National Park Service
U.S. Department of the Interior

Lake Meredith National Recreation Area
Texas

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LAKE MEREDITH
NATIONAL RECREATION AREA

Personal Watercraft Use
Environmental Assessment

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National Park Service
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Texas

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Personal Watercraft Use
Environmental Assessment

February 2003

SUMMARY

Lake Meredith National Recreation Area is near Fritch, Texas, in the center of the Texas Panhandle, about 40 miles north of Amarillo, Texas. Lake Meredith was formed in the 1960s when the U.S. Bureau of Reclamation constructed Sanford Dam on the Canadian River. The dam was built to supply water to 11 communities in the Panhandle by means of 322 miles of pipeline. The national recreation area consists of about 45,000 acres; the reservoir covers about 10,000 acres.

Lake Meredith is a major site of water-based recreation in the Panhandle, averaging more than 1.5 million visits per year from 1992 to 1999. There are no comparable large bodies of water or land that provide such recreational diversity in the Panhandle area. The waters of Lake Meredith National Recreation Area support a major sport fishery, and facilities for camping, picnicking, and boating are also provided. Lake Meredith is the only public land in a radius of approximately 50 miles that permits the hunting of deer, quail, ducks, and other migratory birds.

The purpose of and the need for taking action is to evaluate a range of alternatives and strategies for managing personal watercraft (PWC) use at Lake Meredith National Recreation Area in order to ensure the protection of park resources and values while offering recreational opportunities as provided for in the national recreation area's enabling legislation, purpose, mission, and goals. Upon completion of this process in accordance with the National Environmental Policy Act (NEPA), the National Park Service (NPS) may either take action to adopt special regulations to manage PWC use, or it may discontinue PWC use at this park unit.

BACKGROUND

More than one million PWC are estimated to be in operation today in the United States. Sometimes referred to as "Jet Skis" or "Wet Bikes," these vessels use an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. They are used for enjoyment, particularly for touring and maneuvers such as wave jumping, and they are capable of speeds in the 60 mph range. While PWC use remains a relatively new recreational activity, it has occurred in 32 of the 87 national park system units that allow motorized boating.

After studies in Everglades National Park showed that PWC use resulted in damage to vegetation, adversely impacted shorebirds, and disturbed the life cycles of other wildlife, the National Park Service prohibited PWC use by a special regulation at the park in 1994. In recognition of its duties under its Organic Act and NPS *Management Policies,* as well as increased awareness and public controversy about PWC use, the National Park Service subsequently reevaluated its methods of PWC regulation. Historically, the Park Service had grouped personal watercraft with all vessels; thus, PWC use was allowed when the superintendent's compendium allowed the use of other vessels. Later the National Park Service closed seven units to PWC use through the implementation of horsepower restrictions, general management plan revisions, and park-specific regulations such as those promulgated by Everglades National Park.

In May 1998 the Bluewater Network filed a petition urging the National Park Service to initiate a rulemaking process to prohibit PWC use throughout the national park system. In response to the petition, the National Park Service issued an interim management policy requiring superintendents of parks where PWC use can occur but had not yet occurred to close the unit to such use until the rule was finalized. The National Park Service envisioned the servicewide regulation as an opportunity to evaluate impacts from PWC use before authorizing the use. On March 21, 2000, the Park Service

issued a regulation prohibiting PWC use in most units and required 21 units to determine the appropriateness of continued PWC use.

In response to the PWC final regulation, Bluewater Network sued the National Park Service, challenging the agency's decision to allow continued PWC use in 21 units while prohibiting that same use in other units. In response to the suit, the Park Service and the environmental group negotiated a settlement. Each park desiring to continue long-term PWC use must promulgate a park-specific special regulation in 2002. In addition, the settlement stipulates that the Park Service must base its decision to issue a park-specific special regulation to continue PWC use through an environmental analysis conducted in accordance with National Environmental Policy Act (NEPA). The NEPA analysis at a minimum, according to the settlement, must evaluate PWC impacts on water quality, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety.

As the settlement deadline approached and the park units were preparing to prohibit PWC use, the National Park Service, Congress, and PWC user groups sought legal methods to keep the parks open to this activity. However, no method was successful. On November 7, 2002, this park unit closed to PWC use. If as a result of this environmental assessment an alternative is selected that would allow PWC use to continue, then a special regulation to authorize that use will be drafted.

ALTERNATIVES CONSIDERED

This environmental assessment evaluates three alternatives concerning PWC use at Lake Meredith.

- Alternative A — Continue PWC use under a special regulation.
- Alternative B — Continue PWC use under a special regulation with new management strategies and mitigation to reduce user conflicts in certain lake areas (preferred alternative).
- No-action alternative — Discontinue PWC use entirely.

Based on the environmental analysis prepared for PWC use at Lake Meredith, alternative B is the park's preferred alternative and is also considered the environmentally preferred alternative because it would best fulfill park responsibilities as trustee of this sensitive habitat; ensure safe, healthful, productive, and aesthetically and culturally pleasing surroundings; and attain a wider range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences.

ENVIRONMENTAL CONSEQUENCES

Impacts of the three PWC management alternatives were assessed in accordance with *Director's Order #12: Conservation Planning, Environmental Impact Analysis and Decision-making (DO #12).* The *DO #12 Handbook* requires that impacts to park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision-makers to understand the implications of those impacts in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists.

To determine impacts, methodologies were identified to measure the change in park resources that would occur with the implementation of the PWC management alternatives. Thresholds were established for each impact topic to help understand the severity and magnitude of changes in resource conditions, both adverse and beneficial.

Each PWC management alternative was compared to a baseline to determine the context, duration, and intensity of resource impacts. The baseline, for purposes of impact analysis, is the continuation of PWC use and current management projected over the next 10 years (alternative A).

Table A summarizes the results of the impact analysis for the impact topics that were assessed. The analysis assumed alternatives would be implemented beginning in 2002 and considered a 10-year period, from 2002 to 2012.

TABLE A: SUMMARY OF THE IMPACT ANALYSIS

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
Water Quality	PWC use impacts: Short- and long-term, negligible, adverse impacts based on ecotoxicological and human health benchmarks. Cumulative effects: Negligible adverse impacts in 2002 and 2012 from all organic compounds except benzene. Moderate adverse impacts from benzene in 2002, decreasing to minor by 2012 due to improved emission controls.	PWC use impacts: Short- and long-term, negligible, adverse impacts based on ecotoxicological and human health benchmarks. Beneficial impacts from additional management restrictions. Cumulative effects: Negligible adverse impacts in 2002 and 2012 from all organic compounds except benzene. Minor to moderate adverse impacts from benzene in 2002, decreasing to negligible by 2012 due to improved emission controls, no-wake zones, and a PWC user education program.	PWC use impacts: Beneficial impact on water quality relative to alternative A. Cumulative effects: Negligible impacts for all organic compounds except benzene in 2002 and 2012. Minor adverse impacts from benzene in 2002, decreasing to negligible by 2012.
Air Quality			
• Impacts to Human Health from Airborne Pollutants Related to PWC Use	PWC use impacts: Minor adverse impacts from CO and negligible impacts from VOC, PM_{10}, and NO_x in 2002 and 2012. Cumulative effects: Moderate adverse impacts from CO and VOC, and negligible impacts from PM_{10} and NO_x in 2002. Slight reduction in impacts by 2012 but still moderate for CO and negligible for PM_{10} and NO_x.; VOC impact level reduced to minor.	PWC use impacts: Slight reduction in impact levels compared to alternative A but still minor adverse impacts from CO and negligible impacts from VOC, PM_{10}, and NO_x in 2002 and 2012. Cumulative effects: Moderate adverse impacts from CO, and negligible impacts from PM_{10} and NO_x in 2002 and 2012. Minor adverse impacts from VOC in 2002, decreasing to negligible in 2012.	PWC use impacts: Beneficial impacts on air quality from banning PWC use. Cumulative effects: Moderate adverse impacts from CO and negligible impacts from PM_{10} and NO_x in 2002 and 2012; minor adverse impacts from VOC emissions in 2002 decreasing to negligible in 2012.
• Impacts to Air Quality Values from Pollutants Related to PWC Use	PWC use impacts: Negligible impacts to visibility and minor adverse impacts from ozone exposure in 2002 and 2012. Cumulative effects: Negligible impacts to visibility in both 2002 and 2012. Moderate impacts from ozone exposure in 2002 and 2012, primarily due to transport of pollutants from south and east Texas.	PWC use impacts: Negligible impacts to visibility, although slight reduction in $PM_{2.5}$ emissions; minor impacts from ozone exposure in 2002 and 2012. Cumulative effects: Same impact levels as for alternative A, although slight reduction in $PM_{2.5}$ emissions.	PWC use impacts: Beneficial impact for visibility and ozone exposure from eliminating PWC use. Cumulative effects: Same impact levels as for alternative A, although slight reduction in $PM_{2.5}$ emissions.
Soundscapes	PWC use impacts: Temporary, negligible, adverse impacts at most locations over the short and long term; minor to moderate adverse impacts in the canyons on the northern portion of the lake and at backcountry locations. Over the long term reduced noise levels due to newer engine technologies. Cumulative effects: Temporary, minor to moderate, adverse impacts in some locations, with natural sounds predominating at most locations except near boat launches, marinas.	PWC use impacts: Temporary, minor, adverse impacts at most locations over the short and long term. Beneficial impacts in the back coves because of no-wake restrictions. Over the long term reduced noise levels due to newer engine technologies. Cumulative effects: Temporary, minor, adverse impacts, with natural sounds predominating at most locations except near boat launches and marinas.	PWC use impacts: Beneficial impacts due to eliminating PWC use. Cumulative effects: Temporary, minor, adverse impacts, particularly near boat launches and marinas, but there would be no contribution to noise from PWC use within the national recreation area.

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
Wildlife and Wildlife Habitat	PWC use impacts: Short-term, negligible impacts at most locations because PWC users would operate at least 50 feet from the shoreline and must access the shore at no-wake speeds; few wildlife use the open water, where speeds are higher. Cumulative effects: Short-term, negligible to minor, adverse effects. Impacts would be temporary.	PWC use impacts: Overall reduction in impacts because of no-wake zones. Short-term, negligible, adverse impacts at most locations because PWC users would operate at least 50 feet from the shoreline and must access the shore at no-wake speeds. In addition, few wildlife use the open water, where PWC speeds are higher. Cumulative effects: Short-term, negligible to minor, adverse effects. Impacts would be temporary.	PWC use impacts: Beneficial impacts from prohibiting PWC use at Lake Meredith. Cumulative effects: Short-term, negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife. Impacts would be temporary.
Threatened or Endangered Species or Species of Special Concern	PWC use impacts: No effect or not likely adversely affect any federal or state listed species. Cumulative effects: Not likely to adversely affect these species.	PWC use impacts: No effect. Cumulative effects: Not likely to adversely affect these species.	PWC use impacts: Beneficial impacts as compared to alternative A. Cumulative effects: Not likely to adversely affect these species.
Shoreline Vegetation	PWC use impacts: Negligible adverse impacts over the short and long term. Cumulative effects: Continued negligible adverse impacts, with no perceptible changes to plant community size, integrity, or continuity through 2012.	PWC use impacts: Negligible adverse impacts over the short and long term. Beneficial impacts because of PWC restrictions in back coves. Cumulative effects: Continued negligible adverse impacts.	PWC use impacts: Beneficial impacts as a result of banning PWC use Cumulative effects: Continued negligible adverse impacts.
Visitor Experience	PWC use impacts: Negligible to minor adverse impacts for most visitors in the short and long term. Cumulative effects: Long-term, negligible, adverse impacts, since there would be little noticeable change in visitor experiences. Most visitors would continue to be satisfied with their park experiences.	PWC use impacts: Beneficial impact of no-wake zone for some visitors, particularly anglers. Negligible to minor adverse impacts in the short and long term for most other visitors. Cumulative effects: Short and long-term, moderate, adverse impacts for PWC users, but negligible adverse impacts for most other visitors.	PWC use impacts: Beneficial impacts on most park visitors from banning PWC use. Short- and long-term, moderate, adverse impacts on PWC users who could no longer ride in the national recreation area. Cumulative effects: Beneficial impacts for most visitors compared to alternative A. Negligible adverse effects to visitor experiences at other regional waterbodies as a result of PWC users displaced from Lake Meredith.
Visitor Conflicts and Safety	PWC use impacts: Short- and long-term, minor, adverse impacts due to the number of visitors and boats on high use days, particularly at popular boat launches. Adverse effects on anglers if no-wake zones along the shore were not observed. Cumulative effects: Minor adverse impacts for all user groups in the short and long term.	PWC use impacts: Short- and long-term, minor, adverse impacts. Beneficial impacts to anglers with no-wake zones in back coves. Cumulative effects: Minor adverse impacts for all user groups in the short and long term.	PWC use impacts: Beneficial impacts by reducing visitor conflicts and enhancing safety. Cumulative effects: Negligible adverse impacts over the short and long term, with no contribution from PWC use.
Cultural Resources			
• Archeological Sites and Submerged Cultural Resources	PWC use impacts: Potential minor adverse impacts as a result of illegal collection and vandalism. Cumulative effects: Minor to moderate adverse impacts due to the number of visitors and the potential for illegal collection or destruction.	PWC use impacts: Minor adverse impacts from possible illegal collection and vandalism, but a user education program and no-wake zone could limit these effects. Cumulative effects: Minor to moderate adverse, similar to alternative A.	PWC use impacts: Minor beneficial impacts. Cumulative effects: Minor to moderate adverse impacts.

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
• Ethnographic Resources	PWC use impacts: Short-term, minor to moderate adverse impacts. Long-term reduction in PWC noise levels from newer engine technologies. Cumulative effects: Minor to moderate adverse impacts on resources that are readily accessible.	PWC use impacts: Short-term, minor to moderate, adverse impacts, with effects potentially reduced with a user education program and no-wake zones. Long-term reduction in PWC noise levels from newer engine technologies. Cumulative effects: Minor to moderate adverse impacts.	PWC use impacts: Minor beneficial impacts by reducing the potential for disruptions. Cumulative effects: Minor to moderate adverse impacts.
Socioeconomic Effects	Continuing PWC use would have no additional impact on the local or regional economy.	Additional management restrictions (including no-wake zones) could reduce PWC-related revenue. However, given the relatively low levels of PWC use at Lake Meredith, no measurable impacts on the local and regional economies expected.	Banning PWC use would reduce PWC-related revenue. However, given the relatively low levels of PWC use at Lake Meredith, no measurable impacts on the local and regional economies expected.
National Recreation Area Management and Operations			
• Conflicts with State and Local Regulations	No conflicts with state regulations. Negligible impacts, including cumulative impacts.	No conflicts with state PWC regulations. Negligible impacts, including cumulative impacts.	No conflict with state PWC regulations. Negligible impacts, including cumulative impacts`.
• Enforcement Needs	Moderate adverse impacts; additional staff would be needed to regulate existing PWC use.	Moderate adverse impacts, similar to alternative A, with more staff would be needed to ensure full compliance with PWC use restrictions and to enforce and educate visitors about the new regulations.	Moderate adverse impacts with more staff needed to ensure compliance with the PWC ban.

No park resources or values would be impaired by implementing any of the alternatives being considered.

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PURPOSE OF AND NEED FOR ACTION

Lake Meredith National Recreation Area is near Fritch, Texas, in the center of the Texas Panhandle, about 40 miles north of Amarillo, Texas. The lake was formed in the 1960s when the U.S. Bureau of Reclamation constructed Sanford Dam on the Canadian River. The dam was built to supply water to 11 Panhandle communities by means of 322 miles of pipeline.

Congress created Lake Meredith National Recreation Area on November 28, 1990. Public Law 101-628 states this national park system unit is "to provide for public outdoor recreation use and enjoyment of the lands and waters associated with Lake Meredith in the State of Texas, and to protect the scenic, scientific, cultural, and other values contributing to the public enjoyment of such lands and waters" (16 USC 460eee). The legislation codified the long-standing administrative arrangements between the Bureau of Reclamation and the National Park Service (NPS) (136 Cong. Rec. 17,473). By making Lake Meredith part of the national park system, Congress emphasized the importance of protecting and interpreting the natural and cultural resources of the park.

More than one million personal watercraft[*] are estimated to be in operation today in the United States. Sometimes referred to as "Jet Skis" or "Wet Bikes," these vessels use an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. They are used for enjoyment, particularly for touring and maneuvers such as wave jumping, and they are capable of speeds in the 60 mph range.

The National Park Service maintains that PWC use emerged and gained popularity in park units before it could initiate and complete a "full evaluation of the possible impacts and ramifications." While PWC use remains a relatively new recreational activity, it has occurred in 32 of 87 park units that allow motorized boating.

The National Park Service first began to study PWC use in Everglades National Park. The studies showed that PWC use over emergent vegetation, shallow grass flats, and mud flats commonly used by feeding shorebirds damaged the vegetation, adversely impacted the shorebirds, and disturbed the life cycles of other wildlife. Consequently, managers at Everglades determined that PWC use remained inconsistent with the resources, values, and purposes for which the park was established. In 1994 the National Park Service prohibited PWC by a special regulation at the park (59 FR 58781).

Other public entities have taken steps to limit, and even to ban, PWC use in certain waterways as national researchers study more about the effects of PWC use. At least 34 states have either implemented or have considered regulating PWC use and operation (63 FR 49314). Similarly, various federal agencies, including the Fish and Wildlife Service and the National Oceanic and Atmospheric Administration, have managed PWC use differently than other classes of motorized watercraft.

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[*] Personal watercraft, as defined in 36 CFR 1.4(a) (2000), refers to a vessel, usually less than 16 feet in length, which uses an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. The vessel is intended to be operated by a person or persons sitting, standing, or kneeling on the vessel, rather than within the confines of the hull. The length is measured from end to end over the deck excluding sheer, meaning a straight line measurement of the overall length from the foremost part of the vessel to the aftermost part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments, are not included in the measurement. Length is stated in feet and inches.

Specifically, the National Oceanic and Atmospheric Administration regulates PWC use in most national marine sanctuaries. The regulation resulted in a court case where the Court of Appeals for the District of Columbia declared such PWC-specific management valid. In *Personal Watercraft Industry Association v. Department of Commerce,* 48 F.3d 540 (D. C. Cir. 1995), the court ruled that an agency can discriminate and manage one type of vessel (specifically personal watercraft) differently than other vessels if the agency explains its reasons for the differentiation.

In February 1997 the Tahoe Regional Planning Agency (TRPA), the governing body charged with ensuring no derogation of Lake Tahoe's water quality, voted unanimously to ban all two-stroke, internal combustion engines, including personal watercraft, because of their effects on water quality. Lake Tahoe's ban began in 2000.

In July 1998 the Washington State Supreme Court in *Weden v. San Juan County* (135 Wash. 2d 678 [1998]) found that the county had the authority to ban the use of personal watercraft as a proper use of its police power in order to protect the public health, safety, or general welfare. Further, personal watercraft are different from other vessels, and Washington counties may treat them differently.

In recognition of its duties under the Organic Act and National Park Service *Management Policies,* as well as because of increased awareness and public controversy, the National Park Service reevaluated its methods of PWC regulation. Historically, the National Park Service grouped personal watercraft with all vessels; thus, people could use such craft when the unit's superintendent's compendium allowed the use of other vessels. Later the Park Service closed seven units to PWC use through horsepower restrictions, general management plan revisions, and park specific regulations such as those promulgated by Everglades National Park.

In May 1998 the Bluewater Network, a coalition of more than 70 organizations representing more than 4 million Americans, filed a petition urging the National Park Service to initiate a rulemaking process to prohibit PWC use throughout the national park system. In response to the petition, the Park Service issued an interim management policy requiring superintendents of parks where PWC can occur but where it had never occurred to close the unit to such use until the rule was finalized. In addition, the National Park Service proposed a specific PWC regulation premised on the notion that personal watercraft differ from conventional watercraft in terms of design, use, safety record, controversy, visitor impacts, resource impacts, horsepower to vessel length ratio, and thrust capacity (63 FR 178 [Sept. 15, 1998]: 49312–17).

The National Park Service envisioned the servicewide regulation as an opportunity to evaluate impacts from PWC use before authorizing the use. The preamble to the servicewide regulation calls the regulation a "conservative approach to managing PWC use" considering the resource concerns, visitor conflicts, visitor enjoyment, and visitor safety. During a 60-day comment period the National Park Service received nearly 20,000 comments.

As a result of public comments and further review, the National Park Service promulgated an amended regulation that prohibited PWC use in most units and required the remaining units to determine the appropriateness of continued PWC use (36 CFR 3.24(a), 2000; 65 FR 55 [Mar. 21, 2000]: 15077–90). Specifically, the regulation allowed the National Park Service to designate PWC use areas and to continue their use by promulgating a special regulation in 11 units including Lake Meredith National Recreation Area, and by amending the superintendent's compendium in 10 units (36 CFR 3.24(b), 2000). The National Park Service based the distinction between designation methods on the units' degree of motorized watercraft use.

In response to the PWC final regulation, Bluewater Network sued the National Park Service under the Administrative Procedures Act and the NPS Organic Act. The organization challenged the National Park Service's decision to allow continued PWC use in 21 units while prohibiting such use in other units. In addition, the organization also disputed the National Park Service's decision to allow 10 units to continue PWC use after 2002 by making entries in the superintendent's compendium, which would not require the opportunity for public input through a notice and comments on the rulemaking process. Further, the environmental group claimed that because PWC use causes water and air pollution, generates increased noise levels, and poses public safety threats, the National Park Service acted arbitrarily and capriciously when making the challenged decisions.

In response to the suit, the National Park Service and the environmental group negotiated a settlement. The resulting settlement agreement, signed by the judge on April 12, 2001, changed portions of the National Park Service's PWC rule. While 21 units could continue PWC use in the short term, each of those parks desiring to continue long-term PWC use must promulgate a park-specific special regulation in 2002. In addition, the settlement stipulates that the National Park Service must base its decision to issue a park-specific special regulation to continue PWC use through an environmental analysis conducted in accordance with the National Environmental Policy Act (NEPA). The NEPA analysis at a minimum, according to the settlement, must evaluate PWC impacts on water quality, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety.

In 2001 the National Park Service adopted its new management policy for personal watercraft. The policy prohibits PWC use in national park system units unless their use remains appropriate for the specific park unit (*Management Policies 2001,* sec. 8.2.3.3). The policy statement authorizes the use based on the park's enabling legislation, resources, values, other park uses, and overall management strategies.

As the settlement deadline approached and the park units were preparing to prohibit PWC use, the National Park Service, Congress, and PWC user groups sought legal methods to keep the parks open to this activity. However, no method was successful. On April 22, 2002, the following units closed for PWC use: Assateague Island National Seashore; Big Thicket National Preserve; Pictured Rocks National Lakeshore; Fire Island National Seashore; and Gateway National Recreation Area. On September 15, 2002, eight other park units were scheduled to close to PWC use, including Lake Meredith National Recreation Area.

The proposed September 16, 2002, prohibition of PWC use was averted with the execution of a stipulated modification to the settlement agreement. The modified settlement agreement was approved by the court on September 9, 2002, and extended unrestricted PWC use in selected national park system units, including Lake Meredith National Recreation Area, until November 6, 2002. Park units that prepare an environmental assessment to analyze PWC use alternatives and then select an alternative to continue such use will have to draft a special regulation to authorize that use in the future.

PURPOSE OF AND NEED FOR ACTION

The purpose of and the need for taking action is to evaluate a range of alternatives and strategies for the management of PWC use at Lake Meredith National Recreation Area in order to ensure the protection of park resources and values while offering recreational opportunities as provided for in the national recreation area's enabling legislation, purpose, mission, and goals. Upon completion of the NEPA process, the National Park Service may either take action to adopt special regulations to

manage PWC use at Lake Meredith National Recreation Area, or it may discontinue PWC use at this park unit, as allowed for in the NPS March 2000 rule.

The alternatives being considered include the following:

- Alternative A — Continue PWC use under a special regulation.
- Alternative B — Continue PWC use under a special regulation with new management strategies and mitigation to reduce user conflicts in certain lake areas.
- No-action alternative — Discontinue PWC use entirely.

SCOPE OF THE ANALYSIS

Motorcraft and other watercraft use in Lake Meredith has occurred since the reservoir was opened for recreational use in 1965. PWC users began to appear on the lake during the late 1970s, when personal watercraft were first manufactured, and their use has increased steadily since then. While some effects of PWC use are similar to those of other motorcraft and therefore difficult to distinguish, the focus of this action is in support of decisions and rulemaking specific to PWC use. Although the settlement agreement with Bluewater Network and the need for action define the scope of the environmental assessment, the National Environmental Protection Act requires an analysis of cumulative effects on resources of all past, present, and reasonably foreseeable actions when added to the effects of the proposal (40 CFR 1508.7, 2000). The scope of the analysis is to define management alternatives specific to PWC use in consideration of other uses, actions, and activities cumulatively affecting park resources and values.

PURPOSE AND SIGNIFICANCE OF LAKE MEREDITH NATIONAL RECREATION AREA

Congress establishes national park system units to fulfill specified purposes, based on a park's unique and significant resources. A park's purpose, as established by Congress, is the fundamental building block for its decisions to conserve resources while providing for "enjoyment of future generations."

Lake Meredith National Recreation Area is in the center of the Texas Panhandle, about 40 miles north of Amarillo. Formed in the 1960s when the U.S. Bureau of Reclamation constructed Sanford Dam on the Canadian River, the reservoir supplies water to 11 communities. Private lands surrounding Lake Meredith are primarily used for ranching and farming. Oil and gas development occurs within the national recreation area and on adjacent private lands.

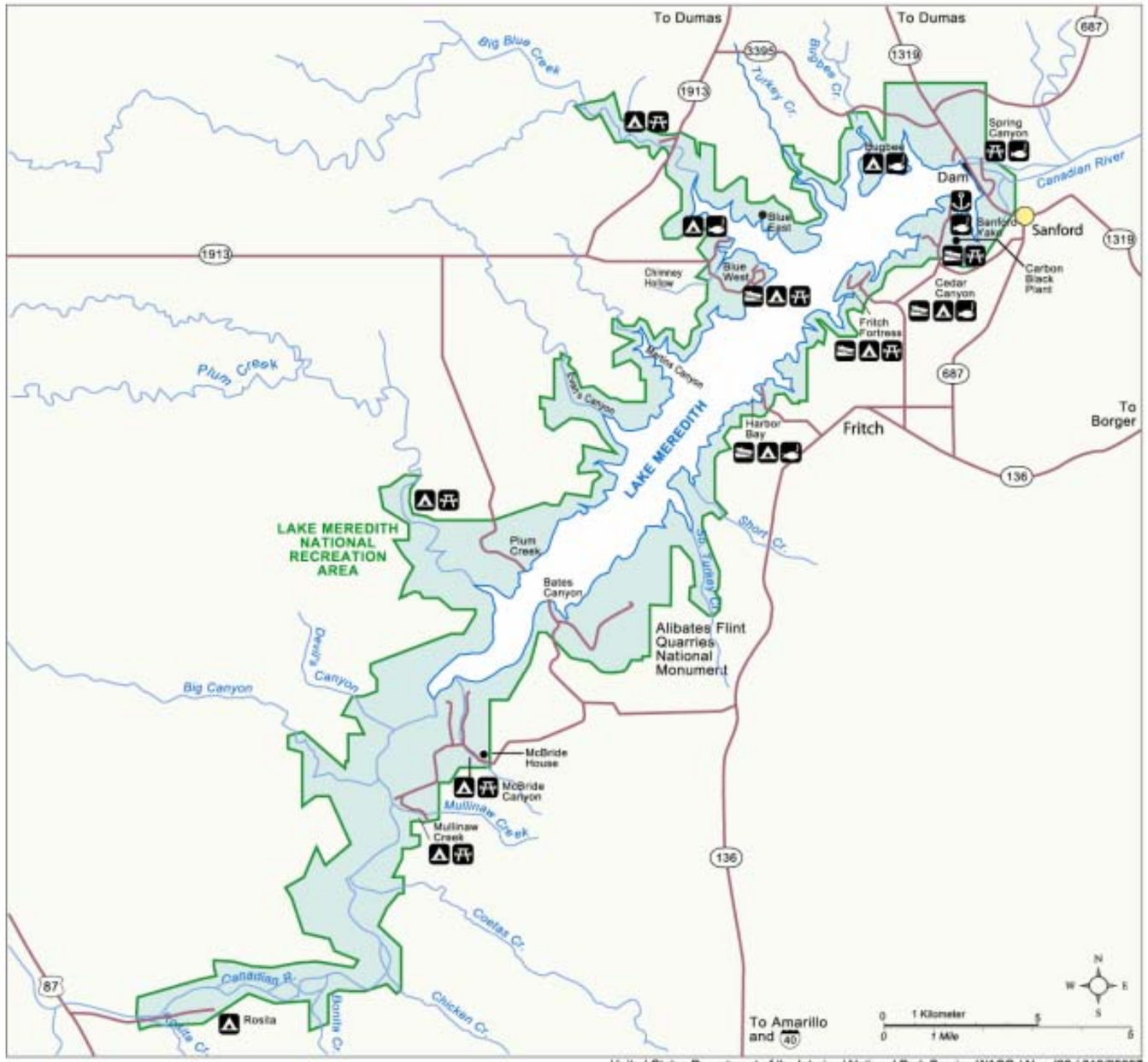
Lake Meredith has become a major site of water-based recreation in the Panhandle region, averaging more than 1.5 million visits per year from 1992 to 1999. There are no comparable large bodies of water or land that provide such recreational diversity in the Panhandle. The largest nearby recreation area is Palo Duro Canyon State Park, a beautiful scenic and historic area, but it lacks the water resources of Lake Meredith.

The land and waters of Lake Meredith National Recreation Area are a major sport fishery. Facilities for camping, picnicking, and boating also exist. Lake Meredith is the only public land in a radius of approximately 50 miles that permits the hunting of deer, quail, ducks, and other migratory birds.

Lake Meredith National Recreation Area

Texas

Location



Campground
Boat ramp
Fishing
Water
Ranger station
Picnic area
Marina
Park land

blank back of map

PURPOSE OF LAKE MEREDITH NATIONAL RECREATION AREA

The purpose of the park is addressed in the following statements excerpted from the park's *Strategic Plan*. The legislation creating Lake Meredith mandates the National Park Service to:

- Provide for the safe public use, understanding, and enjoyment of the diverse recreational opportunities.
- Educate the public to instill an understanding and sense of stewardship of the cultural, natural, historic, scenic and recreational resources of the park.
- Provide opportunities for scientific study of natural and cultural resources.

SIGNIFICANCE OF LAKE MEREDITH NATIONAL RECREATION AREA

The following park resources and values define the significance of Lake Meredith:

- The impounding of the Canadian River in 1965 created a man-made lake that fulfills outdoor recreational needs such as sport fishing, hunting, boating, horseback riding, hiking, scuba diving, and bird watching for the five-state region of the Panhandle Plains.
- The lake, located on the windswept, arid plains of the Texas Panhandle, is the largest body of water within a 200-mile radius and provides the main water source for three-quarters of a million people in 11 cities.
- The scenic, colorful Canadian River breaks contain the evidence of over 12,000 years of human occupation and use.
- The lake, wetlands, and High Plains prairie provide premier habitat for migratory waterfowl and endangered species, including but not limited to, bald eagle, Arkansas River shiner, and the state-listed Texas horned lizard.
- The park protects a portion of the significant High Plains ecosystem, including the imperiled Texas cottonwood/tall grass community.
- The park contains special geological features, such as "filled chimneys," agatized Alibates dolomite, and the Canadian River cut, which exposes more than 250 million years of geologic history and divides the High Plains to the north from the Llano Estacado (Staked Plains) to the south.

BACKGROUND

NPS Organic Act and Management Policies

By enacting the NPS Organic Act of 1916, Congress directed the U.S. Department of the Interior and the National Park Service to manage units "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 USC 1). Congress reiterated this mandate in the Redwood National Park Expansion Act of 1978 by stating that the National Park Service must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC 1a-1).

