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Natural Resource Stewardship and Science

Terrestrial Carbon Sequestration in National Parks

Values for the Conterminous United States

Natural Resource Report NPS/NRSS/EQD/NRR—2014/880

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Great Smoky Mountains National Park. Photograph courtesy of Robert Crootof, NPS Photo.

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Leslie Richardson[1], Christopher Huber[1], Zhiliang Zhu[2], and Lynne Koontz[3]

[1]Fort Collins Science Center
U.S. Geological Survey
Fort Collins, Colorado

[2]USGS National Center
U.S. Geological Survey
Reston, Virginia

[3]Environmental Quality Division
National Park Service
Fort Collins, Colorado

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NPS 999/127137, November 2014

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Executive Summary

Lands managed by the National Park Service (NPS) provide a wide range of beneficial services to the American public. This study quantifies the ecosystem service value of carbon sequestration in terrestrial ecosystems within NPS units in the conterminous United States for which data were available. Combining annual net carbon balance data with spatially explicit NPS land unit boundaries and social cost of carbon estimates, this study calculates the net metric tons of carbon dioxide sequestered annually by park unit under baseline conditions, as well as the associated economic value to society. Results show that, in aggregate, NPS lands in the conterminous United States are a net carbon sink, sequestering more than 14.8 million metric tons of carbon dioxide annually. The associated societal value of this service is estimated at approximately $582.5 million per year. While this analysis provides a broad overview of the annual value of carbon sequestration on NPS lands averaged over a five year baseline period, it should be noted that carbon fluxes fluctuate from year to year, and there can be considerable variation in net carbon balance and its associated value within a given park unit. Future research could look in-depth at the spatial heterogeneity of carbon flux within specific NPS land units.

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Introduction

Lands managed by the National Park Service (NPS) provide a wide range of economic and social benefits. These lands serve as unique recreational and tourist destinations, generating considerable economic activity within park gateway communities (Cullinane Thomas et al., 2014). In addition to this direct use, ecosystems protected by NPS lands support a number of beneficial services depended on by the broader American public, such as water purification, habitat for endangered species, and nutrient cycling. Assessing the economic value derived from these "ecosystem services" contributes to an understanding of the role that NPS plays as a steward of our Nation's natural capital and the broad contribution these lands make to societal well-being. Recent guidance from a report put forward by the President's Council of Advisors on Science and Technology highlights the importance for Federal agencies to incorporate this type of information into planning and management decisions (PCAST, 2011).

In a collaborative effort between the NPS and the U.S. Geological Survey (USGS), this study quantifies the economic value of one specific ecosystem service provided by NPS lands – the benefits of climate regulation resulting from terrestrial carbon sequestration. While some land units within the National Park System are carbon sources, meaning they release more carbon dioxide (CO_2) into the atmosphere than they absorb and store in vegetation and soils, many are carbon sinks, sequestering more CO_2 than they emit. For any given land unit, the carbon balance depends on various factors, including land cover type (e.g., barren compared to forested), soil type, land uses, wildfire and other disturbances, and hydrologic and climatic conditions. The remainder of this report summarizes the net CO_2 flux within NPS units where data were available, and calculates the associated economic value of this service to society.

Methods and Data Sources

Valuing Ecosystem Services

Monetizing the economic value of an ecosystem service first requires connecting an ecological function to a clearly defined end product that is valued by people (National Research Council, 2004). NPS lands comprise various ecosystems (e.g., forests, grasslands) that often sequester more CO_2 in their soil and vegetation than they release into the atmosphere. This ecological process leads to climate regulation, an ecosystem service that contributes to many aspects of human well-being (Millennium Ecosystem Assessment, 2005). Tying an appropriate measure of economic value to the quantity of CO_2 sequestered at a given point in time on a given land unit reveals the societal benefits provided by this process. Therefore, two key pieces of information are required to quantify the value of carbon sequestration on NPS lands: 1) The annual rate of carbon storage within each park unit (net carbon balance) and 2) The economic value associated with the net carbon balance. The data sources used in this analysis are described below.

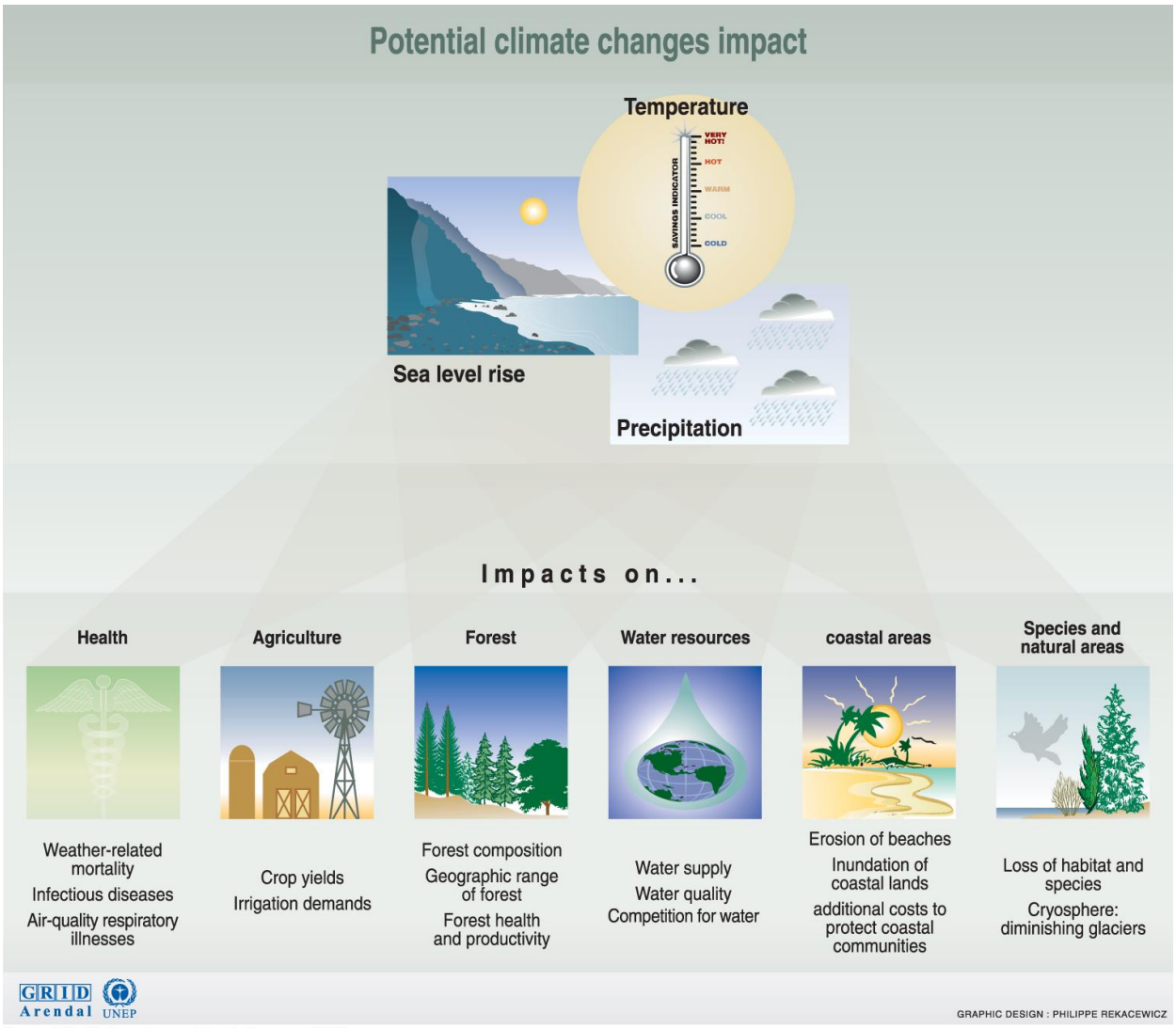
Quantifying Net Carbon Balance on NPS Lands

The USGS has conducted a national carbon sequestration assessment as required by Congress under the Energy Independence and Security Act (EISA) of 2007. The main objectives of this assessment are to estimate the amount of carbon stored in ecosystems, the capacity of the ecosystems to sequester carbon, and the effects of natural and anthropogenic processes that control ecosystem carbon balances. The USGS has completed this assessment for the conterminous United States (see Zhu et al., 2011; Zhu and Reed, 2012; Zhu and Reed, 2014) and is nearing completion for Alaska and Hawaii. This research uses a combination of models, statistical methods, remote sensing data, and field input data to estimate carbon stock (how much carbon is stored for a given land unit), net carbon balance (either sink or source as the rate of annual change in carbon stock), and various emissions, such as that of wildfires. The methodology framework and constraints are described in detail in Zhu et al. (2010). The majority of the data produced in the USGS national carbon assessment are presented as digital maps (250 meter spatial resolution) derived over a baseline (2001-2005) and projected (through 2050) time dimension for major terrestrial ecosystems, such as forests, agricultural lands, wetlands, and grasslands.

