



**Produced by the NPS Environmental Leadership Program, with technical assistance from EPA's Office of Air and Radiation/Office of Atmospheric Programs Climate Change Division/Program Integration Branch and NPS's Natural Resources Stewardship and Science Division.**

This document reports the accomplishments of Delaware Water Gap National Recreation Area (NRA) staff who participated in the joint NPS and EPA Climate Friendly Places (CFP) Workshop in November 2005. In conjunction with their Environmental Management System (EMS) planning, Delaware Water Gap NRA developed the following commitments to reduce greenhouse gases and criteria air pollutants through the climate friendly management of transportation, energy, and waste, as well as increased outreach and education efforts.

## **THE CHALLENGE OF CLIMATE CHANGE**

Climate change presents significant risks and challenges to the National Park System. Imagine Glacier Bay National Park & Preserve without any glaciers, or vast sections of the freshwater Everglades submerged by rising seas. Imagine vast changes in the forests of Delaware Water Gap NRA including forest fragmentation through widespread urban development and the increased invasion of pests and pathogens as the climate warms and tree species shift. These scenarios are all potential consequences of future climate change. While climate change could benefit some parks, bringing longer seasons for camping and other temperate-weather pursuits, providing longer growing seasons for many plants, and improving conditions for species at the northern limits of their range, many parks are at risk of losing their natural identity and unique resources as the effects of climate change are realized.

Delaware Water Gap NRA is a 70,000 acre span that encompasses much of eastern Pennsylvania and western New Jersey. The Delaware River runs through the park and is of exceptional quality, but it is not contained within the park so the park alone cannot protect the river. The single greatest threat to Delaware Water Gap NRA is the increased urbanization around the park boundaries. As the residential population increases, the park is realizing effects on water quality and air quality. In addition, large portions of the surrounding communities use the primary park highway as a thoroughfare for jobs and this generates a large source of greenhouse gas and criteria air pollutant emissions in the park. Possible effects of climate change in Delaware Water Gap NRA include vast changes in migration patterns of birds and animals as forests are fragmented, an increase in heat-related deaths in urban areas, reduced air quality with correlating health

problems, and more extreme weather events such as droughts, floods, freezes, and thaws.

Scientists cannot predict the severity of future climate change or its impacts with certainty. However, the current warming trend suggests that the problem is real and should be taken seriously. Average global temperatures on the Earth's surface have increased about 1.1°F since the late 19<sup>th</sup> century, and the 10 warmest years of the 20<sup>th</sup> century all occurred in the last 15 years. The single leading cause of this warming is linked to the buildup of greenhouse gases in the atmosphere—primarily carbon dioxide, methane, and nitrous oxide—which trap heat that otherwise would be released to space.

Many scientists believe that the continued addition of carbon dioxide and other greenhouse gases to the atmosphere is likely to raise the Earth's average temperature more rapidly in the next century; a global average warming of 4-7°F by the year 2100 is considered likely. Rising global temperatures would further raise sea level and would affect all aspects of the water cycle, including snow cover, mountain glaciers, timing of spring runoff, water temperature, and aquatic life. Climate change also could affect human health, alter crops, animal habitats, and many other features of our natural and managed environments.

## GREENHOUSE GAS AND CRITERIA AIR POLLUTANT EMISSIONS AT DELAWARE WATER GAP NATIONAL RECREATION AREA

Naturally occurring greenhouse gases (GHGs) include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and water vapor. Human activities (e.g., fuel combustion in stationary and mobile sources, agriculture, and waste generation) lead to increased concentrations of these gases in the atmosphere. In addition, there are other more powerful GHGs—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>)—called high-global warming potential (high-GWP) gases that are created in smaller quantities by various industrial processes such as aluminum, iron, and steel production. While GHGs contribute to climate change on a global scale, the impacts of criteria air pollutants (CAPs) are often local and regional in nature. CAPs, which lead to numerous air quality and public health problems, include sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), volatile organic compounds (VOC), particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>), and carbon monoxide (CO)

