

AFFECTED ENVIRONMENT – GGNRA AND MUIR WOODS

Carbon Footprint

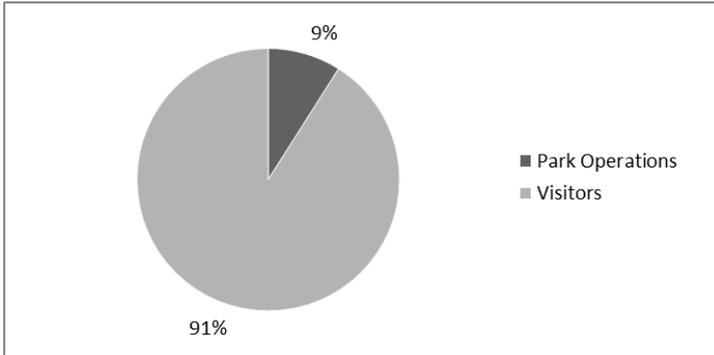
A “carbon footprint” is a measure of the impact human activities have on the environment in terms of the amount of greenhouse gases produced, and is measured in units of carbon dioxide. The greenhouse effect is a natural phenomenon that keeps the earth’s temperature stable at an average of 60° F. Without this natural warming effect, our planet would be uninhabitable at an average temperature of 14° F. However, human actions are disturbing this balance through over-production of large amounts of two main greenhouse gases, carbon dioxide (CO₂) and methane (CH₄). The increase in greenhouse gases is causing an overall warming of the planet, commonly referred to as *global warming*. The term *climate change* describes the variable consequences of global warming over time.

The National Park Service has a goal of reducing its contribution to global warming and climate change through the reduction of emissions. To begin tracking the results of their efforts, the park staff inventoried its emissions in 2006 using the Climate Leadership in Parks (CLIP) tool developed by the National Park Service and the Environmental Protection Agency. The CLIP tool converts emissions of various greenhouse gases into a common “metric tons of carbon equivalent” (MTCE) unit, which provides a basis for comparison among gases and simplifies reduction tracking. The conversion of a greenhouse gas to an MTCE unit is based on how strongly that particular gas contributes to the greenhouse effect, and how many tons of carbon emission would have the same effect.

The emissions inventory (NPS 2007c) then looked at the relative input of various sectors: stationary combustion (building furnaces, dryers, electrical generators, hot water heaters), purchased electricity, mobile combustion (vehicles, buses, heavy equipment), wastewater treatment, and solid waste disposal (garbage transportation and decomposition) for Golden Gate National Recreation Area and Muir Woods National Monument. Based on the emissions inventory completed in 2006, emissions from visitors (mobile combustion primarily from personal automobile use) represents 91% of gross emissions and emissions from park operations represents 9% (see figure 1). Figure 2 shows how the National Park Service’s emissions from park operational activities are distributed among sectors when visitor emissions are excluded.

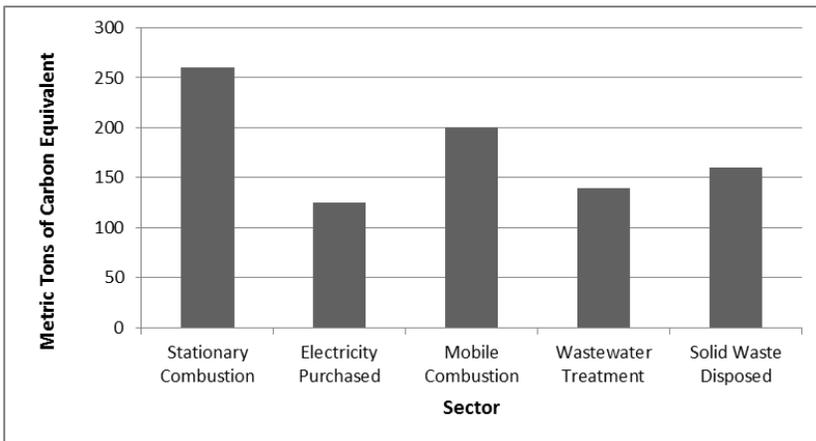
Visitor emission totals consist of an approximation of how much gasoline is consumed while driving to various park locations. Using annual visitor vehicle counts to many of the different locations in the park, the total number of miles driven by visitors was approximated (based on the assumption that they were driving from somewhere in the Bay Area). The resulting total vehicle miles driven by visitors was put into the CLIP tool. The CLIP tool then used assumptions about the different types of cars and the miles per gallon capacity of each to determine approximate fuel consumption.