To better understand the value of carbon sequestration on lands managed by the NPS, this effort utilizes the above-discussed baseline data on modeled annual net carbon balance produced in the USGS carbon sequestration assessment for the conterminous United States. By overlaying a spatial map of net ecosystem carbon balance averaged over the five year baseline period (2001-2005) with a spatial map of NPS land unit boundaries, we are able to estimate the average annual net carbon balance on 293 land units within the National Park System. It should be noted that net carbon balance can vary in both magnitude and sign over time (positive or negative). Data were not available for land units that include primarily human-made features, such as the Lincoln Memorial or the Vietnam Veterans Memorial, or those outside of the conterminous United States, such as the National Park of American Samoa or Hawai'i Volcanoes National Park. Annual net carbon balance is multiplied by 3.667 to convert to metric tons of carbon dioxide (CO_2) per year.

Applying the Social Cost of Carbon

Over time, the accumulation of CO_2 and other greenhouse gases in the atmosphere can affect sea level, temperature, and precipitation (IPCC, 2013). These climate changing effects can impact society in numerous ways (Figure 1). NPS lands play an important role in mitigating climate change impacts by protecting healthy ecosystems that function as a carbon sink. This net carbon uptake benefits society by helping to reduce overall atmospheric concentrations of CO_2 and the associated economic damages. Understanding the economic benefit of these avoided impacts contributes to a more comprehensive understanding of the overall value of NPS lands.



Source: United States environmental protection agency (EPA).

Figure 1. The potential impacts of climate change.

Atmospheric CO_2 concentrations from current emissions will persist far into the future (IPCC, 2013), meaning the release of one metric ton of CO_2 has damaging effects to society that extend through time. Individuals often place a higher value on avoided damages that occur closer to the present than impacts that occur further into the future. Therefore, the economic value of cumulative damages that occur in future years must be discounted to obtain their present value. The economic value associated with a metric ton of CO_2 released into the atmosphere is reflected by the "social cost of carbon" (SCC) estimates published by a U.S. government interagency working group (Interagency Working Group on Social Cost of Carbon, 2013). Based on three integrated assessment models (IAMs), the SCC estimates capture future changes in the value of agricultural productivity, human health, damages from increased flooding, and the value of certain ecosystem services due to climate change. The interagency group selected four SCC

estimates recommended for use in regulatory analyses; three of these estimates are based on the average SCC from the three IAMs, at discount rates of 2.5%, 3% and 5%, while the fourth represents the 95th percentile SCC estimate across the three IAMs at a 3% discount rate, and is included to represent higher than anticipated damages from climate change further out in the tails of the SCC distribution (Interagency Working Group on Social Cost of Carbon, 2013). The interagency group recommends including all four estimates in regulatory impact analyses.

In this study, we apply SCC estimates per one metric ton of carbon dioxide emitted in the year 2013, and inflate these values to 2013 dollars using the Consumer Price Index, as they were originally reported in 2007 dollars. This results in a SCC average value of $39.32 per metric ton of CO_2 based on the central 3% discount rate. To demonstrate sensitivity to the discount rate, the majority of the results are also presented using average SCC estimates of $61.79 and $12.36 per metric ton of CO_2, based on discount rates of 2.5% and 5%, respectively. The fourth 95th percentile SCC estimate of $113.47 (3% discount rate) is also included in this analysis, and reflects higher than anticipated damages from climate change. It should be noted that the SCC estimates do not reflect all potential damages from climate change, and may be viewed as a lower bound of the full benefits associated with reduced CO_2 emissions (Howard, 2014). See Appendix 1 for more information on the SCC estimates used in this analysis.

Results

Based on available data, results of this analysis demonstrate that collectively, NPS lands in the conterminous United States are a net carbon sink. As a whole, approximately 14.8 million metric tons of CO_2 are sequestered annually on average under baseline conditions, and this has an associated value of approximately $582.5 million based on a 3% discount rate in 2013. Results by park unit are presented in Table A in Appendix 2. Of the 293 park units with available data, 78% were found to function as net carbon sinks on average over the five year baseline period. These lands sequester more than 15.7 million metric tons of CO_2 annually, valued at $618.6 million with a 3% discount rate. Alternatively, the remaining 22% of land units that function as carbon sources were found to emit 918.2 thousand metric tons of CO_2 annually, at a cost to society of $36.1 million.

Figure 2 highlights the twenty park units within the conterminous United States that were estimated to have the largest societal value associated with carbon sequestration. Great Smoky Mountains National Park was found to sequester the largest amount of CO_2, valued at nearly $64.4 million in 2013 with a 3% discount rate. At first glance, it may be surprising that park units composed largely of a desert environment, such as Mojave National Preserve and Death Valley National Park, ranked among the top twenty park units in terms of carbon sequestration value during the baseline period. However, recent studies provide evidence to suggest that desert

ecosystems have the ability to store much more carbon dioxide than previously thought (Evans et al., 2014; Wohlfahrt et al., 2008). In addition, the results in Figure 2 are influenced by the total size of the park unit. Table B in Appendix 2 presents a normalized, per hectare net quantity of CO_2 stored or released by park unit. In general, these results show that park units with a predominantly desert environment have relatively low sequestration per hectare compared to some of the more forested parks.

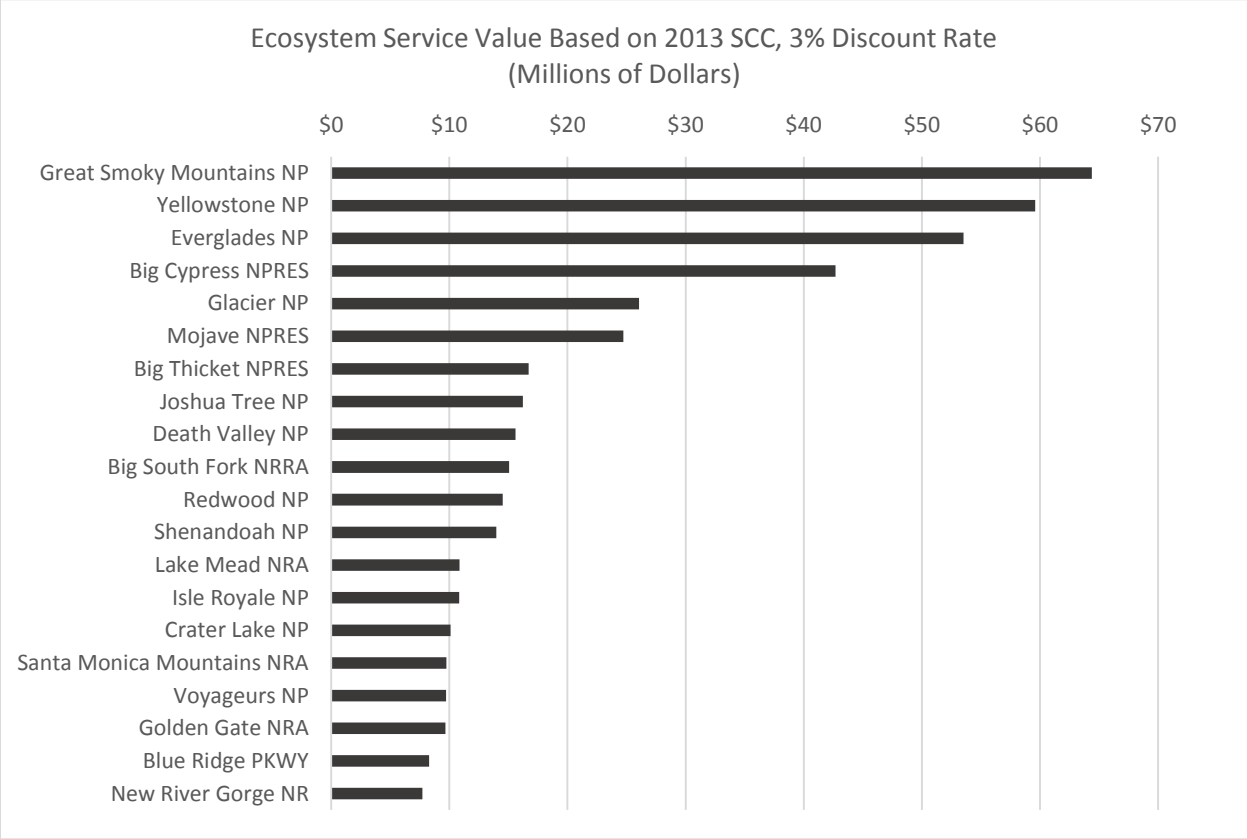


Figure 2. Top 20 NPS Units by Carbon Sequestration Value.

Park units such as Mount Rainier National Park and North Cascades National Park were found to be net carbon sources (Table A in Appendix 2), which could be due to factors such as major wildfires, insect outbreaks, and permanent ice and snow occurring during the years of the assessment data. These results are consistent with previous research which has shown that certain regions of the United States tend to function as carbon sinks, whereas others tend to function as carbon sources. For instance, Potter et al. (2007) found that terrestrial ecosystems in the southern Appalachian Mountains, the western Gulf Coast states, the northern Rocky Mountains, and the Sierra Nevada Mountains show consistently high carbon sink fluxes on an annual basis, whereas terrestrial ecosystems in regions such as the Pacific Northwest consistently show periodically high carbon source fluxes on an annual basis. While the estimates presented in Figure 2 and

Table A in Appendix 2 reflect an aggregation across an entire NPS unit, considerable variability in net carbon balance within a given unit likely exists. In addition, the analysis is constrained to five years of baseline data. If conditions change over time—for example, if a given park unit experiences less wildfires than usual and the vegetation there begins to recover—that park unit could potentially transition from a net source to a net sink.