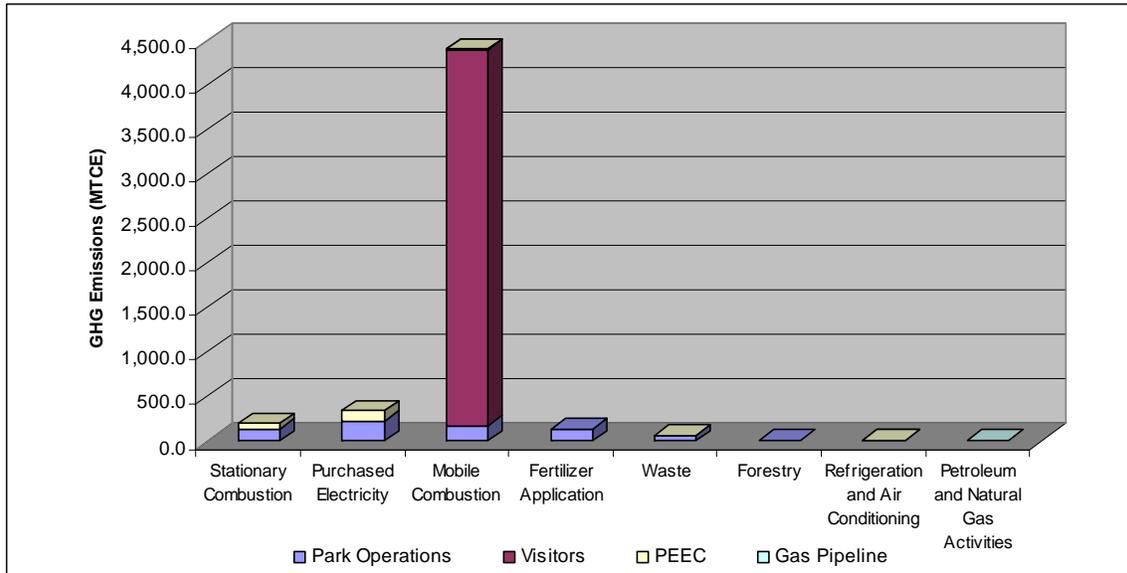
Delaware Water Gap NRA is the sixth park to complete an inventory of its GHG emissions and the twenty-seventh park to complete an inventory of its CAP emissions. The GHG and CAP inventory completed for Delaware Water Gap NRA was developed by the park, with minimal EPA and NPS assistance, using the Climate Leadership in Parks (CLIP) tool. The purpose of the Excel-based tool is to enable park personnel to complete GHG and CAP inventories themselves. In the past, the Climate Friendly Parks program was limited in the number of parks it could reach due to the large amount of resources required to put on a workshop, including the conducting of a comprehensive inventory. The CLIP tool guides park personnel through the various steps involved in estimating emissions, automates the calculations, and generates summary reports and reduction targets for the park. By enabling parks to develop their own inventories and action plans, EPA and NPS hope to expand the Climate Friendly Parks program to many more parks than would otherwise be possible.

THE CLIMATE LEADERSHIP IN PARKS (CLIP) tool is an interactive, user-friendly spreadsheet model that will be distributed to the National Parks. The CLIP tool gives park staff the information they need to calculate and reduce GHG and CAP emissions, which result from various park activities including, among others, energy consumption, visitor transportation, and waste management.