Figure 1: Gross Emissions for Golden Gate National Recreation Area



Source: *Climate Change Action Plan for Golden Gate National Recreation Area, August 2007*

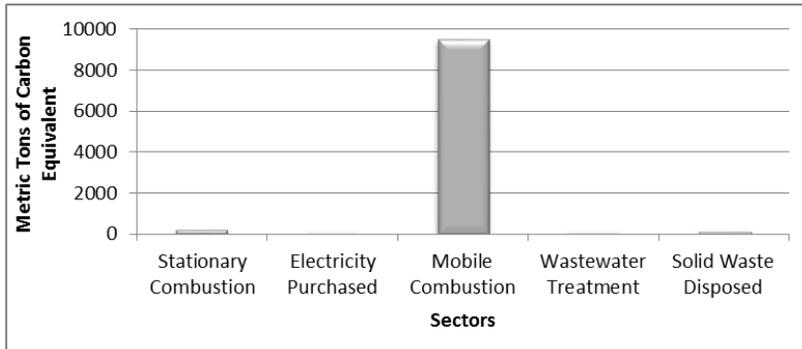
Figure 2: 2006 Gross Park Emissions by Sector, Excluding Visitors



Source: *Climate Change Action Plan for Golden Gate National Recreation Area, August 2007*

Figure 3 shows how the sectors of emissions are distributed when visitor emissions are included. The vast majority of emissions at Golden Gate National Recreation Area are attributable to visitor mobile combustion (vehicles).

Figure 3: 2006 Gross Park Emissions by Sector, Including Visitors



Source: *Climate Change Action Plan for Golden Gate National Recreation Area, August 2007*

In 2008, Golden Gate National Recreation Area’s emissions inventory was updated and included the following emissions statistics for Golden Gate National Recreation Area (including park lands in the three-county area and Alcatraz Island) and Muir Woods National Monument. These data represent existing baseline conditions.

Table 1: Emission Statistics for Golden Gate National Recreation Area

	Marin County	San Francisco County	San Mateo County	Alcatraz Island	Muir Woods
Statutory combustion	523	148	No Data Available	632	5
Purchased electricity	385	382	No Data Available	0	17
Mobile combustion	1047	1419	No Data Available	1167	4873
Wastewater treatment	263	0	No Data Available	31	1
Solid waste	332	472	No Data Available	0	50
Gross emissions	2551	2422	No Data Available	1830	4946

ENVIRONMENTAL CONSEQUENCES – GGNRA & MUIR WOODS

Methodology

Comment [sb1]: Here I changed the unit name to MTCO2E

Carbon Footprint and Air Quality

The park's contribution to global climate change is evaluated by assessing the relative production of greenhouse gases (CO₂) for each of the alternatives. Certain actions included in the alternatives of the plan would have an effect on the parks' total greenhouse gas emissions, known as the carbon footprint. Because some of the actions, such as the construction of new facilities could increase CO₂ emissions, and other actions, such as providing alternative transportation and reducing visitors' dependency on personal automobiles, could reduce CO₂ emissions, it is important to evaluate the impact that these actions could have on global warming. Although the National Park Service would pursue sustainable practices whenever possible in all decisions regarding operations, facilities management, and development in the parks, and the parks' focus on using renewable energy is a continuation of current management trends, the changes in energy consumption, energy availability, or costs compared to current conditions is of interest to NPS managers and the public.