Despite these mandates, the Organic Act and its amendments afford the National Park Service latitude when making resource decisions that balance visitor recreation and resource preservation. By these acts Congress "empowered [the National Park Service] with the authority to determine what uses of park resources are proper and what proportion of the parks resources are available for each use" (*Bicycle Trails Council of Marin v. Babbitt,* 82 F.3d 1445, 1453 (9th Cir. 1996)).

However, courts have consistently interpreted the Organic Act and its amendments to elevate resource conservation above visitor recreation. *Michigan United Conservation Clubs v. Lujan,* 949 F.2d 202, 206 (6th Cir. 1991) states, "Congress placed specific emphasis on conservation." The *National Rifle Ass'n of America v. Potter,* 628 F.Supp. 903, 909 (D.D.C. 1986) states, "In the Organic Act Congress speaks of but a single purpose, namely, conservation." The NPS *Management Policies* also recognize that resource conservation takes precedence over visitor recreation. The policy dictates "when there is a conflict between conserving resources and values and providing for enjoyment of them, conservation is to be predominant" (NPS *Management Policies 2001,* sec. 1.4.3).

Because conservation remains predominant, the National Park Service seeks to avoid or to minimize adverse impacts on park resources and values. Yet, the Park Service has discretion to allow negative impacts when necessary (NPS *Management Policies 2001,* sec. 1.4.3). While some actions and activities cause impacts, the Park Service cannot allow an adverse impact that constitutes a resource impairment (NPS *Management Policies,* sec. 1.4.3). The Organic Act prohibits actions that permanently impair park resources unless a law directly and specifically allows for the acts (16 USC 1a-1). An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (NPS *Management Policies,* sec. 1.4.4). To determine impairment, the Park Service must evaluate "the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (NPS *Management Policies,* sec. 1.4.4).

Because park units vary based on their enabling legislation, natural resources, cultural resources, and missions, the recreational activities appropriate for each unit and for areas within each unit vary as well. An action appropriate in one unit could impair resources in another unit. Thus, this environmental assessment analyzes the context, duration, and intensity of impacts related to PWC use at Lake Meredith, as well as the potential for resource impairment, as required by *Director's Order #12: Conservation Planning, Environmental Impact Analysis and Decision-making* (DO #12) (NPS 2001).

SUMMARY OF AVAILABLE RESEARCH ON THE EFFECTS OF PERSONAL WATERCRAFT

Over the past two decades PWC use in the United States increased dramatically. However, there are conflicting data about whether PWC use is continuing to increase. While the National Transportation Safety Board (NTSB) estimates that retailers sell approximately 200,000 personal watercraft each year and people currently use another 1 million (NTSB 1998), the PWC industry argues that PWC sales have decreased by 50% from 1995 to 2000 (American Watercraft Association [AWA] 2001). National PWC ownership increased every year between 1991 and 1998; the rate of annual increase peaked in 1994 at 32% and dropped slightly in 1999, 2000, and 2001 (see Table 1).

The majority of personal watercraft used today are powered by conventional two-stroke engines (NPS 1998a; California Air Resources Board [CARB] 1999). However, multiple studies have demonstrated that four-stroke engines are substantially cleaner than carbureted, two-stroke engines, generating approximately 90% fewer emissions (British Columbia Ministry of Water, Land and Air Protection 1993; Oregon Department of Environmental Quality [ODEQ] 1999; TRPA 1999). PWIA notes that

TABLE 1: NATIONAL PWC REGISTRATION TREND

Year	No. of Boats Owned	Boat Ownership Trend (Percentage Change)	No. of Personal Watercraft Owned	PWC Ownership Trend (Percentage Change)
1991	16,262,000	--	305,915	--
1992	16,262,000	0%	372,283	21.7%
1993	16,212,000	0%	454,545	22.1%
1994	16,239,000	0%	600,000	32.0%
1995	15,375,000	-5%	760,000	26.7%
1996	15,830,000	3%	900,000	18.4%
1997	16,230,000	3%	1,000,000	11.1%
1998	16,657,000	3%	1,100,000	10.0%
1999	16,773,000	1%	1,096,000	-0.4%
2000	16,965,000	1%	1,078,400	-1.6%
2001			1,053,560	-2.4%

SOURCES: M. Schmidt, USCG, e-mail comm., for boat numbers, Sept. 4, 2001; National Marine Manufacturers Association (NMMA) for PWC numbers, 2002.

direct-injection engines have been available in personal watercraft for four years; and three PWC manufacturers introduced four-stroke engines for the 2002 model year (PWIA to NPS, May 28, 2002, comment on *Lake Mead National Recreation Area Lake Management Plan and Draft Environmental Impact Statement).* The Environmental Protection Agency assumes that the existing two-stroke engine models would not be completely replaced by newer PWC technology until 2050 (40 CFR 89, 90, 91).

The average operating life of a personal watercraft is 5 to 10 years, depending on the source. The formula for determining the operating life of personal watercraft was published in the *Federal Register* on October 4, 1996 (US EPA 1996a). Based on this formula, the National Park Service expects that by 2012 most boat owners will already be in compliance with the 2006 EPA marine engine standards. The Personal Watercraft Industry Association believes that the typical operating life of a personal watercraft rental is 3 years and of a privately owned vessel approximately 5 to 7 years (PWIA to NPS, May 28, 2002, comment on *Lake Mead National Recreation Area Lake Management Plan and Draft Environmental Impact Statement*).

Environmental groups, PWC users and manufacturers, and land managers express differing opinions about the environmental consequences of PWC use, and about the need to manage or to limit this recreational activity. Various research studies on the effects of PWC use are summarized below for water pollution, air pollution, noise, wildlife, vegetation and shoreline erosion, and health and safety.

Water Pollution

Two-stroke, carbureted engines discharge as much as 30% of their fuel unburned directly into the water (NPS 1999; CARB 1999). Hydrocarbons, including benzene, toluene, ethylbenzene, and xylene (BTEX) and polyaromatic hydrocarbons (PAHs), are also released, as well as methyl tertiary-butyl ether (MTBE) in states that use this additive. The amount of pollution correctly attributed to PWC use compared to other motorboats and the degree to which PWC use affects water quality remains debatable. As noted in a report by the Oregon Department of Environmental Quality, every waterbody has different conditions (e.g., water temperature, air temperatures, water mixing, motorboating use, and winds) that affect the pollutants' impacts (ODEQ 1999).

A recent study conducted by the California Air Resources Board consisted of a laboratory test designed to comparatively evaluate exhaust emissions from marine and PWC engines, in particular two- and four-stroke engines (CARB 2001). The results of this study showed a difference in emissions (in some cases 10 times higher total hydrocarbons in two-stroke engines) between these two types of

engines. An exception was air emissions of NO_x, which was higher in four-stroke than in two-stroke engines. Concentrations of pollutants (MTBE, BTEX) in the tested water were consistently higher for two-stroke engines.

In 1996 the Environmental Protection Agency promulgated a rule to control exhaust emissions from new marine engines, including outboard motors and personal watercraft (US EPA 1996a). As a result of the rule, the Environmental Protection Agency estimated an overall 52% reduction in hydrocarbon emissions from marine engines from present levels by 2010, and a 75% reduction by 2030, based on phasing out polluting machines. The 1997 EPA rule delayed implementation by one year (US EPA 1996a, 1997).

Discharges of MTBE and PAHs particularly concern scientists because of their potential to adversely affect the health of people and aquatic organisms. Scientists need to conduct additional studies on PAHs (Allen et al. 1998) and on MTBE (NPS 1999), as well as long-term studies on the effect of repeated exposure to low levels of these pollutants (Asplund 2001).

At Lake Tahoe concern about the negative impact on lake water quality and aquatic life caused by the use of two-stroke marine engines led to at least 10 different studies relevant to motorized watercraft in the Tahoe Basin in 1997 and 1998. The results of these studies (Allen et al. 1998) confirmed that (1) petroleum products are in the lakes as a result of motorized watercraft operation, and (2) watercraft powered by carbureted two-stroke engines discharge pollutants at an order of magnitude greater than do watercraft powered by newer technology engines (TRPA 1999).

On June 25, 1997, the Tahoe Regional Planning Agency adopted an ordinance prohibiting the "discharge of unburned fuel and oil from the operation of watercraft propelled by carbureted two-stroke engines" beginning June 1, 1999. Following the release of an environmental assessment in January 1999, this prohibition was made permanent.

PAHs (which include benzo(a)pyrene, naphthalene, and 1-methyl naphthalene) are released during the combustion of fuel, although some PAHs are also found in unburned gasoline. PAHs, as well as other hydrocarbon emissions, could potentially be reduced as new four-stroke and direct-injection engines replace older carbureted two-stroke engines. The conversion of carbureted two-stroke engines would be an important step toward substantially reducing petroleum-related pollutants.

Some research shows that PAHs, including those from PWC emissions, adversely affect water quality by means of harmful phototoxic effects on ecologically sensitive plankton and other small water organisms (US EPA 1998; Oris et al. 1998; Landrum et al. 1987; Mekenyan et al. 1994; Arfsten et al. 1996). This in turn can affect aquatic life and ultimately aquatic food chains. The primary concern is in shallow water ecosystems.

Air Pollution

Personal watercraft emit various compounds that that may adversely affect air quality. In two-stroke engines commonly used in personal watercraft the fuel oil is used once and is expelled as part of the exhaust; and the combustion process results in emissions of air pollutants such as nitrogen oxides (NO_x), volatile organic compounds (VOC), particulate matter (PM), and carbon monoxide (CO). In areas with high PWC use some air quality degradation likely occurs (US EPA 1996a, 2000). Kado et al. (2000) found that two-stroke engines had considerably higher emissions of airborne particulates and PAHs than four-stroke engines tested. Changing from two-stroke, carbureted engines to two-stroke direct-injected engines may result in increases of airborne-particulate associated PAHs (Kado et

al. 2000). Further research is needed to identify what impact this would have on PAH concentrations in water. It is assumed that the 1996 EPA rule concerning marine engines will substantially reduce air emissions from personal watercraft in the future (US EPA 1996a).

In August 2002 the U.S. Environmental Protection Agency proposed additional rules that would further reduce boating emissions. The proposal includes evaporative emission standards for all boats and would reduce emissions from fuel tanks, etc., by 80% (67 FR 157 [Aug. 14, 2002]: 53049–115).

Noise

Noise levels emitted by PWC engines vary from vessel to vessel, depending on many factors. No literature was found that definitively describes scientific measurements of PWC noise. Some PWC industry literature states that all recently manufactured watercraft emit fewer than 80 decibels (dB) at 50 feet from the vessel, whereas some literature from public interest groups attribute levels as high as 102 dB without specifying distance. None of this literature adequately describes the methodology for collecting the data to determine those levels. Because of this, the National Park Service contracted noise measurements of personal watercraft and other boat types in 2001 at Glen Canyon National Recreation Area; preliminary analysis of this data indicates maximum levels for PWC-generated noise at 50 feet of approximately 68 to 78 A-weighted dB (dBA). Other motorboat types were measured during that study at approximately 65 to 86 dBA at 50 feet (Harris Miller Miller & Hanson, Inc., 2002).

Regulations for boating and water use activities established by the National Park Service prohibit vessels from operating at more than 82 dB measured at 82 feet (25 meters) from the vessel (36 CFR 3.7). However, this regulation does not imply that there are no noise impacts from vessels operating below that limit. Noise impacts from PWC use are caused by a number of factors. Noise from human sources, including personal watercraft, can intrude on natural soundscapes, masking the natural sounds that are an intrinsic part of the environment. This can be especially true in quiet places, such as in secluded lakes, coves, river corridors, and backwater areas. Also, PWC use in areas where there are nonmotorized users (such as canoeists, sailors, people fishing or picnicking, and kayakers) can disrupt the “passive” experience of park resources and values.

Komanoff and Shaw (2000) note that the biggest difference between noise from personal watercraft and that from motorboats is that the former continually leave the water, which magnifies noise in two ways. Without the muffling effect of water, the engine noise is typically 15 dBA louder and the smacking of the craft against the water surface results in a loud “whoop” or series of them. With the rapid maneuvering and frequent speed changes, the impeller has no constant “throughput” and no consistent load on the engine. Consequently, the engine speed rises and falls, resulting in a variable pitch. This constantly changing noise is often perceived as more disturbing than the constant noise from motorboats.

PWC users tend to operate close to shore, to operate in confined areas, and to travel in groups, making noise more noticeable to other recreationists. Motorboats traveling back and forth in one area at open throttle or spinning around in small inlets also generate complaints about noise levels; however, most motorboats tend to operate away from shore and to navigate in a straight line, thus being less noticeable to other recreationists (Vlasich 1998).

Research conducted by the Izaak Walton League (IWL) indicates that one PWC unit can emit between 85 and 105 dB of sound, and that wildlife or humans located 100 feet away may hear sounds of 75 dB. This study also stated that rapid changes in acceleration and direction may create a greater disturbance

and emit sounds of up to 90 dB (IWL 1999). Other studies conducted by the New Jersey State Police indicate that a PWC unit with a 100-horsepower (hp) engine emits up to 76 dBA, while a single, 175-hp outboard engine emits up to 81 dBA. The Personal Watercraft Industry Association (PWIA) believes that through the year 2002, most PWC output is between 155 and 165 hp (PWIA e-mail to NPS, Sept. 23, 2002).

Sea-Doo research indicates that in three out of five distances measured during a sound level test, PWC engines were quieter than an outboard motorboat. Sea-Doo also found that it would take approximately four personal watercraft operating 50 feet from shore to produce 77 dBA, and it would take 16 personal watercraft operating 15 feet from shore to emit 83 dBA of sound, which is equal to one open exhaust boat at 1,600 feet from the shore. In response to public complaints, the PWC industry has employed new technologies to reduce sound by about 50% to 70% on 1999 and newer models (Sea-Doo 2000; Hayes 2002). Additionally, by 2006 the EPA requirements will reduce PWC noise, in association with improvements to engine technology (US EPA 1996b). EPA research also indicated that one PWC unit operating 50 feet from an onshore observer emits a sound level of 71 dBA, and studies conducted using the Society of Automotive Engineers (2001) found that two PWC units operating 50 feet from the shore emit similar sound levels of about 74 dBA (PWIA 2000).

Most studies on the effects of noise on soundscapes and human receptors have focused on highway and airport noise. Komanoff and Shaw (2000) used the analytical approaches of these studies to perform a noise-cost analysis of personal watercraft. They concluded that the cost to beachgoers from PWC noise was more than $900 million per year. The cost per personal watercraft was estimated to be about $700 per vessel each year or $47 for each three-hour "personal watercraft day." They further concluded that the cost per beachgoer was the highest at secluded lake sites, where beachgoers had a higher expectation of experiencing natural quiet and usually invested a larger amount of time and personal energy in reaching the area. However, because there are many more visitors to be affected at popular beaches, noise costs per personal watercraft were highest at crowded sites (*Drowning in Noise: Noise Costs of Jet Skis in America* [Komanoff and Shaw 2000]).

Wildlife Impacts

Although relatively few studies have specifically examined PWC effects on wildlife, several researchers have documented wildlife disturbances from personal watercraft and motorboats. A study recently completed in Florida examined the distance at which waterbirds are disturbed by both personal watercraft and outboard-powered boats (Rodgers and Schwikert 2002). Flush distances varied from 65 to 160 feet for personal watercraft, and flush distances for most species were greater for motorboats than for personal watercraft 80% of the time. The authors note that PWC use may be more threatening to waterbirds since PWC users can navigate in shallow secluded waterways where birds typically eat and rest. Burger (2000) examined the behavior of common terns in relation to PWC use and other boats and noted that PWC users traveled faster and came closer to banks, resulting in more flight response in terns and contributing to lower reproductive success.

Shoreline Vegetation

The effects of PWC use on aquatic communities have not been fully studied, and scientists disagree about whether PWC use adversely impacts aquatic vegetation. Most of the concern arises from the shallow draft of personal watercraft, which allows access to shallow areas that conventional motorboats cannot reach. Like other vessels, personal watercraft may destroy grasses that occur in shallow water ecosystems. Anderson (2000) studied the effect of PWC wave-wash on shallow salt marsh

vegetation and found that although the waves from personal watercraft are not different from those generated by other boats, personal watercraft can enter marsh channels and create sediment suspension problems in these areas.

Erosion Effects

Some studies have examined the erosion effects of waves generated by personal watercraft, and other studies suggest that personal watercraft may disturb sediments on river or lake bottoms and cause turbidity. Conflicting research exists concerning whether PWC-caused waves result in erosion and sedimentation. PWC-generated waves vary in size depending on the environment, including weight of the driver, number of passengers, and speed. Anderson (2000) studied the effect of PWC wave-wash on shallow salt marsh vegetation and found that although the waves from personal watercraft are not different from those generated by other boats, personal watercraft can enter marsh channels and create sediment suspension problems in these areas.

Health and Safety Concerns

Industry representatives report that PWC accidents decreased in some states in the late 1990s. The National Transportation Safety Board reported that in 1996 personal watercraft represented 7.5% of state-registered recreational boats but accounted for 36% of recreational boating accidents (NTSB 1998). In the same year PWC operators accounted for more than 41% of people injured in boating accidents. PWC operators accounted for approximately 85% of the persons injured in accidents studied in 1997 (NTSB 1998).

Increased PWC use in recent years has resulted in more concern about the health and safety of operators, swimmers, snorkelers, divers, and other boaters. A 1998 NTSB study revealed that while recreational boating fatalities have been declining in recent years, PWC-related fatalities have increased (NTSB 1998). Nationwide PWC accident statistics provided by the U.S. Coast Guard support the increase in PWC-related fatalities (see Table 2). However, since a peak of 84 PWC-related fatalities in 1997, accidents, injuries, and fatalities involving personal watercraft have decreased (M. Schmidt,

TABLE 2: NATIONWIDE PWC ESTIMATES AND ACCIDENT STATISTICS

Year	Recreational Boats Owned*	PWC Owned*	No. of PWC in Accidents	No. of PWC Injuries	No. of PWC Fatalities	No. of All Boats Involved in Accidents	Percentage of PWC Involved in Accidents
1987	14,515,000	N/A	376	156	5	9,020	4.2
1988	15,093,000	N/A	650	254	20	8,981	7.2
1989	15,658,000	N/A	844	402	20	8,020	10.5
1990	15,987,000	N/A	1,162	532	28	8,591	13.5
1991	16,262,000	305,915	1,513	708	26	8,821	17.2
1992	16,262,000	372,283	1,650	730	34	8,206	20.1
1993	16,212,000	454,545	2,236	915	35	8,689	25.7
1994	16,239,000	600,000	3,002	1,338	56	9,722	30.9
1995	15,375,000	760,000	3,986	1,617	68	11,534	34.6
1996	15,830,000	900,000	4,099	1,837	57	11,306	36.3
1997	16,230,000	1,000,000	4,070	1,812	84	11,399	35.7
1998	16,657,000	1,100,000	3,607	1,743	78	11,368	31.7
1999	16,773,000	1,096,000	3,374	1,614	66	11,190	30.2
2000	16,965,000	1,078,400	3,282	1,580	68	11,079	29.6
Total			**33,851**	**15,238**	**645**		

SOURCE: M. Schmidt, USCG, e-mail comm., Sept. 4, 2001.
*Estimates provided by the NMMA (M. Schmidt, USCG, pers. comm., Sept. 4, 2001).
N/A: Not available.

U.S. Coast Guard [USCG], pers. comm., Sept. 4, 2001). The U.S. Coast Guard's Office of Boating Safety studied exposure data to assess boating risks. This method allows for a comparison between boat types based on comparable time in the water. PWC use ranked second in boat type for fatalities per million hours of exposure in 1998, with a 0.24 death rate per million exposure hours.

Since PWC operators can be as young as 12 in several states, accidents can involve children. The American Academy of Pediatrics (2000) recommends that no one younger than 16 operate personal watercraft.

Some manufacturing changes on throttle and steering may reduce potential accidents. For example, on more recent models, Sea-Doo developed an off-power assisted steering system that helps steer during off-power as well as off-throttle situations. This system, according to company literature, is designed to provide additional maneuverability and improve the rate of deceleration (Sea-Doo 2001a).

PWC USE AND REGULATION AT LAKE MEREDITH NATIONAL RECREATION AREA

A variety of watercraft are present on Lake Meredith, including canoes, rowboats, personal watercraft, runabouts, day cruisers, ski boats, sailboats (some with auxiliary motors), and houseboats. Activities on the lake associated with boating include sightseeing, waterskiing, fishing, hunting, scuba diving, swimming, camping, racing, and sailing. Boaters come primarily from communities in and around the Panhandle, but also from Kansas, Colorado, and New Mexico. Lake Meredith averaged more than 1.5 million visitors per year from 1992 to 1999.

Visitors launch watercraft at one of five developed boat ramps or at other authorized primitive launch sites. Due to sedimentation and intermittent river flows, only rafts and canoes are occasionally capable of accessing the lake from upstream of the lake proper. Watercraft travel over the main surface of the lake, along the shore, and in coves and back bays. Many boaters camp in shoreline campgrounds that are accessible to boats.

PWC use began on Lake Meredith soon after the introduction of this type of watercraft in the 1970s. According to park staff, PWC use currently comprises approximately 20% of boat use on the lake. The primary use season is May through September (an estimated 3,500 PWC visitor-days) and the off-season is November through March (an estimated 575 PWC visitor-days). All boats, including personal watercraft, are permitted to operate only from sunrise to sunset.

Most PWC users gain access to the reservoir from campgrounds, and they operate wherever the lake is navigable. They do not commonly operate in the intermittent flowing Canadian River because it is normally too shallow and contains dense vegetation and a heavy load of suspended sediment. Likewise, access to streambeds in side canyons of the reservoir is limited because of dense vegetation and shallow water levels. The stream areas are accessed by other boats, primarily for fishing.

The "Superintendent's Compendium" (see appendix A) addresses the following actions affecting watercraft:

- The stilling basin below Sanford Dam is closed to all boating and hunting, including any vessel or device propelled by hand, sail or machinery, or rigid or inflatable construction, and used for support ("Closures and Public Use Limits," sec. 1.5).
- Operating a vessel without a special permit in excess of 5 mph or creating a wake is prohibited in all marked "No Wake" areas on the lake ("Boating and Water Use Activities," sec. 3.6(d)(1)).

- Launching of boats is permitted at the following developed launch ramps ("Boating and Water Use Activities," sec. 3.6(d)(1)(h)):

Sanford-Yake	all boats year-round
Cedar Canyon	all boats year-round
Fritch Fortress	all boats year-round
Harbor Bay	all boats year-round
Blue West	all boats year-round
Bates Canyon	all boats year-round if water level high enough, otherwise closed
Plum Creek	all boats year-round if water level high enough, otherwise closed
Primitive Areas	primarily small boats during the waterfowl hunting seasons

OBJECTIVES IN TAKING ACTION

Objectives are "what must be achieved to a large degree for the action to be considered a success" (DO #12). All alternatives selected for detailed analysis must meet all objectives to a larger degree, as well as resolve purpose of and need for action. Objectives for managing PWC use must be grounded in the park's enabling legislation, purpose, significance, and mission goals and be compatible with direction and guidance provided by the forthcoming general management plan.

Using Lake Meredith National Recreation Area's enabling legislation, mandates, direction for the general management plan (in progress), issues, and servicewide objectives, park staff identified the following management objectives relative to PWC use:

Water Quality

- Manage PWC emissions that enter the lake in accordance with anti-degradation policies and goals.
- Protect aquatic organisms from PWC emissions and sediment disturbances so that the viability of dependent species is conserved.

Air Quality

- Manage PWC activity so that air emissions of harmful compounds do not contribute to air quality degradation and do not adversely affect visitors' health and safety.

Soundscapes (Noise)

- Manage noise from PWC use in affected areas so that visitors' health, safety, and experiences are not adversely affected.

Wildlife and Wildlife Habitat

- Protect birds and waterfowl from the effects of PWC-generated noise, especially during nesting seasons.
- Protect fish and wildlife species and their habitat from PWC disturbances.
- Protect fish and wildlife from the adverse effects of bioaccumulation of contaminants from PWC emissions.

Threatened, Endangered, or Special Concern Species

- Protect threatened or endangered species, or species of special concern, and their habitats from PWC disturbances.

Shoreline Vegetation

- Manage PWC use to protect shoreline vegetation from visitor impacts related to such use.
- Manage PWC use to protect sensitive shoreline areas from any potential erosion caused by PWC activity.

Visitor Experience

- Manage potential conflicts between PWC users and other park visitors.

Visitor Conflict and Visitor Safety

- Minimize or reduce the potential for PWC user accidents.
- Minimize or reduce the potential for safety conflicts between PWC users and other water recreationists.
- Provide a safe and healthful environment for park visitors.

Cultural Resources

- Manage PWC use and access to protect cultural resources, including sacred sites important to Native Americans.

Socioeconomic Environment

- Work cooperatively with concessioners and local businesses that rent or sell personal watercraft.

National Recreation Area Management and Operations

- Provide a safe and healthful environment for park visitors.
- Seek cooperation with local and state entities to manage or regulate PWC use.

ISSUES AND IMPACT TOPICS

Issues associated with PWC use at the park were identified during scoping meetings with NPS staff and as a result of public comments. Many of these issues were identified in the settlement agreement with the Bluewater Network, which requires that at a minimum the effects of PWC use be analyzed for the following: water quality, air quality, soundscapes, wildlife and wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety. Potential impacts to other resources were considered as well. The following impact topics are discussed in the "Affected Environment" chapter and analyzed in the "Environmental Consequences" chapter. If no impacts are expected, based on available information, then the issue was eliminated from further discussion, as explained on page 21.

WATER QUALITY

The vast majority of PWC in use today are two-stroke, carbureted engines, which discharge as much as 30% of their fuel unburned directly into the water (NPS 1999; CARB 1999). New technology and implementation of EPA's 2006 emission requirements are designed to reduce water quality impacts. Hydrocarbons, including BTEX, are also released, as well as MTBE. These discharges could have potential adverse effects on water quality at Lake Meredith.

Some research shows that PAHs, including those from PWC emissions, adversely affect water quality by means of harmful phototoxic effects on ecologically sensitive plankton and other small water organisms (US EPA 1998; Oris et al. 1998; Landrum et al. 1987; Mekenyan et al. 1994; Arfsten et al. 1996). This in turn can affect aquatic life and ultimately aquatic food chains. The primary concern is in shallow water ecosystems.

Water quality and quantity is of paramount importance to Lake Meredith National Recreation Area, the U.S. Bureau of Reclamation, the Canadian River Municipal Water Authority, as well as the 11 communities that receive over 70% of their water requirements from the lake. Up to 24 billion gallons of water (75,000 acre-feet) are distributed annually to over 450,000 citizens and industrial users in the Texas Panhandle. Lake Meredith is also one of the region's major tourist and recreation resources.

Water quality concerns focus on naturally occurring dissolved solids (e.g., chlorides and sulfates) and illegal discharges of contaminants into the watershed and reservoir, as well as pollution resulting from agriculture, stormwater runoff, municipal releases, sedimentation, and industrial releases or spillage from oil and gas production activities (there are over 175 active wells in or around the lake), as well as the operation of watercraft.

AIR QUALITY

Pollutant emissions such as nitrogen oxides and volatile organic compounds from PWC use may adversely affect air quality. PWC emissions could have some localized impacts, particularly if PWC use increased. New technology and implementation of EPA's 2006 emission requirements are designed to reduce some air quality impacts.

Lake Meredith National Recreation Area is a class II air quality area. Although the park is not subject to provisions that apply to class I areas for the prevention of significant deterioration, the 1963 Clean Air Act (42 USC 7401 et seq.) provides that the federal land manager has an affirmative responsibility to protect air quality related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse pollution impacts. There are about a dozen major sources of air pollutants within a 30-mile radius of Lake Meredith (fertilizer plants, carbon black plants, refineries/smelters, and power plants), as well as oil and gas wells and associated production facilities. Winds carry large amounts of particulates throughout the area. Boats and personal watercraft would account for only a small fraction of air pollution compared to other sources.

SOUNDSCAPES

PWC-generated noise varies from vessel to vessel. No literature was found that definitively described scientific measurements of personal watercraft noise. Some literature states that all recently manufactured watercraft emit fewer than 80 dB at 50 feet from the vessel, while other sources attribute levels

as high as 102 dB without specifying distance. None of this literature fully describes the method used to collect noise data.

The National Park Service contracted for noise measurements of personal watercraft and other motorized vessels in 2001 at Glen Canyon National Recreation Area (Harris Miller Miller & Hanson, Inc. 2002). The results show that maximum PWC noise levels at 50 feet ranged between 68 to 76 dBA. Noise levels for other motorboat types measured during that study ranged from 65 to 86 dBA at 50 feet.

Noise limits established by the National Park Service require vessels to operate at less than 82 dB at 82 feet from the vessel. Personal watercraft may be more disturbing than other motorized vessels because of rapid changes in acceleration and direction of noise. The reservoir area of Lake Meredith is not traditionally known for natural quiet. Highway traffic, oil and gas production, and compressors associated with natural gas production and transport operate 24 hours a day. Personal watercraft are operated during the warm season, and their use is restricted to the hours between sunrise and sunset. Large boats and speedboats normally generate the most noise on the lake, and during the summer fishing boats are on the reservoir 24 hours a day. Park staff have received very few complaints about PWC noise from visitors. Although PWC use is not a leading or major source of noise, there may be some areas of the park where management objectives are designed to minimize noise impacts.

WILDLIFE AND WILDLIFE HABITAT

Some research suggests that PWC use impacts wildlife activities, causing alarm or flight, avoidance of habitat, and effects on reproductive success. This is thought to be caused by PWC speed, noise, and access, and PWC use may have a greater impact on wildlife than other types of watercraft. However, because of Lake Meredith's low water level, much of the wildlife habitat is inaccessible by personal watercraft (the national recreation area consists of about 46,000 acres, but the lake is only 10,000 acres). Park staff have witnessed neither the harassment of wildlife by PWC users nor PWC collisions with wildlife.

THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

PWC use could have an effect on sensitive species if watercraft disrupted them during feeding or nesting. Additionally, PWC users who land on the beach have access to shoreline areas where sensitive species may occur.

Federally listed threatened, endangered, or candidate species that either are or may be potentially found in Lake Meredith National Recreation Area include the bald eagle, black-tailed prairie dog (historically an extirpated species), Arkansas River shiner, lesser prairie chicken (potential resident in higher elevations of flat land), mountain plover (potential habitat for a species considered migratory by the Texas Parks and Wildlife Department), whooping crane (potential seasonal migratory species), and the interior least tern (potentially along the Canadian River corridor, although the nearest known colony is 75 miles east of the park in Oklahoma). There are no known federally threatened or endangered plants in the park. Species of concern and state-listed species that either are or may be found in the park include the American peregrine falcon, the arctic peregrine falcon (a possible winter migrant), the Texas horned lizard, and the Mexican mud-plantain (plant species).

SHORELINE VEGETATION

PWC operators may disembark from their craft to explore, sunbathe, or beachcomb along the shore. These visitors may trample upland vegetation along the shoreline in order to access trails or to explore along the shore.

The shoreline of Lake Meredith is an artificial habitat that can fluctuate greatly. It is most heavily impacted by erosion caused by wind and wave action. Rain runoff and mass wasting also actively affect shoreline habitat. The inherent characteristics of the lake's steep sides and slopes (up to 35%), in conjunction with fluctuating water depth, prevents vegetation from becoming established along most of the shoreline. Exotic species (such as salt cedar) have invaded many areas along the shoreline.