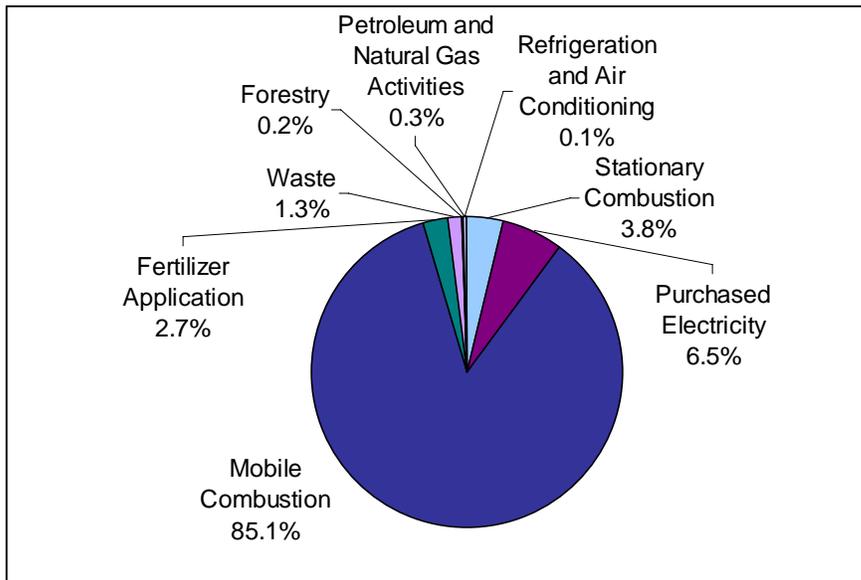
### Greenhouse Gas Emissions

In 2004, Delaware Water Gap's GHG emissions totaled 5,185 metric tons of carbon equivalent (MTCE). As Figure 1 demonstrates, these emissions were estimated for stationary combustion, purchased electricity, mobile combustion (i.e., highway vehicles, non-road equipment, and watercraft), fertilizer application, landfilled waste, air conditioning and refrigeration, forestry (i.e., burning of forested land), and petroleum and natural gas activities (a gas pipeline crosses the park).

**Figure 1 – Delaware Water Gap NRA’s 2004 GHG Emissions by source and park emitting entity**



**Figure 2 – Sources of Delaware Water Gap NRA’s 2004 GHG emissions by percent of total GHG emissions**



As Figure 2 shows, mobile combustion represent Delaware Water Gap’s greatest source of GHG emissions by far (85 percent of total), with most of those emissions coming from visitors’ automobiles. Emissions from purchased electricity (7 percent) are the second largest source and are distributed between park operations and the Pocono Environmental Education Center (PEEC), the park’s main concessionaire. Stationary combustion accounts for about 4 percent of emissions; fertilizer application supplied 3 percent, and waste 1 percent. The remaining sources (refrigeration, forestry, and the gas pipeline) each account for less than one percent of GHG emissions.

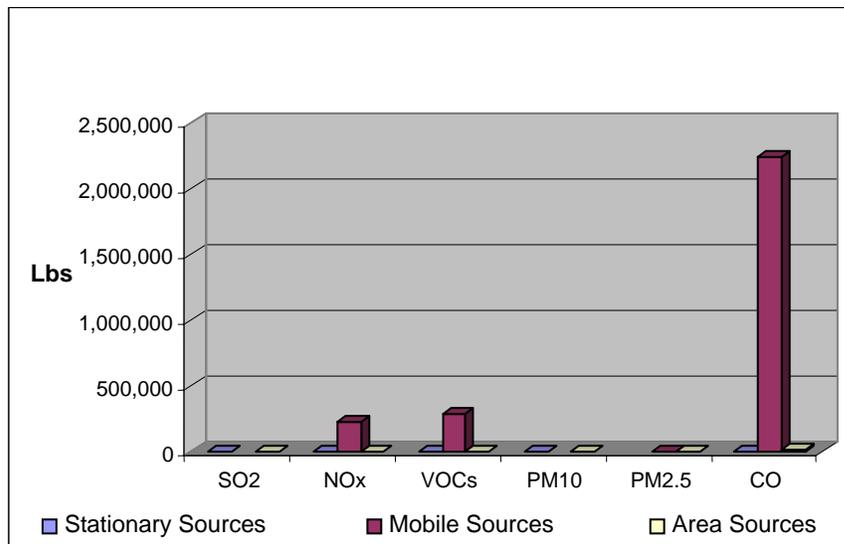
**Criteria Air Pollutant Emissions**

Sources of CAP emissions for this study included stationary sources (e.g., furnaces and fuel tanks), mobile sources, and area sources (e.g., burning of forested land). All three park units (park operations, visitors, and PEEC) contributed to these emissions.