The analysis of the effects of the actions contained in this plan on the parks' carbon footprint is based on a comparison with existing conditions. The baseline that is used for comparison is the carbon footprint of the no-action alternative, which is included in the "Natural Resources – Golden Gate National Recreation Area" section of Part 8. The park staff inventoried its emissions in 2006 as part of their *Climate Change Action Plan* using the NPS and EPA CLIP tool. The CLIP tool converts emissions of various greenhouse gases into a common "metric tons of carbon dioxide equivalent" unit, which provides a basis for comparison among gases and simplifies reduction tracking. The conversion of a greenhouse gas to metric tons of carbon equivalent is based upon how strongly that particular gas contributes to the greenhouse effect, and how many tons of carbon emission would have the same effect.

The carbon footprint of each action alternative was calculated using the CLIP tool. National Park Service staff input energy consumption information (gallons of diesel fuel used, kilowatt hours per year, miles driven) into the CLIP tool based on assumptions made for facility use (square footage of building space), NPS operations, and recreational demand. Actions that had attributing emissions were assessed in comparison to existing conditions. The CLIP tool produces quantitative measures of gross emissions, measured as metric ton carbon dioxide equivalent (MTCO₂e). This data provides a measurement of the carbon footprint. While the gross emissions of the alternatives are expressed numerically, the impact analysis (especially for effects on park resources) is general and qualitative. Overall, the goal of the analysis was to assist park managers with evaluating carbon footprint as part of their decision-making process.

The thresholds to determine the impact intensity for carbon footprint are defined as follows:

Negligible: The action would result in a change in total greenhouse gas emissions, but the change would be at the lowest level of detection, or not measurable. Impacts would not result in a change to local air quality.

Minor: The action would result in a slight, but detectable, change in total greenhouse gas emissions. Impacts could result in a change to local air quality, but the change would be so slight that it would not be of any measurable or perceptible consequence.

Moderate: The action would result in a modest change in total greenhouse gas emissions, which could result in a change to local air quality.

Major: The action would result in a substantial change in total greenhouse gas emissions, which could result in a change to local air quality.

Carbon Footprint and Air Quality - GGNRA

No-action Alternative

Analysis

The continuation of current conditions and management would continue to result in adverse impacts to air quality/carbon footprint. Baseline greenhouse gas (GHG) emissions (2008) for Golden Gate National Recreation Area (park lands in Marin and San Francisco counties only; no data is available for San Mateo County) are estimated at 4,891 MTCO_{2e}. Emissions from mobile combustion represent about 50% of gross emissions.

At Alcatraz Island, mobile combustion associated with the operation of the ferry concession would continue to be the largest contributor of island GHG emissions. However, ferry service is increasingly efficient with supplemental energy from solar and wind power generation on-board. Stationary combustion associated with power generation using diesel generators would be mitigated by onsite generated renewable energy. With the construction of the solar array, 60% of the island's energy will be generated by the sun, and thereby reduce total emissions. Total GHG emissions for Alcatraz Island under the no-action alternative would be 1,927 MTCO_{2e}.

Total gross emissions of the entire Golden Gate National Recreation Area/Alcatraz Island (excluding San Mateo) would be 6,818 MTCO_{2e}.

Greenhouse Gas emissions from visitors and NPS operations do contribute to elevated ozone and other air quality concerns. The National Park Service would continue to reduce greenhouse gas emissions by reducing energy consumption and replacing high-emitting apparatus with green technology—a beneficial impact.

Overall, when compared to background levels of air pollution and GHG emissions in the region or the nation (estimated at 6 billion in 2007), impacts to air quality from the no-action alternative would be long term, adverse, and negligible.

Conclusion

Total gross emissions of the entire Golden Gate National Recreation Area and Alcatraz Island (excluding San Mateo) would be 6,818 MTCO_{2e}, resulting in long-term, minor to moderate, adverse impacts to the park's carbon footprint. Overall, when compared to background levels of air pollution and GHG emissions in the region or the nation (estimated at 6 billion in 2007), impacts to air quality from the no-action alternative would be long term, adverse, and negligible.