Table 1 shows the quantity of CO_2 uptake and the associated carbon sequestration value for all park units within each NPS region. Collectively, NPS units within the Southeast region were found to sequester the largest amount of CO_2, with more than 5.3 million metric tons of CO_2 sequestered annually under baseline conditions and an associated value of $210.2 million with a 3% discount rate in 2013. Data were not available for park units outside of the conterminous United States, such as those in Alaska and Hawaii.

Table 1. Average Annual Net Ecosystem Balance (metric tons of CO_2) and Associated Net Economic Value, Summarized by NPS Region.

Region	Annual Metric Tons of CO_2	Value by Discount Rate ($ Millions)			
		2.5%	3%	5%	3% (95th)*
Intermountain	3,482,323	$215.2	$136.9	$43.0	$395.1
Midwest	1,527,841	$94.4	$60.1	$18.9	$173.4
National Capital	87,509	$5.4	$3.4	$1.1	$9.9
Northeast	1,139,938	$70.4	$44.8	$14.1	$129.3
Pacific West	3,230,205	$199.6	$127.0	$39.9	$366.5
Southeast	5,345,302	$330.3	$210.2	$66.1	$606.5
Total	**14,813,118**	**$915.3**	**$582.5**	**$183.1**	**$1,680.8**

*The 3% (95^{th}) value accounts for higher than anticipated damages from climate change.

Conclusions

Lands within the National Park System play an important role in reducing climate related damages by sequestering CO_2. This report summarizes the baseline net carbon balance and associated 2013 societal value supported by NPS lands in the conterminous United States for which data were available. Comparable data on net carbon balance for land units outside of the conterminous United States, such as those in Alaska and Hawaii, were not available at the time of this analysis, but will be available in the future. The results of this study demonstrate that, as a whole, NPS lands within the conterminous United States serve as a large net sink of CO_2, sequestering 14.8 million metric tons of CO_2 in terrestrial ecosystems in a single year, which is estimated to be valued at $582.5 million with a 3% discount rate. In the absence of NPS

designation, some of this value would likely still be realized, but it is not possible to assess the alternative land use scenario and carbon sequestration potential of these lands with any certainty. While this analysis has provided a broad overview of the value of carbon sequestration on NPS lands under current conditions, it should be noted that net carbon balance can fluctuate from year to year, and there can be considerable variation in this metric within a given park unit. Future research could look in-depth at the spatial heterogeneity of carbon flux within specific NPS land units, but would require significant research investment.

The USGS national carbon sequestration assessment was used in this effort to demonstrate the annual ecosystem service value of carbon sequestration on NPS lands under current conditions. The USGS assessment also projects net carbon balances through the year 2050, based on numerous greenhouse-gas-emissions scenarios documented in a report published by the Intergovernmental Panel on Climate Change (Nakicenovic et al., 2000). While these projections are associated with greater uncertainty than baseline conditions, they could be used to conduct a similar analysis of the forecasted ecosystem service value of carbon sequestration on NPS lands. The USGS national assessment is best used to answer broad-scale questions, such as how much carbon is stored in different ecosystems across the entire United States, or how much does the carbon storage change over space and time. However, management actions have the potential to greatly impact the amount of CO_2 released or sequestered on the nation's public lands (Olander et al., 2012). For example, restoration activities focused on returning the water flows of the central Everglades to a more natural state is expected to greatly increase the ecosystem service value of carbon sequestration in Everglades National Park (Richardson et al., 2014). The USGS is conducting more targeted studies in support of land management planning by the Department of the Interior. These studies focus on evaluation of carbon sequestration potential and the effect of land management practices at a management-unit scale. For example, the USGS, in cooperation with the University of Maryland and Yellowstone National Park, is supporting a study that examines differences in land management and the associated impact on carbon stored in ecosystems within the Greater Yellowstone Ecosystem. This type of information could be used to evaluate the effect on societal well-being from changes in park management and carbon sequestration potential.

While this effort has focused on the value of carbon sequestration on NPS lands, these lands provide a wide range of additional ecosystem services that provide considerable value to the American public. There is ample opportunity for future research to continue to explore the value of ecosystem services provided by lands within the National Park System.

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Appendix 1

The social cost of carbon (SCC) estimates used in this analysis reflect the damages caused by the climate changing effects over the lifecycle of one metric ton of CO_2 emitted into the earth's atmosphere, and were designed to be used in regulatory analyses to analyze the benefits of projects that reduce CO_2 emissions (Interagency Working Group on Social Cost of Carbon, 2013). The SCC estimates are based on three complex integrated assessment models, which were parameterized using projected future socioeconomic conditions as well as expected atmospheric accumulations of CO_2. These predicted damages over the lifecycle of an additional ton of CO_2 include, but are not limited to, the change in value of net agricultural productivity, human health, damages from increased flooding, and the value of certain ecosystem services. These SCC estimates do have limitations, particularly with respect to incomplete treatment of both non-catastrophic and catastrophic damages from climate change (Interagency Working Group on Social Cost of Carbon, 2010), and the omission of other potential climate impacts and effects (Howard, 2014). Thus, the SCC may be viewed as a lower bound estimate of the full benefits associated with reduced CO_2 emissions.

The SCC published by the working group represents the societal damages caused by the climate changing effects of emitting an additional metric ton of CO_2 into the earth's atmosphere. Conversely, as is the case with many of the NPS units in this study, the SCC estimates represent the societal benefits realized from an additional metric ton of CO_2 removed from the atmosphere. It is important to highlight the fact that these SCC estimates are time and discount rate specific. For example, a metric ton of CO_2 emitted in 2013 has a different SCC value compared to a metric ton of CO_2 emitted in 2014. Additionally, a metric ton of CO_2 emitted in 2013 will have a different SCC estimate depending on whether a 3% or 5% discount rate is used.

This analysis is based on SCC estimates specific for the year 2013. Inflating these estimates to 2013 dollars from 2007 dollars using the Consumer Price Index results in a SCC of $39.32 per metric ton of CO_2, which coincides with a central discount rate of 3%. This value per metric ton of CO_2 was calculated as the average expected damages across the working group's three integrated assessment models, which included the 3% discount rate as a model parameter. This 3% discount rate reflects the real rate of return on long-term government debt, and is recommended by the Office of Management and Budget for use in regulatory analyses to reflect the 'social rate of time preference,' that is, the rate at which society discounts future consumption flows to their present value (OMB, 2003). Also included in this present analysis, for sensitivity purposes, are 2013 SCC estimates of $61.79 and $12.36 per metric ton of CO_2, coinciding with model parameter discount rates of 2.5% and 5%. A fourth SCC estimate of $113.47 is included in this analysis, also for sensitivity purposes, to account for higher than anticipated damages from climate change. This fourth SCC estimate coincides with a discount rate of 3%, but was calculated at the 95th percentile of the damages output distribution from the working group's three integrated assessment models, as opposed to the average output for the

previously mentioned SCC estimates. The 95th percentile SCC estimate does not account for additional sources of damages beyond what is included in the three average SCC estimates, but instead accounts for larger, yet less-likely damages associated with a higher intensity of effects from climate change.

The discount rate and time specific nature of these SCC estimates cannot be overstated. SCC estimates for 2013 are used in this analysis, along with coinciding discount rates; therefore, the results presented in this analysis should be interpreted as the baseline value of CO_2 sequestered or released by NPS units in 2013, and cannot be used to estimate future economic values or the net present value of carbon sequestration on any given NPS unit. This is because the working group's SCC estimates increase nonlinearly over time due to the nature of the lifecycle and projected future accumulations of CO_2 in the earth's atmosphere. This means that future emissions of CO_2 are more damaging due to the higher projected accumulation of CO_2 stock in the atmosphere relative to years prior. One implication of this is that the value of carbon sequestration on NPS lands is expected to increase over time.

Appendix 2

Table A. Average Annual Net Ecosystem Balance (metric tons of CO_2) and Associated Net Economic Value by NPS Unit*