Motorized watercraft of all types can access the shoreline along the majority of Lake Meredith. Shoreline access and trampling of vegetation are issues not restricted to PWC users. However, the lower the lake level, the more restrictive the lake is for watercraft. In backwater areas there is a high concentration of shoreline vegetation. The predominant vegetative cover consists of blue grama, little bluestem, and buffalo grasses. Such areas have shallow waters that can only be accessed by shallow-draft boats. In order to fish in shallow, grassy waters, many visitors use bass boats with small trolling motors. Personal watercraft, however, tend to avoid these areas to prevent damage to the propulsion system from submerged grasses and sediment.

VISITOR EXPERIENCE

Some segments of the public view PWC use as a nuisance due to their noise, speed, and overall environmental effects. Others believe that PWC use is no different from other motorized watercraft and that people have a right to enjoy the sport. One of the goals of the general management plan that is being undertaken is to maintain the natural quiet in order to enhance the visitor experience. While the draft plan was being developed, many comments were received regarding PWC noise. The primary concern involves changes in noise, pitch, and volume due to the way in which personal watercraft are operated. Additionally, the sound of any watercraft can carry for long distances, especially on a calm day.

VISITOR CONFLICTS AND SAFETY

In 1996 personal watercraft made up 7.5% of the state-registered recreational boats in the United States, but accounted for 36% of recreational boating accidents (NTSB 1998; CARB 1999). In part, this is believed to be a "boater education" issue, i.e., inexperienced riders lose control of the craft; yet it also is a function of the PWC operation (i.e., no brakes or clutch). When drivers let up on the throttle to avoid a collision, steering becomes difficult. Between 1997 and 2001 there were a total of 6 PWC accidents and 122 violations on Lake Meredith. The majority of violations involve speeding in the no-wake zone and failure to pay the permit fee. While the use of watercraft at Lake Meredith has increased, the number of accidents has decreased. As a result of proactive boat patrols, there have been only four PWC-related accidents in the last three years. During the first 30 years of the park's existence there were two water-related deaths per year.

The primary user conflict at the park is between anglers and PWC users. Anglers complain that PWC operation disrupts fishing in some back coves of the lake. PWC speeds, wakes, and proximity to other users can pose conflicts and hazards to other recreationists, including swimmers, canoeists, water-skiers, scuba divers, and those viewing nature.

CULTURAL RESOURCES

Archeological sites are common in Lake Meredith National Recreation Area. A shoreline survey was completed in 1981, and 44 prehistoric and 8 historic sites were located between the high and low waterlines. Sites along the shoreline are most threatened by natural erosion due to fluctuating reservoir water levels and wind-driven wave action. Wave action from boats and personal watercraft is a minor problem compared to wind-driven waves that hit the shoreline. In recent years, there have been no reports of people taking artifacts from shoreline sites.

Uncontrolled access to cultural sites remains a problem at Lake Meredith. Both PWC users and boaters can access sites along and near the shoreline. The park does not have sufficient staff to enforce regulations throughout the year.

ETHNOGRAPHIC RESOURCES

Native American sacred sites that are listed on, or may be eligible for listing on, the National Register of Historic Places may be affected by erosion along shorelines, or by uncontrolled visitor access since riders are able to access areas less accessible to most motorcraft. Previous consultations were held with Native American tribes concerning the exposure of human remains found eroding from the lake shore. Any proposed erosion control efforts that relate to PWC use should be planned in consultation with culturally associated tribes.

SOCIOECONOMIC ENVIRONMENT

National PWC ownership increased every year between 1991 and 1998; the rate of annual increase peaked in 1994 at 32% and dropped slightly in 1999, 2000, and 2001 (see Table 1). The Marina at Lake Meredith currently rents up to five personal watercraft on an hourly basis. However, rentals are low compared to other boat rentals because of the higher insurance costs for personal watercraft, which are passed on to consumers. There are no current plans at the marina to expand the facility or change the PWC rental arrangement. Some local businesses that cater to PWC users may be adversely affected if PWC use was banned. PWC use is viewed as a relatively small portion of the recreational business at several boating and water-related establishments.

PARK MANAGEMENT AND OPERATIONS

Impact to Park Operations from Increased Enforcement Needs

PWC use may require additional park staff to enforce standards, limits, or closures because of relatively high accident rates and visitor conflicts. Boating regulations are enforced by both NPS rangers and Texas Parks and Wildlife officers. Coast Guard Auxiliary officers assist with safety patrols (no enforcement) on holidays and busy weekends. Whether the park would need additional staff to enforce the provisions of the PWC management alternatives is an issue. Any alternative that would restrict use would require the purchase of additional buoys to mark the no-wake zones of designated coves. Additional expense would be associated with time required for staff to set and maintain the new buoys.

Conflict with State and Local Ordinances and Policies Regarding PWC Use

Some national, state, and local governments have taken action, or are considering taking action, to limit, ban, or otherwise manage PWC use. While the park may be exempt from these local actions, consistency with national, state and local plans must be evaluated.

ISSUES ELIMINATED FROM FURTHER CONSIDERATION

The following issues were eliminated from further analysis for the reasons stated below.

Museum Collections — Although the Lake Meredith National Recreation Area maintains a museum collection, these materials are housed in a protective environment and are not specifically affected by PWC use.

Historic Structures / Cultural Landscapes — Historic structures and cultural landscapes exist in the park, including the McBride house (located near McBride Canyon) and the carbon black plant (in the northern end of the park). However, these sites are not located on or near the lake or its shoreline (the McBride house is about 1.5 miles from the shore). Therefore, they are not specifically affected by PWC use.

Wetlands — Any potential impacts to wetlands in the vicinity of the shoreline are evaluated under the topic "Shorelines and Shoreline Vegetation." (The extent of the area of impact is defined in the methodology section for shoreline vegetation.) Wetlands that occur farther inland would not be affected by PWC use because of the limited distance that PWC users generally walk when not using their machines.

Floodplains — The level of PWC use and associated PWC activities identified in each alternative would have no adverse impacts on floodplains. No development is proposed by the alternatives; thus, no flooding would result from PWC use and causing impacts to human safety, health, or welfare.

Prime and Unique Agricultural Lands — No prime and unique agricultural farmland exists in the vicinity of areas that would be affected by PWC use.

Energy Requirements and Natural or Depletable Resource Requirements — PWC operation requires the use of fossil fuels. While PWC use could be limited or banned within this park unit, no alternative considered in this environmental assessment would affect the number of personal watercraft used within the region or the amount of fuel that is consumed. The level of PWC use considered in this environmental assessment is minimal. Fuel is not now in short supply, and PWC use would not have an adverse effect on continued fuel availability.

Impacts to Economically Disadvantaged or Minority Populations (Executive Order 12898) — Local residents may include low-income populations. However, these populations would not be particularly or disproportionately affected by continuing or discontinuing PWC use. Other areas near the park are available to all PWC users.

RELATIONSHIP TO OTHER PLANS, POLICIES, AND ACTIONS

Other plans, policies, and actions at the federal, state, and local level that may affect decisions for PWC use were discussed with the NPS staff, along with existing and future plans and policies at Lake Meredith. The following plans, policies, and actions could affect the alternatives being considered for personal watercraft. These plans and policies are also considered in the analyses of cumulative effects.

PARK POLICIES, PLANS, AND ACTIONS

- *Development Concept Plan / Road Classification Plan and Environmental Assessment for Lake Meredith Recreation Area, and General Management Plan Amendment and Environmental Assessment for Alibates Flint Quarries National Monument, Texas* (1984) — This project would rehabilitate and maintain existing recreation facilities, including roads, parking facilities, and trails within the national recreation area.
- *Strategic Plan* (October 1, 2000 – September 30, 2005) — The park's *Strategic Plan* contains a long-term goal to protect, restore, and maintain ecosystems, rare plants and animal populations, archeological and ethnographic resources, and recreational activities. The plan also specifies 57% visitor satisfaction by 2005 and increased visitor safety.
- *Oil and Gas Management Plan Environmental Impact Statement* (2002a) — This plan addresses impacts to various resources at Lake Meredith from oil and gas operations in the park. Oil and gas operations are potential sources of hydrocarbon contamination in reservoir waters.
- *General Management Plan* — A program is underway to develop a general management plan for Lake Meredith. The team will examine the park's facilities and discuss the need for or the possibility of removing two boat ramps. These ramps have not been open for years; therefore, the closure should not affect visitor use or enjoyment. This project is underway but it is too early to predict what, if any, changes will be made to park facilities.

LOCAL OR STATE POLICIES, PLANS, OR ACTIONS

- There are no current plans to expand the Marina at Lake Meredith (the park concessioner on Lake Meredith) or to change the PWC rental arrangement. The marina currently rents five personal watercraft.

ALTERNATIVES

All alternatives must be consistent with the purpose and significance of the Lake Meredith National Recreation Area, and they must meet the purpose of and need for action, as well as the objectives for the project. Three alternatives are described in this section; options that were considered but dismissed are discussed on page 31.

The alternatives are analyzed in accordance with the National Environmental Policy Act and are the result of agency and public scoping input. The alternatives range from continuing PWC use under a special regulation to banning PWC use after November 6, 2002. Table 3 at the end of this chapter summarizes the alternatives being considered, and Table 4 summarizes the impacts of each alternative. Table 5 lists the issues associated with PWC use, management objectives for addressing the issues, and an analysis of how well each alternative meets the objectives.

ALTERNATIVE A — CONTINUE PWC USE UNDER A SPECIAL REGULATION

PWC use would continue to be allowed and would be managed under a special regulation that includes the following current provisions of the "Superintendent's Compendium":

- The stilling basin* below Sanford Dam is closed to all boating and hunting, including any vessel or device propelled by hand, sail or machinery, or rigid or inflatable construction, and used for support ("Closures and Public Use Limits," sec. 1.5).
- Operating a vessel without a special permit in excess of 5 mph or creating a wake is prohibited in all marked "No Wake" areas on the lake ("Boating and Water Use Activities," sec. 3.6(d)(1)).
- Launching of boats is permitted at the following developed launch ramps ("Boating and Water Use Activities," sec. 3.6(d)(1)(h)):

Sanford-Yake	all boats year-round
Cedar Canyon	all boats year-round
Fritch Fortress	all boats year-round
Harbor Bay	all boats year-round
Blue West	all boats year-round
Bates Canyon	all boats year-round if water level high enough, otherwise closed
Plum Creek	all boats year-round if water level high enough, otherwise closed
Primitive Areas	primarily small boats during the waterfowl hunting seasons

This alternative would allow unrestricted use of the lake. Existing use would be managed under the following provisions:

- Conduct water patrols and enforcement on an irregular basis (a less than daily occurrence).
- Enforce the Texas Parks and Wildlife Code relating to PWC use, as summarized below (Texas 2002):

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* The stilling basin is a 14-acre area formed by concrete structures at the upper end of the outlet channel, which is intended to carry water discharged from the spillway and flood control outlet works back to the river. The water level in the outlet channel is maintained by groundwater seepage when no releases have been made recently.

1. Each occupant must wear a U.S. Coast Guard approved personal flotation device.
2. The cutoff switch (if provided) must be attached to the operator.
3. No PWC operation allowed between sunset and sunrise.
4. No PWC operations within 50 feet of any other vessel, person, stationary platform or other object, or shore, except at headway speed.
5. Operator must be 16 years of age, or be accompanied by a person at least 18 years of age; or must be at least 13 years of age and have successfully completed a boating safety course prescribed and approved by the state.
6. No PWC operation within any area where motorboat use is prohibited by state law or local rule or regulation.
7. No towing water skis, an aquaplane, a surfboard, a tube, or any other similar device, unless the craft is designed to carry a minimum of two persons.
8. No jumping the wake of another vessel recklessly or coming unnecessarily close to that vessel.
9. No operation in a manner that requires the operator to swerve at the last possible moment to avoid a collision.

ALTERNATIVE B — CONTINUE PWC USE UNDER A SPECIAL REGULATION WITH MITIGATION TO REDUCE USE CONFLICTS IN LAKE AREAS AND TO PROTECT WATER RESOURCES (PREFERRED ALTERNATIVE)

Under alternative B Lake Meredith National Recreation Area would adopt a special regulation that would allow continued PWC operation similar to alternative A, but use would be restricted to reduce user conflicts in lake areas and to protect water resources.

The following management strategies would be adopted:

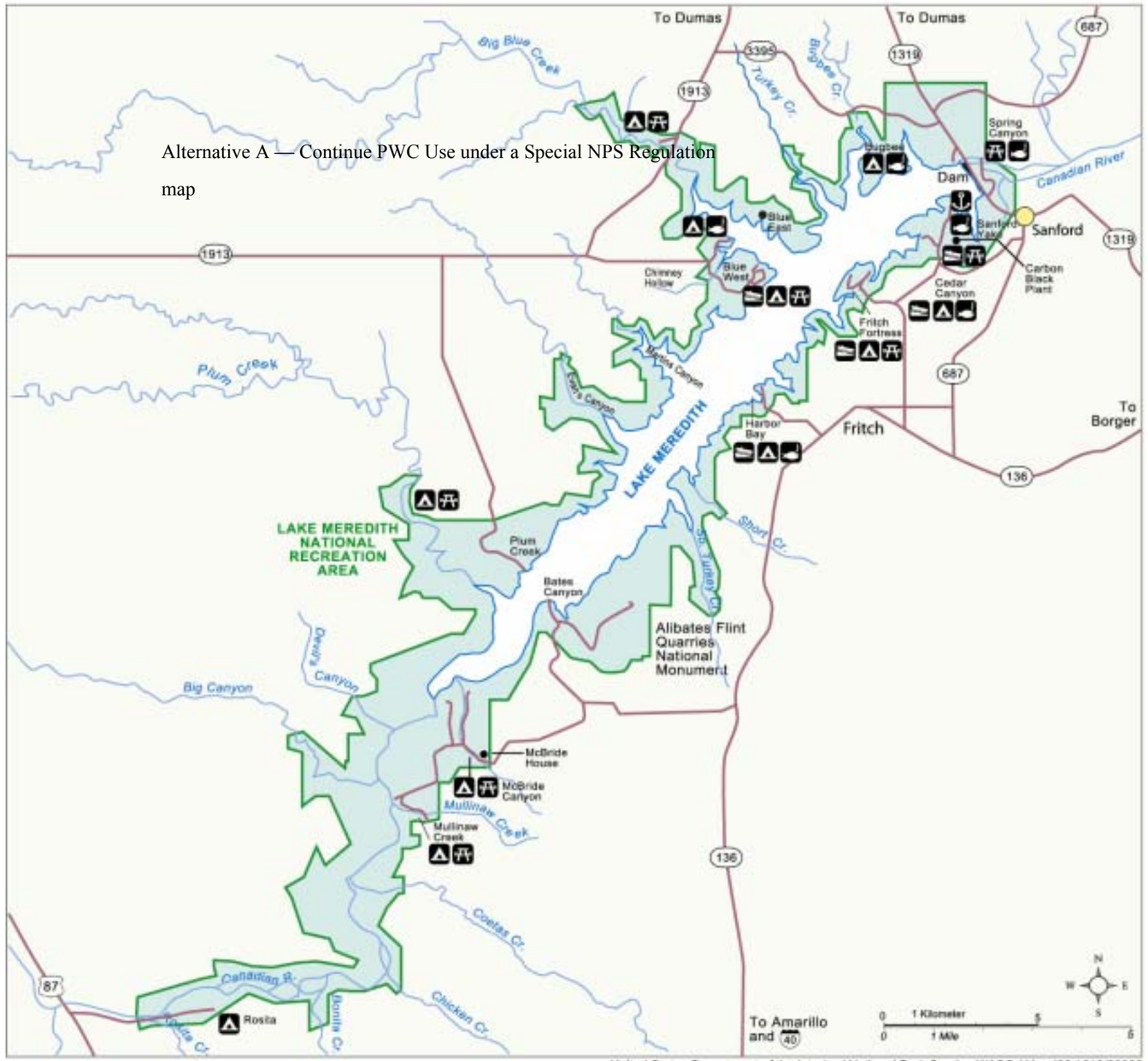
- Establish the following back coves on the lake as no-wake zones: North Turkey, Bugbee Canyon, North Canyon, South Canyon, Sexy Canyon, Amphitheater Cove, coves between day markers 9 and 11, Fritch Canyon, and Short Creek (plus Evans Canyon and Canal Canyon should the water level ever get high enough). A map of the lake would be developed to identify these no-wake zones, and they would be clearly marked with buoys (see the map inset on the Alternative B map). Maps would be posted at the park, and informational pamphlets would be made available to the public.
- Enhance PWC user education through interpretive talks, onsite bulletins, and brochures for PWC registrants and visitors who rent personal watercraft. Educate PWC users about the advantages of using watercraft with cleaner burning engines.
- Prohibit PWC fueling on the lake except at the marina fuel dock, with an attendant providing the fuel service.
- Permit PWC fueling by operators onshore and out of the water.
- Prohibit carrying of extra fuel on personal watercraft.
- Continue to monitor water quality tests on Lake Meredith available from other agencies.

All Texas and federal watercraft laws and regulations, as described for alternative A, would apply to PWC operators, including regulations that address reckless or negligent operation, excessive speed, hazardous wakes or washes, hours of operation, age of driver, and distance between vessels.

Lake Meredith National Recreation Area

Texas

Alternative A -- Continue PWC Use under a Special Regulation



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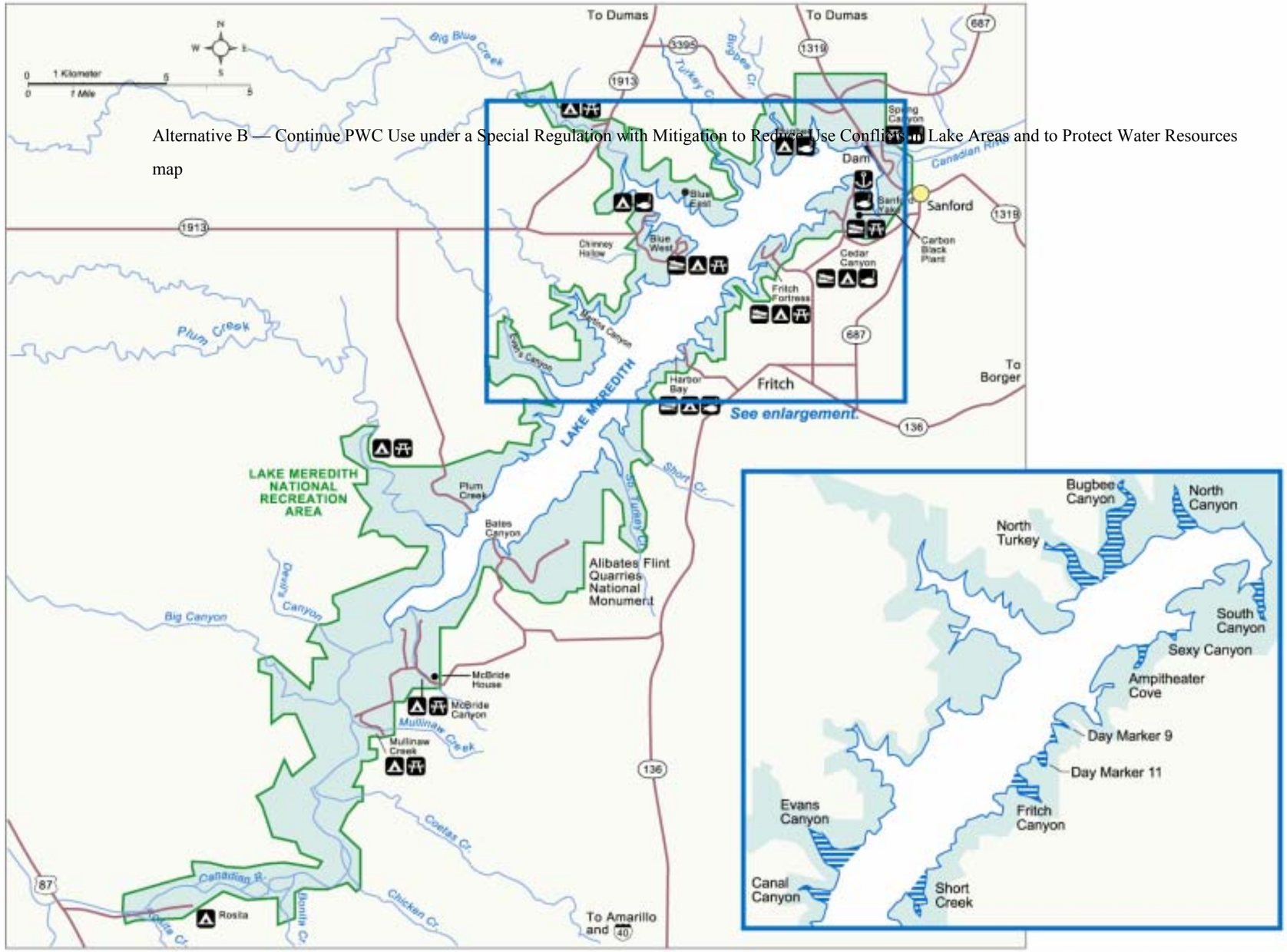
Lake Meredith National Recreation Area
Texas

Alternative B -- Continue PWC Use under a Special Regulation with Mitigation to Reduce Use Conflicts in Lake Areas and to Protect Water Resources

Alternative B — Continue PWC Use under a Special Regulation with Mitigation to Reduce Use Conflicts in Lake Areas and to Protect Water Resources map



United States Department of the Interior / National Park Service WASO / Nov. '02 / 618/20039

Campground | Boat ramp | Fishing | Water | Park land
Ranger station | Marina | Picnic area | Controlled area (no wake)

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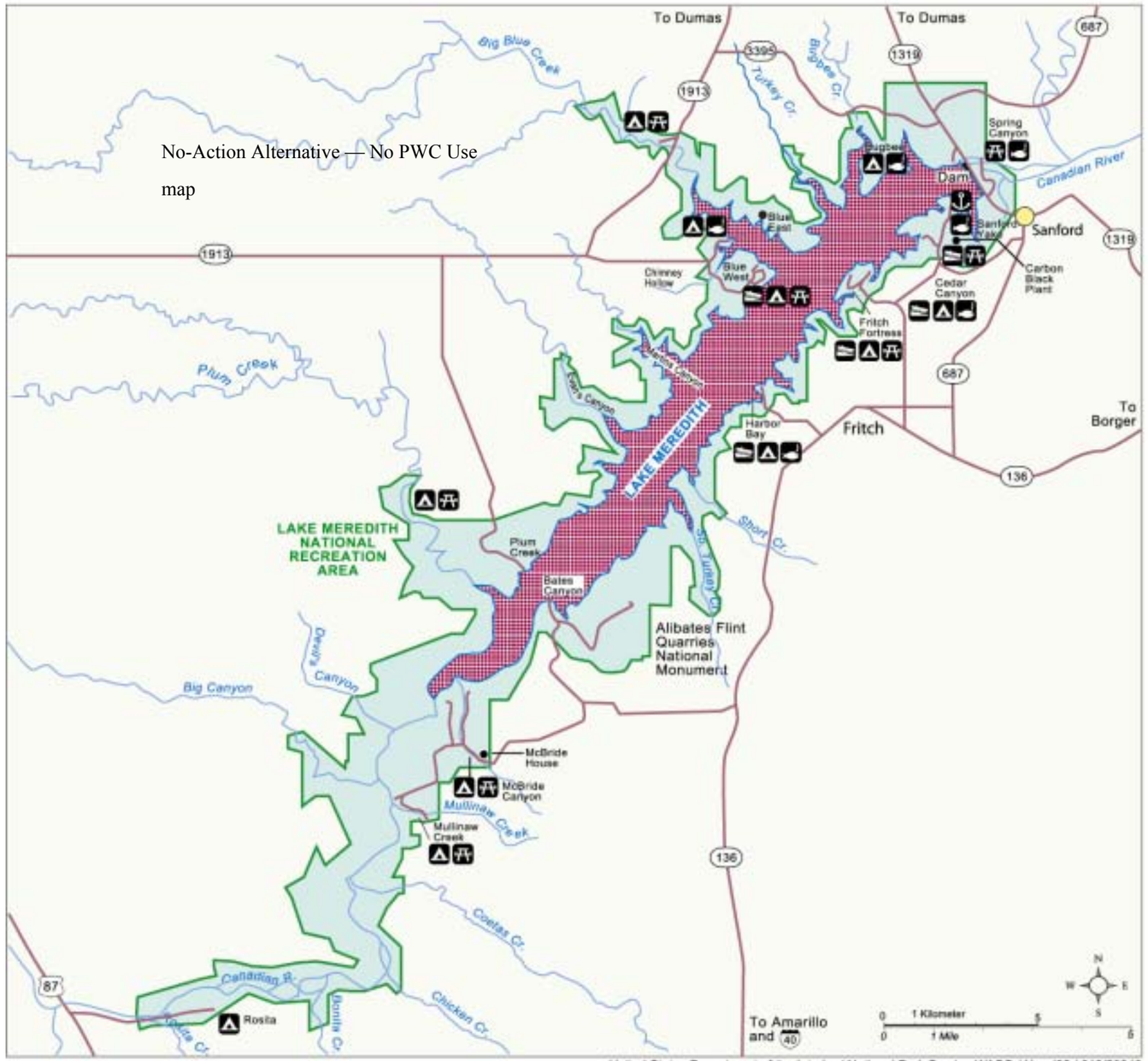
Lake Meredith National Recreation Area
Texas

No-Action Alternative -- No PWC Use



United States Department of the Interior / National Park Service WASO / Nov. '02 / 618/20040

Campground	Boat ramp	Fishing	PWC use prohibited
Ranger station	Picnic area	Marina	Park land

blank back of map

NO-ACTION ALTERNATIVE — NO PWC USE

The no-action alternative would discontinue all PWC use, and the National Park Service would take no action to draft a special regulation to continue such use after November 6, 2002. Visitors would be educated about why no PWC use is allowed.

OTHER ALTERNATIVES OR OPTIONS CONSIDERED

An option was considered to require all personal watercraft to meet the 75% reduction in total hydrocarbon emissions by 2015. However, this option was dropped because given PWC use levels at Lake Meredith and the Environmental Protection Agency's assumptions about the conversion period to convert to clean engine technology, most personal watercraft in use by 2015 would likely be newer models compliant with the EPA 2006 emission standards. Therefore, the benefits of this option would not be appreciably different than those under alternative B.

THE ENVIRONMENTALLY PREFERRED ALTERNATIVE

The environmentally preferred alternative is defined by the Council on Environmental Quality as the alternative that best meets the following criteria or objectives, as set out in section 101 of the National Environmental Policy Act:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Ensure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage and maintain, whenever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities.
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

This discussion also summarizes the extent to which each alternative meets section 102(1) of the National Environmental Policy Act, which asks that agencies administer their own plans, regulations, and laws so that they are consistent with the policies outlined above to the fullest extent possible.

Alternative A would satisfy the majority of the six requirements detailed above; however, alternative A would not ensure safe, healthful, productive, and aesthetically pleasing surroundings by allowing PWC use in areas frequented by passive outdoor recreationists. Alternative A would not attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences because of the potential impacts of PWC use to visitor experiences and other opportunities in the national recreation area, such as the permitted use of ethnographic resources. For this reason, alternative A is not preferred from an environmental perspective.

Alternative B would have impacts on the national recreation area's natural resources similar to those under alternative A. However, the establishment of no-wake zones would benefit other visitors, such as anglers. Over the long term this alternative would help visitors enjoy beneficial use by allowing access to national recreation area amenities by PWC users while accommodating passive outdoor recreationists and meeting resource management objectives. This alternative would accommodate recreational opportunities for visitors, including PWC users, while protecting park resources and enhancing the experiences of non-PWC visitors. Alternative B is designed to meet the National Park Service's general prohibition on PWC use for the protection of park resources and values while providing access to the national recreation area by PWC operators.

The no-action alternative would ensure a safe, healthful, productive, and aesthetically and culturally pleasing area for visitors to access without the threat of PWC users introducing noise and safety concerns. The no-action alternative would attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences by removing the PWC use from the national recreation area entirely. However, the no-action alternative would not maintain an environment that supports diversity and variety of individual choice, nor would it achieve a balance between population and resource use that permits a wide sharing of amenities.

Based on the analysis prepared for PWC use at Lake Meredith National Recreation Area, alternative B is considered the environmentally preferred alternative by best fulfilling park responsibilities as trustee of sensitive habitat; by ensuring safe, healthful, productive, and aesthetically and culturally pleasing surroundings; and by attaining a wider range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences.

TABLE 3: SUMMARY OF ALTERNATIVES

	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
Location Restrictions	Unrestricted use of the lake except for the stilling basin below Sanford Dam.	Same as alternative A.	No PWC use.
Wake Restrictions	Abide by Texas state regulations regarding wake restrictions, i.e. no person operating a PWC shall jump the wake of another vessel. Also, creating a wake is prohibited in all marked "No Wake" areas.	Same as alternative A but also designate back coves on the lake as no-wake zones.	Not applicable.
Launch Restrictions	Launch and retrieval of personal watercraft permitted at: • Sanford-Yake — all year • Cedar Canyon — all year • Fritch Fortress — all year • Blue West — all year • Bates Canyon — all year if water level sufficient • Plum Creek — all year if water level sufficient • Primitive Areas — all year if water level sufficient • Campgrounds/campsites adjacent to lake	Same as alternative A.	No PWC launching or retrieval permitted.
Equipment and Emissions Restrictions	None.	Prohibit PWC fueling on lake except by attendant at the marina fuel dock. Allow PWC fueling on shore, out of water. Prohibit the carrying of extra fuel on board.	No PWC use.

	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
Operating / Safety Requirements	Enforce Texas Parks and Wildlife Code relating to PWC use: • Each occupant must wear a U.S. Coast Guard approved personal flotation device. • The cutoff switch (if provided) must be attached to the operator. • No PWC operation allowed between sunset and sunrise. • No PWC operations within 50 feet of any other vessel, person, stationary platform or other object, or shore, except at headway speed. • Operator must be 16 years of age, or be accompanied by a person at least 18 years of age; or must be at least 13 years of age and have successfully completed a boating safety course prescribed and approved by the state. • No PWC operation within any area where motorboat use is prohibited by state law or local rule or regulation. • No towing water skis, an aquaplane, a surfboard, a tube, or any other similar device, unless the craft is designed to carry a minimum of two persons. • No jumping the wake of another vessel recklessly or coming unnecessarily close to that vessel. • No operation in a manner that requires the operator to swerve at the last possible moment to avoid a collision.	Same as alternative A.	Not applicable.
Enforcement	No changes in enforcement.	Same as alternative A, plus enhance boater education through interpretive talks, onsite bulletins, and brochures provided to PWC registrants and visitors who rent personal watercraft.	Focus on enforcing the personal watercraft ban.
Education	Continue current boater education program.	Enhance boater education through interpretive talks, onsite bulletins, brochures for PWC registrants and visitors who rent personal watercraft, post maps of the lake with no-wake zones clearly marked, and provide informational pamphlets to the public. Educate PWC users about the advantages of using watercraft with cleaner burning engines.	Educate visitors on why PWC are prohibited within the national recreation area.