Alternative 1: Connecting People with the Parks (NPS Preferred Alternative for Park Sites in Marin, San Francisco, and San Mateo Counties)

Analysis

Although visitor opportunities would be expanded and enhanced under alternative 1, the levels and patterns of visitor use and travel within the park under alternative 1 would remain substantially the same as under the no-action alternative; consequently, the impacts to air quality/carbon footprint resulting from visitor use at Golden Gate National Recreation Area would be the same as under the no-action alternative.

Impacts to air quality/carbon footprint from new recreational development under alternative 1 would result in short-term, minor, adverse impacts due to emissions associated with construction activities. Long-term, adverse impacts on air quality/carbon footprint would also be expected due to increases in energy consumption and related emissions attributed to these new facilities.

Beneficial impacts would occur from the removal of a modest number of facilities and structures that use energy for their operation and maintenance, resulting in long-term reductions in air quality emissions and the carbon footprint. Short-term adverse impacts to air quality would occur as a result of the construction activities needed to remove the facilities and reclaim the disturbed sites.

Under alternative 1, gross emissions for the three-county area of Golden Gate National Recreation Area would be increased by 4% to 5,104 MTCO_{2e}.

At Alcatraz Island, visitor opportunities would be expanded and there would be access to more areas on the island, resulting in increased ferry transportation and visitor use. This would result in slightly increased emissions associated with the ferry concession (mobile combustion) and wastewater treatment. Emissions associated with energy use would also increase due to increases in facility usage and energy demand. Gross emissions for Alcatraz Island under alternative 1 could increase by about 14% to 2,188 MTCO_{2e}.

The combined effect of the actions included in alternative 1 would increase the gross emissions of the entire park (the three-county area and Alcatraz Island) by 7% to 7,292 MTCO_{2e}. This would result in long-term, minor, adverse impacts on the Park Service's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Conclusion

The combined effect of the actions included in alternative 1 would increase the gross emissions of the entire park (the three-county area and Alcatraz Island) by 7% to 7,292 MTCO_{2e}. This would result in long-term, minor, adverse impacts on the National Park Service's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Alternative 2: Preserving and Enjoying Coastal Ecosystems

Analysis

Although visitor opportunities would be expanded and enhanced under alternative 2, the levels and patterns of visitor use and travel within Golden Gate National Recreation Area would remain substantially the same as under the no-action alternative; consequently, the impacts to air quality/carbon footprint resulting from visitor use would be the same as under the no-action alternative.

Impacts to air quality/carbon footprint from new recreational development under alternative 2 would result in short-term, minor, adverse impacts due to emissions associated with construction activities. Long-term, adverse impacts on air quality/carbon footprint would also be expected due to increases in energy consumption and related emissions attributed to these new facilities.

Beneficial impacts would occur from the removal of certain facilities and structures that use energy for their operation and maintenance, resulting in long-term reductions in air quality emissions and the carbon footprint. Short-term adverse impacts to air quality would occur as a result of the construction activities needed to remove the facilities and reclaim the disturbed sites.

Under alternative 2, gross emissions for the three-county area of Golden Gate National Recreation Area would be reduced by 4% to 4,708 MTCO_{2e}, the lowest of all of the alternatives for the three-county area.

At Alcatraz Island, visitor opportunities would be expanded and would result in increased ferry transportation and visitor use on the island. This would result in slightly increased emissions associated with the ferry concession (mobile combustion) and wastewater treatment. Emissions associated with energy use would also increase due to increases in facility usage and energy demand. Gross emissions for Alcatraz Island under alternative 2 would increase by about 6% to 2,050 MTCO_{2e}, the lowest of the three action alternatives for Alcatraz Island.

The combined effect of the actions included in alternative 2 would reduce the gross emissions of the entire park (the three-county area and Alcatraz Island) by 1% to 6,758 MTCO_{2e}, the lowest of all of the alternatives. This would result in long-term, minor, beneficial impacts on the park's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Conclusion

The combined effect of the actions included in alternative 2 would reduce the gross emissions of the entire park (the three-county area and Alcatraz Island) by 1% to 6,758 MTCO_{2e}, the lowest of all of the alternatives. This would result in long-term, minor, beneficial impacts on the park's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Alternative 3: Focusing on National Treasures (NPS Preferred Alternative for Alcatraz Island)

Analysis

Although visitor opportunities would be expanded and enhanced under alternative 3, the levels and patterns of visitor use and travel within the park under alternative 1 would remain substantially the same as under the no-action alternative; consequently, the impacts to air quality/carbon footprint resulting from visitor use would be the same as under the no-action alternative.