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
Abraham Lincoln Birthplace NHS	902	$55.7	$35.5	$11.1	$102.4
Acadia NP	105,540	$6,521.3	$4,149.8	$1,304.5	$11,975.6
Adams NHP	-11	-$0.7	-$0.4	-$0.1	-$1.2
African Burial Ground NM	-	-	-	-	-
Agate Fossil Beds NM	1,287	$79.5	$50.6	$15.9	$146.0
Alagnak WR	-	-	-	-	-
Alibates Flint Quarries NM	660	$40.8	$26.0	$8.2	$74.9
Allegheny Portage Railroad NHS	2,200	$136.0	$86.5	$27.2	$249.7
American Memorial P	-	-	-	-	-
Amistad NRA	9,259	$572.1	$364.1	$114.4	$1,050.6
Andersonville NHS	1,863	$115.1	$73.2	$23.0	$211.4
Andrew Johnson NHS	-4	-$0.2	-$0.1	> -$0.1	-$0.4
Aniakchak NM&PRES	-	-	-	-	-
Antietam NB	2,380	$147.1	$93.6	$29.4	$270.0
Apostle Islands NL	70,637	$4,364.7	$2,777.5	$873.1	$8,015.2
Appomattox Court House NHP	3,861	$238.6	$151.8	$47.7	$438.1
Arches NP	-7,976	-$492.8	-$313.6	-$98.6	-$905.0
Arkansas Post NMEM	920	$56.9	$36.2	$11.4	$104.4
Arlington House, The Robert E. Lee Memorial NMEM	66	$4.1	$2.6	$0.8	$7.5
Assateague Island NS	20,513	$1,267.5	$806.6	$253.5	$2,327.6
Aztec Ruins NM	150	$9.3	$5.9	$1.9	$17.1
Badlands NP	66,343	$4,099.4	$2,608.6	$820.0	$7,528.0
Bandelier NM	23,707	$1,464.9	$932.2	$293.0	$2,690.1
Bent's Old Fort NHS	367	$22.7	$14.4	$4.5	$41.6
Bering Land Bridge NPRES	-	-	-	-	-
Big Bend NP	138,576	$8,562.6	$5,448.8	$1,712.8	$15,724.2
Big Cypress NPRES	1,085,905	$67,098.1	$42,697.8	$13,421.8	$123,217.6
Big Hole NB	1,272	$78.6	$50.0	$15.7	$144.4
Big South Fork NRRA	383,209	$23,678.5	$15,067.8	$4,736.5	$43,482.7
Big Thicket NPRES	424,950	$26,257.7	$16,709.0	$5,252.4	$48,219.1
Bighorn Canyon NRA	56,728	$3,505.3	$2,230.6	$701.2	$6,437.0
Biscayne NP	9,736	$601.6	$382.8	$120.3	$1,104.7
Black Canyon of the Gunnison NP	9,930	$613.6	$390.5	$122.7	$1,126.8
Blue Ridge PKWY	210,372	$12,998.9	$8,271.8	$2,600.2	$23,870.9

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
Bluestone NSR	12,721	$786.0	$500.2	$157.2	$1,443.4
Booker T. Washington NM	726	$44.9	$28.5	$9.0	$82.4
Boston African American NHS	-	-	-	-	-
Boston Harbor Islands NRA	1,459	$90.2	$57.4	$18.0	$165.6
Boston NHP	-	-	-	-	-
Brices Cross Roads NBS	-	-	-	-	-
Brown v. Board of Education NHS	-	-	-	-	-
Bryce Canyon NP	9,395	$580.5	$369.4	$116.1	$1,066.0
Buck Island Reef NM	-	-	-	-	-
Buffalo NR	152,368	$9,414.8	$5,991.1	$1,883.3	$17,289.1
Cabrillo NM	-	-	-	-	-
Canaveral NS	48,393	$2,990.2	$1,902.8	$598.1	$5,491.2
Cane River Creole NHP	59	$3.6	$2.3	$0.7	$6.7
Canyon de Chelly NM	-1,023	-$63.2	-$40.2	-$12.6	-$116.1
Canyonlands NP	-2,809	-$173.6	-$110.4	-$34.7	-$318.7
Cape Cod NS	37,381	$2,309.8	$1,469.8	$462.0	$4,241.7
Cape Hatteras NS	20,891	$1,290.8	$821.4	$258.2	$2,370.5
Cape Krusenstern NM	-	-	-	-	-
Cape Lookout NS	16,333	$1,009.2	$642.2	$201.9	$1,853.3
Capitol Reef NP	33,384	$2,062.8	$1,312.7	$412.6	$3,788.1
Capulin Volcano NM	458	$28.3	$18.0	$5.7	$52.0
Carl Sandburg Home NHS	660	$40.8	$26.0	$8.2	$74.9
Carlsbad Caverns NP	8,896	$549.7	$349.8	$110.0	$1,009.4
Carter G. Woodson NHS	-	-	-	-	-
Casa Grande Ruins NM	-44	-$2.7	-$1.7	-$0.5	-$5.0
Castillo de San Marcos NM	-4	-$0.2	-$0.1	> -$0.1	-$0.4
Castle Clinton NM	-	-	-	-	-
Catoctin Mountain P	13,590	$839.7	$534.4	$168.0	$1,542.0
Cedar Breaks NM	-851	-$52.6	-$33.5	-$10.5	-$96.5
Cedar Creek & Belle Grove HP	3,865	$238.8	$152.0	$47.8	$438.6
César E. Chávez NM	154	$9.5	$6.1	$1.9	$17.5
Chaco Culture NHP	11,078	$684.5	$435.6	$136.9	$1,257.0
Chamizal NMEM	-18	-$1.1	-$0.7	-$0.2	-$2.1
Channel Islands NP	157,754	$9,747.6	$6,202.9	$1,949.8	$17,900.4
Charles Pinckney NHS	-7	-$0.5	-$0.3	-$0.1	-$0.8
Charles Young Buffalo Soldiers NM	-7	-$0.5	-$0.3	-$0.1	-$0.8
Chattahoochee River NRA	-17,525	-$1,082.8	-$689.1	-$216.6	-$1,988.5
Chesapeake & Ohio Canal NHP	35,871	$2,216.4	$1,410.4	$443.4	$4,070.2

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
Chickamauga and Chattanooga NMP	23,417	$1,447.0	$920.8	$289.4	$2,657.2
Chickasaw NRA	7,712	$476.5	$303.2	$95.3	$875.0
Chiricahua NM	-1,584	-$97.9	-$62.3	-$19.6	-$179.8
Christiansted NHS	-	-	-	-	-
City of Rocks NRES	95	$5.9	$3.7	$1.2	$10.8
Clara Barton NHS	-	-	-	-	-
Colonial NHP	8,584	$530.4	$337.5	$106.1	$974.1
Colorado NM	3,641	$225.0	$143.2	$45.0	$413.2
Congaree NP	88,661	$5,478.3	$3,486.1	$1,095.8	$10,060.3
Coronado NMEM	458	$28.3	$18.0	$5.7	$52.0
Cowpens NB	2,560	$158.2	$100.6	$31.6	$290.4
Crater Lake NP	256,881	$15,872.7	$10,100.5	$3,175.0	$29,148.3
Craters of the Moon NM&PRES	-11,716	-$723.9	-$460.7	-$144.8	-$1,329.4
Cumberland Gap NHP	94,488	$5,838.4	$3,715.3	$1,167.9	$10,721.5
Cumberland Island NS	78,866	$4,873.1	$3,101.0	$974.8	$8,948.9
Curecanti NRA	9,839	$607.9	$386.9	$121.6	$1,116.4
Cuyahoga Valley NP	45,045	$2,783.4	$1,771.2	$556.8	$5,111.3
Dayton Aviation Heritage NHP	-117	-$7.3	-$4.6	-$1.5	-$13.3
De Soto NMEM	-	-	-	-	-
Death Valley NP	396,421	$24,494.9	$15,587.3	$4,899.8	$44,981.9
Delaware Water Gap NRA	162,620	$10,048.3	$6,394.2	$2,010.0	$18,452.5
Denali NP&PRES	-	-	-	-	-
Devils Postpile NM	125	$7.7	$4.9	$1.5	$14.1
Devils Tower NM	561	$34.7	$22.1	$6.9	$63.7
Dinosaur NM	-3,183	-$196.7	-$125.2	-$39.3	-$361.2
Dry Tortugas NP	-	-	-	-	-
Edgar Allan Poe NHS	-	-	-	-	-
Effigy Mounds NM	3,245	$200.5	$127.6	$40.1	$368.2
Eisenhower NHS	583	$36.0	$22.9	$7.2	$66.2
El Malpais NM	4,206	$259.9	$165.4	$52.0	$477.3
El Morro NM	829	$51.2	$32.6	$10.2	$94.0
Eleanor Roosevelt NHS	-180	-$11.1	-$7.1	-$2.2	-$20.4
Eugene O'Neill NHS	37	$2.3	$1.4	$0.5	$4.2
Everglades NP	1,361,447	$84,123.8	$53,532.1	$16,827.5	$154,483.4
Federal Hall NMEM	-	-	-	-	-
Fire Island NS	1,701	$105.1	$66.9	$21.0	$193.1
First Ladies NHS	-	-	-	-	-
First State NM	2,486	$153.6	$97.8	$30.7	$282.1