Table 1 and Figure 3 present the results of Delaware Water Gap’s 2004 CAP emission inventory. Mobile sources are the largest source of emissions, and CO accounts for the largest share of emissions. Visitor vehicles produced ninety-seven percent of the CO, and ninety-nine percent of the VOCs and NO<sub>x</sub>. Stationary combustion accounts for most of the SO<sub>2</sub> produced; however, in relation to other pollutants, the emissions of this gas are low. The burning of forested land accounts for most of the particulate matter emitted.

The fact that visitors are responsible for the most GHG and CAP emissions underscores the park’s popularity. This popularity creates an opportunity for Delaware Water Gap to reduce emissions both inside and outside park boundaries through education and outreach.

**Figure 3 – Delaware Water Gap NRA’s 2004 CAP emissions by gas and source**



**Table 1 – Delaware Water Gap NRA’s 2004 CAP emission results by gas and source (lbs)**

Source	CAP Emissions (lbs)					
	SO <sub>2</sub>	NO <sub>x</sub>	VOCs	PM <sub>10</sub>	PM <sub>2.5</sub>	CO
Stationary Combustion	238	938	1,597	21	NA	261
Park Operations	196	770	1,597	17	NA	214
PEEC	43	168	0	4	NA	47
Mobile Combustion	NA	229,108	288,503	NA	1,554	2,248,902
Park Operations	NA	2,866	3,854	NA	160	51,473
Visitors	NA	226,127	284,527	NA	1,392	2,195,360
PEEC	NA	114	122	NA	2	2,069
Area Sources	125	233	524	1,529	1,255	15,016
Park Operations	124	229	151	1,474	1,255	14,606
PEEC	1	4	372	55	0	410
<b>Total CAP Emissions</b>	<b>363</b>	<b>230,279</b>	<b>290,623</b>	<b>1,550</b>	<b>2,809</b>	<b>2,264,179</b>

## HOW DELAWARE WATER GAP IS RESPONDING TO CLIMATE CHANGE

Recognizing the significance of climate change and the potential it has to alter so many aspects of the park, including the long-term sustainability of park resources and land, workshop participants proposed three topics where climate change mitigation and air pollution reduction actions could be incorporated and the effects could be realized within a relatively short timeframe: transportation, energy, waste, and outreach and education. Based on these four areas, the group broke into four teams which then developed “climate friendly” objectives and targets that would be undertaken by Delaware Water Gap NRA’s employees and overseen by the park’s Environmental

Management Team (EMT). After the objectives and targets were established, each team determined the project(s) that would achieve those objectives and targets as well as the associated actions, timelines, parties responsible, and desired results comprising each project. These objectives and targets will be integrated into the EMS that Delaware Water Gap is developing and the park elected to include greenhouse gas reduction as an important component of its EMS. Delaware Water Gap NRA’s goals as a Climate Friendly Park bring more visibility to this issue while serving as a statement of the park’s commitment to reducing human-caused threats to the natural environment.

THE CLIMATE FRIENDLY PLACES PROGRAM is funded through an interagency agreement between the U.S. Environmental Protection Agency and the National Park Service. The program encourages and enables national parks and, in the future, entities such as state and local parks, refuges, schools and universities, zoos and aquariums, and science museums, to develop both short and long-term, comprehensive strategies to reduce their greenhouse gas (GHG) and criteria air pollutant (CAP) emissions. Furthermore, the program entails a commitment on the part of the participating park to educate the public about what actions the park is taking to mitigate its GHG and CAP emissions.