Impacts to air quality/carbon footprint from new recreational development under alternative 3 would result in short-term, minor, adverse impacts due to emissions associated with construction activities. Long-term, adverse impacts on air quality/carbon footprint would also be expected due to increases in energy consumption and related emissions attributed to these new facilities.

Beneficial impacts would occur from the removal of certain facilities and structures that use energy for their operation and maintenance, resulting in long-term reductions in air quality emissions and the carbon footprint. Short-term adverse impacts to air quality would occur as a result of the construction activities needed to remove the facilities and reclaim the disturbed sites.

Under alternative 3, gross emissions for the three-county area of the park would be reduced by 2% to 4,799 MTCO_{2e}.

At Alcatraz Island, visitor opportunities would be expanded and would result in increased ferry transportation and visitor use on the Island. This would result in slightly increased emissions associated with the ferry concession (mobile combustion) and wastewater treatment. Emissions associated with purchased electricity would also increase due to increases in facility usage and energy demand. Gross emissions for Alcatraz Island under alternative 3 would increase by about 7% to 2,062 MTCO_{2e}.

The combined effect of the actions included in alternative 3 would increase the gross emissions of the entire park (the three-county area and Alcatraz Island) by 1% to 6,861 MTCO_{2e}. This would result in long-term, minor, adverse impacts on the park's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Conclusion

The combined effect of the actions included in alternative 3 would increase the gross emissions of the entire park (the three-county area and Alcatraz Island) by 1%, to 6,861 MTCO_{2e}. This would result in long-term, minor, adverse impacts on the park's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Carbon Footprint and Air Quality – Muir Woods

No-action Alternative

Analysis

The continuation of current conditions and management would continue to result in adverse impacts to air quality/carbon footprint. Baseline GHG emissions (2008) for Muir Woods National Monument are estimated at 2,257 MTCO_{2e}.

Mobile combustion associated with visitor travel in personal automobiles and the pilot shuttle would continue to be the largest contributor of GHG emissions (2,179 MTCO_{2e}), representing about 96% of gross emissions at the monument.

Greenhouse gas emissions from visitors and NPS operations do contribute to elevated ozone and other air quality concerns. The National Park Service would continue to reduce greenhouse gas emissions by reducing energy consumption and replacing high-emitting apparatus with green technology—resulting in a beneficial impact.

Overall, when compared to background levels of air pollution and GHG emissions in the region or the nation (estimated at 6 billion in 2007), impacts to air quality from the no-action alternative would be long term, adverse, and negligible.

Conclusion

Total gross emissions for Muir Woods National Monument would be estimated at 2,257 MTCO_{2e}, resulting in long-term, minor, adverse impacts to the monument's carbon footprint. Overall, when compared to background levels of air pollution and GHG emissions in the region or the nation (estimated at 6 billion in 2007), impacts to air quality from the no-action alternative would be long term, adverse, and negligible.

Alternative 1: Connecting People with the Parks (NPS Preferred Alternative for Park Sites in Marin, San Francisco, and San Mateo Counties)

Analysis

Under alternative 1 visitor travel to the monument would be altered so that dependency on personal automobiles would be reduced. About 25% of parking would be removed and the Muir Woods shuttle would be expanded and could run on compressed natural gas, a lower emissions fuel. As a result, mobile combustion is estimated to be reduced by 20% to 1,740 MTCO_{2e}. When compared to the no-action alternative, impacts to air quality/carbon footprint would be reduced—resulting in a beneficial impact.