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
Flight 93 NMEM	2,959	$182.9	$116.4	$36.6	$335.8
Florissant Fossil Beds NM	5,299	$327.4	$208.3	$65.5	$601.3
Ford's Theatre NHS	-	-	-	-	-
Fort Bowie NHS	-326	-$20.2	-$12.8	-$4.0	-$37.0
Fort Caroline NMEM	-7	-$0.5	-$0.3	-$0.1	-$0.8
Fort Davis NHS	220	$13.6	$8.7	$2.7	$25.0
Fort Donelson NB	2,890	$178.5	$113.6	$35.7	$327.9
Fort Frederica NM	-59	-$3.6	-$2.3	-$0.7	-$6.7
Fort Laramie NHS	304	$18.8	$12.0	$3.8	$34.5
Fort Larned NHS	293	$18.1	$11.5	$3.6	$33.3
Fort Matanzas NM	488	$30.1	$19.2	$6.0	$55.3
Fort McHenry NM&SHRINE	-4	-$0.2	-$0.1	> -$0.1	-$0.4
Fort Necessity NB	1,536	$94.9	$60.4	$19.0	$174.3
Fort Point NHS	-	-	-	-	-
Fort Pulaski NM	-565	-$34.9	-$22.2	-$7.0	-$64.1
Fort Raleigh NHS	1,049	$64.8	$41.2	$13.0	$119.0
Fort Scott NHS	-44	-$2.7	-$1.7	-$0.5	-$5.0
Fort Smith NHS	-22	-$1.4	-$0.9	-$0.3	-$2.5
Fort Stanwix NM	-29	-$1.8	-$1.2	-$0.4	-$3.3
Fort Sumter NM	-4	-$0.2	-$0.1	> -$0.1	-$0.4
Fort Union NM	433	$26.7	$17.0	$5.3	$49.1
Fort Union Trading Post NHS	374	$23.1	$14.7	$4.6	$42.4
Fort Vancouver NHS	154	$9.5	$6.1	$1.9	$17.5
Fort Washington P	440	$27.2	$17.3	$5.4	$49.9
Fossil Butte NM	293	$18.1	$11.5	$3.6	$33.3
Franklin Delano Roosevelt MEM	-	-	-	-	-
Frederick Douglass NHS	-	-	-	-	-
Frederick Law Olmsted NHS	-	-	-	-	-
Fredericksburg & Spotsylvania NMP	24,730	$1,528.1	$972.4	$305.7	$2,806.1
Friendship Hill NHS	1,753	$108.3	$68.9	$21.7	$198.9
Gates of the Arctic NP&PRES	-	-	-	-	-
Gateway NRA	-473	-$29.2	-$18.6	-$5.8	-$53.7
Gauley River NRA	34,774	$2,148.7	$1,367.3	$429.8	$3,945.8
General Grant NMEM	-	-	-	-	-
George Rogers Clark NHP	-11	-$0.7	-$0.4	-$0.1	-$1.2
George Washington Birthplace NM	693	$42.8	$27.3	$8.6	$78.6
George Washington Carver NM	158	$9.7	$6.2	$1.9	$17.9
George Washington MEM PKWY	-5,523	-$341.2	-$217.1	-$68.3	-$626.6

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
Gettysburg NMP	7,800	$481.9	$306.7	$96.4	$885.0
Gila Cliff Dwellings NM	462	$28.5	$18.2	$5.7	$52.4
Glacier Bay NP&PRES	-	-	-	-	-
Glacier NP	662,704	$40,948.5	$26,057.5	$8,191.0	$75,197.0
Glen Canyon NRA	123,072	$7,604.6	$4,839.2	$1,521.2	$13,965.0
Golden Gate NRA	245,425	$15,164.8	$9,650.1	$3,033.5	$27,848.4
Golden Spike NHS	268	$16.5	$10.5	$3.3	$30.4
Governors Island NM	-	-	-	-	-
Grand Canyon NP	-70,443	-$4,352.7	-$2,769.8	-$870.7	-$7,993.2
Grand Portage NM	1,595	$98.6	$62.7	$19.7	$181.0
Grand Teton NP	156,753	$9,685.8	$6,163.5	$1,937.5	$17,786.8
Grant-Kohrs Ranch NHS	796	$49.2	$31.3	$9.8	$90.3
Great Basin NP	75,702	$4,677.6	$2,976.6	$935.7	$8,589.9
Great Sand Dunes NP&PRES	68,085	$4,207.0	$2,677.1	$841.5	$7,725.6
Great Smoky Mountains NP	1,637,935	$101,208.0	$64,403.6	$20,244.9	$185,856.5
Greenbelt P	-5,702	-$352.3	-$224.2	-$70.5	-$647.0
Guadalupe Mountains NP	40,836	$2,523.2	$1,605.7	$504.7	$4,633.6
Guilford Courthouse NMP	-231	-$14.3	-$9.1	-$2.9	-$26.2
Gulf Islands NS	14,254	$880.7	$560.5	$176.2	$1,617.4
Hagerman Fossil Beds NM	3,330	$205.7	$130.9	$41.2	$377.8
Haleakala NP	-	-	-	-	-
Hamilton Grange NMEM	-	-	-	-	-
Hampton NHS	33	$2.0	$1.3	$0.4	$3.7
Harpers Ferry NHP	7,235	$447.1	$284.5	$89.4	$821.0
Harry S Truman NHS	-4	-$0.2	-$0.1	> -$0.1	-$0.4
Hawai'i Volcanoes NP	-	-	-	-	-
Herbert Hoover NHS	18	$1.1	$0.7	$0.2	$2.1
Hohokam Pima NM	-249	-$15.4	-$9.8	-$3.1	-$28.3
Home of Franklin D Roosevelt NHS	-1,470	-$90.9	-$57.8	-$18.2	-$166.9
Homestead NM	73	$4.5	$2.9	$0.9	$8.3
Hopewell Culture NHP	1,415	$87.5	$55.7	$17.5	$160.6
Hopewell Furnace NHS	1,705	$105.4	$67.0	$21.1	$193.5
Horseshoe Bend NMP	6,168	$381.1	$242.5	$76.2	$699.9
Hot Springs NP	5,310	$328.1	$208.8	$65.6	$602.5
Hovenweep NM	70	$4.3	$2.7	$0.9	$7.9
Hubbell Trading Post NHS	59	$3.6	$2.3	$0.7	$6.7
Independence NHP	-	-	-	-	-
Indiana Dunes NL	12,658	$782.2	$497.7	$156.5	$1,436.4

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
Isle Royale NP	275,355	$17,014.2	$10,827.0	$3,403.4	$31,244.5
James A Garfield NHS	-	-	-	-	-
Jean Lafitte NHP&PRES	8,647	$534.3	$340.0	$106.9	$981.2
Jefferson NEM	-	-	-	-	-
Jewel Cave NM	2,101	$129.8	$82.6	$26.0	$238.4
Jimmy Carter NHS	238	$14.7	$9.4	$2.9	$27.0
John D. Rockefeller, Jr. MEM PKWY	19,065	$1,178.0	$749.6	$235.6	$2,163.3
John Day Fossil Beds NM	8,192	$506.2	$322.1	$101.3	$929.6
John Fitzgerald Kennedy NHS	-	-	-	-	-
John Muir NHS	444	$27.4	$17.4	$5.5	$50.3
Johnstown Flood NMEM	319	$19.7	$12.5	$3.9	$36.2
Joshua Tree NP	412,464	$25,486.2	$16,218.1	$5,098.1	$46,802.3
Kalaupapa NHP	-	-	-	-	-
Kaloko-Honokohau NHP	-	-	-	-	-
Katmai NP&PRES	-	-	-	-	-
Kenai Fjords NP	-	-	-	-	-
Kennesaw Mountain NBP	-22,233	-$1,373.8	-$874.2	-$274.8	-$2,522.8
Keweenaw NHP	638	$39.4	$25.1	$7.9	$72.4
Kings Canyon NP	18,467	$1,141.1	$726.1	$228.3	$2,095.5
Kings Mountain NMP	5,739	$354.6	$225.7	$70.9	$651.2
Klondike Gold Rush NHP	-	-	-	-	-
Knife River Indian Villages NHS	352	$21.8	$13.8	$4.4	$39.9
Kobuk Valley NP	-	-	-	-	-
Korean War Veterans MEM	-	-	-	-	-
Lake Chelan NRA	68,496	$4,232.4	$2,693.3	$846.6	$7,772.2
Lake Clark NP&PRES	-	-	-	-	-
Lake Mead NRA	275,762	$17,039.3	$10,843.0	$3,408.4	$31,290.7
Lake Meredith NRA	14,664	$906.1	$576.6	$181.3	$1,664.0
Lake Roosevelt NRA	24,569	$1,518.1	$966.0	$303.7	$2,787.8
Lassen Volcanic NP	28,463	$1,758.7	$1,119.2	$351.8	$3,229.7
Lava Beds NM	21,228	$1,311.7	$834.7	$262.4	$2,408.8
Lewis and Clark NHP	7,352	$454.3	$289.1	$90.9	$834.3
Lincoln Boyhood NMEM	491	$30.4	$19.3	$6.1	$55.8
Lincoln Home NHS	-	-	-	-	-
Lincoln MEM	-	-	-	-	-
Little Bighorn Battlefield NM	858	$53.0	$33.7	$10.6	$97.4
Little River Canyon NPRES	42,350	$2,616.8	$1,665.2	$523.4	$4,805.5
Little Rock Central High School NHS	-	-	-	-	-