TABLE 4: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
Water Quality	Continuing PWC use as managed until November 6, 2002, would have short- and long-term, negligible, adverse effects on water quality based on ecotoxicological and human health benchmarks. All pollutant loads would be well below benchmarks. Cumulative impacts from PWC and motorized boat use in 2002 and 2012 would be negligible based on ecotoxicological benchmarks. Cumulative impacts based on human health benchmarks from benzene would be moderate in 2002, decreasing to minor by 2012 due to improved emission controls. The evaporation of benzene and the presence of a thermocline could affect the impact assessment for both 2002 and 2012. Therefore, focused water quality monitoring immediately following a high-use day would be needed to confirm the estimates of impacts from benzene. No impairment.	Continued PWC use with management restrictions would result in short- and long-term, negligible, adverse effects on water quality based on ecotoxicological and human health benchmarks, similar to alternative A. All threshold volumes needed to dilute PWC emissions in area 2 would be smaller than under alternative A because of the additional management restrictions (specific no-wake zones for personal watercraft). Prohibiting PWC fueling on the lake would reduce the potential for accidental spills and associated impacts on water quality. Also, the PWC user education program could result in lower PWC emission rates in 2012. Cumulative impacts in 2002 from PWC and motorboat use would range from negligible to moderate. Impacts from benzene would be moderate in 2002 in area 1 and minor in area 2. Focused water quality monitoring would be needed immediately following a high-use day to confirm these impact estimates. By 2012 all threshold volumes would be substantially reduced as a result of improved emission controls, no-wake zones, and a PWC user education program; all cumulative impacts based on ecotoxicological and human health benchmarks would be negligible. No impairment.	Discontinuing PWC operations would have a beneficial impact on water quality relative to alternative A. Overall, cumulative impacts for all organic compounds except benzene would be negligible in 2002 and 2012. For benzene, impacts based on human health benchmarks would be minor in 2002, decreasing to negligible by 2012. No impairment.
Air Quality			
• Impacts to Human Health from Airborne Pollutants Related to PWC Use	Continuing PWC use would result in minor adverse impacts from CO and negligible impacts from VOC, PM_{10}, and NO_x in 2002 and 2012. In 2002 cumulative emission levels would result in moderate impacts for CO and VOC, and negligible impacts for PM_{10} and NO_x. In 2012 cumulative CO emissions would be reduced slightly, but impact levels would still be moderate; the VOC impact level would be reduced to minor; and the PM_{10} and NO_x impact levels would remain negligible. Continued reductions in PM_{10}, HC, and VOC emissions would occur over time due to improved emission controls. No impairment.	Continuing PWC use would result in minor adverse impacts from CO and negligible impacts from VOC, PM_{10}, and NO_x in 2002 and 2012, although emissions would be reduced slightly compared to alternative A. Cumulative emission levels in 2002 and 2012 would be moderate for CO and negligible for PM_{10} and NO_x. Emission levels for VOC would be minor in 2002, decreasing to negligible in 2012 as a result of improved engine technology. Overall, PWC emissions of HC and VOC are estimated to be 25% to 38% of the cumulative boating emissions in 2002 and would be reduced to below 20% by 2012 with technology improvements. No impairment.	The no-action alternative would have beneficial impacts on air quality because PWC use would be banned within the recreation area, resulting in decreased emissions. Cumulative impacts would be reduced as compared to alternative A but would still be moderate for CO and negligible for PM_{10} and NO_x in 2002 and 2012, even though future emissions of most pollutants would gradually decline as a result of improved engine technology. Impacts from VOC emissions would decrease from minor in 2002 to negligible in 2012. No impairment.
• Impacts to Air Quality Values from Pollutants Related to PWC Use	There would be negligible impact levels to visibility from PWC in both 2002 and 2012. There would be a minor adverse impact level for ozone exposure in 2002 and 2012 from PWC use.	There would be negligible impact levels to visibility from PWC use (although $PM_{2.5}$ emissions would be reduced slightly), and a minor adverse impact level for ozone exposure in 2002 and 2012.	There would be a beneficial impact for visibility and ozone exposure, as there would be no emissions from personal watercraft. For cumulative impacts, there

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
	On a cumulative basis there would be negligible impact levels to visibility from all motorized watercraft emissions in both 2002 and 2012. The impact level for ozone exposure in 2002 and 2012 is expected to remain moderate. Ambient elevated ozone levels in the area of Lake Meredith appear to be primarily a result of ozone formation in south and east Texas, and subsequent transport into the Texas Panhandle. No impairment.	On a cumulative basis there would be negligible impact levels to visibility from all motorized watercraft in both 2002 and 2012, although $PM_{2.5}$ emissions would be reduced slightly. The impact level for ozone exposure in 2002 and 2012 is expected to remain moderate due to the transport of pollutants from south and east Texas. No impairment.	would be a negligible impact to visibility in 2002 and 2012 from all motorized watercraft use, although $PM_{2.5}$ emissions would be reduced slightly. A moderate impact level from ozone is expected to continue due to the transport of pollutants from south and east Texas. No impairment.
Soundscapes	Noise generated by PWC use would continue to have temporary, negligible, adverse impacts at most locations over the short and long term, and minor to moderate adverse impacts in the canyons on the northern portion of the lake and at backcountry locations. Impact levels would be related to the number of personal watercraft operating, as well as the sensitivity of other visitors. Over the long term PWC noise levels would be reduced with the introduction of newer engine technologies. Cumulative noise impacts from personal watercraft, motorboats, and other visitors would be temporary, minor to moderate, and adverse in some locations over the short and long term because these sounds would be heard occasionally throughout the day. For the most part, natural sounds would still predominate at most locations. The highest sound impacts would occur near boat launches and marinas. No impairment.	Noise from PWC use would have temporary, minor, adverse impacts at most locations over the short and long term. However, there would be beneficial impacts in the back coves where no-wake restrictions would be in effect. Impact levels would be related to the number of PWC operators, as well as the sensitivity of other visitors. Over the long term PWC noise levels would be reduced with the introduction of newer engine technologies. Cumulative noise impacts from PWC and motorboat use, as well as other visitor activities, would be temporary, minor, and adverse over the short and long term, with these sounds heard occasionally throughout the day. In the back coves there would be a beneficial impact, since these areas would be designated no-wake zones. For the most part, natural sounds would still predominate at most locations. The highest sound impacts would occur near the boat launches and marinas. No impairment.	No longer allowing PWC use at Lake Meredith would have beneficial impacts on other visitors with the elimination of this noise source. Cumulative noise impacts from motorboats and other visitor activities would be temporary, minor, and adverse over the short and long term, particularly near the boat launches and marinas, but there would be no contribution of noise from PWC use within Lake Meredith. No impairment.
Wildlife and Wildlife Habitat	Impacts would be short term and negligible at most locations because PWC users would operate at least 50 feet from the shoreline and must access the shore at no-wake speeds. In addition, few wildlife use the open water, where speeds are higher. On a cumulative basis, all visitor activities would continue to have short-term, negligible to minor, adverse effects on wildlife and wildlife habitat. Impacts would be temporary. No impairment.	There would be a reduction in overall impacts caused by PWC use because of no-wake zones. Impacts would be short term and negligible at most locations because PWC users would operate at least 50 feet from the shoreline and must access the shore at no-wake speeds. Few wildlife use the open water, where PWC speeds are higher. On a cumulative basis, all visitor activities would continue to have short-term, negligible to minor, adverse effects on wildlife and wildlife habitat. Impacts would be temporary. No impairment.	Prohibiting PWC use at Lake Meredith would eliminate associated impacts to wildlife and habitat, a beneficial impact. Cumulative impacts from other visitor uses would have short-term, negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. All impacts would be temporary. No impairment.
Threatened or Endangered Species or Species of Special Concern	Overall, continued PWC use at Lake Meredith would have no effect or would not likely adversely affect any federal or state listed species, since the identified species are either not present as permanent residents, do not have preferred habitat in the areas used by personal watercraft,	PWC use would have no effect on federal or state listed or sensitive species since potential interactions would be extremely limited, short term, and temporary. Cumulative effects from all park visitor activities would not likely adversely affect these species since they are	Because PWC users would no longer have access to Lake Meredith National Recreation Area, there would be beneficial impacts on federal or state listed species as compared to alternative A. On a cumulative basis the activi-

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
	or are not normally accessible. Cumulative effects from all park visitor activities would not likely adversely affect these species since the identified species are not present, do not nest in the park, or are not accessible during the course of normal visitor activities, which are primarily water-based recreation. No impairment.	not present or are not accessible during the course of normal visitor activities on Lake Meredith. No impairment.	ties of other visitors and other boaters would not likely adversely affect federal or state listed animals and plants because generally these species are not present or are not accessible during the course of normal visitor activities. PWC contribution to overall cumulative impacts to federal or state listed animal and plant species would be eliminated. No impairment.
Shoreline Vegetation	PWC use and activities would have negligible adverse impacts over the short and long term because there would be no perceptible changes to plant community size, integrity, or continuity, now or in the future (2012). On a cumulative basis, other visitor activities are more prevalent than PWC use. However, no obvious impacts currently exist, and none are expected in the future, so impacts to shoreline vegetation would continue to be negligible. There would be no perceptible changes to plant community size, integrity, or continuity through 2012. No impairment.	PWC use would have negligible adverse impacts over the short and long term because there would be no perceptible changes to plant community size, integrity or continuity now or in the future (2012). PWC restrictions in back coves would result in beneficial impacts to shoreline vegetation. On a cumulative basis other visitor activities are more prevalent than PWC use. However, no obvious impacts currently exist, and impacts to shoreline vegetation would continue to be negligible. There would be no perceptible changes to plant community size, integrity, or continuity now or by 2012. No impairment.	Impacts on shoreline vegetation would be beneficial as a result of banning PWC use. There would be no perceptible changes to plant community size, integrity, or continuity now, and none are expected by 2012. Cumulative impacts from other visitor uses would continue, but are expected to be negligible in the short and long term. PWC contribution to overall vegetation impacts would be eliminated. There would be no perceptible changes to plant community size, integrity, or continuity now or by 2012. No impairment.
Visitor Experience	Continued PWC use at Lake Meredith would have negligible to minor adverse impacts on visitor experiences in the short and long term. When related to other visitor activities, such as off-road vehicle use, PWC use would not appreciably limit the critical characteristics of visitor experiences. Cumulative effects of PWC use, other watercraft, and other visitors would continue to result in long-term, negligible adverse impacts, since there would be little noticeable change in visitor experiences. Most visitors would continue to be satisfied with their park experiences.	Some visitors, particularly anglers, would experience beneficial impacts as a result of no-wake zones established in back coves and lake arms. Most other visitors would experience negligible to minor adverse impacts in the short and long term. When related to other visitor activities, PWC use would not appreciably limit the critical characteristics of visitor experiences. Cumulative impacts would be moderate for PWC users but negligible over the short and long term for most other visitors because there would be little noticeable change in visitor experiences.	The no-action alternative would have a beneficial impact on the experiences of most park visitors because PWC use would be banned. Impacts on PWC users who would no longer be able to ride in the national recreation area would be short and long term, moderate, and adverse. Cumulative impacts would be beneficial as compared to alternative A. Most visitors would continue to be satisfied with their experiences at Lake Meredith. On a regional scale there would be a negligible adverse effect on visitor experiences at other waterbodies in the region as a result of PWC users displaced from Lake Meredith.
Visitor Conflicts and Safety	Continued PWC use would have short- and long-term, minor, adverse impacts on visitor conflicts and safety at Lake Meredith due to the number of visitors and boats present on high-use days, particularly at popular boat launches. Conflicts at other locations would remain negligible because use is lower, and conflicts would be less likely to occur, although violations of the no-wake zones along the	Continued PWC use would have short- and long-term, minor, adverse impacts on visitor conflicts and safety due to the number of visitors and boats present on high-use days. Establishing no-wake zones in back coves could benefit anglers who have complained about speed violations in these areas. Cumulative impacts related to visitor conflicts and safety would be minor for all user groups in the short and	Discontinuing PWC use would result in beneficial impacts by reducing visitor conflicts and enhancing safety. PWC-related contributions to overall cumulative impacts to visitor safety would be eliminated. Visitor safety impacts from other sources would be negligible.

Impact Topic	Alternative A — Continue PWC Use under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative — No PWC Use
	shore would continue to adversely impact anglers. Cumulative impacts related to visitor conflicts and safety would be minor for all user groups in the short and long term.	long term.	
Cultural Resources			
• Archeological Sites and Submerged Cultural Resources	PWC use within the recreation area could result in minor adverse impacts on potentially listed archeological sites and submerged cultural resources as a result of illegal collection and vandalism. Cumulative impacts on archeological and submerged cultural resources that are readily accessible could be minor to moderate adverse, due to the number of visitors and the potential for illegal collection or destruction. No impairment.	PWC use within the recreation area could have minor adverse impacts on archeological sites and submerged cultural resources from possible illegal collection and vandalism. However, under this alternative a user education program and no-wake zone could limit these effects. Cumulative impacts on archeological and submerged cultural resources that are readily accessible would be minor to moderate adverse, similar to alternative A. No impairment.	Prohibiting PWC use would have minor beneficial impacts on archeological sites and submerged cultural resources. Cumulative impacts from all visitor activities would continue to be minor to moderate, depending on the accessibility of the resource and the potential for illegal collection or damage. No impairment.
• Ethnographic Resources	PWC-related intrusions during the use of ethnographic resources would result in short-term, minor to moderate, adverse impacts. Over the long term PWC noise levels could be reduced as a result of newer engine technologies. On a cumulative basis all visitor activities could result in minor to moderate adverse impacts on those resources that are readily accessible, due to possible short-term interruptions in their use. All impacts would continue at existing levels. No impairment.	PWC-related intrusions during the use of ethnographic resources would result in short-term, minor to moderate, adverse impacts. The introduction of a user education program and the expansion of no-wake zones could limit some of these effects. Over the long term PWC noise levels could be reduced as a result of newer engine technologies. On a cumulative basis all visitor activities could result in minor to moderate adverse impacts on those resources that are readily accessible, due to possible short-term interruptions in their use. All impacts would continue at existing levels. No impairment.	Prohibiting PWC use would have minor beneficial impacts on ethnographic resources by limiting the potential for disruptions when these resources are being used. Effects from other watercraft users and land-based user groups would have the potential for minor to moderate adverse cumulative impacts to ethnographic resources. No impairment.
Socioeconomic Effects	Continuing PWC use would have no additional impact on the local or regional economy.	Additional management restrictions (including no-wake zones) could reduce PWC-related revenue. However, given the relatively low levels of PWC use at Lake Meredith, no measurable impacts on the local and regional economies are expected.	Banning PWC use would reduce PWC-related revenue. However, given the relatively low levels of PWC use at Lake Meredith, no measurable impacts on the local and regional economies are expected.
National Recreation Area Management and Operations			
• Conflicts with State and Local Regulations	PWC and boating regulations within the national recreation area would be the same as state regulations. Continued PWC use would not result in conflicts with state regulations. Therefore, impacts (including cumulative impacts) would be negligible.	PWC use restrictions would not result in conflicts with state PWC regulations or policies. Impacts (including cumulative impacts) related to conflicts with federal or state requirements or policies would be negligible.	Discontinuing PWC use within the national recreation area would not result in conflict with state PWC regulations and there are no local PWC regulations. Therefore, impacts (including cumulative impacts) related to such conflicts would be negligible.
• Enforcement Needs	This alternative would have moderate adverse impacts on park operations. Additional staff would be needed to regulate existing PWC use.	Similar to alternative A, this alternative would have moderate adverse impacts on park operations. More staff would be needed to ensure full compliance with PWC and use restrictions in the lake, and park staff would have to spend more time initially enforcing and educating visitors about the new regulations.	This alternative would have moderate adverse impacts on park operations. More staff would be needed to ensure compliance with the PWC ban.

TABLE 5: ANALYSIS OF HOW THE ALTERNATIVES MEET THE OBJECTIVES

Issue	Objective	Alternative A — Continue PWC Use under a Special Regulation	Alternative B — Continue PWC Use under a Special Regulation with Management Restrictions	No-Action Alternative — No PWC Use
Water Quality				
The vast majority of personal watercraft in use today are conventional, two-stroke, carbureted engines which discharge as much as 30% of their fuel unburned directly into the water. Hydrocarbons, including BTEX and PAHs, are also released. These discharges have potential adverse effects on water quality.	Manage PWC emissions in accordance with anti-degradation policies and goals.	Meets objective under future EPA emission standards.	Same as alternative A.	Fully meets objective.
Some research shows that PAHs, including those from PWC emissions, adversely affect water quality by means of harmful phototoxic effects on ecologically sensitive plankton and other small water organisms. This in turn can affect aquatic life and ultimately aquatic food chains. The primary concern is in shallow water ecosystems.	Protect aquatic organisms from PWC emissions and sediment disturbances so that the viability of dependent species is conserved.	Meets objective under future EPA emission standards. Direct PWC access to shallow water in the expansive backwater areas is limited due to sediment load in the water and sedimentation in the delta zone.	Same as alternative A.	Fully meets objective.
Other water quality issues may include impacts on drinking water sources, indirect effects on threatened or endangered species sensitive to water quality changes and degradation, and effects on other fish.	Issues addressed in objective above.	Addressed in other topics.	Addressed in other topics.	Addressed in other topics.
Air Quality				
Pollutant emissions, particularly NO_x and VOC from personal watercraft, may adversely affect air quality. These compounds react with sunlight to form ozone. To the extent that nitrogen loading in air contributes to nutrient loading in the water column, PWC use adversely affects water quality.	Manage PWC activity so that air emissions of harmful compounds do not contribute to air quality degradation and do not adversely affect visitors' health and safety.	Meets objective under future EPA emission standards. The threat from PWC use is small compared to industrial sites within 30 miles of the reservoir to the southwest.	Same as alternative A.	Fully meets objective.
Soundscapes				
PWC-generated noise varies from vessel to vessel. Some literature states that all recently manufactured watercraft emit fewer than 80 dB at 50 feet from the vessel, while other sources attribute levels as high as 102 dB without specifying distance. None of this literature fully describes the method used to collect noise data. Noise measurements in 2001 at Glen Canyon National Recreation Area show that at 50 feet maximum PWC noise levels ranged from 68 to 76 dBA and for other motorboat types from 65 to 86 dBA. Noise limits established by the National Park Service are 82 dB at 82 feet. Personal watercraft may be more disturbing than other motorized vessels because of rapid changes in acceleration and	Manage noise from PWC use in affected areas so that visitors' health, safety, and experiences are not adversely affected.	Meets objective in most open water areas and as a result of future EPA emission standards.	Meets objective in most open water areas and proposed no-wake zones, and as a result of future EPA emission standards.	Fully meets objective.

Issue	Objective	Alternative A — Continue PWC Use under a Special Regulation	Alternative B — Continue PWC Use under a Special Regulation with Management Restrictions	No-Action Alternative — No PWC Use
direction of noise.				
Wildlife and Wildlife Habitat				
Some research suggests that personal watercraft have a greater impact on waterfowl and nesting birds because of their noise, speed, and ability to access shallow-water areas more readily than other types of watercraft. This may force nesting birds to abandon eggs during crucial embryo development stages and flush other waterfowl from habitat, causing stress and associated behavior changes. Collisions with waterfowl and wildlife may also be a concern	Protect birds and waterfowl from the effects of PWC-generated noise, especially during nesting seasons.	Meets objective. Most nesting occurs in shallow backwater areas and infrequently along the shoreline. Due to inadequate water depth, vegetation, and the presence of alluvial fans, personal watercraft cannot access most bird habitat.	Same as alternative A, with even more protection afforded to backwater coves.	Fully meets objective.
Some research suggests that PWC use impacts wildlife by interrupting normal activities, causing alarm or flight, causing animals to avoid habitat, displacing habitat, and affecting reproductive success. This is thought to be caused by a combination of PWC speed, noise, and ability to access sensitive areas, especially in shallow water. Literature suggests PWC users can access sensitive shorelines, disrupting riparian habitat areas critical to wildlife.	Protect fish and wildlife species and their habitat from PWC disturbances. Protect fish and wildlife from the adverse effects that result from the bioaccumulation of contaminants from PWC emissions.	Meets objective. The Environmental Protection Agency rates the health of aquatic resources for the Lake Meredith watershed and the reservoir as "Better Quality, Low Vulnerability" to such stressors as pollutant loadings.	Fully meets objective.	Fully meets objective.
Threatened, Endangered, or Special Concern Species				
In some areas PWC use is believed to cause harm to threatened or endangered species because the machine's engine, submerged under the water, muffles the warning sounds some species depend on to escape from imminent danger.	Protect threatened and endangered species, and species of special concern, and their habitats from PWC disturbances.	Meets objective. There is no habitat for the Arkansas River shiner in the reservoir, and the bald eagle is not affected.	Same as alternative A.	Fully meets objective.
Shoreline Vegetation				
PWC users are able to access areas where most other motorized craft cannot go, which may disturb sensitive plant species. In addition, PWC users may land on the shoreline, allowing access to areas where sensitive vegetation and plant species exist.	Manage PWC use to protect shoreline vegetation from visitor impacts related to such use.	Meets this objective. PWC are unable to get close to much of the shoreline. There are no known sensitive plant species along the shoreline of Lake Meredith.	Same as alternative A, with even more protection provided to backwater cove shoreline vegetation.	Fully meets objective.
Some research shows that personal watercraft create a wake at slower speeds than most larger boats, and when driven close to shore, their wakes can lead to erosion and ultimately shoal formation.	Manage PWC use to protect sensitive shoreline areas from any potential erosion caused by PWC activity.	Meets objective. Wind-driven waves and storm runoff are the major causes of shoreline erosion at the reservoir.	Same as alternative A, with more protection provided to backwater cove shoreline vegetation.	Same as alternative A.
Visitor Experience				
Some research suggests that personal watercraft are viewed by some segments of the public as a nuisance due to their noise, speed, and overall environmental effects. However, others believe that personal watercraft are no	Manage the potential for conflicts between PWC users and other park visitors.	Meets objective to a large degree. PWC users would continue to have access to the park as currently managed, so that some conflict between PWC	Fully meets objective. Additional restricted access at selected coves areas would reduce conflict potential.	Does not meet objective.

Issue	Objective	Alternative A — Continue PWC Use under a Special Regulation	Alternative B — Continue PWC Use under a Special Regulation with Management Restrictions	No-Action Alternative — No PWC Use
different from other motorcraft and that people have a right to enjoy the sport.		users and those who do not wish to be disturbed (e.g. anglers) may continue in certain areas.		
Visitor Safety and Visitor Conflicts				
In 1996 personal watercraft made up 7.5% of the state-registered recreational boats in the United States, but accounted for 36% of recreational boating accidents. In part, this is believed to be a "boater education" issue, i.e., inexperienced riders lose control of the craft; yet it also is a function of the PWC operation (i.e., no brakes or clutch). When drivers let up on the throttle to avoid a collision, steering becomes difficult.	Minimize or reduce the potential for PWC user accidents. Provide a safe and healthful environment for park visitors.	Meets objective. The number of tickets issued to PWC users in recent years has been declining.	Fully meets objective. The number of tickets issued to PWC users in recent years has been declining. Park staff would improve and enhance education and enhance enforcement in order to reduce accidents and user conflicts.	Fully meets objective
Personal watercraft, due to their ability to reach speeds in the 60 mph range and to access shallow-draft areas, can create wakes that pose a conflict and safety hazard to other users, such as canoeists and kayakers.	Minimize or reduce the potential safety conflicts between PWC users and other water recreationists.	Meets objective. If visitor and PWC use increases, the potential for conflict could increase.	Fully meets objective with additional protection provided in selected cove areas.	Fully meets objective.
Cultural Resources				
Cultural resources that are listed on, or may be eligible to be listed on, the National Register of Historic Places may be affected by erosion along shorelines, or by uncontrolled visitor access since riders are able to access, beach, and launch in areas less accessible to most motorcraft.	Manage PWC use and access to protect cultural resources, including sacred sites important to Native Americans.	Meets objective. Law enforcement patrols help control illegal damage to cultural sites, but PWC users can access shoreline areas where cultural resources are located.	Same as alternative A.	Fully meets objective.
Socioeconomic Environment				
National PWC ownership increased every year between 1991 and 1998; the rate of annual increase peaked in 1994 at 32% and dropped slightly in 1999, 2000, and 2001. Some local businesses that cater to PWC users may be adversely affected if PWC use was banned. PWC use is viewed as a small portion of the recreational business at several boating and water-related establishments.	Work cooperatively with concessioners and local businesses that repair, rent, or sell personal watercraft.	Fully meets objective. Locally, one company rents personal watercraft, and none sells them. Regionally, five shops in Amarillo sell new or used personal watercraft but have diverse revenue sources.	Fully meets objective.	Meets objective, but banning PWC use could affect PWC sales / rentals.
National Recreation Area Management and Operations				
Some states and local governments have taken action or are considering taking action to limit, ban, and otherwise manage PWC use. While the park may be exempt from these local actions, consistency with state and local plans must be evaluated.	Seek cooperation with local and state entities that manage or regulate PWC use.	Fully meets objective. PWC use is managed under state law, and there is no anticipated change in the state law.	Fully meets objective.	Fully meets objective.

Issue	Objective	Alternative A — Continue PWC Use under a Special Regulation	Alternative B — Continue PWC Use under a Special Regulation with Management Restrictions	No-Action Alternative — No PWC Use
Personal watercraft, because of their increased accident rates and visitor safety conflicts, may require additional park staff to enforce standards and limits.	Provide a safe and healthful environment for park visitors.	Meets objective with current enforcement of state boating regulations.	Meets objective but additional enforcement activities required to ensure compliance. Visitor conflicts would be reduced in areas closed to PWC use.	Meets objective but additional enforcement activities required to ensure compliance.

AFFECTED ENVIRONMENT

WATER QUALITY

WATERSHED DESCRIPTION

Lake Meredith National Recreation Area is in the Canadian River watershed. It was created by the construction of the Sanford Dam, which was completed in 1965. In addition to the Canadian River, Lake Meredith also captures water directly from Bugbee Creek, Turkey Creek, Big Blue Creek, Plum Creek, Short Creek, and South Turkey Creek. A total of over 16,000 square miles of watershed drain into Lake Meredith (USGS 2002a).

The U.S. Environmental Protection Agency has listed the Lake Meredith watershed as being of better quality with low vulnerability to stressors such as pollutant loadings (US EPA 1999c).

RESERVOIR OPERATION

Lake Meredith is used for recreation and water supply for over 500,000 people in 11 cities in the Texas Panhandle. At historic pool elevation (2,898 feet), the reservoir volume is 315,752 acre-feet of water (NPS 2002b), and typical depth is 85 feet (Southwest Parks and Monuments Association [SPMA] 1993). At conservation pool elevation (2,941 feet), the reservoir volume is 891,270 acre-feet (NPS 2002b). Elevation (and volume) of the reservoir varies based on municipal and industrial use, precipitation, and evaporation. The annual maximum monthly elevations range from 2,882 to 2,915 feet — all lower than the conservation pool elevation. Current elevation of the lake is 2,883.5 feet (14.5 feet lower than historic pool elevation), with a volume of 203,700 acre-feet, as measured at USGS Station 07227900 (USGS 2002a). Based on this elevation, the typical depth would be approximately 80 feet. Table 6 shows reservoir pool elevations and volumes.

TABLE 6: LAKE MEREDITH RESERVOIR POOLS

Reservoir Pool	Elevation (feet)	Volume (acre-feet)
Surcharge Pool*	3,005	>2,389,036
Flood Control Pool*	2,965	1,358,594
Conservation Pool*	2,941	891,270
Historic Average Pool*	2,898	315,752
Current Pool (as of 10/3/02)**	2,883.5**	203,700**

* NPS 2002b.
** USGS 2002a.

WATER QUALITY DATA

Since 1965 water quality has been routinely monitored by the Texas Natural Resources Conservation Commission, the U. S. Geological Survey, and the Canadian River Municipal Water Authority, with the primary purpose of ensuring that domestic water attains state drinking water standards. Between these three entities, a total of 29 water quality monitoring stations exist in the vicinity of Lake Meredith. Currently, there are three active stations at the lake and approximately 10 tributary stations. The Canadian River Municipal Water Authority collects fecal coliform data from 12 additional sites on the lake, the U. S. Geological Survey manages four additional sites that are scattered across the Canadian River basin.

Monitoring reports indicate that water quality in Lake Meredith is generally very good, although high dissolved solids and elevated chloride levels are of concern because average concentrations exceed criteria for the segment, and concentrations tend to be increasing (NPS 2002b).

Only one set of water quality sample results that included organic contaminants was located for Lake Meredith on the USGS web site (USGS 2002b). The sample contained results for benzene, xylene, ethyl benzene, and MTBE (collected at USGS station 354113101360101 on July 13, 1999). All results are non-detectable at 0.2 µg/L. Water quality samples from 1965 through 1984 taken at station 07227900 were not analyzed for organic contaminants (USGS 2002a).

TEXAS SURFACE WATER QUALITY STANDARDS

State-Designated Stream Segments and Uses

In accordance with EPA guidelines, the Texas Natural Resource Conservation Commission (TNRCC) classified major stream segments within the state according to designated uses (TNRCC 2000). In order to support or achieve the designated uses of these stream segments, the commission promulgated numerical criteria for each use and each segment.

The area of potential PWC use in the Lake Meredith National Recreation Area includes only Lake Meredith (segment 0102). The Canadian River upstream of Lake Meredith (segment 0103) and the Canadian River downstream of Sanford Dam and Lake Meredith (segment 0101) are not accessed by personal watercraft. As defined in the "Texas Surface Water Quality Standards," the designated uses for Lake Meredith are contact recreation, exceptional aquatic life, and public water supply. Designated uses for the Canadian River upstream and downstream of the lake are contact recreation and high aquatic life (TNRCC 2000).

Numeric Standards

The "Texas Surface Water Quality Standards" for toxic materials and the protection of aquatic life do not include aquatic life standards for typical gasoline organic constituents such as benzene or PAHs. For freshwater, Texas water quality standards for benzo(a)pyrene and benzene are shown in Table 7.

TABLE 7: TEXAS SURFACE WATER QUALITY STANDARDS FOR THE PROTECTION OF HUMAN HEALTH

Chemical	Ingestion of Water and Fish (µg/L)	Ingestion of Fish Only (µg/L)
Benzo(a)pyrene	0.099	0.81
Benzene	5	106

Source: TNRCC 2000.

No segment-specific standards are provided for organic compounds associated with gasoline.

Antidegradation Policy

The state-established antidegradation policy is designed to protect water quality at existing levels and to prevent a deterioration of water quality below achievable uses for a given stream segment (TNRCC 2000, sec. 307.5). The policy has three levels of protection:

1. Existing uses will be maintained and protected.
2. For instream segments whose quality exceeds designated uses, degradation may only be allowed for important social and economic development.
3. No degradation will be allowed for outstanding natural resource waters. No waters in the state are currently designated as an outstanding natural resource.

For Lake Meredith, antidegradation means that existing uses should be maintained and protected.

AIR QUALITY

Lake Meredith National Recreation Area is approximately 40 miles northeast of Amarillo and approximately 15 miles west of Borger, Texas. It is in the Upper Panhandle (Region 1) air quality monitoring district and straddles three counties: Hutchinson, Moore, and Potter (although the majority of the unit is in Hutchinson County). During most of the year, prevailing airflow is from the southwest. Lake Meredith is in a class II area for purposes of air quality.

The Texas Commission on Environmental Quality (TCEQ), formerly the Texas Natural Resources Conservation Commission, is the lead environmental agency for the state. The State Implementation Plan is Texas' plan for complying with the federal Clean Air Act. The plan consists of narrative, rules, and agreements that Texas will use to clean up polluted areas, and it is regularly revised (TCEQ 2002a). According to the Amarillo regional office (the office closest to Lake Meredith), air contaminants from industrial sources in Borger (a Phillips Petroleum refinery, an associated chemical plant, and several carbon black plants) may affect the unit, but not to a substantial degree (TCEQ 2002b).

Air quality is monitored using a statewide air quality surveillance network. Data are collected from air monitoring sites, local agencies, and private monitoring networks. Generally, monitoring sites are near metropolitan areas since these areas have the highest pollutant levels; no monitoring sites are in or near Lake Meredith National Recreation Area. According to the Texas Commission on Environmental Quality, the air monitoring station nearest to Lake Meredith is in Amarillo (45 miles away), where $PM_{2.5}$ is monitored (E. Raglan, TCEQ Region 1, pers. comm., J. Lau, URS, Oct. 21, 2002). Data from this site have shown no exceedances, and the Amarillo Regional Office has recommended to the U.S. Environmental Protection Agency that the site be closed because air quality has been consistently below standards. Air quality in the region is generally good and it is in attainment with all national ambient air quality standards (NAAQS) (see Table 8).