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### STRATEGY 1: REDUCE FUEL USE AND GHG EMISSIONS FROM TRANSPORTATION SOURCES

As the inventory results indicate, eighty-five percent of GHG emissions within Delaware Water Gap NRA are due to mobile combustion. In addition, the largest source of CAP emissions are mobile sources and the most emitted CAP gas is carbon monoxide (CO) at 2,248,902 pounds/year. Consequently, the reduction of fuel use and emissions from transportation within the park is a significant environmental aspect on which Delaware Water Gap staff chose to focus their climate friendly efforts.

#### Reduce Fuel Use and Emissions from Park Staff Transportation

Spanning a large portion of eastern Pennsylvania’s border and some of New Jersey’s northwestern border, Delaware Water Gap NRA is heavily traveled by commuters, visitors, and commercial vehicles. Unfortunately, it is difficult for the park to distinguish among these groups, so park staff chose to lead by example through reducing their fuel consumption by fifteen percent in the next three years, which will have quite an impact considering the amount of driving that is required of the staff to maintain such a large area. The actions Delaware Water Gap will take regarding staff transportation fuel and emissions reduction include:

- Investigating and evaluating park fleet needs and reducing the number of vehicles where possible;
- Encouraging trip planning and management by employees;
- Replacing vehicles with more fuel-efficient models by developing a vehicle replacement checklist with fuel efficiency as one of the criteria;
- Investigating fleet maintenance practices to achieve maximum vehicle efficiency; and
- Investigating fueling practices to incorporate fuel types that are more efficient.

### **Reduce Fuel Use and Emissions from Visitor Transportation**

The majority of Delaware Water Gap's GHG and CAP emissions were from visitor vehicles. Although it is difficult to reach the commercial vehicle drivers and commuters traveling through the park on a daily basis, Delaware Water Gap staff decided to approach the problem aggressively through the following commitments:

- Apply for funding to investigate alternative transportation for commuters and visitors;
- Host a Transportation Scholar to investigate and participate in regional planning transportation efforts;
- Promote the use of the McDade bicycle trail and provide parking for bicycle users;
- Encourage incidental business permit holders to provide a shuttle system for walkers, bicycle riders, and floaters; and
- Work with Pocono Mountain Vacation Bureau to educate their clientele and provide a climate friendly visit to the park.

### **Reduce Fuel Use and Emissions from Partner and Cooperator Transportation**

In addition to park staff and visitors, there are many concessionaires, camps, and other private entities operating on park grounds and contributing to the park's emissions. Delaware Water Gap will explore incentives, such as Revised Special Use Permits, for partners and cooperators to encourage a reduction in fuel consumption. Also, the park will incorporate an EMS component in all contracts and general agreements with partners and cooperators that addresses fuel consumption.

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## **STRATEGY 2: REDUCE EMISSIONS THROUGH ENERGY MANAGEMENT**

Improving energy efficiency and implementing alternative energy sources reduces park-based fuel use, lowers emissions, decreases electricity consumption, and offers monetary benefits to the park. Delaware Water Gap has made energy efficiency a priority in their energy management decisions.

**Maximize the Renewable Electric Energy Sources Available to the Park and Perform Energy Audits in Park Buildings to Increase Energy Efficiency**

In 2004, Delaware Water Gap's purchased electricity was the second most contributing source of the park's total GHG emissions. In order to reduce the park's emissions from purchased electricity, the park will assess the availability of green energy suppliers in the area, research state subsidy options, and negotiate a new contract with their current utility, PPL Electric Utilities. Additionally, the park wants to conduct energy audits in all occupied park buildings and selected historic buildings with the goal of decreasing energy demand by twenty-five percent based on 2004 data.

**Implement Sustainable Design and Construction of Park Assets**

To ensure that all future design and construction projects incorporate sustainable principles, Delaware Water Gap will implement the Leadership in Energy and Environmental Design (LEED) checklist to review all new projects. The following steps were identified by the park as action items to implement sustainable design and construction:

- Require LEED checklist on all design contracts;
- Identify potential low cost, low technology sustainable rehabilitation product options;
- Send park representatives for LEED training; and
- Train park staff on LEED checklist.

**Conserve Park Watersheds, Forests, and Landscapes**

Delaware Water Gap NRA identified the area of conservation, specifically in the areas of park watersheds, forests, and landscapes, as an important component to their overall energy management tactic. Population has doubled in the past fifteen years in Pike County (northern third of the park) alone and as a result, urbanization is a constant issue the park must address. By committing to the action items below, Delaware Water Gap hopes to prevent degradation of the water quality, maintain forests as emission sinks, reduce transportation emissions through the implementation of smart growth within the surrounding communities.

- Identify priority watersheds within the area and fill in any gaps of baseline data needed;
- Implement specific, identified components of the tri-state watershed management plan;
- Develop active partnerships with county and township zoning/planning boards that support smart growth;
- Develop regional smart growth planning consortium involving the Pinchot Institute and local conservation groups; and
- Investigate and develop seed funding from NPS-WRD.

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### **STRATEGY 3: WASTE MANAGEMENT**

Diverting the park's waste stream through increased recycling efforts and waste management procedures will reduce the amount of waste sent to landfills, the largest human-generated source of methane (a greenhouse gas) emissions in the United States. Recycling projects should include encouragements for staff, park visitors, and the general public to engage in emissions-reducing activities. For example, in conjunction with a more rigorous recycling program at the park including visitor-generated waste, Delaware Water Gap NRA will produce educational pamphlets, brochures, post recycling information on the park website, and put recycling tips in the park publication *Spanning the Gap*.

#### **Improve Current Waste Management System**

In conjunction with the visitor targeted recycling efforts, the park will institutionalize the park recycling programs for existing waste streams by:

- Educating park staff on recycling streams, schedules, pick-up locations, and the reasons why they should be recycling;
- Investigating the feasibility of offering incentives (i.e. time off of work, monetary compensation, donations to a charity or cause, recognition) for park employees or divisions to increase recycling; and
- Seeking other federal agencies to cooperate in the disposition of waste to encourage recycling.

Also, Delaware Water Gap set forth a detailed plan (refer to list below) to improve the park's existing recycling tracking systems for incorporation into the NPS Facility Management Software System (FMSS).

- Complete an Integrated Solid Waste Alternative Plan.
- Begin marketing the concept of modifying the FMSS to accommodate waste inventory data.
  - identify coordinator at park HQ
  - identify coordinator at WASO
  - identify other parks with the same need
- Recommend and encourage action from WASO in conjunction with other parks.
- Modify the FMSS so that it can accommodate the data.
- IF FMSS can't be modified, track data in park spreadsheets and create a system for updating regularly.

#### **Implement Green Procurement Practices**

An effective method of reducing the waste stream is to manage new procurements by requiring purchase of products made of recycled materials or with reduced packaging and other "green" practices. Delaware Water Gap will institutionalize green purchasing throughout the park via these action items:

- Distribute a list of required suppliers/products for purchases \$2500 or less;
- Incorporate green purchasing into audits;
- Conduct awareness training for park personnel regarding green purchasing;
- Develop and maintain a tracking system for green purchases; and
- Include green practices in evaluation criteria for contract selection.

As a first step in the park's green procurement process, the park committed to reinstate the program to purchase and use re-refined motor oil. Delaware Water Gap staff has set the goal of using re-refined motor oil in 100% of the motorized vehicles & equipment on park grounds.

#### **Program to Reduce Waste Generation by Park Visitors**

During the workshop, a few Delaware Water Gap NRA staff decided to organize a carry-in/carry-out pilot test for waste in a few selected areas of the park. Starting in 2006, a few sites will be identified for the pilot test, materials will be developed to publicize the pilot test in the selected areas, and the effectiveness of the pilot studies will be evaluated. If the pilot test yields positive results, it will inform future waste management policies and reduce the park labor cost from waste hauling.

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### **STRATEGY 4: INCREASE CLIMATE CHANGE OUTREACH AND EDUCATION**

Climate change is a complex issue, often ignored and minimally understood by the public. With a thorough understanding of the benefits of reducing GHG and CAP emissions in the park, Delaware Water Gap staff can serve as demonstrators of the park's climate change efforts, and as interpreters and educators for the public.