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
Longfellow NHS	-	-	-	-	-
Lowell NHP	-4	-$0.2	-$0.1	> -$0.1	-$0.4
Lower Saint Croix NSR	7,022	$433.9	$276.1	$86.8	$796.8
Lyndon B Johnson NHP	1,118	$69.1	$44.0	$13.8	$126.9
Lyndon Baines Johnson Memorial Grove on the Potomac NMEM	-	-	-	-	-
Maggie L Walker NHS	-	-	-	-	-
Mammoth Cave NP	186,221	$11,506.6	$7,322.2	$2,301.7	$21,130.5
Manassas NBP	8,848	$546.7	$347.9	$109.4	$1,004.0
Manzanar NHS	-194	-$12.0	-$7.6	-$2.4	-$22.1
Marsh-Billings-Rockefeller NHP	1,217	$75.2	$47.9	$15.0	$138.1
Martin Luther King Jr NHS	-	-	-	-	-
Martin Luther King, Jr. MEM	-	-	-	-	-
Martin Van Buren NHS	-70	-$4.3	-$2.7	-$0.9	-$7.9
Mary McLeod Bethune Council House NHS	-	-	-	-	-
Mesa Verde NP	7,250	$448.0	$285.1	$89.6	$822.6
Minidoka NHS	147	$9.1	$5.8	$1.8	$16.6
Minute Man NHP	2,505	$154.8	$98.5	$31.0	$284.2
Minuteman Missile NHS	18	$1.1	$0.7	$0.2	$2.1
Mississippi NRRA	-5,721	-$353.5	-$224.9	-$70.7	-$649.1
Missouri NRR	34,781	$2,149.1	$1,367.6	$429.9	$3,946.7
Mojave NPRES	628,619	$38,842.4	$24,717.3	$7,769.7	$71,329.4
Monocacy NB	2,318	$143.2	$91.1	$28.6	$263.0
Montezuma Castle NM	18	$1.1	$0.7	$0.2	$2.1
Moores Creek NB	304	$18.8	$12.0	$3.8	$34.5
Morristown NHP	5,251	$324.5	$206.5	$64.9	$595.8
Mount Rainier NP	-227,574	-$14,061.8	-$8,948.2	-$2,812.8	-$25,822.8
Mount Rushmore NMEM	2,303	$142.3	$90.5	$28.5	$261.3
Muir Woods NM	3,656	$225.9	$143.8	$45.2	$414.8
Natchez NHP	55	$3.4	$2.2	$0.7	$6.2
National Capital Parks	-1,063	-$65.7	-$41.8	-$13.1	-$120.7
National Capital Parks - Central	-271	-$16.8	-$10.7	-$3.4	-$30.8
National Capital Parks - East	-4,327	-$267.4	-$170.1	-$53.5	-$491.0
National Park of American Samoa	-	-	-	-	-
Natural Bridges NM	2,043	$126.2	$80.3	$25.2	$231.8
Navajo NM	103	$6.3	$4.0	$1.3	$11.7
New Bedford Whaling NHP	-	-	-	-	-
New River Gorge NR	195,796	$12,098.2	$7,698.7	$2,420.0	$22,216.9
Nez Perce NHP	2,274	$140.5	$89.4	$28.1	$258.0

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
Nicodemus NHS	-4	-$0.2	-$0.1	> -$0.1	-$0.4
Ninety Six NHS	3,806	$235.2	$149.7	$47.0	$431.9
Niobrara NSR	13,572	$838.6	$533.6	$167.7	$1,540.0
Noatak NPRES	-	-	-	-	-
North Cascades NP	-384,492	-$23,757.8	-$15,118.2	-$4,752.3	-$43,628.3
Obed W&SR	15,838	$978.6	$622.7	$195.8	$1,797.1
Ocmulgee NM	-2,343	-$144.8	-$92.1	-$29.0	-$265.9
Olympic NP	33,868	$2,092.7	$1,331.7	$418.6	$3,843.0
Oregon Caves NM	1,276	$78.9	$50.2	$15.8	$144.8
Organ Pipe Cactus NM	-31,921	-$1,972.4	-$1,255.1	-$394.5	-$3,622.1
Ozark NSR	89,544	$5,533.0	$3,520.9	$1,106.8	$10,160.6
Padre Island NS	51,877	$3,205.5	$2,039.8	$641.2	$5,886.5
Palo Alto Battlefield NHP	2,369	$146.4	$93.1	$29.3	$268.8
Pea Ridge NMP	5,812	$359.1	$228.5	$71.8	$659.5
Pecos NHP	8,346	$515.7	$328.2	$103.2	$947.0
Pennsylvania Avenue NHS	-	-	-	-	-
Perry's Victory & Intl. Peace MEM	-	-	-	-	-
Petersburg NB	-3,014	-$186.3	-$118.5	-$37.3	-$342.0
Petrified Forest NP	-8,962	-$553.8	-$352.4	-$110.8	-$1,016.9
Petroglyph NM	290	$17.9	$11.4	$3.6	$32.9
Pictured Rocks NL	190,911	$11,796.4	$7,506.6	$2,359.7	$21,662.7
Pinnacles NP	36,003	$2,224.6	$1,415.6	$445.0	$4,085.2
Pipe Spring NM	7	$0.5	$0.3	$0.1	$0.8
Pipestone NM	-84	-$5.2	-$3.3	-$1.0	-$9.6
Piscataway P	10,275	$634.9	$404.0	$127.0	$1,165.9
Point Reyes NS	184,622	$11,407.8	$7,259.4	$2,281.9	$20,949.1
Port Chicago Naval Magazine NMEM	-	-	-	-	-
Poverty Point NM	1,030	$63.7	$40.5	$12.7	$116.9
President William Jefferson Clinton Birthplace Home NHS	-	-	-	-	-
Presidio of San Francisco	161	$10.0	$6.3	$2.0	$18.3
Prince William Forest P	33,025	$2,040.6	$1,298.5	$408.2	$3,747.3
Pu'uhonua O Hōnaunau NHP	-	-	-	-	-
Pu'ukoholā Heiau NHS	-	-	-	-	-
Rainbow Bridge NM	37	$2.3	$1.4	$0.5	$4.2
Redwood NP	369,106	$22,807.0	$14,513.2	$4,562.1	$41,882.4
Richmond NBP	-473	-$29.2	-$18.6	-$5.8	-$53.7
Rio Grande W&SR	15	$0.9	$0.6	$0.2	$1.7

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
River Raisin NBP	51	$3.2	$2.0	$0.6	$5.8
Rock Creek P	-9,787	-$604.8	-$384.8	-$121.0	-$1,110.6
Rocky Mountain NP	177,578	$10,972.6	$6,982.4	$2,194.9	$20,149.8
Roger Williams NMEM	-	-	-	-	-
Ronald Reagan Boyhood Home NHS	-	-	-	-	-
Rosie the Riveter WWII Home Front NHP	-7	-$0.5	-$0.3	-$0.1	-$0.8
Ross Lake NRA	-37,667	-$2,327.5	-$1,481.1	-$465.6	-$4,274.1
Russell Cave NM	869	$53.7	$34.2	$10.7	$98.6
Sagamore Hill NHS	-	-	-	-	-
Saguaro NP	-37,378	-$2,309.6	-$1,469.7	-$462.0	-$4,241.3
Saint Croix Island HIS	-	-	-	-	-
Saint Croix NSR	79,372	$4,904.4	$3,120.9	$981.0	$9,006.4
Saint Paul's Church NHS	-	-	-	-	-
Saint-Gaudens NHS	488	$30.1	$19.2	$6.0	$55.3
Salem Maritime NHS	-	-	-	-	-
Salinas Pueblo Missions NM	583	$36.0	$22.9	$7.2	$66.2
Salt River Bay NHP&EP	-	-	-	-	-
San Antonio Missions NHP	1,041	$64.3	$40.9	$12.9	$118.2
San Francisco Maritime NHP	-	-	-	-	-
San Juan Island NHP	-623	-$38.5	-$24.5	-$7.7	-$70.7
San Juan NHS	-	-	-	-	-
Sand Creek Massacre NHS	7,059	$436.2	$277.6	$87.2	$801.0
Santa Monica Mountains NRA	247,933	$15,319.8	$9,748.7	$3,064.5	$28,133.0
Saratoga NHP	5,882	$363.4	$231.3	$72.7	$667.4
Saugus Iron Works NHS	-4	-$0.2	-$0.1	> -$0.1	-$0.4
Scotts Bluff NM	2,032	$125.5	$79.9	$25.1	$230.5
Sequoia NP	145,994	$9,021.0	$5,740.5	$1,804.5	$16,566.0
Sewall-Belmont House NHS	-	-	-	-	-
Shenandoah NP	355,336	$21,956.2	$13,971.8	$4,392.0	$40,320.0
Shiloh NMP	9,010	$556.7	$354.3	$111.4	$1,022.3
Sitka NHP	-	-	-	-	-
Sleeping Bear Dunes NL	159,793	$9,873.6	$6,283.1	$1,975.0	$18,131.7
Springfield Armory NHS	-	-	-	-	-
Statue Of Liberty NM	-	-	-	-	-
Steamtown NHS	-	-	-	-	-
Stones River NB	2,193	$135.5	$86.2	$27.1	$248.8
Sunset Crater Volcano NM	1,349	$83.4	$53.1	$16.7	$153.1
Tallgrass Prairie NPRES	2,285	$141.2	$89.8	$28.2	$259.2