Emissions from stationary combustion and purchased electricity would be slightly reduced when compared to the no-action alternative as result of facility removal and corresponding reductions in energy usage. Emissions associated with wastewater treatment and solid waste would be the same as under the no-action alternative.

Short-term adverse impacts to air quality would occur as a result of the construction activities needed to remove facilities (buildings and parking areas) and reclaim the disturbed sites.

Long-term, adverse impacts on air quality/carbon footprint would also be expected due to increases in energy consumption and related emissions attributed to the new welcome center/shuttle parking located on Highway 101.

The combined effect of the actions included in alternative 1 is estimated to decrease the gross emissions of Muir Woods National Monument by 20% to 1,812 MTCO_{2e}. This would result in long-term, minor, beneficial impacts on the Park Service's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Conclusion

The combined effect of the actions included in alternative 1 is estimated to decrease the gross emissions of Muir Woods National Monument by 20% to 1,812 MTCO_{2e}. This would result in long-term, minor, beneficial impacts on the Park Service's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Alternative 2: Preserving and Enjoying Coastal Ecosystems

Analysis

Under alternative 2 visitor travel to the monument would be altered so that dependency on personal automobiles would be significantly reduced. Most of the parking at the monument would be removed and the Muir Woods shuttle would be expanded to a year-round operation and could run on compressed natural gas, a lower emissions fuel. As a result, mobile combustion is estimated to be reduced by 85% to 333 MTCO_{2e}. When compared to the no-action alternative, impacts to air quality/carbon footprint would be reduced—resulting in a beneficial impact.

Emissions from stationary combustion and purchased electricity would be slightly reduced when compared to the no-action alternative as result of facility removal and corresponding reductions in energy usage. Emissions associated with wastewater treatment and solid waste would be the same as under the no-action alternative.

Short-term adverse impacts to air quality would occur as a result of the construction activities needed to remove facilities (buildings and parking areas) and reclaim the disturbed sites as well as from the restoration of Redwood Creek.

Long-term, adverse impacts on air quality/carbon footprint would also be expected due to increases in energy consumption and related emissions attributed to the new welcome center/shuttle parking located on Highway 101.

The combined effect of the actions included in alternative 2 is estimated to decrease the gross emissions of Muir Woods National Monument by 82% to 401 MTCO_{2e}. This would result in long-term, major, beneficial impacts on the Park Service's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Conclusion

The combined effect of the actions included in alternative 2 is estimated to decrease the gross emissions of Muir Woods National Monument by 82% to 401 MTCO_{2e}. This would result in long-term, major, beneficial impacts on the Park Service's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Alternative 3: Focusing on National Treasures (NPS Preferred Alternative for Muir Woods National Monument)

Analysis

Under alternative 3 visitor travel to the monument would be altered so that dependency on personal automobiles would be reduced. About 25% of parking would be removed and the Muir Woods shuttle would be expanded and could run on compressed natural gas, a lower emissions fuel. As a result, mobile combustion is estimated to be reduced by 20% to 1,740 MTCO_{2e}. When compared to the no-action alternative, impacts to air quality/carbon footprint would be reduced—resulting in a beneficial impact.

Emissions from stationary combustion and purchased electricity would be slightly reduced when compared to the no-action alternative as result of facility removal and corresponding reductions in energy usage. Emissions associated with wastewater treatment and solid waste would be the same as under the no-action alternative.

Short-term adverse impacts to air quality would occur as a result of the construction activities needed to remove facilities (buildings and parking areas) and reclaim the disturbed sites as well as from targeted restoration of Redwood Creek.

The combined effect of the actions included in alternative 3 is estimated to decrease the gross emissions of Muir Woods National Monument by 20% to 1,813 MTCO₂e. This would result in long-term, minor, beneficial impacts on the Park Service's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.

Conclusion

The combined effect of the actions included in alternative 3 is estimated to decrease the gross emissions of Muir Woods National Monument by 20% to 1,813 MTCO₂e. This would result in long-term, minor, beneficial impacts on the Park Service's carbon footprint. As in the no-action alternative, impacts to air quality (when compared to background levels of air pollution in the region and nation) would be negligible.