TABLE 8: NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Primary Standards (Human Health)		Secondary Standards (Air Quality Related Values)	
	Average Type	Concentration[a]	Average Type	Concentration[a]
CO	8-hour[b]	9 ppm (10 mg/m^3)	No secondary standard	
	1-hour[b]	35 ppm (40 mg/m^3)	No secondary standard	
Pb	Maximum Quarterly Average[h]	1.5 µg/m^3	Same as primary standard	
NO_2	Annual Arithmetic Mean[h]	0.053 ppm (100 µg/m^3)	Same as primary standard	
O_3 (implementation of 8-hour standard not currently final)	1-hour[c]	0.12 ppm (235 µg/m^3)	Same as primary standard	
	8-hour[i]	0.08 ppm (157 µg/m^3)	Same as primary standard	
PM_{10}	Annual Arithmetic Mean[d]	50 µg/m^3	Same as primary standard	
	24-hour[e]	150 µg/m^3	Same as primary standard	

Pollutant	Primary Standards (Human Health)		Secondary Standards (Air Quality Related Values)	
	Average Type	Concentration[a]	Average Type	Concentration[a]
$PM_{2.5}$ (monitored but standards not currently final)	Annual Arithmetic Mean[d,f]	15 µg/m^3	Same as primary standard	
	24-hour[g]	65 µg/m^3	Same as primary standard	
SO_2	Annual Arithmetic Mean[h]	0.03 ppm (80 µg/m^3)	3-hour[b]	0.50 ppm
	24-hour[b]	0.14 ppm		(1300 µg/m^3)

a. Parenthetical value is an approximately equivalent concentration.
b. Not to be exceeded more than once per year.
c. Attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than 1, as determined according to Appendix H of the O3 NAAQS.
d. Not to be exceeded by the 3-year average of the annual mean concentrations.
e. Not to be exceeded by the 3-year average of the annual 99th percentile concentrations.
f. May be spatially averaged over several "community-oriented" sites in an area.
g. Not to be exceeded by the 3-year average of the annual 98th percentile concentrations.
h. Never to be exceeded.
i. Not to be exceeded by the 4th highest annual value averaged over a 3 year period.

The National Park Service maintains records of ozone levels measured as SUM06, which indicate overall regional ozone exposure. The SUM06 data are based on the three-month highest measured values obtained during daylight hours and averaged over a five-year period. Current values indicate regional ozone levels at Lake Meredith are between 19 and 25 ppm-hours. According to data from the NPS Air Quality Division, Lake Meredith is close to the boundary of the 12–19 ppm-hour contour line. Monitoring data show that ozone originating southeast of Lake Meredith in industrial regions of Texas, such as the Dallas / Fort Worth area, is causing the slight elevation in ozone levels. There are no reports of ozone injury to plants in the unit. Visibility at Lake Meredith, as indicated by fine particulate matter less than 2.5 microns in aerodynamic diameter ($PM_{2.5}$), is generally good.

SOUNDSCAPES

NATURAL AND HUMAN NOISE LEVELS

Noise is defined as an unwanted sound. Sounds are described as noise if they interfere with an activity or disturb the person hearing them. Sound is measured in a logarithmic unit called a decibel (dB). Since the human ear is more sensitive to middle and high frequency sounds than to low frequency sounds, sound levels are weighted to reflect human perceptions more closely, referred to as dBA. Table 9 illustrates common sounds and the measured sound level.

TABLE 9: SOUND LEVEL COMPARISON CHART

Decibels	How it Feels	Equivalent Sounds
140-160	Near permanent damage level from short exposure	Large caliber rifles (e.g., .243, 30-06)
130-140	Pain to ears	.22 caliber weapon
100	Very loud	Air compressor at 20 feet; garbage trucks and city buses
	Conversation stops	Power lawnmower; diesel truck at 25 feet
90	Intolerable for phone use	Steady flow of freeway traffic; 10 HP outboard motor; garbage disposal
80		Muffled Jet ski at 50 feet; automatic dishwasher; near drilling rig; vacuum cleaner
70		Drilling rig at 200 feet; window air conditioner outside at 2 feet
60	Quiet	Window air conditioner in room; normal conversation
50	Sleep interference	Quiet home in evening; drilling at 800 feet
		Bird calls
40		Library
30		Soft whisper
20		In a quiet house at midnight; leaves rustling

Note: Modified from Final Environmental Impact Statement, Miccosukee 3-1 Exploratory Well, Broward County, Florida (U.S. Department of the Interior).

For the average human a 10 dB increase in the measured sound level is subjectively perceived as being twice as loud, and a 10 dB decrease is perceived as half as loud. The decibel change at which the average human would indicate that the sound is just perceptibly louder or perceptibly quieter is 3 dB.

One aspect of experiencing a national park system area is the ability to hear the sounds associated with natural resources, often referred to as "natural sounds" or "natural quiet." Natural sounds generally include sounds such as wind through trees and calling birds, while natural quiet includes the sounds associated with still nights. "Noise" is defined as unwanted sound that interferes with an activity or disturbs the person hearing it.

NOISE LEVELS AT LAKE MEREDITH NATIONAL RECREATION AREA

The reservoir area of Lake Meredith is not traditionally known for natural quiet, although numerous natural quiet areas exist within the recreation area. Near-constant winds, which average 12–14 mph and can reach 30–40 mph during early spring, produce background noise (NPS 2002b). Primary sources of additional noise are recreational activities, highway traffic, oil and gas production, and continuously running compressors associated with natural gas production and transport. During the summer, fishing boats use the reservoir throughout the day. Personal watercraft are operated during the warm season, although their use is restricted to the hours between sunrise and sunset. Large boats and speedboats normally generate the most noise on the lake (NPS 2002b).

A noise study (Foch 2000) was conducted for the Lake Meredith National Recreation Area and Alibates Flint Quarries National Monument in the latter part of 1998 for the *Oil and Gas Management Plan / Environmental Impact Statement*. The study measured ambient noise levels, which include the natural and human made sounds heard at specific locations. Two kinds of information were collected about ambient sounds to gauge the audibility of intruding noise: sound levels, which indicate how loud the ambient sounds are; and sound spectra, which indicate predominant frequencies in the ambient sounds. Onsite monitoring was conducted at eight locations, several of which were within the vicinity of PWC use areas. The summer noise monitoring was completed in June, with monitoring repeated at several sites in August 1998. Ambient sounds were monitored and recorded at one- to three-hour intervals.

Background sound levels throughout most of the recreation area were due to wind, ranging from 34 dB to 50 dB 90% of the time (referred to as L_{90}). Table 10 presents the ambient noise levels measured within Lake Meredith. The areas with the highest ambient noise levels were closest to the lake,

TABLE 10: MEASURED SOUND LEVELS AT VARIOUS LOCATIONS WITHIN LAKE MEREDITH NATIONAL RECREATION AREA

Measurement Location	Sound Level (dBA) L_{90}
McBride Ranch — Picnic grove 300 yards from information kiosk.	36.3
Rosita Creek — Center of "Flats" area.	34.4
Harbor Bay — Under tree 15 yards from center of road and 39 yards from shore. Repeated because recording was not made on first visit.	44.8 40.6
Marina — Between parking lot and water.	48.9
Spring Canyon — On beach beside furthest "No Lifeguard" sign. Repeated because the wind was gusting to 30 mph.	47.3 43.3
Bugbee Shores — 0.3 mile beyond end of pavement and a few yards from shore.	49.8
Blue West — 30 yards to right of end of pavement and 10 yards from shore.	48.4
Overlook Ramada — 0.9 mile north of Fritch Fortress road, opposite unmarked road to amphitheater.	34.4

SOURCE: James D. Foch January 17, 2000.

including the marina, Spring Canyon, Bugbee Shores, and Blue West. These areas are also closest to waves, swimmers, boats, PWC users, and (in some locations) vehicles.

VISITOR RESPONSES TO PWC NOISE

Many factors affect how an individual responds to noise. Primary acoustical factors include the sound level, its frequency, and duration. Secondary acoustical factors include the spectral complexity, sound level fluctuations, frequency fluctuation, rise-time of the noise, and localization of the noise source (Mestre Greve Associates 1992). Non-acoustical factors also play a role in how an individual responds to sounds. These factors vary from the past experience and adaptability of an individual to the predictability of when a noise will occur. The listener's activity also affects how he/she responds to noise.

PWC and outboard motors are similar in the actual noise level they generate (in terms of decibels), which is generally around 80 dB or less at 50 feet from a motorized boat or personal watercraft (US EPA 1974) but can range from below 80 to as much as 102 dB (Sea-Doo 2000; Bluewater Network 2001). The National Park Service has established a noise limit for boating and water use activities of 82 dB at 82 feet (25 meters) (36 CFR 3.7). Personal watercraft generate noise that varies in pitch and frequency due to the nature of their construction and use. The two-stroke engines are often used at high speeds, and the craft bounce along the top of the water such that the motor discharges noise below and above the water surface. To visitors this irregular noise seems to be more annoying that that of a standard motorboat that is cruising along the shoreline, even though the maximum noise levels may be similar for the two watercraft. Additionally, visitors who expect to experience natural quiet may consider the irregular noise of personal watercraft more annoying, especially if the craft is operating in one location for extended periods of time (Komanoff and Shaw 2000).

WILDLIFE AND WILDLIFE HABITAT

Wildlife habitat in Lake Meredith National Recreation Area includes both natural and human-made / influenced environments. The higher land elevations and side drainages of the Canadian River Breaks within the recreation area are primarily natural habitats. The Canadian River bed is a blend of natural and human modified habitats as a result of reservoir operations in New Mexico and the construction of Sanford Dam, which created Lake Meredith. Some cottonwood/tallgrass galleries and natural wetland/ floodplain areas remain mostly upstream from the reservoir. Many springs in the Canadian River Breaks dried up in historic times due to groundwater extractions for farms, ranches, and municipalities. Exotic plant infestations (such as salt cedar) further modified the natural habitat and expended groundwater (NPS 2002e).

The human-made reservoir creates fleeting wetlands, shallow water ecosystems, and deeper water habitats that can change radically with annual and seasonal water level fluctuations, which make these artificial habitats unpredictable and unstable. Wildlife and vegetation communities utilizing these areas are subject to, and must cope with, unpredictable threats or advantages created by the greatly fluctuating water levels. Beyond this, recreational uses and impacts on reservoir habitats are slight in comparison to reservoir water level changes and associated natural wave erosion in this windy environment.

Because of Lake Meredith's low water level, much of the wildlife habitat is inaccessible by personal watercraft (the park comprises 46,000 acres, but the lake consists of only 10,000 acres). Park staff have not witnessed the harassment of wildlife by PWC users or PWC collisions with wildlife.

MAMMALS

The National Park Service estimates that 60 species of mammals occur in Lake Meredith National Recreation Area. Common mammals include mule deer, white-tailed deer, and coyote. Small mammals include porcupines, raccoons, foxes, weasels, ferrets, mink, badgers, river otters, skunks, ground squirrels, rabbits, pocket gopher, mole, a few bats, and several varieties of rats and mice. Larger predators include black bear, mountain lions, bobcats, wolves, and coyotes (NPS 2002b). The habitats of most mammals expected in the park are away from the shoreline, and animals move to the interior if disturbed by noise or watercraft activities (LAW et al. 2002).

BIRDS

Over 200 species of birds are present at Lake Meredith, including wild turkey, bobwhite, scaled quail, mourning dove, roadrunner, and red-winged blackbird.

Lake Meredith exists along the Central Flyway, and large numbers of ducks, geese, and other migratory birds occur seasonally. Migratory birds use open water areas or wetlands from fall to spring. Migratory waterfowl use open water wetland areas below the stilling basin. Common waterfowl include mallards, blue- and green-winged teals, common golden eye, and great blue heron. Other commonly seen birds include willets, yellowlegs, bitterns, moorhens, coots, gulls, terns, pie-billed and horned grebes, yellow-throated warblers, black-crowned night herons, yellow-crowned night herons, and several species of swallows. Hawks are known to frequent areas below the stilling basin in Spring Canyon (NPS 2002b).

Great blue herons are common year-round at the lake. Often seen wading in the shallows looking for bass or other large fish, they build flat, loose nests high in trees, which may be used for more than one season. Females lay up to four eggs per year. There is one rookery area within Lake Meredith National Recreation Area, located well off all established roadways and watercraft access (NPS 2002b).

FISH

Approximately 15 species of fish inhabit Lake Meredith, making it one of the most popular fishing areas in the region. Common species include walleye, catfish, largemouth and sand bass, crappie, bluegill, and carp. Most anglers use developed boat launch areas at Blue West, Fritch Fortress, and Cedar Canyon to access other areas of the lake. Some shoreline fishing occurs in these developed areas, as well as from the floating pier on the stilling basin. The Texas Parks and Wildlife Department stock the pond area of the stilling basin with nonnative trout several times each year (NPS 2002b).

AMPHIBIANS AND REPTILES

Eleven amphibian species and 32 reptile species are found at Lake Meredith, including two poisonous snakes (prairie rattlesnake and diamondback rattlesnake) (NPS 2002b).

AQUATIC INVERTEBRATES

Lake Meredith has not been surveyed for aquatic invertebrates. Generally, the abundance and type of organisms present depend on the water quality and habitat conditions. The shoreline has little to no

aquatic vegetation, except in upstream coves, reducing the potential diversity and density of shoreline aquatic invertebrates.

THREATENED, ENDANGERED, OR SPECIAL CONCERN SPECIES

WILDLIFE SPECIES

Ten federally or state listed threatened, endangered, or candidate species have either been documented or are likely to occur within Lake Meredith National Recreation Area. In addition, nine state species of special concern could occur in the park based on available habitat, but have not been observed there. Table 11 provides a list of all listed species.

TABLE 11: FEDERAL AND STATE LISTED WILDLIFE IDENTIFIED IN THE VICINITY OF LAKE MEREDITH NATIONAL RECREATION AREA

Common Name	Scientific Name	Federal Status	State Status	Observed at Lake Meredith
BIRDS				
American Peregrine Falcon	*Falco peregrinus anatum*		E	
Baird's Sparrow	*Ammodramus bairdii*		SC	
Bald Eagle	*Haliaeetus leucocephalus*	T	T	X
Ferruginous Hawk	*Buteo regalis*		SC	
Interior Least Tern	*Sterna antillarum*	E	E	
Lesser Prairie Chicken	*Tympanuchus pallidicinctus*	C		
Mountain Plover	*Charadrius montanus*	PT		
Snowy Plover	*Charadrius alexandrinus*		SC	
Western Burrowing Owl	*Athene cunicularia hypugaea*		SC	
Whooping Crane	*Grus americana*	E	E	
MAMMALS				
Black-footed Ferret	*Mustela nigripes*	E	E	
Black-tailed Prairie Dog	*Cynomys ludovicianus*	C		X
Cave Myotis Bat	*Myotis velifer*		SC	
Plains Spotted Skunk	*Spilogale putorius interrupta*		SC	
Prairie Vole (Hutchinson County)	*Microtus ochrogaster taylori*		SC	
REPTILES				
Texas Garter Snake	*Thamnophis sirtalis annectens*		SC	
Texas Horned Lizard	*Phrynosoma cornutum*		T	X
FISHES				
Arkansas River Shiner (Hutchinson, Potter Counties)	*Notropis girardi*	T		X
Arkansas River Speckled Chub (Potter County)	*Macrhybopsis aestivalis tetranemus*		SC	

SOURCE: NPS 2002b.

C = Candidate; E = Endangered Species; T = Threatened Species, P = Proposed; SC = Special Concern Species listed by Texas Heritage Program / Conservation Data Center (no regulatory status).

Of these 19 species, only four have been documented in the park: bald eagle, Arkansas River shiner, black-tailed prairie dog, and Texas horned lizard. The following describes these four species and the other listed threatened, endangered, or candidate species.

Bald Eagle — Bald eagles are considered winter residents and have been documented at Lake Meredith. Bald eagles roost and perch in tall trees near water and feed primarily on fish and waterfowl. Winter habitat includes reservoirs, lakes, playas, rivers, and marshes. Most wintering bald eagles migrate north in February and March. According to park staff, bald eagles winter in the area in substantial numbers, but roost primarily in the Bonita Creek area at the southern end of Lake Meredith, where between four and seven eagles can be found on an average winter day. There is no known summer nesting of bald eagles in the area. Park staff cooperate with the Audubon Society in an annual mid-winter bald eagle survey. During especially cold winters when the lake freezes, the number of eagle sightings increases. Eagles

leave the area each morning, and some may visit the lake, but sightings around the lake are uncommon. During winter, bald eagles scavenge and eat mammals and waterfowl at the upper end of Lake Meredith (NPS 2002b).

Arkansas River Shiner — The Arkansas River shiner is a small (maximum length of 2 inches), silvery minnow. The species once inhabited wide, sandy-bottomed rivers and streams throughout the Arkansas River basin in Kansas, New Mexico, Oklahoma, and Texas. Today the fish is found primarily in scattered reaches of the Canadian River in New Mexico, Oklahoma, and Texas. It requires at least 80 consecutive miles of river to complete its life cycle. Threats include habitat loss from the construction of water impoundments, reduced streamflows caused by water diversions or groundwater withdrawals, decreased water quality, and possible inadvertent collection of shiners by the commercial bait fish industry. Competition from the Red River shiner, an introduced species, also threatens the Arkansas River shiner (NPS 2002b).

Effective May 4, 2001, the U.S. Fish and Wildlife Service designated critical habitat for the Arkansas River shiner on 1,148 miles of rivers in four states: portions of the Arkansas River in Kansas, the Cimarron River in Kansas and Oklahoma, the Beaver / North Canadian River in Oklahoma, and the Canadian / South Canadian River in New Mexico, Texas, and Oklahoma (66 FR 65 [April 4, 2001]: 18001–34). Critical habitat includes 300 feet from each shoreline.

Critical habitat for the Arkansas River shiner within the national recreation area was designated along the Canadian River from the western park boundary downstream to the confluence with Coetas Creek. The U.S. Fish and Wildlife Service also designated 300 feet on either side of the river as critical habitat because a relatively intact riparian zone is necessary for the long-term survival of the shiner, allowing for natural flooding patterns, channel adjustments, nutrient input, buffering from sediment and pollutants, and protected side channels and backwater habitats for larvae and juvenile fish (NPS 2002b). The historical lake level has never been high enough to permit recreational use in the area designated as critical habitat (for the past 30 years there has been no water south of Plum Creek). During flood stage, however, the water level may be high enough to include the critical habitat.

Black-tailed Prairie Dog — One black-tailed prairie dog town was documented in Lake Meredith National Recreation Area; however, the colony was eradicated in April 2001 due to a natural outbreak of bubonic plague (NPS 2002b). The National Park Service anticipates that black-tailed prairie dogs are likely to recolonize the park in the future.

Prairie dogs eat almost any kind of green vegetation in the vicinity of their tunnels. Slight use is made of insects, although grasshoppers and noctuid larvae are prominent food items. Currently listed as a candidate species, the species is being studied by the U.S. Fish and Wildlife Service to assess the need for listing under the Endangered Species Act (NPS 2002b).

Texas Horned Lizard — The Texas horned lizard has been documented in Lake Meredith National Recreation Area and Alibates Flint Quarries National Monument. It is well adapted to arid, sandy areas of the Southwest. Ants are their staple food, of which they can consume up to 400 per day (NPS 2002b). The lizard could possibly occur along the upper edges of the more remote and less disturbed shorelines. The lizard is active during the daytime but retreats into shaded areas to avoid the most intense heat of the day. It is not likely that this lizard would frequent areas used by personal watercraft.

Peregrine Falcon — Breeding pairs of American peregrine falcons nest on cliffs in the Trans-Pecos region of west Texas, which is south of Lake Meredith. Habitat includes meadows, mudflats, beaches, marshes, and lakes where birds and other prey are abundant. The Arctic peregrine migrates through Texas twice a year to and from wintering areas in South America (TPWD 2002) and is listed only for its similarity in appearance to the American variety. While

both falcons may be potential winter migratory residents of Lake Meredith National Recreation Area, there is no documented evidence of breeding or nesting by either species within the recreation area. Neither species has critical habitat within the impact analysis area.

Interior Least Tern — The interior least tern historically bred on sandbars along the Canadian River. The creation of Lake Meredith resulted in unfavorable vegetation succession along the sandbars of the river, which has discouraged breeding by this species. The species generally winters along the Gulf Coast and south to South America (Think Quest 2002). There is no documented evidence of breeding or nesting by the Interior least tern within Lake Meredith National Recreation Area.

Lesser Prairie Chicken — The lesser prairie chicken prefers grasslands with some shrubs and is a potential resident of the higher elevations within Lake Meredith National Recreation Area. It is unlikely that this species visits the reservoir area.

Mountain Plover — The mountain plover is associated with shortgrass and shrub/steppe landscapes in the Rocky Mountain and Great Plains states. Breeding mountain plovers are strongly associated with prairie dog towns and grassland heavily grazed by domestic livestock. Most mountain plovers breed in Colorado and Montana, and winter in California, although they have been known to breed and winter in Texas. Mountain plovers are rarely found near water (64 FR 30 [Feb. 16, 1999]: 7587–601). There is no documented evidence of mountain plovers breeding or nesting at Lake Meredith.

Whooping Crane — Whooping cranes primarily winter, and potentially breed, in coastal Texas near the Aransas National Wildlife Refuge. This flock of whooping cranes, the only self-sustaining wild population, migrates between Aransas National Wildlife Refuge and Wood Buffalo National Park in Canada (North American Crane Working Group 2002). Whooping cranes do not breed near Lake Meredith National Recreation Area; they are potentially occasional winter residents.

Black-footed Ferret — Black-footed ferrets are closely associated with prairie dog colonies found in short and mid-grass prairies of the Great Plains. The only known black-footed ferrets currently in existence occur in captivity or at reintroduction sites (Nebraska Game and Parks 2002). It is unlikely that ferrets occur in Lake Meredith National Recreation Area.

There are also nine state listed species of concern by the Texas Heritage Program / Conservation Data Center that have no regulatory status. Very few of the listed species of concern would occur in areas frequented by personal watercraft. The cave myotis bat may feed at the lake at night. The Texas garter snake could occur in shoreline vegetation. The Arkansas River speckled chub (which shares the same habitat as the Arkansas River shiner) could occur in upstream reaches of the lake tributaries.

PLANT SPECIES

No federally listed plant species are expected or known to occur in the park (NPS 2002b). One rare vascular plant is known to occur in Potter County, which includes Lake Meredith National Recreation Area. This species, the Mexican mud-plantain *(Heteranthera mexicana),* is a state species of concern. The only designated critical habitat for this plant in the park is the Canadian River and some side tributaries from the western boundary of the park to Coetas Creek (on the southeastern portion of the park). This approximately 7-mile stretch of the Canadian River is inaccessible to most motorboat and PWC users because the sand bar built by sediment transported into the reservoir by the river normally prohibits boat or PWC travel upstream from the lake (NPS 2002a). Seasonally, canoeists, kayakers, and rafters can travel downstream if the water is of sufficient depth.

SHORELINE VEGETATION

Vegetative cover in Lake Meredith is sparse due to soil and climatic conditions. Most of the region's precipitation is in the form of brief, intense thunderstorms and much of its benefit is lost through rapid runoff. Topsoil is lost through wind and water erosion. Constant winds and high temperatures contribute to high evaporative rates, which reduce the effectiveness of precipitation for plant growth. Much of the terrain surrounding the park consists of flat grasslands. The predominant vegetative cover is comprised of blue grama, little bluestem, and buffalo grasses. Interspersed with the grasses are scattered clumps of sand sagebrush, yucca, broom snakeweed, plains pricklypear, feather dalea, one-seeded juniper, and mesquite. Stands of cottonwood and hackberry trees occur in side canyons. Varying lake levels have encouraged the encroachment of salt cedar in floodplain areas (NPS 2002b). As shown in Table 12, 11 cover types have been classified, which include major vegetation types, water, bare land, and urban (developed) areas.

TABLE 12: LAND CLASSIFICATION TYPE AND PERCENTAGE, LAKE MEREDITH NATIONAL RECREATION AREA

Land Classification Type	Acres*	Percentage of Park
Water	10,547.86	25.39
Yucca Grassland	4,382.83	10.55
Mesquite Grassland	2,820.79	6.79
Mixed Grassland	5,263.54	12.67
Vegetated Cliffs	8,674.26	20.88
Disturbed Grassland	469.44	1.13
Riverine Grassland	2,056.40	4.95
Emergent Vegetation	764.40	1.84
Emergent Scrub/Shrub	1,370.93	3.30
Unconsolidated Shore	195.25	0.47
Mixed Forest	4,033.86	9.71
Bare Land	951.34	2.29
Urban	12.46	0.03
Total	**41,543.36**	**100.00**

SOURCE: NPS 2002b.

*Acres are derived from the existing Lake Meredith boundary map, which does not account for approximately 3,434 acres (7.6%) of the park's administered land.

Very little emergent shoreline vegetation would be affected by PWC use. This emergent wetland vegetation consists of reeds, rushes, cattails, and also shrub/scrub floodplain species such as cottonwoods, willows, salt cedar, seep willow, and switch grass. In more densely vegetated side canyons, trees (including hackberry, one-seed juniper, cottonwood, soapberry, mesquite and salt cedar) can be found near the shoreline.

The lower the lake level, the more restrictive the lake is for watercraft. In backwater areas there is a high concentration of vegetation. Such areas have shallow waters that can only be accessed by shallow-draft boats. In order to fish in shallow, grassy waters, many visitors use bass boats with small trolling motors. Personal watercraft, however, tend to avoid grasses to prevent damage to the propulsion system (NPS 2002a). Streams and rivers feeding into the Canadian River may have more vegetation at shoreline, although the area is very sandy and saline, and some of the larger plant species tend to be exotic plants like salt cedar.

The shoreline of the lake is an artificial habitat that can fluctuate greatly. It is most heavily impacted by erosion caused by wind and wave action. Rain runoff and mass wasting also actively affect shoreline habitat. The inherent characteristics of the lake's steep sides and slopes (up to 35%), in conjunc-

tion with fluctuating water depth, prevents vegetation from becoming established along most of the shoreline. Also, exotic species (such as the invasive salt cedar) rapidly modify many local habitats.

Motorized watercraft of all types can access the shoreline along the majority of Lake Meredith. Shoreline access and trampling of vegetation are issues not restricted to PWC users. Some erosion does occur as a result of wakes caused by personal watercraft and boats. However, because the water level fluctuates and the lake is typically windy (winds average 20 mph), slumping and sliding continue, with a much greater impact than erosion from wakes (LAW et al. 2002).

WETLAND COMMUNITIES

Wetlands occurring in the recreation area include riverine, lacustrine (littoral), and palustrine (wetlands found inland from obvious water bodies [e.g., springs, and ponds]). Approximately 4,397 acres of palustrine wetlands, 9,593 acres of lacustrine wetlands, and 1,455 acres of riverine wetlands were mapped in Lake Meredith National Recreation Area (comprising approximately 34% of the park). However, wetlands acreage fluctuates with changes to lake levels.

The majority of the wetlands are in the southern half of the recreation area, with large areas of palustrine wetlands, along with areas of lacustrine and riverine wetlands. The majority of this area is inaccessible by boat or personal watercraft. Areas of riverine wetlands also occur along Big Blue Creek and South Turkey Creek. Palustrine wetlands occur in the stilling basin below the dam, which is inaccessible to boats or personal watercraft. Other small wetland areas consisting of emergent vegetation are located within the canyons on the periphery of the lake (NPS 2002b).

VISITOR USE AND EXPERIENCE

Lake Meredith National Recreation Area is located in a sparsely populated area of the Texas Panhandle. Headquarters for the recreation area are in Fritch, Texas, on the northeastern side of the lake. Communities that utilize the recreation area include Amarillo, Lubbock, and Dumas, Texas; Guymon, Oklahoma; and Clovis, New Mexico.

ANNUAL VISITOR USE

Visitor data for 1992 to 2001 indicate that visitation varies (see Table 13). Over the last 10 years, the recreation area has had an average annual 2.3% decrease in annual visitation. However, due to esti-

TABLE 13: AVERAGE ANNUAL VISITATION AT LAKE MEREDITH NATIONAL RECREATION AREA, 1992–2001

Year	Number of Visitors	Percentage Change from Previous Year
1992	1,448,591	--
1993	1,480,987	+2.2%
1994	1,535,448	+3.5%
1995	1,470,137	-4.4%
1996	1,676,466	+12.3%
1997	1,683,646	+0.4%
1998	1,636,419	-2.9%
1999	1,779,138	+8.0%
2000	1,615,751	-10.1%
2001	1,248,278	-29.4%
Average	**1,588,929**	**-2.3%**

SOURCE: NPS 2002d.

mated population increases in the Panhandle region, total visitation is anticipated to increase over the next 10 years to equal 1999 visitation rates. The majority of the visitor use is regional in nature; however, residents of almost all southern states and 13 countries have been documented.

MONTHLY VISITOR USE

Monthly visitor use is documented for specific locations within the recreation area. The monthly use data collected in July and August 2000 (the most recent data available) were used to establish the number of visitors likely to be at specific locations (see Table 14).

TABLE 14: MONTHLY VISITOR USE FOR THE SUMMER MONTHS 2000

Name of Visitor Use Area	May	June	July	August	September	Total
Sanford-Yake Marina	31,231	27,689	37,415	20,986	18,099	**135,420**
Cedar Canyon	44,699	59,983	41,633	30,825	18,078	**195,218**
Spring Canyon	No data	13,895	20,437	11,806	7,249	**53,387**
Fritch Fortress	28,781	24,063	42,060	18,477	14,728	**128,109**
Harbor Bay	54,989	50,764	58,139	23,471	12,048	**199,411**
McBride Canyon	9,422	9,751	10,588	8,390	20,969	**59,120**
Plum Creek	5,733	1,999	1,789	147	1,404	**11,072**
Blue West	10,990	14,861	16,237	7,035	8,169	**57,292**
Big Blue Creek	17,535	7,618	15,033	7,912	7,158	**55,256**
Bugbee Canyon	7,504	5,663	5,079	3,815	2,902	**24,963**
North Canyon Viewpoint	2,839	2,007	3,796	593	1,836	**11,071**
Rosita Meadows	10,481	10,120	13,176	7,898	6,640	**48,315**
Total						**978,634**

SOURCE: NPS 2000d.

NOTE: Visitor numbers are not cumulative, i.e. the same people may be counted more than once if they visit more than one location on a given day.

SEASONAL USE PATTERNS

Spring is the beginning of the visitor use period. In late spring for several weeks school groups in groups of 50–100 arrive daily for outdoor educational programs. Tours of Alibates Flint Quarries National Monument are the main focus of most visiting school groups. Weekend use increases at Lake Meredith as visitors from the region go fishing, boating, horseback riding, bird watching, and off-road vehicle (ORV) driving.

Summer use at Lake Meredith by boaters and campers increases dramatically. Users are generally families from the four-state region who stay for weekly periods.

Fall use is moderate to high; lake activities decline slightly but fishing becomes a primary use again and various hunting seasons open. During hunting season, visitor uses such as hiking, off-road bicycling, and horseback riding are limited due to safety issues and concerns.

Winter use is light, consisting of regional visitors (NPS 2002b).

VISITOR ACTIVITIES

Numerous visitor use areas occur along Lake Meredith, including three information stations, 16 day and overnight visitor use areas, numerous roads and trails, and other activities. The information stations provide information and brochures for the park. The day and overnight visitor use areas provide facilities such as campgrounds, picnic areas, lake access, hiking trails, horseback riding trails, and scenic viewing areas (see Table 15). Water-oriented activities include boating, fishing, PWC use, water skiing, scuba diving, and swimming. Other recreational activities are described below (NPS 2002b).