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
Thaddeus Kosciuszko NMEM	-	-	-	-	-
Theodore Roosevelt Birthplace NHS	-	-	-	-	-
Theodore Roosevelt Inaugural NHS	-	-	-	-	-
Theodore Roosevelt Island NM	385	$23.8	$15.1	$4.8	$43.7
Theodore Roosevelt NP	24,965	$1,542.6	$981.6	$308.6	$2,832.8
Thomas Edison NHP	-15	-$0.9	-$0.6	-$0.2	-$1.7
Thomas Jefferson MEM	-	-	-	-	-
Thomas Stone NHS	546	$33.8	$21.5	$6.8	$62.0
Timpanogos Cave NM	176	$10.9	$6.9	$2.2	$20.0
Timucaun EHP	16,615	$1,026.7	$653.3	$205.4	$1,885.3
Tonto NM	198	$12.2	$7.8	$2.4	$22.5
Tumacácori NHP	290	$17.9	$11.4	$3.6	$32.9
Tupelo NB	-	-	-	-	-
Tuskegee Airmen NHS	356	$22.0	$14.0	$4.4	$40.4
Tuskegee Institute NHS	114	$7.0	$4.5	$1.4	$12.9
Tuzigoot NM	150	$9.3	$5.9	$1.9	$17.1
Ulysses S Grant NHS	-7	-$0.5	-$0.3	-$0.1	-$0.8
Upper Delaware NSR&NRR	129,867	$8,024.5	$5,106.4	$1,605.2	$14,736.0
Valley Forge NHP	7,228	$446.6	$284.2	$89.3	$820.1
Vanderbilt Mansion NHS	854	$52.8	$33.6	$10.6	$97.0
Vicksburg NMP	5,302	$327.6	$208.5	$65.5	$601.7
Vietnam Veterans MEM	-	-	-	-	-
Virgin Islands Coral Reef NM	-	-	-	-	-
Virgin Islands NP	-	-	-	-	-
Voyageurs NP	247,445	$15,289.7	$9,729.6	$3,058.4	$28,077.6
Walnut Canyon NM	3,088	$190.8	$121.4	$38.2	$350.4
War in the Pacific NHP	-	-	-	-	-
Washington Monument	-	-	-	-	-
Washita Battlefield NHS	92	$5.7	$3.6	$1.1	$10.4
Weir Farm NHS	198	$12.2	$7.8	$2.4	$22.5
Whiskeytown NRA	84,235	$5,204.9	$3,312.1	$1,041.1	$9,558.1
White House	-	-	-	-	-
White Sands NM	-3,058	-$189.0	-$120.3	-$37.8	-$347.0
Whitman Mission NHS	66	$4.1	$2.6	$0.8	$7.5
William Howard Taft NHS	-7	-$0.5	-$0.3	-$0.1	-$0.8
Wilson's Creek NB	1,999	$123.5	$78.6	$24.7	$226.8
Wind Cave NP	31,283	$1,933.0	$1,230.1	$386.7	$3,549.7
Wolf Trap NP for the Performing Arts	150	$9.3	$5.9	$1.9	$17.1

Park Unit	Annual Metric Tons of CO_2**	Value by Discount Rate ($ thousands)			
		2.5%	3%	5%	3% (95th)
Women's Rights NHP	-29	-$1.8	-$1.2	-$0.4	-$3.3
World War II Memorial	-	-	-	-	-
World War II Valor in the Pacific NM	-	-	-	-	-
Wrangell-St. Elias NP&PRES	-	-	-	-	-
Wright Brothers NMEM	-326	-$20.2	-$12.8	-$4.0	-$37.0
Wupatki NM	-4,298	-$265.6	-$169.0	-$53.1	-$487.7
Yellowstone NP	1,515,696	$93,654.8	$59,597.2	$18,734.0	$171,986.0
Yosemite NP	151,110	$9,337.1	$5,941.6	$1,867.7	$17,146.4
Yucca House NM	11	$0.7	$0.4	$0.1	$1.2
Yukon-Charley Rivers NPRES	-	-	-	-	-
Zion NP	26,637	$1,645.9	$1,047.4	$329.2	$3,022.5

*A dash represents missing data. Due to rounding, monetary values listed as '> -$0.1' represents an estimate between -$50 and $0.

**A negative value denotes a net carbon source.

Table B. Average Annual Net Ecosystem Balance (metric tons of CO_2) per Hectare by NPS Unit*

Park Unit	Annual Metric Tons of CO_2 Per Hectare**
Abraham Lincoln Birthplace NHS	6.6
Acadia NP	6.7
Adams NHP	-2.1
African Burial Ground NM	-
Agate Fossil Beds NM	1.0
Alagnak WR	-
Alibates Flint Quarries NM	1.2
Allegheny Portage Railroad NHS	4.1
American Memorial P	-
Amistad NRA	0.4
Andersonville NHS	8.8
Andrew Johnson NHS	-0.8
Aniakchak NM&PRES	-
Antietam NB	1.8
Apostle Islands NL	2.5
Appomattox Court House NHP	5.4
Arches NP	-0.3
Arkansas Post NMEM	3.0
Arlington House, The Robert E. Lee Memorial NMEM	10.3
Assateague Island NS	1.0
Aztec Ruins NM	1.2
Badlands NP	0.7
Bandelier NM	1.7
Bent's Old Fort NHS	1.1
Bering Land Bridge NPRES	-
Big Bend NP	0.4
Big Cypress NPRES	3.7
Big Hole NB	4.7
Big South Fork NRRA	7.7
Big Thicket NPRES	9.4
Bighorn Canyon NRA	1.2
Biscayne NP	0.1
Black Canyon of the Gunnison NP	0.8
Blue Ridge PKWY	5.7
Bluestone NSR	7.2
Booker T. Washington NM	7.4
Boston African American NHS	-
Boston Harbor Islands NRA	2.3
Boston NHP	-
Brices Cross Roads NBS	-
Brown v. Board of Education NHS	-
Bryce Canyon NP	0.6
Buck Island Reef NM	-
Buffalo NR	4.0
Cabrillo NM	-
Canaveral NS	2.0
Cane River Creole NHP	0.7
Canyon de Chelly NM	0.0
Canyonlands NP	0.0
Cape Cod NS	2.3
Cape Hatteras NS	1.7
Cape Krusenstern NM	-
Cape Lookout NS	1.4
Capitol Reef NP	0.3
Capulin Volcano NM	1.4
Carl Sandburg Home NHS	6.0
Carlsbad Caverns NP	0.5
Carter G. Woodson NHS	-
Casa Grande Ruins NM	-0.2
Castillo de San Marcos NM	-0.3
Castle Clinton NM	-
Catoctin Mountain P	5.8
Cedar Breaks NM	-0.3
Cedar Creek & Belle Grove HP	2.8
César E. Chávez NM	3.2
Chaco Culture NHP	0.8
Chamizal NMEM	-0.9
Channel Islands NP	1.6
Charles Pinckney NHS	-0.6
Charles Young Buffalo Soldiers NM	-0.2
Chattahoochee River NRA	-5.0
Chesapeake & Ohio Canal NHP	4.2
Chickamauga and Chattanooga NMP	7.0

Park Unit	Annual Metric Tons of CO_2 Per Hectare**
Chickasaw NRA	1.9
Chiricahua NM	-0.3
Christiansted NHS	-
City of Rocks NRES	0.0
Clara Barton NHS	-
Colonial NHP	2.3
Colorado NM	0.4
Congaree NP	9.0
Coronado NMEM	0.2
Cowpens NB	7.6
Crater Lake NP	3.5
Craters of the Moon NM&PRES	-0.1
Cumberland Gap NHP	9.4
Cumberland Island NS	5.3
Curecanti NRA	0.6
Cuyahoga Valley NP	3.4
Dayton Aviation Heritage NHP	-2.5
De Soto NMEM	-
Death Valley NP	0.3
Delaware Water Gap NRA	5.9
Denali NP&PRES	-
Devils Postpile NM	0.4
Devils Tower NM	1.0
Dinosaur NM	0.0
Dry Tortugas NP	-
Edgar Allan Poe NHS	-
Effigy Mounds NM	3.2
Eisenhower NHS	2.1
El Malpais NM	0.1
El Morro NM	1.6
Eleanor Roosevelt NHS	-2.5
Eugene O'Neill NHS	6.6
Everglades NP	2.2
Federal Hall NMEM	-
Fire Island NS	0.2
First Ladies NHS	-
First State NM	5.3
Flight 93 NMEM	3.2

Park Unit	Annual Metric Tons of CO_2 Per Hectare**
Florissant Fossil Beds NM	2.2
Ford's Theatre NHS	-
Fort Bowie NHS	-0.8
Fort Caroline NMEM	-0.1
Fort Davis NHS	1.1
Fort Donelson NB	8.3
Fort Frederica NM	-0.5
Fort Laramie NHS	0.8
Fort Larned NHS	1.0
Fort Matanzas NM	4.4
Fort McHenry NM&SHRINE	-0.2
Fort Necessity NB	4.1
Fort Point NHS	-
Fort Pulaski NM	-0.3
Fort Raleigh NHS	16.4
Fort Scott NHS	-6.3
Fort Smith NHS	-1.2
Fort Stanwix NM	-4.3
Fort Sumter NM	0.0
Fort Union NM	1.5
Fort Union Trading Post NHS	1.8
Fort Vancouver NHS	1.8
Fort Washington P	3.2
Fossil Butte NM	0.1
Franklin Delano Roosevelt MEM	-
Frederick Douglass NHS	-
Frederick Law Olmsted NHS	-
Fredericksburg & Spotsylvania NMP	5.9
Friendship Hill NHS	6.4
Gates of the Arctic NP&PRES	-
Gateway NRA	0.0
Gauley River NRA	7.7
General Grant NMEM	-
George Rogers Clark NHP	-0.9
George Washington Birthplace NM	3.8
George Washington Carver NM	1.8
George Washington MEM PKWY	-2.0
Gettysburg NMP	3.2