#### **Program to Incorporate Climate Change Issues into Park Staff Training**

By establishing an employee climate change education program, Delaware Water Gap NRA empowers park staff to integrate climate change knowledge and mitigation actions into their daily routines at all levels and provides more opportunity for climate friendly communication with the public. The park's target is to educate fifty percent of park employees about climate change issues within the next eighteen months. The components of the training program are as follows:

- Place signs on THINK mobiles to communicate the importance of using electric vehicles to employees;
- Develop an All Employee message from the Superintendent;
- Deliver climate change message at the All Employee meeting and Holiday luncheon; and
- Investigate the possibility of putting employee targeted signs on other vehicles & other demonstration projects.

### **Incorporate Climate Change Awareness into Visitor Education**

By obtaining space for climate change education displays in area visitor centers, Delaware Water Gap hopes to reach more visitors than would be possible through the park's visitor centers. The following tasks will contribute to Delaware Water Gap's goal of having four climate change park displays in four visitor centers within two years:

- Use EPA/NPS existing brochures and/or create a new brochure about the effects of climate change;
- Create Delaware Water Gap NRA staff contact cards, stickers, and giveaways with climate friendly messages for visitors;
- Contact area visitor centers and inquire about space for exhibits and/or brochure display;
- Create wayside exhibits;
- Investigate possibility of funding for brochures with the Delaware Water Gap Friends Group; and
- Incorporate climate friendly activities into park Junior Naturalist booklet.

### **Encourage Climate Change Awareness at Community & Builders/Suppliers Events**

As part of the climate change education of stakeholders within the community and partners, Delaware Water Gap will incorporate climate change issues into three community events and find partners to promote climate change education at the events. In order to increase the impact of climate change awareness, the park will also send a climate change education booth to a convention or trade show for builders and suppliers.

### **Facilitate Climate Change Education for State/Local Educators**

The educators of our nation should have access to climate change curriculum because they are responsible for educating and guiding our youth to be responsible citizens and future leaders. Delaware Water Gap NRA understands the positive impact that available climate change training could have on the nation's educators and students and has committed to the actions below:

- Investigate the possibility of establishing a Pennsylvania Governor's Institute for Climate Change curriculum;
  - Apply for a Parks as Classrooms grant;
  - Establish a series of Parks as Classrooms workshops for educators and professionals to develop a climate friendly parks curriculum;
  - Distribute Parks as Classrooms curriculum packets to schools throughout the states;
  - Host Parks as Classrooms professional development workshops; and
  - Present a climate change lesson plan focusing on national parks for students participating in the 2006 Enviro-thon.
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## CONCLUSION

Delaware Water Gap NRA has a unique opportunity to influence the thinking of large portions of the urban population in Pennsylvania, New Jersey, New York, and much of the Northeastern part of the United States. This report summarizes the operational actions that they have committed to in response to this important challenge. Important among these are actions to significantly reduce fuel use and emissions in the transportation area, to improve energy conservation in buildings, and develop better waste management procedures. Delaware Water Gap NRA recognizes that these actions alone will not prevent the changes predicted from climate change and have therefore put education and outreach as a priority action for these efforts.

The Climate Friendly Workshop at Delaware Water Gap NPA also served as an important enhancement mechanism for the park's established EMS. Realistic environmental commitments created by Delaware Water Gap staff and approved by the park's EMT, will significantly reduce the park's GHG and CAP emissions in the coming years. However, the greatest impact Delaware Water Gap NRA will have on climate change is the effectiveness and extent of climate change education available to the public at the park.

The ultimate objective is to have Delaware Water Gap NRA model climate friendly behavior for their visitors. The more climate friendly information that the park can convey to the public, the greater the possibility is that the public will respond through direct action. The park faces an uncertain future due to the possible effects of climate change. However, addressing the issues of climate change and air pollution through direct action and education can have far-reaching, positive consequences for the park's future.