TABLE 15: LAKE MEREDITH VISITOR USE AREAS

Name of Visitor Use Area	Facilities / Recreational Activities Provided
Sanford-Yake (marina area)	Boat-launching ramps, picnic/camping areas, sanitary facilities, designated fishing pier, concessioner's 300-slip marina, and a ½-mile paved trail from overflow parking lot down to boat launch.
Cedar Canyon	Boat-launching ramps, picnic/camping areas, sanitary facilities, and a boat dock where fishing is allowed.
Harbor Bay	Boat-launching ramps, picnic/camping areas, sanitary facilities, and a boat dock where fishing is allowed; good windsurfing area.
Blue West	Boat-launching ramps, picnic/camping areas, sanitary facilities, and a boat dock where fishing is allowed.
Fritch Fortress	Boat-launching ramps, picnic/camping areas, sanitary facilities, a boat dock where fishing is allowed, and a special use amphitheater.
Plum Creek	Picnic/camping areas, sanitary facilities, boat launching ramps (only accessible when lake is at or near full pool levels), and 8-mile Devils Canyon multi-purpose trail.
Bates Canyon	Picnic/camping areas, sanitary facilities, boat launching ramps (only accessible when lake is at or near full pool levels), and numerous miles of dirt roads used for mountain biking.
McBride Canyon	Picnic/camping areas, sanitary facilities, and the McBride house and site (a national register historic property).
Mullinaw Creek	Picnic/camping areas, sanitary facilities, and an unmarked 6-mile hiking trail.
Big Blue Creek	ORV use area allowing motorcycles, 3- and 4-wheeled all-terrain vehicles and dune buggies, picnic/camping areas, sanitary facilities, multitude of dirt trails with miles of creek and river off-road riding available.
Rosita Meadows	ORV use area allowing motorcycles, 3- and 4-wheeled all-terrain vehicles and dune buggies, picnic/camping areas, sanitary facilities, multitude of dirt trails with miles of creek and river off-road riding available.
Bugbee	Bank fishing, picnic/camping areas, swimming, sanitary facilities, and boat launching from the shoreline.
Chimney Hollow	Bank fishing, picnic/camping areas, swimming, sanitary facilities, and boat launching from the shoreline.
Spring Canyon/ Stilling Basin	Only designated swimming beach in the park, picnic/camping areas, sanitary facilities, bank fishing, fishing pier, and scuba diving by permit only.
North Canyon Viewpoint	Scenic overlook area of the lake.
South Canyon	No visitor facilities; popular area for bank fishing and swimming in the canyon.
Sanford Dam	The dam is a primary visitor attraction within the recreation area, and the road provides an alternative route for visitors to access the west side of Lake Meredith.

SOURCE: NPS 2002b.

Camping

Camping is available at numerous visitor use areas, and facilities range from no designated sites to individual campsites with picnic tables, shade shelters, and grills.

- Big Blue Creek has no designated camping sites, although there are chemical toilets and picnic tables.

- Blue West campground has individual campsites with picnic tables, shade shelters, and some grills. The campground is seldom full, there are no camping fees, and there is an excellent view of the lake.
- Bugbee is a semi-developed camping area with no individual campsites. Some picnic tables and an "outback" chemical toilet are provided. Camping availability changes with fluctuating lake levels.
- Cedar Canyon is a small shoreline campground. There are no designated camping sites, and availability varies as lake level fluctuates. A comfort station with running water and flush toilets is located in the boat ramp parking lot.
- Fritch Fortress provides views from a bluff location. Individual campsites have picnic tables, shade shelters, and grills. A public boat ramp is nearby.
- Harbor Bay is a shoreline campground just outside Fritch, Texas. Harbor Bay has no individual campsites, and camping availability varies greatly with rising and falling lake levels. Some picnic tables are provided, although there are no RV hookups.
- McBride Canyon has no designated camping sites and no access to the lake. It is a beautiful area with huge cottonwood trees shading picnic tables.
- Mullinaw Creek has undeveloped sites with picnic tables and chemical toilets. Horseback riding is allowed, and corrals are available for horse camping groups.
- Plum Creek has no designated camping spots. It contains some large shade trees and is popular with hunters and horseback riders. Hitch rails and horse pens are provided.
- The Rosita Meadows are along the Canadian River. There are no designated camping sites, drinking water, or RV hookups.
- Chimney Hollow offers some camping and picnicking opportunities.
- The Sanford-Yake campground is on a bluff overlooking Lake Meredith near the marina. The campground is similar to more traditional NPS campgrounds. Individual campsites have picnic areas, shade shelters, and grills. A public boat ramp is located at the marina.

Roads, ORV Use Areas, and Trails

The park maintains 53 miles of dirt and paved roadways, occupying an estimated 193 acres. Due to the isolated nature of the 16 discrete use areas, visitors must navigate over a road and highway system consisting of farm-to-market roads, county roads, and state and U.S. highways.

Two areas within Lake Meredith National Recreation area allow the use of all-terrain vehicles, including Big Blue Creek (194 acres) and Rosita Meadows (2,421 acres). Motorcycles, three- and four-wheelers, and dune buggies are permitted only in these two areas, but these areas are not set aside strictly for off-road use. ORV use within the Big Blue Creek area is restricted to the cutbanks of the creek because water typically exists in the creek year-round. A few established trails lead away from the water's edge.

The Rosita area is restricted to ORV riding below 3,000 feet in elevation; however, numerous trails have been established above that elevation and are still open to the public. An abundant trail system winds through meadows and on top of some sandy hillsides. Approximately 3 miles of off-road riding exists in the riverbed east of the campground, extending to an area in the park called Chicken Creek.

The Devils Canyon trail is an 8-mile trail from in the lower campground of Plum Creek to more remote canyons. This is a multi-use trail for hiking, off-road bicycling, and horseback riding. A half mile paved trail leads from the overflow parking area at the Sanford-Yake Marina to the boat launch.

Hunting and Fishing Areas

Hunting is permitted in the following areas of Lake Meredith National Recreation Area: Plum Creek, Blue West, Big Blue Creek, Bugbee, the Triangle, Alibates, McBride and Mullinaw Canyons, Big Canyon, Saddle Horse Canyon, Devils Canyon, Rosita Area, Bonita Creek, Chicken Creek, and Coetas Creek. Hunting season begins September 1 and continues through May 10 each year. Texas state seasons and bag limits are enforced during this period for dove, turkey, deer, waterfowl, quail, pheasant, rabbits, coyotes and raccoon. Hunting areas are not closed to the general public during hunting season.

Fishing is permitted on the lake and in the coves where visitors can find access. Two public fishing piers are located at the Sanford-Yake Marina and at the Stilling Basin in Spring Canyon. Prohibited fishing areas exist where signs are posted around the intake tower near the dam, Glory Hole, and swimming areas. Fishing is allowed year-round and Texas state bag and possession limits are enforced for large-mouth, small-mouth and sand bass; variety of catfish; crappie; and rainbow trout; bluegill; perch; carp and walleye. An average of 40 permits are issued each year for fishing tournaments. Good fishing areas for bass are located on the north side of the lake; for walleye, the face of the dam on the south side of the lake and Arrowhead Island; for crappie, the southwest end of the lake around the mouth of the Canadian River; and for trout (stocked twice a year) at Spring Canyon.

Shoreline Use

Most of Lake Meredith is bordered by steep, rocky canyons; therefore, access to the lake from non-designated areas is limited. Several camping areas provide shoreline access, including Bugbee, Cedar Canyon, and Harbor Bay. Five boat launch sites provide access to the shoreline, including Blue West, Sanford-Yake Marina, Cedar Canyon, Harbor Bay, and Fritch Fortress. The stilling basin is the only designated swimming beach in the park and has no lifeguards. Swimming is also available in the Bugbee, Chimney Hollow, and South Canyon areas. Bank fishing is available in the Bugbee, Chimney Hollow, South Canyon, and stilling basin areas.

Beaches adjacent to waterfront campsites are popular swim areas. Sometimes PWC users and swimmers exist in areas of the lake at the same time, usually with no problems. The park has installed “No boat buoys” in areas with a large number of swimmers, and both PWC and boats have complied with the buoys, and no conflicts have occurred (B. Briggs, NPS, pers. comm., L. Pine, URS, Oct. 17 2002, re: park questions).

Watercraft Use (Motorboats, Sailboats, Canoes, and Sea Kayaks)

The largest group of motorized watercraft in the recreation area consists of motorboats. PWC make up 20% of all motorized watercraft. There are five boat launches on Lake Meredith, including Blue West, Sanford-Yake, Cedar Canyon, Harbor Bay, and Fritch. Due to low lake levels, only three of these launch ramps (South Canyon, Cedar Canyon, and Blue West) were open during the summer of 2002. Boat launches are shared by all watercraft, and land-based facilities (such as restrooms and picnic areas) are used by all park visitors.

Sailboaters, sea kayakers, and canoeists also use Lake Meredith. The lake is a prime location for sailboating due to the frequent wind at the lake. Seasonally, canoeists, kayakers, and rafters travel downstream along the Canadian River and some side tributaries from the western boundary of the park to Coetas Creek (if the water is sufficiently deep). This approximately 7-mile stretch of river is inaccessible by most motorboats and PWC users because the sand bar built by sediment transported into the reservoir by the river normally prohibits boat or PWC travel upstream from the lake.

PWC Use

Personal watercraft were first used in Lake Meredith in the mid 1970s, with use increasing during the late 1970s and early 1980s and growing moderately over the next two decades. The typical PWC use season lasts approximately 18 to 22 weeks, from mid-May to mid-September, or if weather permits, from mid-April to October.

There are five boat launch sites at Lake Meredith: Blue West, Sanford-Yake, Cedar Canyon, Harbor Bay, and Fritch Fortress. Due to low water levels (a 21-foot decrease from 2001), only three launch ramps (South Canyon, Cedar Canyon, and Blue West) were open as of May 2002. Because most of the lake is bordered by steep, rocky canyons, access to Lake Meredith from nondesignated areas is limited. However, PWC users may launch at Bugbee Creek, where there is drive-in access to the shoreline.

PWC operators on Lake Meredith are required to abide by Texas boating laws and regulations. Park staff indicated that the costs of enforcing PWC regulations are considered incidental to the enforcement of general boating regulations, as no funding or personnel are dedicated exclusively to enforcing PWC regulations at Lake Meredith. Boating regulations are enforced by NPS rangers and Texas Parks and Wildlife officers (see "National Recreation Area Management and Operations").

Most PWC users come to Lake Meredith for the day, although some camp and launch their craft from shore. Visitors to Lake Meredith include those using PWC exclusively, as well as those who bring fishing boats or houseboats. According to park staff, most visitors (including PWC users) travel less than 150 miles, although visitors also frequently come from Kansas, Colorado, New Mexico, and other parts of Texas. The personal watercraft used at Lake Meredith are typically two- to three-person machines with conventional two-stroke engines. Very few rentals are available in Lake Meredith. Most PWC users visiting Lake Meredith likely own their own personal watercraft (LAW et al., 2002).

Watercraft visitation data are collected only when Lake Meredith officials are on patrol. According to Lake Meredith personnel, PWC account for approximately 20% of all watercraft used on Lake Meredith each year, and an estimated 4,075 personal watercraft were used in Lake Meredith in 2001. Estimates provided by Lake Meredith staff indicate that the average group size for PWC visitors is approximately 3.5 people per craft, resulting in approximately 14,260 people who used personal watercraft in Lake Meredith during 2001, or 1.14% of total Lake Meredith visitation (LAW et al. 2002). No data are available for prior years, so it is unknown whether this is a typical year. However, it is likely that PWC use was lower than average because 2001 appears to have had unusually low visitation overall.

VISITOR SATISFACTION

Generally, visitors to Lake Meredith National Recreation Area are satisfied with their experiences. According to a 2000 visitor survey, 73% of all respondents were satisfied overall with appropriate

facilities, services, and recreational opportunities. Visitors rated combined recreational opportunities at Lake Meredith with a 76% satisfaction measure. A total of 80% specifically rated outdoor recreation as "good" (35%) or "very good" (45%). Visitors rated combined visitor services with an 84% satisfaction measure and combined park facilities (including campgrounds, picnic areas, and trails) with a 69% satisfaction measure.

VISITOR CONFLICTS AND SAFETY

RELATED FEDERAL AND STATE PWC REGULATIONS

Lake Meredith National Recreation Area abides by Texas Parks and Wildlife regulations. Boating regulations are enforced by NPS rangers and Texas Parks and Wildlife officers. In addition, the U.S. Coast Guard Auxiliary helps with boat patrols (no enforcement). The Texas Parks and Wildlife Code stipulates the following regulations for PWC use (Texas 2002):

- Each occupant must wear a U.S. Coast Guard approved personal flotation device.
- The cutoff switch (if provided) must be attached to the operator.
- No PWC operation allowed between sunset and sunrise.
- No PWC operations within 50 feet of any other vessel, person, stationary platform or other object, or shore, except at headway speed.
- Operator must be 16 years of age, or be accompanied by a person at least 18 years of age; or must be at least 13 years of age and have successfully completed a boating safety course prescribed and approved by the state.
- No PWC operation within any area where motorboat use is prohibited by state law or local rule or regulation.
- No towing water skis, an aquaplane, a surfboard, a tube, or any other similar device, unless the craft is designed to carry a minimum of two persons.
- No jumping the wake of another vessel recklessly or coming unnecessarily close to that vessel.
- No operation in a manner that requires the operator to swerve at the last possible moment to avoid a collision.

Personal watercraft are permitted in Lake Meredith except in areas where other vessels are restricted. Currently the only area off limits to all boaters, including PWC users, is the stilling basin below Sanford Dam. All motorboaters, including PWC operators, are required to purchase permits. PWC operators are subject to all federal and state laws. Regulations applying to vessels also apply to personal watercraft. There are no local ordinances regarding PWC operation.

Boating regulations are enforced by NPS rangers and Texas Parks and Wildlife officers. Between 1997 and 2001, NPS rangers issued 393 written violation notices to all watercraft operators on Lake Meredith, with 271 violations to boats and 122 violations to PWC operators (see Table 16). The majority of violations for boats were due to failing to pay the recreation fee, violating no-wake zones, towing without an observer, and riding on gunwales or bows.

An interagency scuba team, consisting of the National Park Service, Hutchinson County Sheriff's Department, Fritch Police Department, Borger Police Department, the Texas Fish and Wildlife Department, conducts underwater search and rescue when necessary. The National Park Service houses and maintains the scuba equipment.

TABLE 16: BOATING ACCIDENTS AND VIOLATION NOTICES, 1997–2001

	Number of Incidents		Minor Damage		Extensive Damage		
Boats	13		7		6		
Personal Watercraft	6		5		1		
Boat Violation Notices	Fee Violations	Lack of Personal Flotation Devices	No-Wake Violations	Improper Towing	Alcohol	Other	Total
Boats	115	52	22	31	11	40	271
Personal Watercraft	31	6	37	14	0	34	122

SOURCE: Lake Meredith National Recreation Area.

PWC-RELATED CONFLICTS WITH OTHER VISITORS

The majority of conflicts are between PWC operators and anglers, who have reported that PWC users disrupt fishing in some of the backwater coves. The majority of violations that would affect other visitors involve speeding in no-wake zones. Table 16 shows boating accidents and violations at Lake Meredith from 1997 through 2001.

While the use of watercraft at Lake Meredith National Recreation Area has increased, the number of accidents has decreased. As a result of proactive boat patrols, there have been only four PWC accidents in the last three years. During the first 30 years that the park was in existence, there were two water-related deaths per year. These deaths were caused by a variety of factors, including drowning, hypothermia, horseplay, overloaded boats, lack of personal flotation devices, illegal or reckless watercraft operation, medical conditions, carbon monoxide poisoning, sailing at night, operator error, and alcohol consumption. The records do not specifically state the type of watercraft involved.

When PWC users comply with Texas regulations, there are few conflicts between PWC operators and other visitors. However, boating near swimmers can pose a safety conflict for both parties. As discussed under "Soundscapes," noise generated by personal watercraft can also affect visitor experiences.

CULTURAL RESOURCES

HISTORICAL BACKGROUND

Prehistoric sites in the Texas Panhandle are divided into three temporal periods: Paleoindian, dating from 10,000 to 5,000 B.C.; Archaic, 5000 B.C. to A.D. 200; and Neoindian, A.D. 200–1541. The last period is further divided into the Palo Duro culture (400–800), the Plains Woodland (200–1200) that paralleled the Palo Duro and supplanted it, and the Panhandle aspect (1200–1500). The Panhandle aspect, and particularly the Antelope Creek phase, is best understood, and sites of this period make up the majority of known archeological sites within Lake Meredith and the adjacent Alibates Flint Quarries. The prehistoric period is reflected by a number of site type categories within the park, including village sites, camp sites, surface artifact scatters, quarry/workshops, rock shelters, petroglyph sites, and special function sites. Two sites from the prehistoric period — Alibates Flint Quarries and McBride Canyon Ruin — are listed on the National Register of Historic Places. The Wichita and Affiliated Tribes of Oklahoma, and the Kiowa Tribe of Oklahoma, claim cultural affiliation with sites of this period.

Historical period sites are included in the Plains stage, which dates from A.D. 1541 to 1876. Apachean groups moving into the area and subsisting on wild plants, bison, deer, and antelope initially

characterize this period. These groups controlled the High Plains until approximately 1720 when the Comanche, allied with Kiowa and Kiowa Apache bands, claimed the Panhandle as an extension of their hunting grounds. Archeological sites of the native people of this period include quarry/workshop sites, artifact scatters, tipi rings, and isolated features such as hearths and roasting pits, all of which have been found in the park. Other tribes that may claim cultural affiliation with sites in this period include the Comanche, Kiowa, Kiowa Apache, Jicarilla Apache, Mescalero Apache, Fort Sill Apache, Apache Tribe of Oklahoma, and Caddo Tribe.

European contact with the native groups began in 1541, eventually leading to the displacement of the Comanche and allied tribes by 1876. Immediately after this, New Mexican sheepherders (pastores) moved onto the High Plains and grazed their flocks over much of the area for the next decade. By the mid-1800s, the Native Americans were becoming supplanted by cattle ranchers. In the late 1800s large cattle ranches were established in the Panhandle; farming, oil, and gas activities have dominated the area since. The later, Euroamerican period is characterized by homesteading and livestock industry features.

ARCHEOLOGICAL RESOURCES

Archeological resources consist of any material remains or physical evidence of past human life or activities, including the record of the effects of human activities on the environment. They are capable of revealing scientific or humanistic information through archeological research (NPS 1997). Even though an inventory of archeological resources within the neighboring Alibates Flint Quarries National Monument was completed in 1999, less than 20% of Lake Meredith National Recreation Area has been surveyed. More than 420 archeological sites have been recorded within the park boundaries. Most of these sites have been found through numerous small surveys associated with the construction of Sanford Dam, lake-related facility developments around the reservoir, and as a result of fire-related activities or fence line surveys along park boundaries.

Archeological resources are divided into the two major categories of prehistoric and historic. Forty-four prehistoric and eight historic archeological sites have been identified along the Lake Meredith shoreline as of 1981, according to NPS staff. More significantly, Native American remains have been found eroding from the shore of Lake Meredith.

The Canadian River and its tributaries were an important focal point for prehistoric and historic activities and a major trade route. Localized outcrops of Alibates flint represented a major resource and a highly sought material utilized by prehistoric and historic populations because of its superior tool making qualities and coloration. Archeological site patterning in the area was enhanced due to the concentrated resources, and that is reflected in the high density of sites located on uplands, side drainages, slopes, and tributary drainages along the Canadian River. Many sites were found in the bottomlands along the river before the reservoir was filled. Many remain intact, covered by water and sediments. Petroglyphs are rare in the Texas Panhandle; these occur along caprock outcrops and talus slopes that contain boulders inside the parks. Flint outcrops are localized phenomena found within the Alibates Dolomite, talus slopes, and gravel exposures. More than 700 caprock quarry pits have been located in the limited areas that have been surveyed. Only a few of the currently listed recorded archeological sites have been evaluated for eligibility to the National Register of Historic Places.

SUBMERGED CULTURAL RESOURCES

While a specific assessment of submerged cultural resources has not been conducted at Lake Meredith National Recreation Area, archeological investigations conducted prior to the construction of Sanford Dam indicate a good likelihood that significant sites have been inundated by the reservoir.

ETHNOGRAPHIC RESOURCES

NPS guidelines define an ethnographic resource as

> a tangible or intangible aspect of a cultural system, past or present, that is identified as significant by a recognized ethnic group. Tangible resources include cultural resources that should be preserved primarily for their historic, technical, aesthetic, or scientific values and other natural and material entities that should be specifically managed with awareness of their ideological, religious, or utilitarian associations with ongoing cultural practices. Intangible resources consist of cultural practices and their associated knowledge and beliefs (NPS 1997).

In addition, the National Historic Preservation Act specifically recognizes that tangible "properties of traditional religious and cultural importance to an Indian Tribe" (sec. 201(d)(6)(a)). The presence of resources with cultural significance to living communities has never been specifically evaluated at Lake Meredith.

Native American Ethnographic Resources. Previous Native American consultations indicate that resources of concern to contemporary tribes exist within the park. Consultations in 1995–96, associated with the excavation and reburial of human remains found eroding from the lakeshore, revealed that archeological sites, especially those with the potential to contain human remains, hold particular cultural sensitivity to associated tribes and should be considered ethnographic, as well as archeological resources. Furthermore, as a result of the excavation and reburial, there is a demonstrated potential for the presence of buried human remains even in the absence of visible artifactual, structural, or other cultural remains.

Previous consultations also indicate that certain plant and animal species in the park may retain specific cultural significance, but additional consultation must be conducted to determine if proposed PWC use alternatives would have any effects on these ethnographic resources.

Finally, tribal consultations identified traditional cultural concerns with the disturbance of natural processes by "mitigating" natural erosion. Any proposed erosion control efforts that relate to PWC use should be planned in consultation with culturally associated tribes. Further consultation may reveal the presence of additional resources of cultural significance to associated American Indian tribes.

Ethnographic Resources Important to Non-Indian Communities: Although no specific ethnographic resources associated with non-Indian communities have yet been confirmed, several cultural resources on park lands associated with former residents or users of the area have been identified. Descendents of some of these former residents may still reside in the area and may continue to attach some cultural value to certain park lands and/or resources. For example, descendents of the McBride, Leverton, Purlock, Forma, Sanford, or Coon families may still be present and may still have some associations with particular places within the park. Some oral historical information may be included in public testimony about the inundation of the area by Sanford Dam or in the memories of local residents. Additionally, there may be long-term user groups who have developed particular attachments to and/or uses of certain places within the park boundaries, and some of these places may have developed ethnographic value over time. In the absence of such information, however, no evidence

exists to suggest that there are resources of cultural significance to members of traditionally associated non-Indian communities.

SOCIOECONOMIC ENVIRONMENT

Lake Meredith National Recreation Area extends for 22 miles across portions of Moore, Hutchinson, and Potter Counties. It comprises 46,349 acres of grassland and canyonland. It provides recreational opportunities for more than 1 million visitors annually, and supplies water for 500,000 people in 11 surrounding cities. Lake Meredith is one of the largest public lakes within 250 miles of Amarillo, Texas, and is the primary boating destination in the Panhandle area. Agriculture and oil and gas operations are the mainstays of the local economy.

Census data show that the population of Hutchinson County (which is where the majority of the park is located) decreased 2.2% between April 2000 and July 2001, while Texas in general experienced a population increase of 2.3% (U.S. Census Bureau 2002). Between 1990 and 2000, the population of Hutchinson County decreased by 7.1%, while Texas increased by 22.8% in the same time period, which is above the national population increase of 13.1%. The counties of Moore and Potter (which contains part of Amarillo to the south of the park) experienced almost no growth between 2000 and 2001, but a 12.6% and 16.1% increase respectively between 1990 and 2000. Due to estimated population increases in the Panhandle region, total visitation to the park is anticipated to increase over the next ten years to equal 1999 visitation rates of approximately 1,780,000.

As previously discussed, PWC use accounts for approximately 20% of all watercraft used on Lake Meredith. Most visitors come for the day and travel less than 150 miles. Very few personal watercraft are available for rent within the recreation area.

Several alternate areas for PWC use exist in the Texas Panhandle region. These include Greenbelt Lake 65 miles east of Amarillo, Buffalo Springs Lake near Lubbock, and Lake Texoma on the Texas-Oklahoma border near Sherman, 347 miles east of Amarillo (LAW et al. 2002).

Ten PWC-related businesses are located in the vicinity of Lake Meredith. In Amarillo three businesses sell new personal watercraft and two sell used machines. A large, concession-operated marina is located on Lake Meredith, but most of its business is related to other types of motorized watercraft. The marina owns five personal watercraft, which it rents on a hourly basis. The remaining businesses generate income from the PWC user (Law et al. 2002).

Data collected by the National Park Service from local bait and convenience stores suggest that PWC visitation may be much higher than indicated by staff observations. These businesses estimated that between 15% and 33% of their annual revenue is attributable to PWC users. This information seems consistent with the amount of PWC use in Lake Meredith National Recreation Area, but it is not consistent with the proportion of all Lake Meredith visitors estimated to be PWC users. It is possible that the businesses contacted have a much higher proportion of sales to PWC users than area businesses overall, or that they cater to watercraft users (LAW et al. 2002).

NATIONAL RECREATION AREA MANAGEMENT AND OPERATIONS

Lake Meredith National Recreation Area currently has six permanent law enforcement staff positions and one seasonal staff position. On holidays, two other permanent law enforcement rangers assist with enforcement activities. Law enforcement staff focus 75% of their time on land activities and 25% on

the water. Boat patrols are conducted on a regular basis. On weekends, staff members routinely patrol the lake 8 hours a day, while on weekdays patrols are more sporadic with no set number of hours. On holidays, staff members maintain full lake coverage from early morning until after dark (B. Briggs, NPS, pers. comm., P. Roszell, URS, Oct. 3 2002, re: management and operations).

Texas Parks and Wildlife officers routinely patrol the lake, generally 10 to 16 hours per day on weekends and 4 hours per day on weekdays. Coast Guard Auxiliary assist with patrols at a minimum of three times per year, generally during Memorial Day weekend, 4th of July weekend, and Labor Day weekend, but they have no enforcement authority (B. Briggs, NPS, pers. comm., P. Roszell, URS, Oct. 3 2002, re: management and operations).

The recreation area averages 8 to 10 water search and rescues per year. The conditions during these operations vary from mild calm conditions to extreme conditions with gale force winds and swells over six feet high (B. Briggs, NPS, pers. comm., P. Roszell, URS, Oct. 3 2002, re: management and operations).

According to recreation area staff, the current level of enforcement dedicated to water-based recreation is not adequate. At least one additional full time permanent staff member is necessary to provide additional law enforcement for the park (B. Briggs, NPS, pers. comm., P. Roszell, URS, Oct. 3 2002, re: management and operations).

ENVIRONMENTAL CONSEQUENCES

SUMMARY OF LAWS AND POLICIES

Three overarching environmental protection laws and policies guide the National Park Service — the National Environmental Policy Act of 1969, and its implementing regulations; the National Parks Omnibus Management Act of 1998; and the NPS Organic Act.

1. The National Environmental Policy Act is implemented through regulations of the Council on Environmental Quality (CEQ) (40 CFR 1500–1508). The National Park Service has in turn adopted procedures to comply with the act and the CEQ regulations, as found in DO #12 and its accompanying handbook.

2. The National Parks Omnibus Management Act of 1998 (16 USC 5901 et seq.) underscores the National Environmental Policy Act in that both are fundamental to NPS park management decisions. Both acts provide direction for articulating and connecting resource management decisions to the analysis of impacts, using appropriate technical and scientific information. Both also recognize that such data may not be readily available, and they provide options for resource impact analysis should this be the case.

   The Omnibus Act directs the National Park Service to obtain scientific and technical information for analysis. The NPS handbook for DO #12 states that if "such information cannot be obtained due to excessive cost or technical impossibility, the proposed alternative for decision will be modified to eliminate the action causing the unknown or uncertain impact or other alternatives will be selected" (section 4.4).

   Section 4.5 of DO #12 adds to this guidance by stating "when it is not possible to modify alternatives to eliminate an activity with unknown or uncertain potential impacts, and such information is essential to making a well-reasoned decision, the NPS will follow the provisions of the regulations of CEQ (40 CFR 1502.22)." In summary, the Park Service must state in an environmental assessment or impact statement (1) whether such information is incomplete or unavailable; (2) the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific adverse impacts that is relevant to evaluating the reasonably foreseeable significant adverse impacts; and (4) an evaluation of such impacts based on theoretical approaches or research methods generally accepted in the scientific community.

3. The 1916 NPS Organic Act (16 USC 1) commits the Park Service to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations.

GENERAL METHODOLOGY FOR ASSESSING IMPACTS

While much has been observed and documented about the overall effects of PWC use on the environment, as well as public safety concerns, the site-specific impacts, or impacts on any particular resource under all conditions and scenarios, are more difficult to measure and affirm with absolute confidence. Since personal watercraft were introduced in parks, data collected and interpreted about them, as well as their effects on park resources relative to other uses and influences, are difficult to define and quantitatively measure, despite monitoring.

Recognizing this dilemma, the interdisciplinary planning team created a process for impact assessment, based upon the directives of the *DO #12 Handbook* (sec. 4.5(g)). National park system units are directed to assess the extent of impacts on park resources as defined by the context, duration, and intensity of the effect. While measurement by quantitative means is useful, it is even more crucial for the public and decision-makers to understand the implications of those impacts in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists.

To determine impacts, methodologies were identified to measure the change in park resources that would occur with the implementation of the PWC management alternatives. Thresholds were established for each impact topic to help understand the severity and magnitude of changes in resource conditions of the various management alternatives. In the absence of quantitative data, best professional judgment prevailed. In general, the thresholds used come from existing literature on PWC, federal and state standards, and consultation with subject matter experts and appropriate agencies.

Potential impacts are described in terms of type (Are the effects beneficial or adverse?), context (Are the effects site-specific, local, or even regional?), duration (Are the effects short-term, lasting less than one year, or long-term, lasting more than one year?), and intensity (are the effects negligible, minor, moderate, or major). Because definitions of intensity (negligible, minor, moderate, or major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this document.

Each alternative is compared to a baseline to determine the context, duration, and intensity of resource impacts. For purposes of impact analysis, the baseline is the continuation of PWC use and current management projected over the next 10 years (alternative A).

In addition to establishing impact thresholds, the national recreation area's resource management objectives and goals (as stated in the "Purpose of and Need for Action" chapter) were integrated into the impact analysis. In order to further define resource protection goals relative to PWC management, the park's *Strategic Plan* was used to ascertain the "desired future condition" of resources over the long term. The impact analysis then considers whether each management alternative contributes substantially to the park's achievement of its resource goals, or would be an obstacle. The planning team then considered potential ways to mitigate effects of PWC use on park resources, and modified the alternatives accordingly.

For the purposes of analysis, the following assumptions are used for all impact topics (the words "impact" and "effect" are used synonymously throughout the discussion):

> *Short-term impacts:* Those impacts occurring from PWC use in the immediate future or through a single season of use, usually 1 to 6 months.
>
> *Long-term impacts:* Those impacts occurring from PWC use over several seasons of use through the next 10 years.
>
> *Direct impacts:* Those impacts occurring from the direct use or influence of PWC use.
>
> *Indirect impacts:* Those impacts occurring from PWC use that indirectly alter a resource or condition.
>
> *Impact Analysis Area:* Each resource impact is assessed in direct relationship to those resources affected both inside and outside the park, to the extent that the impacts can be substantially traced, linked, or connected to PWC use inside park boundaries. Each impact

topic, therefore, has an impact analysis area relative to the resource being assessed, and it is further defined in the impact methodology.

CUMULATIVE IMPACTS

The CEQ regulations to implement the National Environmental Policy Act require the assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for all alternatives, including the no-action alternative.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects at Lake Meredith and, if applicable, the surrounding region. Park, local, or state policies, plans, or actions are listed on page 22.

IMPAIRMENT ANALYSIS

The NPS *Management Policies 2001* require an analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, as established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the National Park Service the management discretion to allow certain impacts within a park system unit, that discretion is limited by the statutory requirement that the agency must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values. An impact to any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from NPS activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park.