Park Unit	Annual Metric Tons of CO_2 Per Hectare**
Gila Cliff Dwellings NM	1.9
Glacier Bay NP&PRES	-
Glacier NP	1.6
Glen Canyon NRA	0.2
Golden Gate NRA	7.7
Golden Spike NHS	0.2
Governors Island NM	-0.2
Grand Canyon NP	-0.1
Grand Portage NM	5.6
Grand Teton NP	1.2
Grant-Kohrs Ranch NHS	1.2
Great Basin NP	2.4
Great Sand Dunes NP&PRES	0.5
Great Smoky Mountains NP	7.8
Greenbelt P	-12.3
Guadalupe Mountains NP	1.2
Guilford Courthouse NMP	-2.7
Gulf Islands NS	0.3
Hagerman Fossil Beds NM	1.9
Haleakala NP	-
Hamilton Grange NMEM	-3.3
Hampton NHS	1.4
Harpers Ferry NHP	4.8
Harry S Truman NHS	-0.6
Hawai'i Volcanoes NP	-
Herbert Hoover NHS	0.2
Hohokam Pima NM	-0.4
Home of Franklin D Roosevelt NHS	-4.0
Homestead NM	0.8
Hopewell Culture NHP	2.0
Hopewell Furnace NHS	5.0
Horseshoe Bend NMP	7.3
Hot Springs NP	2.4
Hovenweep NM	0.2
Hubbell Trading Post NHS	0.9
Independence NHP	-
Indiana Dunes NL	2.0
Isle Royale NP	1.2

Park Unit	Annual Metric Tons of CO_2 Per Hectare**
James A Garfield NHS	-
Jean Lafitte NHP&PRES	1.0
Jefferson NEM	-
Jewel Cave NM	4.1
Jimmy Carter NHS	7.4
John D. Rockefeller, Jr. MEM PKWY	2.0
John Day Fossil Beds NM	1.4
John Fitzgerald Kennedy NHS	-
John Muir NHS	3.2
Johnstown Flood NMEM	4.4
Joshua Tree NP	1.3
Kalaupapa NHP	-
Kaloko-Honokohau NHP	-
Katmai NP&PRES	-
Kenai Fjords NP	-
Kennesaw Mountain NBP	-19.0
Keweenaw NHP	0.8
Kings Canyon NP	0.1
Kings Mountain NMP	3.6
Klondike Gold Rush NHP	-
Knife River Indian Villages NHS	0.5
Kobuk Valley NP	-
Korean War Veterans MEM	-
Lake Chelan NRA	2.7
Lake Clark NP&PRES	-
Lake Mead NRA	0.5
Lake Meredith NRA	0.9
Lake Roosevelt NRA	0.6
Lassen Volcanic NP	0.7
Lava Beds NM	1.1
Lewis and Clark NHP	5.1
Lincoln Boyhood NMEM	6.1
Lincoln Home NHS	-
Lincoln MEM	-
Little Bighorn Battlefield NM	2.7
Little River Canyon NPRES	6.8
Little Rock Central High School NHS	-
Longfellow NHS	-

Park Unit	Annual Metric Tons of CO_2 Per Hectare**
Lowell NHP	0.0
Lower Saint Croix NSR	1.5
Lyndon B Johnson NHP	1.8
Lyndon Baines Johnson Memorial Grove on the Potomac NMEM	-
Maggie L Walker NHS	-
Mammoth Cave NP	8.9
Manassas NBP	4.3
Manzanar NHS	-0.6
Marsh-Billings-Rockefeller NHP	4.7
Martin Luther King Jr NHS	-
Martin Luther King, Jr. MEM	-
Martin Van Buren NHS	-0.6
Mary McLeod Bethune Council House NHS	-
Mesa Verde NP	0.3
Minidoka NHS	1.1
Minute Man NHP	6.0
Minuteman Missile NHS	1.1
Mississippi NRRA	-0.3
Missouri NRR	1.2
Mojave NPRES	1.0
Monocacy NB	3.5
Montezuma Castle NM	0.0
Moores Creek NB	8.2
Morristown NHP	7.7
Mount Rainier NP	-2.4
Mount Rushmore NMEM	4.5
Muir Woods NM	16.3
Natchez NHP	1.3
National Capital Parks	-3.2
National Capital Parks - Central	-1.0
National Capital Parks - East	-7.7
National Park of American Samoa	-
Natural Bridges NM	0.7
Navajo NM	0.7
New Bedford Whaling NHP	-
New River Gorge NR	6.9
Nez Perce NHP	1.6

Park Unit	Annual Metric Tons of CO_2 Per Hectare**
Nicodemus NHS	-2.9
Ninety Six NHS	9.8
Niobrara NSR	1.2
Noatak NPRES	-
North Cascades NP	-1.9
Obed W&SR	7.4
Ocmulgee NM	-8.4
Olympic NP	0.1
Oregon Caves NM	6.7
Organ Pipe Cactus NM	-0.2
Ozark NSR	2.7
Padre Island NS	1.0
Palo Alto Battlefield NHP	1.7
Pea Ridge NMP	3.4
Pecos NHP	3.1
Pennsylvania Avenue NHS	-
Perry's Victory & Intl. Peace MEM	-
Petersburg NB	-2.7
Petrified Forest NP	-0.1
Petroglyph NM	0.1
Pictured Rocks NL	6.4
Pinnacles NP	3.3
Pipe Spring NM	0.5
Pipestone NM	-0.7
Piscataway P	5.5
Point Reyes NS	6.3
Port Chicago Naval Magazine NMEM	-
Poverty Point NM	2.8
President William Jefferson Clinton Birthplace Home NHS	-
Presidio of San Francisco	0.3
Prince William Forest P	7.4
Pu'uhonua O Hōnaunau NHP	-
Pu'ukoholā Heiau NHS	-
Rainbow Bridge NM	0.6
Redwood NP	7.9
Richmond NBP	-0.8
Rio Grande W&SR	0.1
River Raisin NBP	3.0

Park Unit	Annual Metric Tons of CO_2 Per Hectare**
Rock Creek P	-8.9
Rocky Mountain NP	1.6
Roger Williams NMEM	-
Ronald Reagan Boyhood Home NHS	-
Rosie the Riveter WWII Home Front NHP	-0.1
Ross Lake NRA	-0.8
Russell Cave NM	7.4
Sagamore Hill NHS	-
Saguaro NP	-1.0
Saint Croix Island HIS	-
Saint Croix NSR	2.8
Saint Paul's Church NHS	-
Saint-Gaudens NHS	6.4
Salem Maritime NHS	-
Salinas Pueblo Missions NM	1.3
Salt River Bay NHP&EP	-
San Antonio Missions NHP	3.1
San Francisco Maritime NHP	-
San Juan Island NHP	-0.9
San Juan NHS	-
Sand Creek Massacre NHS	1.4
Santa Monica Mountains NRA	4.1
Saratoga NHP	4.3
Saugus Iron Works NHS	-0.8
Scotts Bluff NM	1.6
Sequoia NP	0.9
Sewall-Belmont House NHS	-
Shenandoah NP	4.5
Shiloh NMP	5.5
Sitka NHP	-
Sleeping Bear Dunes NL	5.6
Springfield Armory NHS	-
Statue Of Liberty NM	-
Steamtown NHS	-
Stones River NB	7.7
Sunset Crater Volcano NM	1.1
Tallgrass Prairie NPRES	0.5
Thaddeus Kosciuszko NMEM	-

Park Unit	Annual Metric Tons of CO_2 Per Hectare**
Theodore Roosevelt Birthplace NHS	-
Theodore Roosevelt Inaugural NHS	-
Theodore Roosevelt Island NM	9.5
Theodore Roosevelt NP	0.9
Thomas Edison NHP	-1.5
Thomas Jefferson MEM	-
Thomas Stone NHS	4.1
Timpanogos Cave NM	1.8
Timucaun EHP	0.9
Tonto NM	0.4
Tumacácori NHP	2.0
Tupelo NB	-
Tuskegee Airmen NHS	9.9
Tuskegee Institute NHS	4.4
Tuzigoot NM	0.5
Ulysses S Grant NHS	-2.2
Upper Delaware NSR&NRR	5.8
Valley Forge NHP	5.2
Vanderbilt Mansion NHS	10.1
Vicksburg NMP	7.9
Vietnam Veterans MEM	-
Virgin Islands Coral Reef NM	-
Virgin Islands NP	-
Voyageurs NP	3.0
Walnut Canyon NM	2.1
War in the Pacific NHP	-
Washington Monument	-
Washita Battlefield NHS	0.7
Weir Farm NHS	6.7
Whiskeytown NRA	4.9
White House	-
White Sands NM	-0.1
Whitman Mission NHS	1.2
William Howard Taft NHS	-4.2
Wilson's Creek NB	2.1
Wind Cave NP	2.3
Wolf Trap NP for the Performing Arts	2.8
Women's Rights NHP	-10.1

Park Unit	Annual Metric Tons of CO_2 Per Hectare**
World War II Memorial	-
World War II Valor in the Pacific NM	-
Wrangell-St. Elias NP&PRES	-
Wright Brothers NMEM	-1.9
Wupatki NM	-0.3
Yellowstone NP	1.7
Yosemite NP	0.5
Yucca House NM	0.6
Yukon-Charley Rivers NPRES	-
Zion NP	0.4

*A dash represents missing data.
**A negative value denotes a net carbon source.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov