

levels than the four-stroke engine. In addition, the EPA emission test data from outboard marine engines indicates that carbon monoxide emissions from four-stroke engines are lower than conventional two-stroke technology engines (EPA 1996). Although the EPA final regulation on emission standards does not contain standards for carbon monoxide, it is expected that the engine technology changes which would be used to meet the EPA standards would result in some modest carbon monoxide reductions (EPA 1996). Under the modified preferred alternative B, PWC used in the recreation area after 2012 will be required to be 100% compliant with the EPA 2006 emission standards for the manufacturing of gasoline marine engines, which would result in a substantial reduction in total emissions. Although there would not be a significant reduction in carbon monoxide emissions over the next ten years, based on the National Park Service model, they would be reduced from 3,168 to 2,955 tons per year assuming a 2% annual increase in visitor use.

Carbon monoxide related fatalities that have occurred in the recreation area have been a result of exposure to extremely high levels of carbon monoxide in confined, poorly ventilated spaces such as under a boat swimming platform or near exhaust ports. The levels of carbon monoxide presented in the analysis represent carbon monoxide levels over the entire recreation area, dispersed in a large volume of air, and are based on year-long boating activity. There has only been one reported fatality caused by carbon monoxide poisoning at the recreation area involving a PWC. This individual died while being towed on his broken PWC behind a motorboat. Nationally, of the 701 boating fatalities reported in 2000, five deaths were attributed to carbon monoxide. None of these deaths involved PWC.

The National Park Service is concerned about fatalities at Glen Canyon National Recreation Area related to carbon monoxide poisoning. The park has an active and aggressive campaign to inform visitors to the recreation area of the risk of carbon monoxide poisoning from exposure to boat generators, engines, and gas appliances. This safety information is provided to visitors at entrance gates, visitor centers, recreation area headquarters, and on the recreation area Web site.

49. One commenter asked the National Park Service to disclose the derivation of the 21% average engine

load as an assumption in the methodology of the air quality analysis.

*NPS Response:* The assumption of an average engine load of 21% for PWC was based on the activity data used in the EPA NONROAD model.

50. One commenter expressed concern over the inconsistencies in the Draft Environmental Impact Statement regarding the volatilization of pollutants to the air and water. This commenter stated that the text should use the same percentage for how much and which pollutants volatilize in both the air and water quality impacts sections. No estimate of the percent that volatilizes is given in the water quality section. In the air quality section it is stated that up to 30% of the fuel from PWC is unburned and is discharged as gaseous hydrocarbons (Draft Environmental Impact Statement, p. 181). The numbers should be consistent for the analysis.

*NPS Response:* The Draft Environmental Impact Statement incorrectly stated that 30% of the fuel is exhausted into the air. However, the Final Environmental Impact Statement correctly states that up to one-third of the fuel delivered to the two-stroke carbureted PWC engine is unburned and discharged into the water instead of exhausted into the air. It is difficult to determine how much of the fuel is volatilized into the atmosphere. As stated in "Methodology and Assumptions" section under "Air Quality," many organic pollutants that are initially dissolved in the water volatilize to the atmosphere, especially if they have high vapor pressures, are lighter than water, and mixing occurs at the air/water interface. It is difficult to assess the specific evaporation rates of exhaust pollutants from PWC because the rates will differ according to the ratio of gas to oil used, by fuel brand, by engine, and operating conditions such as temperature and water aeration.

In 1994, the EPA released a public memorandum entitled "The Effects of Marine Engine Exhaust on Water Quality: Summary of Findings of Various Research Studies." This document summarizes 11 research papers and presents volatilization rates and dilution ratios for observable effects such as taste, odor, and generation of oil film.

At temperatures commonly found in Lake Powell during the summer boating season (77°F–86°F), 78–84% of the gasoline/oil mixture (50:1) for carbureted two-stroke engines would be evaporated from the water to the air in 1.2 hours. This EPA review also cites a study by the Boating Industrial Association (1974) that describes the two-stroke gas/oil mixture as having an

11-day half-life in still water (such as a laboratory tank) and a half-life of less than one day in open, aerated water (such as a lake). A description of the volatile nature of five gasoline constituents has been provided in the "Water Quality" section of the "Affected Environment" chapter.

51. One commenter requested that the Final Environmental Impact Statement include updated information on the July 2002 EPA proposed cleaner evaporative standards for PWC.

*NPS Response:* The text in the "Air Quality Methodology and Assumption" section of the "Environmental Consequences" chapter has been changed to include the proposed EPA evaporative standards.

52. One commenter argued that the National Park Service based its findings on recent studies suggesting that changing from two-stroke carbureted to two stroke direct injection PWC engines might increase PAH emissions. A study by Norman Y. Kado et al, *Airborne Particle Emissions from two- and four-stroke Outboard Marine Engines: Polycyclic Aromatic Hydrocarbon and Bioassay Analysis*, (hereinafter referred to as "Kado Study") quantified PAH concentrations in airborne particulate emissions. The Kado Study showed that the PAH emissions from the direct-injection two-stroke engines tested were greater than from carbureted two-stroke engines. The direct-injection two-stroke outboard engine used in that study was a 1999 model and represented very early technology, and the results of the study are not applicable to newer model direct-injection outboard engines, much less PWC engines.

*NPS Response:* The NPS disagrees with the commenters conclusions. In addition, because many older engines would still be allowed to operate at Lake Powell through 2012, the National Park Service assumes that there would be increased PAH emissions and the Kado Study is relevant. Also, a recent study dated 2003 by the Tahoe Regional Planning Agency (hereinafter referred to as "TRPA Study") compared the concentrations of PAH compounds released into the water and found that the two-stroke carbureted outboard engine emitted lower PAH levels into the water than did the two-stroke direct-injected engine. The four-stroke carbureted outboard engine emitted the lowest PAH levels, as well as other gasoline-related contaminants into the water (TRPA Study dated 2003; CARB). So, while conversion of some carbureted two-stroke engines to direct-injection two-stroke engines would result in increased PAH emissions, the concurrent conversion to four-stroke