The following process was used to determine whether the various PWC management alternatives had the potential to impair park resources and values:

1. The park's enabling legislation, the *General Management Plan,* the *Strategic Plan,* and other relevant background were reviewed with regard to the unit's purpose and significance, resource values, and resource management goals or desired future conditions.
2. PWC management objectives specific to resource protection goals at the park were identified.
3. Thresholds were established for each resource of concern to determine the context, intensity and duration of impacts, as defined above.
4. An analysis was conducted to determine if the magnitude of impact reached the level of "impairment," as defined by NPS *Management Policies.*

The impact analysis includes any findings of impairment to park resources and values for each of the management alternatives.

PWC USE TRENDS

The National Park Service projected PWC and non-PWC visitation for the years 2002 through 2012 by calculating the average recreational visitation over the past five years, estimating visitation growth rates based on population growth rates in the area, and projecting PWC visitation based on national PWC ownership rates (which declined 1.45% annually over the past five years).

PWC use trends were identified to determine direct and indirect impacts of PWC management strategies on recreation area resources. Other visitor use trends were identified to help assess cumulative effects. Use trends were determined using data available from the recreation area records, discussions with state agencies and park representatives, Texas boat statistics, and the socioeconomic report completed by LAW (2002). While the visitor survey data represent only those respondents surveyed, it provides the best data for general visitor trends.

The majority of the visitors to Lake Meredith are from the Texas Panhandle region. Future PWC use in the recreation area was determined based on registration statistics, national PWC ownership statistics, and personal communication with park staff. Texas pleasure boat registration grew 0.42% between 1997 and 2001, although PWC registration in the state declined at an average annual rate of 12% during the same time period (A. Salazar, NPS, pers. comm. P. Steinholtz, URS, Sept. 9 and 17, 2002). National PWC registration trends also show a decline beginning in 1999 (see Table 1, page 9). However, Lake Meredith staff indicate believe that PWC use still appears to be increasing slightly in the recreation area (B. Briggs, NPS, pers. comm., P. Roszell, URS, Oct. 8 2002), despite national and statewide statistics.

Based on the PWC data available, regional population projections, and park staff experience, PWC numbers are estimated to remain at current levels for the next 10 years. Within Lake Meredith National Recreation Area, current average PWC use is approximately 14 craft per day, with a high of 70 PWC on peak weekend days. These numbers are expected to remain the same in 2012.

WATER QUALITY

Most research on the effects of personal watercraft on water quality focuses on the impacts of two-stroke engines, and it is assumed that any impacts caused by these engines also apply to the personal watercraft powered by them. There is general agreement that two-stroke engines (and personal watercraft) discharge a gas-oil mixture into the water. Fuel used in PWC engines contains many hydrocarbons, including benzene, toluene, ethylbenzene, and xylene (collectively referred to as BTEX). Polycyclic aromatic hydrocarbons (PAHs) also are released from boat engines, including those in personal watercraft. These compounds are not found appreciably in the unburned fuel mixture, but rather are products of combustion. Discharges of all these compounds — BTEX and PAHs — have potential adverse effects on water quality. Some research shows that PAHs adversely affect water quality by means of phototoxic effects on ecologically sensitive plankton and other small water organisms (US EPA 1998; Oris et al. 1998; Landrum et al. 1987; MeKenyan et al. 1994; Arfsten et al. 1996). A common gasoline additive, methyl tertiary butyl ether (MTBE) is not used in gasoline sold in Texas.

A typical conventional (i.e., carbureted) two-stroke PWC engine discharges as much as 30% of its fuel unburned directly into the water (NPS 1999; CARB 1999). At common fuel consumption rates, an average two-hour ride on a personal watercraft may discharge 3 gallons of fuel into the water (NPS 1999). According to data from *Personal Watercraft Illustrated* and Bluewater Network (2001), an average 2000 model-year personal watercraft can discharge between 3.8 and 4.5 gallons of fuel during one hour at full throttle. (As described in appendix B, an estimated discharge rate of 3 gallons per hour is used in the water quality impact calculations.)

As described below, hydrocarbon (HC) discharges to water are expected to decrease considerably over the next 10 years due to mandated improvements in engine technology (i.e., direct injection two-stroke and four-stroke engines) (US EPA 1996a, 1997).

GUIDING REGULATIONS AND POLICIES

The U.S. Environmental Protection Agency has developed national recommended ambient water quality criteria for approximately 120 priority pollutants for the protection of both aquatic life and human health (through ingestion of fish/shellfish or water) (US EPA 1999a). These criteria have been adopted as enforceable standards by most states. The Environmental Protection Agency has not established any criteria for the protection of aquatic life for any of the PWC-related compounds stated above. For human health, however, the Environmental Protection Agency has established bnechmarks for benzene, ethylbenzene, toluene, and several PAH compounds. There are no criteria for xylene.

The NPS *Management Policies 2001* state that the Park Service will "take all necessary actions to maintain or restore the quality of surface waters and ground waters within the parks consistent with the Clean Water Act and all other applicable federal, state, and local laws and regulations" (sec. 4.6.3).

Lake Meredith National Recreation Area does not have quantitative water quality data documenting the effects of personal watercraft since they were introduced in the 1970s. To address water quality impacts potentially resulting from continued PWC use, water quality benchmarks were used in the absence of unit-specific data as a basic principle to guide the analysis.

Simply stated, a water quality standard defines the water quality goals of a waterbody by designating uses to be made of the water, by setting minimum criteria to protect the uses, and by preventing degradation of water quality through antidegradation provisions. The antidegradation policy is only one

portion of a water quality standard. Part of this policy (40 CFR 131.12(a)(2)) strives to maintain water quality at existing levels if it is already better than the minimum criteria. Antidegradation should not be interpreted to mean that "no degradation" can or will occur, as even in the most pristine waters, degradation may be allowed for certain pollutants as long as it is temporary and short term (G. Rosenlieb, WRD, NPS, pers. comm., Tom Campbell, URS, 2001).

Other considerations in assessing the magnitude of water quality impacts is the effect on those resources dependent on a certain quality or condition of water. Sensitive aquatic organisms, submerged aquatic vegetation, riparian areas, and wetlands are affected by changes in water quality from direct and indirect sources.

While many parks do have established water quality monitoring programs, the specific organic compounds emitted from personal watercraft are not systematically measured. In the absence of park-specific data, available water quality benchmarks or criteria and estimated discharge rates of organics were used as the basic tools to address water quality impacts potentially resulting from PWC use.

METHODOLOGY AND ASSUMPTIONS

In order to assess the magnitude of water quality impacts to park waters under the various PWC management alternatives, the following methods and assumptions were used:

1. The regulation at 40 CFR 131.12(a)(2) represents an overall goal or principle with regard to PWC use in that the park will strive to fully protect existing water quality so that "fishable / swimmable" uses and other existing or designated uses are maintained. Therefore, PWC use could not be authorized to the degree that it would lower this standard and affect these uses. To do so would potentially violate 40 CFR 131.10, which basically forbids the removal of an existing use (e.g., personal watercraft) because the activity was authorized knowing this level of pollution would occur.
2. State water quality standards governing the waters of the park were examined for pollutants whose concentrations in gasoline were available in the literature and for which ecological and/or human health toxicity benchmarks were available in the literature.
3. Baseline water quality data (if available), especially for pollutants associated with two-stroke engines (PAHs, hydrocarbons), were examined. In Texas, MTBE is not used in gasoline; therefore, it was not included in the analysis. PWC and other motorboats from other states utilizing MTBE as an additive may be found in the reservoir, but given the small numbers involved, they were not considered in the calculations of water quality impacts.
4. Since no models were available to predict concentrations in water of selected pollutants emitted by personal watercraft and motorboats, an approach was developed to provide estimates of whether PWC (and outboard motor) use over a particular time (for example, over a typical busy weekend day) would result in exceedances of the identified standards, criteria, or toxicity benchmarks. The approach is described in appendix B. Results of this approach were then taken into account, along with site-specific information about currents, mixing, wind, turbidity, etc., as well as the specific fate and transport characteristics of the pollutant involved (e.g., volatility), to assess the potential for the occurrence of adverse water quality impacts.
5. In general, the approach provides the information needed to calculate emissions to the receiving waterbody from personal watercraft (and, by estimation, from outboard motors) of selected hydrocarbons whose concentrations in the raw gasoline fuel were available in the literature and for which ecological and/or human health toxicity benchmarks could be acquired

from the literature. The selected chemicals were benzene and three PAHs (benzo(a) pyrene, naphthalene, and 1-methyl naphthalene). The approach outlined a procedure to first estimate the emissions of these pollutants to the water per operational hour (based on literature values) and to then estimate the total loading of the pollutants into the water, based on the estimated hours of use. The approach then provided an estimate of how much water would be required to dilute the calculated emission loading to the level of the water quality standard or benchmark. That volume of water (referred to as the "threshold volume" of water) was then compared to the total available volume of water.

6. The "Texas Surface Water Quality Standards" (TNRCC 2000) do not include aquatic life standards for typical gasoline organic constituents such as benzene or PAHs. As shown in Table 7 on page 43, surface water quality standards for human health protection for benzo(a)pyrene are 0.099 μg/L for ingestion of fish and water, and 0.81 μg/L for ingestion of fish only; and for benzene 5 μg/L and 106 μg/L, respectively.

   Lake Meredith is a designated use for the public water supply (TNRCC 2000), and water in the lake is currently used for drinking water. Therefore, human health standards for ingestion of water and fish were compared with US EPA criteria, and the lower of the two sets of benchmarks were used. Table 17 shows the benchmarks used to assess impacts to ecological organisms and to human health.

TABLE 17: ECOTOXICOLOGICAL AND HUMAN HEALTH BENCHMARKS FOR ORGANIC POLLUTANTS

Chemical	Ecological Benchmark (μg/L)	Source	Human Health Benchmark** (μg/L)	Source
Benzo(a)pyrene	0.014	Suter and Tsao 1996	0.0044	US EPA 1999a
Naphthalene	62	Suter and Tsao 1996	--	--
1-methyl naphthalene	34*	USFWS 1987	--	--
Benzene	130	Suter and Tsao 1996	1.2	US EPA 1999a

* Based on LC_{50} of 3400 μg/L for sheepshead minnow (34 μg/L used for freshwater calculations).
** Based on the consumption of water and fish.

7. The principal mechanisms that result in the loss of the pollutant from the water also were considered. 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. Other compounds that have low vapor pressure, low solubility, and high octanol/water partition coefficients tend to adhere to organic material and clays and eventually adsorb onto sediments. By considering movements of the organics through the water column, an assessment can be made as to whether there could be an issue with standards or benchmarks being exceeded, even on a short-term basis.

8. The threshold volume of water was calculated in acre-feet (1 acre-foot = 1 acre of water 1 foot deep). For example, if results showed that for benzo(a)pyrene, 55 acre-feet of water would be needed to dilute the expected emissions to below the benchmark level, and the receiving body of water is a 100-acre reservoir with an average depth of 20 feet (= 2000 acre-feet) and is well-mixed, then this would indicate little chance of a problem, especially when adding the effects of any other processes that contribute to the loss of benzo(a)pyrene from the water column. However, if the impact area is a 5-acre backwater averaging 2 feet deep (10 acre-feet), then there may be at least a short-term issue, especially if outboard emissions are added or there is little mixing in the area.

9. To assess cumulative impacts, outboard emissions also were determined, based on estimates of relative emissions of unburned fuel and hours of use. Motorboat emissions were then added to PWC emissions to yield a more complete estimation of loading to the receiving waterbody.

Inboards and stern-drive boats contribute little to the loading and were not included in the estimation. The estimates used for relative loading from various outboard engines are obtained from available data.

10. Reductions in emissions from personal watercraft and outboards are outlined by the U.S. Environmental Protection Agency over the next 16 years (see Table 18).

TABLE 18: ESTIMATED EPA REDUCTIONS IN WATERCRAFT EMISSIONS

Date	Action
1999	EPA requires production line testing for 75% HC reduction in new outboards and begins to see reductions as newer models are introduced (US EPA 1997).
2000	EPA requires production line testing for 75% HC reduction in new personal watercraft and begins to see reductions as newer models are introduced (US EPA 1997).
2006	EPA fully implements 75% HC reduction in new outboards and personal watercraft (US EPA 1996a).
2010	EPA estimates a 52% reduction in overall HC emissions from outboards and personal watercraft (US EPA 1996a)
2012	Approximately a 50% reduction in HC emissions estimated for this analysis, based on dates in US EPA (1996a, 1997)
2015	EPA estimates a 68% reduction in overall HC emissions from outboards and personal watercraft (US EPA 1996a)

Key dates in this chronology begin with 1999, when the U.S. Environmental Protection Agency began to require production line testing for 75% HC reduction in new outboard motors, and 2000, when production line testing for 75% HC reduction in new personal watercraft was required (US EPA 1997). These dates represent a delay in testing implementation that was originally scheduled (US EPA 1996a) for 1998 for both personal watercraft and outboard motors. By 2006 all new personal watercraft and outboards manufactured in the United States must have a 75% reduction in HC emissions (US EPA 1996a). For the purpose of estimating water quality impacts in this assessment, overall reductions in HC emissions are conservatively estimated to be 50% in PWC and outboard motors by 2012. This estimate is based on interpolations of the emissions reduction percentages and associated years (2010 and 2015) reported by the U.S. Environmental Protection Agency in 1996 (US EPA 1996a), but with a one-year delay in production line testing (US EPA 1997).

The 50% overall average reduction estimated for 2012 was applied to personal watercraft and outboard motorboats in calculations for alternatives A and B in this assessment, as per US EPA (1996a, 1997). In alternative C, personal watercraft would be banned, and emissions by other motorboats were assumed to decrease by 50%.

11. To evaluate water quality impacts in Lake Meredith, water quality calculations were performed for each of two areas (see Table 19). These are:

    - Area 1 — Lake Meredith (203,700 ac-ft, on October 3, 2002 [USGS 1002a]) minus the volume of water in the 11 no-wake zones listed for area 2 (20,370 ac-ft).
    - Area 2 — Eleven no-wake zones would be established under alternative B (North Turkey Creek, Bugbee Canyon, North Canyon, South Canyon, Sexy Canyon, Amphitheater Cove, the coves between day markers 9 and 11 North Cove, Fritch Canyon, and Short Creek). Two additional canyons, Evans Canyon and Canal Canyon, are south of the current shoreline and not connected to the lake but would become no-wake zones if water levels rose above the current elevation. Big Blue Creek and Martins Canyon are not included as no-wake zones under alternative B. (See the map for alternative B for locations of the no-wake zones.) The 11 no-wake zones are estimated to constitute about 11% of the total surface area of Lake Meredith

at the current water elevation.* Even though the depths of the coves and canyons in the no-wake zone under alternative B are unknown, they are assumed to be less than depths in the main body of the lake. Therefore, the volumes of the coves and canyons was assumed to be approximately 10% of the total volume of the lake (203,700 ac-ft on October 3, 2002 [USGS 2002a]).

These two areas were determined to be the most useful in the analysis of water quality impacts because the canyons and coves listed would be no-wake zones under alternative B. For the purposes of the impact analysis, it was assumed that all use restrictions were in place during 2002.

TABLE 19: ESTIMATED WATER VOLUMES (ACRE-FEET)

Areas	Estimated Area (acres)	Estimated Average Depth (ft)	Volume (ac-ft)
Area 1 — Lake Meredith minus the no-wake zone volumes	8,280	--	183,330
Area 2 — No-Wake Zones (11 canyons and coves)	1,032	--	20,370*
Lake Meredith Total	9,312	22.1	203,700**

* Estimated as 10% of total reservoir volume for use in impact evaluations.

** At pool elevation of 22,883.5 feet on 10/3/02 (USGS 2002a).

For the purpose of estimating available volumes of water in Lake Meredith, it is assumed that the full volume of the reservoir is available for mixing/diluting PWC and motorboat emissions. According to park staff, a thermocline may become established in deeper portions of the reservoir (near a depth of 30 feet) in those years when water temperature and wind conditions are conducive to its creation (B. Briggs, NPS, pers. comm., L. Pine, URS, August 27, 2002, re: management and operations). The depth and strength of any thermocline would vary with year and time of year, typically becoming established in the spring and continuing through the early fall. The volume of water calculated for area 1 does not consider the effect that a thermocline would have on the mixing volume available, and the potential effect of a thermocline in the summer is qualitatively discussed in the impact assessment where appropriate. It is assumed there would be no thermoclines in the no-wake zones because of river flows and shallow depths.

12. Actual counts of personal watercraft and other motorboats were not available from the park. Personal watercraft are thought to represent approximately 20% of the total number of motorized craft on Lake Meredith. During the 2001 boating season there were an estimated 20,375 motorized watercraft on Lake Meredith, including 4,075 personal watercraft and 16,300 motorboats (LAW et al. 2002). Based on the number of months included in the survey and the number of weekends when highest use typically occurs, it is estimated that 70 personal watercraft are on Lake Meredith during a high-use day, plus 280 outboard motorboats, for a total of 350 motorized watercraft. According to information from the park, approximately 5% of the motorboats (20 boats) at any one time have engines of 15 hp or less, and the rest (260 boats) have larger engines. For the purpose of estimating impacts to water quality, smaller outboard motorboats were assumed to have gasoline emission rates twice that of large boats and personal watercraft (see the discussion in appendix B; Allen et al. 1998).

    The numbers of personal watercraft and motorboats using Lake Meredith were assumed to remain constant on an annual basis (see the discussion in "PWC Use Trends"). The predicted lack of change in numbers of motorized watercraft over this period is based on local

* Based on digitized areas of USGS 1:24000 quadrangle sheets for Alibates Ranch, Evans Canyon, and Sanford.

population trends and national boat registration trends. Use would be distributed between areas 1 and 2, as shown in Table 20.

TABLE 20: PREDICTED DISTRIBUTION OF PWC AND MOTORBOAT USE

		Motorboats	
	Personal Watercraft	Greater than 15 hp	15 hp or Less
Area 1 — Lake Meredith minus the no-wake zone areas	60	240	15
Area 2 — no-wake zones	10	20	5
Total	**70**	**260**	**20**

Note: Use is predicted to remain the same in 2012 as in 2002, based on local population trends and national boat registration trends.

The majority of motorboats operating within the recreation area are assumed to have two-stroke outboard engines. A limited number of houseboats operate on the reservoir but were not included since they are typically powered by four-stroke engines. Also, inboard and stern-drive motorboats were not included.

Personal watercraft are launched from several launching ramps on Lake Meredith, including Blue West, Fritch Fortress, Cedar Canyon, Sanford-Yake, and Harbor Bay. Given the fluctuating water levels, all launching ramps have water depths at which they may become unusable.

13. Boating activity, and therefore pollutant loads, would be distributed over an entire day (from early morning to dusk), although for the purpose of calculating impacts, it is assumed that personal watercraft and other motorboats operate for four hours during a single high-use day. When released to water, benzene is subject to rapid volatilization, with a half-life for evaporation of about five hours (US EPA 2001). The loss of benzene from the water column is discussed qualitatively where applicable.
14. For a conservative assessment of available volume of water, no lateral mixing of water across the boundaries between areas was assumed. This assumption applied to the boundaries between the main body of Lake Meredith and the no-wake zones. In actuality, water and PWC emissions in each area will mix with adjacent waters to some unknown extent, thus reducing the concentrations of PWC emissions within each area. By assuming no mixing across the jurisdictional boundaries, the estimated impacts for each alternative are conservative (i.e., actual impacts would be less than those described in this analysis).
15. Some research indicates that PAHs have phototoxic effects in oligotrophic lakes that have high light penetration (Oris et al. 1998). Limited data indicate that in these conditions, PAHs may have toxic effects on fish and zooplankton at very low concentrations (less than 1 µg/L). Due to an absence of recent appropriate water quality data, it is unknown if Lake Meredith is currently oligotrophic (i.e., high light penetration). The most recent USGS data for Secchi depth, which were collected in 1975, show an average depth of 2.9 meters (USGS 2002a), which is considered fairly transparent. However, the Canadian River, the main source of water to the lake, is described as having relatively high turbidity (SPMA 1993). In view of an absence of recent transparency data, the potential for photo-toxic effects of PAHs is discussed in the impact analyses, where appropriate.

IMPACT ANALYSIS AREA

The impact analysis area for water quality includes the jurisdictional boundary of Lake Meredith within the national recreation area. The impact analysis area does not include the Canadian River upstream or downstream of the reservoir or the other tributaries feeding the reservoir.

IMPACT TO WATER QUALITY FROM PWC USE

Given the water quality issues and methodology and assumptions described previously, the following impact thresholds were established in order to describe the relative changes in water quality (both overall, localized, short and long term, and cumulatively) under the various personal watercraft management alternatives.

Negligible: Impacts are chemical, physical, or biological effects that would not be detectable, would be well below water quality standards or criteria, and would be within historical or desired water quality conditions.

Minor: Impacts (chemical, physical, or biological effects) would be detectable but would be well below water quality standards or criteria and within historical or desired water quality conditions.

Moderate: Impacts (chemical, physical, or biological effects) would be detectable but would be at or below water quality standards or criteria; however, historical baseline or desired water quality conditions would be altered on a short-term basis.

Major: Impacts (chemical, physical, or biological effects) would be detectable and would be frequently altered from the historical baseline or desired water quality conditions; and/or chemical, physical, or biological water quality standards or criteria would be slightly and singularly exceeded on a short-term basis.

Impairment: Impacts are chemical, physical, or biological effects that would be detectable and that would be substantially and frequently altered from the historical baseline or desired water quality conditions and/or water quality standards, or criteria would be exceeded several times on a short-term and temporary basis. In addition, these adverse, major impacts to park resources and values would

- contribute to deterioration of the park's water quality and aquatic resources to the extent that the park's purpose could not be fulfilled as established in its enabling legislation;
- affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or
- affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC use would continue within Lake Meredith National Recreation Area with no additional location restrictions. Numbers of personal watercraft using the reservoir during a high-use day would remain constant at 70 per day in 2002 and in 2012. For 2002, it is assumed that 60 personal watercraft would operate in area 1, and 10 in area 2 (see Table 20). Threshold water volumes needed to dilute pollutants from PWC use under alternative A are show in Table 21.

TABLE 21: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC EMISSIONS, ALTERNATIVE A

	Lake Meredith minus No-Wake Zones — Area 1		11 No-Wake Zones — Area 2*	
	2002	2012	2002	2012
Lake Meredith waters open to PWC use (ac-ft)	183,330		20,370	
Ecotoxicological Benchmarks**				
Benzo(a)pyrene (fuel and exhaust)	330	170	55	28
Naphthalene	130	66	22	11
1-methyl naphthalene	370	190	62	31
Benzene	310	160	52	26
Human Health Benchmarks***				
Benzo(a)pyrene (fuel and exhaust)	1,100	530	180	88
Benzene	34,000	17,000	5,700	2,800

* Under alternative B personal watercraft would be allowed to operate only at no-wake speeds in 11 specified coves/canyons. This area is shown under alternative A for comparison purposes.
** Threshold volumes (ac-ft) below which ecotoxicological effects might occur.
*** Threshold volumes (ac-ft) below which human health might be impacted.

The 2002 and 2012 threshold volumes calculated to meet ecotoxicological benchmarks range from 11 to 370 acre-feet. These volumes are extremely small in relation to the volumes of water available (183,330 ac-ft in area 1; 20,370 ac-ft in area 2), indicating that these pollutant loads would be well below the ecological benchmarks, and there would be negligible adverse impacts in both areas in 2002 and in 2012.

Similarly, no pollutant levels would exceed the human health benchmarks for ingestion of water and fish. Threshold volumes would range from 88 to 34,000 acre-feet, which are substantially smaller than the water volumes available. Therefore, personal watercraft would have a negligible adverse impact on human health. Pollutant loads in 2012 would be lower than in 2002 because of the overall 50% reduction in engine emissions as estimated by the U.S. Environmental Protection Agency (1996a, 1997).

Cumulative Impacts. In addition to PWC use, other two-stroke outboard motorboats would contribute pollutants to Lake Meredith. It is assumed that 280 motorboats would use the reservoir during a high-use day in 2002 and 2012 (see Table 20). As described above, it is assumed that total numbers of personal watercraft would remain the same in 2012 as in 2002. Calculated threshold water volumes to dilute all PWC and motorized boat emissions under alternative A are shown in Table 22.

TABLE 22: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC AND MOTORIZED BOAT EMISSIONS, ALTERNATIVE A

	Lake Meredith minus No-Wake Zones — Area 1		11 No-Wake Zones — Area 2*	
	2002	2012	2002	2012
Lake Meredith waters open to PWC use (ac-ft):	183,330		20,370	
Ecotoxicological Benchmarks**				
Benzo(a)pyrene (fuel and exhaust)	1,800	910	220	110
Naphthalene	720	360	88	44
1-methyl naphthalene	2,100	1,000	250	120
Benzene	1,700	860	210	100
Human Health Benchmarks***				
Benzo(a)pyrene (fuel and exhaust)	5,800	2,900	700	350
Benzene	190,000	94,000	23,000	11,000

* Under alternative B personal watercraft would be allowed to operate at only no-wake speeds in 11 specified coves/canyons; this area is shown under alternative A for comparison purposes.
** Threshold volumes (ac-ft) below which ecotoxicological effects might occur.
*** Threshold volumes (ac-ft) below which human health might be impacted.

The calculated threshold volumes for pollutants emitted in 2002 by personal watercraft and other motorboats would be substantially greater than for personal watercraft alone. The volumes would

range from 88 to 2,100 acre-feet for the ecotoxicological benchmarks. In 2012, ecotoxicological threshold volumes would decrease to a range of 44 to 1,000 acre-feet, due to the projected 50% decrease in average emissions. Concentrations of all the organic contaminants evaluated would be well below the water quality benchmarks and likely would not be detectable. Resulting cumulative impacts would be negligible in both 2002 and 2012.

Based on the human health benchmarks, the calculated threshold volumes for pollutants emitted by personal watercraft and boats in 2002 would range from 700 to 190,000 acre-feet. The threshold volumes for benzene (190,000 ac-ft in area 1 and 23,000 ac-ft in area 2) would be slightly higher than water volumes available at the current water elevation. However, because benzene is expected to evaporate rapidly, especially at elevated summer temperatures, benzene concentrations in the two areas could be lower than the human health benchmark in less than five hours following a high-use day. In 2012 human health threshold volumes would decrease to a range of 350 to 94,000 acre-feet, and concentrations of the two organic contaminants evaluated would be well below the water quality benchmarks. In both areas cumulative impacts to human health from benzene would be moderate in 2002 and minor in 2012. If a thermocline was present and the full volume of the lake was not available for mixing, the benzene concentrations and impacts could be greater. Focused water quality monitoring immediately following a high-use day would be needed to confirm benzene concentrations.

Conclusion. Continuing PWC use as managed until November 6, 2002, would have short- and long-term, negligible, adverse effects on water quality based on ecotoxicological and human health benchmarks. All pollutant loads would be well below benchmarks.

Cumulative impacts from PWC and motorized boat use in 2002 and 2012 would be negligible based on ecotoxicological benchmarks. Cumulative impacts based on human health benchmarks from benzene would be moderate in 2002, decreasing to minor by 2012 due to improved emission controls. The evaporation of benzene and the presence of a thermocline could affect the impact assessment for both 2002 and 2012. Therefore, focused water quality monitoring immediately following a high-use day would be needed to confirm the estimates of impacts from benzene.

This alternative would not result in an impairment of water resources.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC use would continue within the reservoir, but no-wake zones would be established in 11 coves and canyons: North Turkey Creek, Bugbee Canyon, North Canyon, South Canyon, Sexy Canyon, Amphitheater Cove, the coves between day markers 9 and 11, North Cove, Fritch Canyon, and Short Creek (see Alternative B map). It is assumed that personal watercraft operating in the no-wake zones under this alternative would discharge gasoline and its constituents at one-quarter the rate expected at full throttle in the open-water portion of the lake (North American Lake Management Society 2002). For the purpose of evaluating impacts to water quality, it was assumed that the no-wake zones were established in 2002. Overall numbers and distribution of personal watercraft (60 in area 1 and 10 in area 2) would remain the same as in alternative A in both 2002 and 2012. In 2012 emission rates for personal watercraft (as well as outboard motorboats) were assumed to decrease by 50%, in accordance with the U.S. EPA manufacturing requirement (1996a, 1997). Also, under alternative B the PWC user education program would be enhanced to include materials describing the advantages of the U.S. EPA emission reduction programs and the anticipated benefits to water and air quality. Estimated threshold water volumes needed to dilute PWC emissions under alternative B are shown in Table 23.

TABLE 23: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC EMISSIONS, ALTERNATIVE B

	Lake Meredith minus No-Wake Zones — Area 1		11 No-Wake Zones — Area 2*	
	2002	2012	2002	2012
Lake Meredith waters open to PWC use (ac-ft):	183,330		20,370	
Ecotoxicological Benchmarks**				
Benzo(a)pyrene (fuel and exhaust)	330	170	14	7
Naphthalene	130	66	6	3
1-methyl naphthalene	370	190	16	8
Benzene	310	160	13	6
Human Health Benchmarks***				
Benzo(a)pyrene (fuel and exhaust)	1,100	530	44	22
Benzene	34,000	17,000	1,400	710

* Personal watercraft would be allowed to operate only at no-wake speeds in 11 specified coves and canyons.

** Threshold volumes (ac-ft) below which ecotoxicological effects might occur.

*** Threshold volumes (ac-ft) below which human health might be impacted.

The 2002 and 2012 calculated threshold volumes to meet ecotoxicological benchmarks would range from 3 to 370 acre-feet in areas 1 and 2. Under alternative B all threshold volumes for area 2 would be lower than under alternative A (see Table 21) because of the stipulated no-wake zones. The calculated threshold volumes for both areas would be extremely small in relation to the volume of water available in these areas (183,330 and 20,370 ac-ft, respectively). Concentrations of all evaluated pollutants would be well below the ecotoxicological benchmarks, and adverse impacts would be negligible.

Similarly, the threshold volumes for human health benchmarks would also be small, ranging from 34,000 acre-feet in area 1 to 22 acre-feet in area 2 — substantially less than the available volumes. Similar to alternative A, there would be negligible adverse impacts on water quality in both areas in 2002 and 2012 based on ecotoxicological and human health benchmarks under alternative B.

In response to the enhanced PWC user education program, PWC emissions (and resulting threshold volumes) in 2012 could be reduced more than the assumed 50%. Also, prohibiting PWC fueling on the lake except at the marina dock would reduce the potential for accidental spills and associated impacts.

Cumulative Impacts. As described for alternative A, other two-stroke outboard motorboats would contribute pollutants to Lake Meredith under alternative B, along with personal watercraft. Numbers of other motorboats using the reservoir during a high-use day would remain at 280 per day in both 2002 and 2012 (see Table 20). Threshold water volumes that would be required to dilute PWC and

Table 24

The 2002 and 2012 calculated threshold volumes based on ecotoxicological benchmarks needed to dilute emissions from all motorized watercraft in area 1 would range from 360 to 2,100 acre-feet. In area 2 the threshold volumes would range from 36 to 200 acre-feet. These volumes are extremely small in relation to the volumes of water available in the two areas, indicating that these pollutant loads would be well below the ecotoxicological benchmarks for the four organics, and there would be negligible cumulative adverse impacts over the short and long term.

