in Davis, California, has developed a sophisticated model to estimate the value of retained stormwater runoff due to vegetation. Inputs to the model consist of geographic location, climate region, surface permeability index, park size, land cover percentages, and types of vegetation. Using that, we compared the modeled runoff with the hypothetical runoff that would leave the same acreage developed at the average density of San Francisco (i.e., with streets, rooftops, parking lots, etc.). In other words, how much more water would flow off the land if San Francisco had no parks? This number comes to 181,904,012 cubic feet of water per year.

The final step is to include in the calculations what it costs to manage stormwater using “hard” infrastructure (e.g., concrete pipes, sewers, large holding tanks, and the like). In San Francisco the cost for stormwater management is \$0.0142 per cubic foot.⁴

Thus, by knowing the stormwater retained by the parks and what the cost of treating that water would have been, we obtained a total annual stormwater retention value of \$1,916,937 for the park system of San Francisco.⁵

Table 6. Stormwater cost savings due to parks, San Francisco

TYPICAL YEAR	INCHES	CUBIC FEET
Rainfall	22.28	444,820,202
Runoff from parkland		47,022,409
Runoff from same acreage if there were no parks (theoretical)		181,904,012
Runoff reduction due to parks		134,881,603
Cost of treating stormwater (per cubic foot)		\$0.0142
Total savings due to park runoff reduction		\$1,916,937

The cost of treating stormwater was provided by the San Francisco Public Utilities Commission.

4 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.

Air pollution removal value

Air pollution in cities can harm health and damage structures, creating both environmental and economic problems. Human cardiovascular and respiratory systems can be affected with broad consequences for health costs and productivity—something seen in the many urban-dwelling children with asthma. In addition, acid deposition, smog, and ozone increase the need to clean, repair, or repaint buildings, bridges, and other costly infrastructure.

The leaves of trees and shrubs absorb gases, and particulates adhere to the plant surface. With its temperate, relatively dry Mediterranean climate, vegetation is not as abundant in San Francisco as it is in places such as Seattle. Yet, given the high population density of the city, the environmental contribution of trees and shrubs in the parks is significant in removing pollutants that would otherwise diminish the health of San Francisco's residents.

The Northeast Research Station of the U.S. Forest Service in Syracuse, New York, has designed a calculator to estimate air pollution removal by urban vegetation. This program, which is based on the Forest Service's earlier Urban Forest Effects (UFORE) model, is location specific, taking into account the air characteristics of San Francisco. (Cities generate dissimilar results based not only on numbers of trees but also on differences in ambient air quality.)

Using aerial photography and computerized mapping, we obtained land cover information for all of San Francisco's parks. (San Francisco has numerous trees on private property as well as on streets, but this study counts only the value of park trees.) We calculated that 31.5% percent of the city's 5,500 acres of parks—1,733 acres—are tree covered.

We then 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 deposition. (The calculator uses 2010 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 pollutant removal.

The result of the Air Quality Calculator for the park system of San Francisco in 2013 was an economic savings of \$3,117,747.

Table 7. Role of parks in cutting air pollution costs, San Francisco

	TONS REMOVED	POLLUTANT REMOVAL VALUE
Carbon dioxide	2,246	\$1,497
Nitrogen dioxide	20,283	\$24,109
Ozone	74,854	\$926,634
Particulate matter	29,357	\$2,163,466
Sulfur dioxide	3,957	\$2,040
Total		\$3,117,747

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 San Francisco 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.

San Francisco would not be what it is without its electrifying offerings of parks and trails. From Telegraph Hill to the Julius Kahn Playground to Stern Grove to the Sutro Baths to Alamo Square and the development-enhancing power of the Mission Creek sports courts, San Francisco provides outstanding value to residents and visitors alike—and the city reaps the 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 have "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 a good place to live.

This study has shown local benefits from San Francisco'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—will 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 San Francisco.

Appendix I. Acknowledgments

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Appendix II. Colloquium attendees

The following individuals took part in the colloquium “How Much Value Does a Park System Bring to a City” in Philadelphia in October 2003:

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Nancy Kafka, The Trust for Public Land, Boston, MA
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