The 2002 and 2012 threshold volumes for human health impacts in area 1 would range from 2,900 to 190,000 acre-feet. There would be a moderate cumulative impact to water quality from benzene in 2002 because the threshold volume (190,000 ac-ft) would be greater than the available water volume in this area. However, it would take less than five hours for the benzene concentration to become lower than the human health criterion. But the presence of a thermocline could reduce the effective mixing volume of the lake. Focused water quality monitoring would be needed immediately following

TABLE 24: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC AND MOTORIZED BOAT EMISSIONS, ALTERNATIVE B

	Lake Meredith minus No-Wake Zones — Area 1		11 No-Wake Zones — Area 2*	
	2002	2012	2002	2012
Lake Meredith waters open to PWC use (ac-ft)	183,330		20,370	
Ecotoxicological Benchmarks**				
Benzo(a)pyrene (fuel and exhaust)	1,800	910	180	90
Naphthalene	720	360	71	36
1-methyl naphthalene	2,100	1,000	200	100
Benzene	1,700	860	170	85
Human Health Benchmarks***				
Benzo(a)pyrene (fuel and exhaust)	5,800	2,900	570	290
Benzene	190,000	94,000	18,000	9,200

* Personal watercraft would be allowed to operate only at no-wake speeds in 11 specified coves and canyons.

** Threshold volumes (ac-ft) below which ecotoxicological effects might occur.

*** Threshold volumes (ac-ft) below which human health might be impacted.

a high-use day to confirm these impact estimates. All other threshold volumes in area 1 would result in negligible adverse impacts on water quality based on human health benchmarks.

In area 2 the threshold volume for benzene in 2002 (18,000 ac-ft) would be somewhat less than the available volume, resulting in a minor impact to water quality. All other human health threshold volumes from personal watercraft and other motorboats would be substantially less than the available volume of the area, resulting in only negligible impacts to water quality.

Conclusion. Continued PWC use with management restrictions would result in short- and long-term, negligible, adverse effects on water quality based on ecotoxicological and human health benchmarks, similar to alternative A. All threshold volumes needed to dilute PWC emissions in area 2 would be smaller under alternative B than under alternative A because of the additional management restrictions (specific no-wake zones for personal watercraft). Prohibiting PWC fueling on the lake would reduce the potential for accidental spills and associated impacts on water quality. Also, the PWC user education program could result in lower PWC emission rates in 2012.

Cumulative impacts in 2002 from PWC and motorboat use would range from negligible to moderate under alternative B. Impacts from benzene in 2002 would be moderate in area 1 and minor in area 2. Focused water quality monitoring would be needed immediately following a high-use day to confirm these impact estimates. By 2012 all threshold volumes would be substantially reduced as a result of improved emission controls, no-wake zones, and a PWC user education program; all cumulative impacts based on ecotoxicological and human health benchmarks would be negligible.

Alternative B would not result in an impairment of water resources.

Impacts of the No-Action Alternative — No PWC Use

Analysis. No PWC use would be allowed within Lake Meredith. Therefore, personal watercraft would not contribute pollutants to lake waters. The no-action alternative would have a beneficial impact on water quality.

Cumulative Impacts. Boating activity on an average high-use day would be the same as described under the previous alternatives — a total of 280 motorboats in 2002 and 2012 (see Table 20). Cumula-

tive emissions in both areas 1 and 2 would be less than under alternative A or B because of the elimination of PWC use (see Table 25).

TABLE 25: THRESHOLD WATER VOLUMES NEEDED TO DILUTE MOTORIZED BOAT EMISSIONS, NO-ACTION ALTERNATIVE

	Lake Meredith minus No-Wake Zones — Area 1		No-Wake Zones — Area 2*	
	2002	2012	2002	2012
Lake Meredith waters open to motorboat use (ac-ft)	183,330		20,370	
Ecotoxicological Benchmarks**				
Benzo(a)pyrene (fuel and exhaust)	1,500	750	170	83
Naphthalene	590	300	66	33
1-methyl naphthalene	1,700	840	190	94
Benzene	1,400	710	160	78
Human Health Benchmarks***				
Benzo(a)pyrene (fuel and exhaust)	4,800	2,400	530	260
Benzene	150,000	77,000	17,000	8,500

* Area 2 would only apply to PWC use under alternative B. Under the no-action alternative this area is being kept so that the effects under the various alternatives can be easily compared.

** Threshold volumes (ac-ft) below which ecotoxicological effects might occur.

*** Threshold volumes (ac-ft) below which human health might be impacted.

Based on ecotoxicological benchmarks, threshold volumes for all pollutants in both areas in 2002 and 2012 would be lower than the water volumes available. In 2002 threshold volumes in area 1 would range from 590 to 1,700 acre-feet, and in area 2 from 66 to 190 acre-feet. These threshold volumes would decrease by half in 2012 because of improvements in motorboat engine technology. Emissions from motorboats would have negligible adverse impacts on water quality.

Based on human health benchmarks, threshold volumes for benzene would range from 17,000 to 150,000 acre-feet, resulting in minor impacts in areas 1 and 2 in 2002. By 2012 thresholds would decrease to 8,500 to 77,000 acre-feet, resulting in negligible impacts in the two areas.

Conclusion. Discontinuing PWC operations would have a beneficial impact on water quality relative to alternative A.

Overall, cumulative impacts for all organic compounds except benzene would be negligible in 2002 and 2012. For benzene, impacts based on human health benchmarks would be minor in 2002, decreasing to negligible by 2012.

This alternative would not result in an impairment of water resources.

AIR QUALITY

Personal watercraft emit various compounds that pollute the air. In the two-stroke engines commonly used in personal watercraft, the lubricating oil is used once and is expelled as part of the exhaust; and the combustion process results in emissions of air pollutants such as volatile organic compounds (VOC), nitrogen oxides (NO_x), particulate matter (PM), and carbon monoxide (CO). Personal watercraft also emit fuel components such as benzene that are known to cause adverse health effects. Even though PWC engine exhaust is usually routed below the waterline, a portion of the exhaust gases go into the air. These air pollutants may adversely impact park visitor and employee health, as well as sensitive park resources. For example, in the presence of sunlight VOC and NO_x emissions combine to

form ozone. Ozone causes respiratory problems in humans, including cough, airway irritation, and chest pain during inhalations (US EPA 1996c). Ozone is also toxic to sensitive species of vegetation. It causes visible foliar injury, decreases plant growth, and increases plant susceptibility to insects and disease (US EPA 1996c). Carbon monoxide can affect humans as well. It interferes with the oxygen carrying capacity of blood, resulting in lack of oxygen to tissues. NO_x and PM emissions associated with PWC use can also degrade visibility (CARB 1997; US EPA 2000). NO_x can also contribute to acid deposition effects on plants, water, and soil. However, because emission estimates show that NO_x from personal watercraft are minimal (less than 5 tons per year), acid deposition effects attributable to personal watercraft use are expected to be minimal.

GUIDING REGULATIONS AND POLICIES

Clean Air Act. The Clean Air Act establishes national ambient air quality standards (NAAQS) to protect the public health and welfare from air pollution. The act also establishes the prevention of significant deterioration (PSD) of air quality program to protect the air in relatively clean areas. One purpose of this program is to preserve, protect, and enhance air quality in areas of special national or regional natural, recreational, scenic, or historic value either regionally or nationally (42 USC 7401 et seq.). The program also includes a classification approach for controlling air pollution.

Lake Meredith National Recreation Area is designated a class II area, and the Clean Air Act allows only moderate air quality deterioration in these areas. In no case, however, may pollution concentrations violate any of the national ambient air quality standards. In contrast, in class I areas very little deterioration of air quality is allowed, and the unit manager has an affirmative responsibility to protect visibility and all other class I area air quality related values from the adverse effects of air pollution.

Conformity Requirements. National park system areas that do not meet the national ambient air quality standards or whose resources are already being adversely affected by current ambient levels require a greater degree of consideration and scrutiny by NPS managers. Areas that do not meet national air quality standards for any pollutant are designated as nonattainment areas. Section 176 of the Clean Air Act states:

> No department, agency, or instrumentality of the Federal Government shall engage in, support in any way or provide financial assistance for, license or permit, or approve, any activity which does not conform to an implementation plan [of the state]. . . . [T]he assurance of conformity to such a plan shall be an affirmative responsibility of the head of such department, agency or instrumentality.

Essentially, federal agencies must ensure that any action taken does not interfere with a state's plan to attain and maintain the national ambient air quality standards in designated nonattainment and maintenance areas.

Lake Meredith National Recreation Area is an attainment area for all pollutants, so the conformity requirements do not apply to this unit.

Applicable PWC Emission Standards. The Environmental Protection Agency issued the gasoline marine engine final rule in August 1996. The rule, which took effect in 1999, affects manufacturers of new outboard engines and the type of inboard engines used in personal watercraft. The agency adopted a phased approach to reduce emissions. The current emission standards were set at levels that are achievable by existing personal watercraft. By 2006 PWC manufacturers will be required to meet a corporate average emission standard that is equivalent to a 75% reduction in VOC emissions. (The corporate average standard allows manufacturers to build some engines to emission levels lower than

the standard and some engines to emission levels higher than the standard, and to employ a mix of technology types, as long as the overall corporate average is at or below the standard.) Because the actual reduction in emissions is dependent on the sale of lower-emitting personal watercraft, the Environmental Protection Agency estimates that a 52% emission reduction will be achieved by 2011 and a 75% emission reduction achieved by 2031 (US EPA 1996a, 1997).

In July 2002 the Environmental Protection Agency proposed new evaporative emissions standards for gasoline-fueled boats and personal watercraft. These proposed standards would require most new boats produced in 2008 or later to be equipped with low-emission fuel tanks or other evaporative emission controls.

NPS Organic Act and Management Policies. The NPS Organic Act of 1916 (16 USC 1 et seq.) and the NPS *Management Policies* guide the protection of park areas. The general mandates of the Organic Act state that the NPS will

> promote and regulate the use of . . . national parks . . . by such means and measures as conform to the fundamental purpose of the said parks, . . . which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations (16 USC 1).

Under its *Management Policies 2001* the NPS will

> seek to perpetuate the best possible air quality in parks to (1) preserve natural resources and systems; (2) preserve cultural resources; and (3) sustain visitor enjoyment, human health, and scenic vistas (sec. 4.7.1).

The *Management Policies* further state that the National Park Service will assume an aggressive role in promoting and pursuing measures to protect air quality related values from the adverse impacts of air pollution. In cases of doubt as to the impacts of existing or potential air pollution on park resources, the National Park Service "will err on the side of protecting air quality and related values for future generations."

The Organic Act and the *Management Policies* apply equally to all areas of the national park system, regardless of Clean Air Act designations. Therefore, the National Park Service will protect resources at both class I and class II designated units. Furthermore, the NPS Organic Act and *Management Policies* provide additional protection beyond that afforded by the Clean Air Act's national ambient air quality standards alone because the National Park Service has documented that specific park air quality related values can be adversely affected at levels below the national standards or by pollutants for which no standard exists.

METHODOLOGY AND ASSUMPTIONS

In order to assess the level of PWC air quality impacts resulting from a given management alternative, the following methods and assumptions were used:

1. The national ambient air quality standards and state/local air quality standards (if applicable) were examined for each pollutant (the standards are included on page 44).
2. Air quality designations for the surrounding area were determined. Lake Meredith National Recreation Area is in an attainment area for each criteria pollutant.

3. The nearest monitoring location to Lake Meredith National Recreation Area is in downtown Amarillo, approximately 45 miles away. Based on data from this site and communication with the Texas Commission on Environmental Quality, all first highest maximum concentrations for each pollutant monitored are below the national ambient air quality standards and air quality is good (TCEQ 2002b). (National ambient air quality standards are shown on page 44.)
4. Typical use patterns of motorized watercraft use were identified (see the "PWC Use Trends" section).
5. The rated horsepower, average engine load, deterioration factors, and other relevant parameters for each watercraft type were taken from default assumptions in the EPA Nonroad model. (This model is used to calculate emissions of criteria pollutants from the operation of nonroad spark-ignition type engines, including personal watercraft. The model allows assumptions to be made regarding the mix of engine types that will be phased in as new engine standards come into effect, and increasing numbers of personal watercraft will be the cleaner-burning four-stroke type. Total hydrocarbon emissions comprise approximately 100% of the VOC for two-stroke engines and 93% of the VOC for four-stroke engines [US EPA 1997; US EPA 2000b].)
6. Any reductions in emissions resulting from implementing control strategies were taken into account, as were changes in emissions resulting from increased or decreased usage.
7. Studies regarding ozone injury on sensitive plants found in the recreation area were requested, but none were available for Lake Meredith.
8. A calculation referred to as SUM06 (ppm-hours) was used for assessing regional ozone exposure levels. These data are collected from rural and urban monitoring sites. The highest three-month, five-year average commonly used for the area was determined by reviewing ambient air quality data (available from the NPS Air Resources Division).
9. Visibility impairment was determined from local monitoring data, or from qualitative evidence such as personal observations and photographs.
10. The air quality impacts of the various alternatives were assessed by considering the existing air quality levels and the air quality related values present, and by using the estimated emissions and any applicable, EPA-approved air quality models. Estimated reductions in hydrocarbon emissions from PWC are assumed to be 50% of 1998 levels, which is consistent with other assumptions.
11. For cumulative impacts, the assessment was completed quantitatively with respect to anticipated use of the recreation area by other recreational watercraft based on emission factors and assumption in EPA's Nonroad model. Types of craft assessed for quantitative cumulative impacts include outboard spark-ignition type engines and personal watercraft. Although outboard engine manufacturers are subject to the same phased-in emission reductions as personal watercraft, the analysis assumes the same engine type mix (and therefore emissions) for outboard boats in 2002 as 2012 (US EPA 1997). Due to this approach, the cumulative impacts analyses are conservative and allow for the possibility that other watercraft such as inboards and diesel engines may be used. Other sources of air pollutants in the area were also considered in the cumulative analysis through a review of the state implementation plan, county records, and the use of best professional judgment.

PWC impact thresholds for air quality are dependent on the type of pollutants produced, the background air quality, and the pollution-sensitive resources (air quality related values) present. Impact thresholds may be <u>qualitative</u> (e.g., photos of degraded visibility) or <u>quantitative</u> (e.g., based on

impacts to air quality related values or federal air quality standards, or emissions based), depending on what type of information is appropriate or available.

PWC impact thresholds for air quality depend on the type of pollutants produced, the background air quality, and the resources in the environmental that may be affected by airborne pollutants (air quality related values). Air quality related values include "visibility and those scenic, cultural, biological, and recreation resources of an area that are affected by air quality" (43 FR 15016).

Impact thresholds may be qualitative, such as photos of degraded visibility, or quantitative, based on impacts on air quality related values or federal air quality standards, or emissions based on emission factor models. The type of thresholds used in an analysis depends on what type of information is appropriate or available. Because the U.S. Environmental Protection Agency has established standards that are regulated by states to protect human health and the environment, two categories of potential airborne pollution impacts from personal watercraft are analyzed: impacts on human health resources, and impacts on air quality related values in the study area. Thresholds for each impact category are discussed separately.

IMPACT ANALYSIS AREA

The impact analysis area includes the immediate location of PWC use and the surrounding recreational area where air pollutants may accumulate. For purposes of this review, the impact analysis area is the Lake Meredith National Recreation Area boundary. It is assumed that air pollutants would dissipate beyond 100 feet from the shore due to air currents.

IMPACT TO HUMAN HEALTH FROM AIRBORNE POLLUTANTS RELATED TO PWC USE

The following impact thresholds for an attainment area have been defined for analyzing impacts to human health from airborne pollutants — CO, PM_{10}, total hydrocarbons (HC), and ozone (O_3). Sulfur oxides (SO_x) are not included because they are emitted by personal watercraft in very small quantities.

	Activity Analyzed		Current Air Quality
Negligible:	Emissions would be less than 50 tons/year for each pollutant.	**and**	The first highest three-year maximum for each pollutant is less than NAAQS.
Minor:	Emissions would be less than 100 tons/year for each pollutant.	**and**	The first highest three-year maximum for each pollutant is less than NAAQS.
Moderate:	Emissions would be greater than or equal to 100 tons/year for any pollutant.	**or**	The first highest three-year maximum for each pollutant is greater than NAAQS.
Major:	Emissions levels would be greater than or equal to 250 tons/year for any pollutant.	**and**	The first highest three-year maximum for each pollutant is greater than NAAQS.

Impairment: Impacts would

have a major adverse effect on park resources and values; and

contribute to deterioration of the park's air quality to the extent the park's purpose could not be fulfilled as established in its enabling legislation; or

affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Both VOC and NO_x are ozone precursors in the presence of sunlight and are evaluated separately in lieu of ozone, which is formed as a secondary pollutant. (Note that in attainment areas the Clean Air Act does not require that NO_x be counted as an ozone precursor). Total HC is not a criteria pollutant, so no impact threshold is assigned; total HC emissions are included for information because they are the target pollutant of the EPA regulations.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. Under this alternative PWC use would continue, with no locational restrictions or changes in speed limits. Based on data collected by NPS staff, PWC annual use in 2002 was estimated to be 4,075 personal watercraft. PWC annual usage rates are expected to remain unchanged through 2012. The impacts of continued PWC use within the recreation area are presented in Table 26.

TABLE 26: PWC EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, ALTERNATIVE A

	CO		PM_{10}		HC		VOC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	92.5	76.9	2.1	1.6	42.8	23.9	44.2	24.6	0.3	0.8
Impact Level	Minor	Minor	Negligible	Negligible	Informa-tion only	Informa-tion only	Negligible	Negligible	Negligible	Negligible

Adverse impact levels in 2002 would be minor for CO as emissions would exceed 50 tons/year, and negligible for VOC, PM_{10}, and NO_x. For 2012, the assessment takes into account the improvement in engine emission rates due to use of cleaner burning, primarily four-stroke PWC engines required by the U.S. Environmental Protection Agency, with an anticipated 50% reduction in HC emissions relative to the 1998 base year. Future impact levels for 2012 would be in the same categories as for 2002. NO_x would increase slightly.

Cumulative Impacts. Other motorized watercraft emissions were assessed quantitatively in combination with PWC emissions, taking into consideration regional and local air pollution sources. Other watercraft at Lake Meredith are assumed to be primarily outboards, 5% of which would be 30 hp or less. During 2002, NPS data indicate use numbers at 16,300 per year, with no projected increase through 2012. The combined emissions from personal watercraft and other motorboats are provided in Table 27.

TABLE 27: PWC AND MOTORIZED BOAT EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, ALTERNATIVE A

	CO		PM_{10}		HC		VOC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	338.0	276.6	7.2	5.4	101.0	50.7	104.1	52.0	4.1	4.7
Impact Level	Moderate	Moderate	Negligible	Negligible	Informa-tion only	Informa-tion only	Moderate	Minor	Negligible	Negligible

Overall, cumulative impact levels for PM_{10}, HC, and NO_x would be negligible, while levels for VOC and CO would be moderate. Combined emissions of CO would be moderate for both 2002 and 2012. Ambient CO levels are assumed to be below national ambient air quality standards within this area. Emission rates of PM_{10} and VOC would be reduced between 2002 and 2012; VOC emissions would result in moderate impacts in 2002 and minor impacts by 2012 as a result of technological improvements. PM_{10} emissions would be negligible throughout the assessment period and would show a reduction by 2012. Additional cumulative emissions reductions are likely as the U.S. EPA implements regulations targeted at improving motorized watercraft engine performance. Due to the relative remoteness of the location from major industrial and commercial development, other sources of air pollution would contribute very little to cumulative air pollution impacts.

Conclusion. Continuing PWC use at Lake Meredith would result in minor adverse impacts from CO and negligible impacts from VOC, PM_{10}, and NO_x in 2002 and 2012.

In 2002 cumulative emission levels would result in moderate impacts for CO and VOC, and negligible impacts for PM_{10} and NO_x. In 2012 cumulative CO emissions would be reduced slightly, but impact levels would still be moderate; the VOC impact level would be reduced to minor; and the PM_{10} and NO_x impact levels would remain negligible. Continued reductions in PM_{10}, HC, and VOC emissions would occur over time due to improved emission controls.

This alternative would not result in an impairment of air quality.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. Under this alternative impacts of PWC emissions would be the same as alternative A, with a total of 4,075 personal watercraft in 2002 and no projected increase through 2012. However, under alternative B no-wake zones would be enforced, leading to slight reductions in projected emissions from personal watercraft. The impacts of continued PWC use within the recreation area are presented in Table 28.

TABLE 28: PWC EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, ALTERNATIVE B

	CO		PM_{10}		HC		VOC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	82.6	68.7	1.9	1.4	38.2	21.3	39.5	21.9	0.3	0.7
Impact Level	Minor	Minor	Negligible	Negligible	Information only	Information only	Negligible	Negligible	Negligible	Negligible

Adverse impact levels in 2002 would be minor for CO as emissions would not exceed 100 tons/year, and negligible for VOC, PM_{10}, and NO_x.

Cumulative Impacts. As described for alternative A, other motorized watercraft emissions were assessed quantitatively in combination with PWC emissions, taking into consideration regional and local air pollution sources (see Table 29).

TABLE 29: PWC AND MOTORIZED BOAT EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, ALTERNATIVE B

	CO		PM_{10}		HC		VOC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	313.7	256.7	6.7	5.0	92.9	46.5	95.8	47.7	3.8	4.3
Impact Level	Moderate	Moderate	Negligible	Negligible	Informa-tion only	Informa-tion only	Minor	Negligible	Negligible	Negligible

Cumulative CO impact levels are assumed to be moderate (greater than 100 tons/year but not exceeding the third highest national ambient air quality standard) for both 2002 and 2012. Emission rates of PM_{10} would result in negligible impacts in 2002 and 2012, and VOC emissions would result in minor impacts in 2002 and negligible impacts in 2012. Emission rates of PM_{10} and VOC would be reduced between 2002 and 2012 as a result of improved engine technology. NO_x emissions would increase slightly but would remain negligible in both years. This alternative would maintain existing air quality conditions. Additional reductions are anticipated following the anticipated implementation of EPA standards covering a wider range of watercraft engine types. The relative remoteness of this location means that there would be little contribution from other industrial or commercial sources of pollutants.

Conclusion. Continuing PWC use would result in minor adverse impacts from CO and negligible impacts from VOC, PM_{10}, and $NO_{x,}$ in 2002 and 2012, although emissions would be reduced slightly compared to alternative A.

Cumulative emission levels in 2002 and 2012 would be moderate for CO and negligible for PM_{10} and NO_x. Emission levels for VOC would be minor in 2002, decreasing to negligible in 2012 as a result of improved engine technology. Overall, PWC emissions of HC and VOC are estimated to be 25% to 38% of the cumulative boating emissions in 2002 and would be reduced to below 20% by 2012 with technology improvements.

This alternative would not result in an impairment of air quality.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Under the no-action alternative PWC use would be banned at Lake Meredith, so there would be no further PWC emissions of CO, PM_{10}, HC, VOC, and NO_x within the study area, resulting in long-term beneficial impacts.

Cumulative Impacts. As described for alternative A, motorized boats are a primary source of air pollutants within Lake Meredith and would continue to emit pollutants. Emission reductions are anticipated as manufacturers meet anticipated standards for a wider range of motorized watercraft than are currently regulated. Cumulative emissions would result in moderate adverse impacts from CO and negligible impacts from PM_{10} and NO_x in 2002 and 2012. Emissions for VOC would result in minor adverse impacts in 2002, decreasing to negligible by 2012 (see Table 30). Emissions would be lower than under alternative A due to the elimination of PWC use.

TABLE 30: MOTORIZED BOAT EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, NO-ACTION ALTERNATIVE

	CO		PM_{10}		HC		VOC		NO_x	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	245.6	199.6	5.1	3.9	58.2	26.8	59.9	27.5	3.7	3.8
Impact Level	Moderate	Moderate	Negligible	Negligible	Informa-tion only	Informa-tion only	Minor	Negligible	Negligible	Negligible

Conclusion. The no-action alternative would have beneficial impacts on air quality because PWC use would be banned within the recreation area, resulting in decreased emissions.

Cumulative impacts would be reduced as compared to alternative A but would still be negligible for PM_{10} and NO_x and moderate for CO in 2002 and 2012, even though future emissions of most pollutants would gradually decline as a result of improved engine technology. Impacts from VOC emissions would decrease from minor in 2002 to negligible in 2012.

The no-action alternative would not impair air quality.

IMPACT TO AIR QUALITY RELATED VALUES FROM PWC POLLUTANTS

Impacts on environmental resources and values include visibility and biological resources (specifically, ozone effects on plants) that may be affected by airborne pollutants emitted from personal watercraft and other sources. These pollutants include ozone, nitrogen oxides, and particulate matter.

$PM_{2.5}$ as a fraction of particulate matter is evaluated for visibility impairment. To assess the impact of ozone on plants, the five-year ozone index value is used. This value is represented as SUM06 ozone measured in ppm-hours. The SUM06 values are interpreted and mapped by the NPS Air Resources Division based on data from rural and urban monitoring sites; they represent the overall condition of the area due to regional emissions of ozone precursor chemicals, and consequent formation of ozone. Local park-specific data were used to assess area specific ozone effects, when available.

	Activity Analyzed		Current Air Quality
Negligible:	Emissions would be less than 50 tons/year for each pollutant.	**and**	There are no perceptible visibility impacts (photos or anecdotal evidence). **and** There is no observed ozone injury on plants. **and** SUM06 ozone is less than 12 ppm-hours.
Minor:	Emissions would be less than 100 tons/year for each pollutant.	**and**	SUM06 ozone is less than 15 ppm-hour.
Moderate:	Emissions would be greater than 100 tons/year for any pollutant. **or** Visibility impacts from cumulative PWC emissions would be likely (based on past visual observations).	**or**	Ozone injury symptoms are identifiable on plants. **and** SUM06 ozone is less than 25 ppm-hours.

Major: Emissions would be equal to or greater than 250 tons/year for any pollutant.

or

Visibility impacts from cumulative PWC emissions would be likely (based on modeling or monitoring).

and Ozone injury symptoms are identifiable on plants.

or

SUM06 ozone is greater than 25 ppm-hours.

Impairment: Air quality related values in the park would be adversely affected. In addition, impacts would

have a major adverse effect on park resources and values;

contribute to deterioration of the park's air quality to the extent the park's purpose could not be fulfilled as established in its enabling legislation; or

affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

According to the National Park Service's SUM06 ozone index maps for year 2000, the ozone level for the recreation area is in the range of 19–25 ppm/hr based on rural monitoring sites.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. Under this alternative PWC use would continue, with no locational restrictions or changes in speed limits. Based on data collected by NPS staff, annual use in 2002 was estimated to total 4,075 personal watercraft, with no projected use increase through 2012.

Table 31 presents the annual PWC emission loads and their impact levels for 2002 and 2012 under this alternative. Impact levels for visibility in both 2002 and 2012 are predicted to be negligible, as emissions would be less than 50 tons/year. The air quality impact level for ozone exposure would be minor adverse in 2002 and 2012. The SUM06 ozone data show ozone to be in the range of 19 to 25 ppm-hours, which indicates a moderate regional impact level; however, this value reflects emissions from all local and regional sources, of which PWC emissions are a very small component. Local park conditions are therefore weighted more heavily in the analysis of PWC use alone.

TABLE 31: AIR QUALITY RELATED IMPACTS FROM PWC EMISSIONS, ALTERNATIVE A

Air Quality Related Value (indicator)	Emission Level (tons/year)/ Local Ozone Data		Visibility Threshold / SUM06 Index Value*		Impact Level	
	2002	2012	2002	2012	2002	2012
Visibility ($PM_{2.5}$)	1.9	1.5	No perceptible visibility impacts	No perceptible visibility impacts	Negligible	Negligible
Ozone injury to plants (injury symptoms and ozone monitoring data)	No park specific effects documented	No park specific effects anticipated	SUM06 index value: 19–25 ppm-hrs (rural monitoring sites)	SUM06 index value: less than or equal to 19–25 ppm-hrs (assumed to be no greater than 2002)	Minor (see analysis)	Minor (see analysis)

* NPS Air Resources Division.

TABLE 32: AIR QUALITY RELATED IMPACTS FROM PWC EMISSIONS AND MOTORIZED BOATS, ALTERNATIVE A

	Emission Level (tons/year)/ Local Ozone Data		Visibility Threshold / SUM06 Index Value*		Impact Level	
Value (indicator)	2002	2012	2002	2012	2002	2012
Visibility ($PM_{2.5}$)	6.6	5.0	No perceptible visibility impacts	No perceptible visibility impacts	Negligible	Negligible
Ozone injury to plants (injury symptoms and ozone monitoring data)	No park specific effects documented	Unknown	SUM06 index value: 19–25 ppm-hrs (rural monitoring sites for year 2000)	SUM06 index value: less than or equal to 19–25 ppm-hrs (assumed to be no greater than year 2002)	Moderate	Moderate

* NPS Air Resources Division.

Cumulative Impacts. The cumulative impact analysis includes other motorized watercraft use, taking into consideration national use trends, as well as current and future emission levels. Cumulative emissions and impacts of all PWC watercraft and other boating activities under alternative A are shown in Table 32.

There would be negligible impact levels to visibility from personal watercraft and from all motorized boats, as $PM_{2.5}$ emissions would be below 50 tons/year for 2002 and 2012. There would likely be moderate cumulative adverse impact levels for ozone exposure for 2002 based on SUM06 ozone values in the range of 19–25 ppm-hours. Predicted 2012 regional SUM06 ozone levels are assumed to be in the same range as year 2002. The SUM06 ozone maps show that ozone levels are concentrated in the industrialized areas of south and east Texas and that ozone and its precursor chemicals are transported northwest into the Texas Panhandle.

Conclusion. Under alternative A there would be negligible impact levels to visibility from PWC in both 2002 and 2012. There would be a minor adverse impact level for ozone exposure in 2002 and 2012 from PWC use.

On a cumulative basis there would be negligible impact levels to visibility from all motorized watercraft emissions in both 2002 and 2012. The impact level for ozone exposure in 2002 and 2012 is expected to remain moderate. Ambient elevated ozone levels in the area of Lake Meredith appear to be primarily a result of ozone formation in south and east Texas, and subsequent transport into the Texas Panhandle.

This alternative would not impair air quality related values.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. Under this alternative the annual number of personal watercraft using Lake Meredith would follow the same trends as alternative A, which assumes a total of 4,075 personal watercraft in 2002, and no projected increase through 2012. Under this alternative no-wake zones would be enforced, slightly reducing projected emissions compared to alternative A (see Table 33). Visibility impact levels would be negligible in 2002 and 2012; ozone injury impact levels would be minor in 2002 and 2012 because no ozone injury on plants within the national recreation area has been observed.

TABLE 33: AIR QUALITY RELATED IMPACTS FROM PWC EMISSIONS, ALTERNATIVE B

Air Quality Related Value (indicator)	Emission Level (tons/year)/ Local Ozone Data		Visibility Threshold / SUM06 Index Value*		Impact Level	
	2002	2012	2002	2012	2002	2012
Visibility ($PM_{2.5}$)	1.7	1.3	No perceptible visibility impacts	No perceptible visibility impacts	Negligible	Negligible
Ozone injury to plants (injury symptoms and ozone monitoring data)	No park specific effects documented	No park specific effects anticipated	SUM06 index value: 19–25 ppm-hrs (rural monitoring sites)	SUM06 index value: less than or equal to 19–25 ppm-hrs (assumed to be no greater than 2002)	Minor (see analysis)	Minor (see analysis)

* NPS Air Resources Division.

Cumulative Impacts. Cumulative emissions and impact levels to air quality related values from all motorized watercraft under alternative B are shown in Table 34.

TABLE 34: AIR QUALITY RELATED IMPACTS FROM PWC EMISSIONS AND MOTORIZED BOATS, ALTERNATIVE B

Air Quality Related Value (indicator)	Emission Level (tons/year)/ Local Ozone Data		Visibility Threshold / SUM06 Index Value*		Impact Level	
	2002	2012	2002	2012	2002	2012
Visibility ($PM_{2.5}$)	6.1	4.6	No perceptible visibility impacts	No perceptible visibility impacts	Negligible	Negligible
Ozone injury to plants (injury symptoms and ozone monitoring data)	No park-specific effects documented	Unknown	SUM06 index value: 19–25 ppm-hrs (rural monitoring sites for year 2000)	SUM06 index value: less than or equal to 19–25 ppm-hrs (assumed to be no greater than year 2002)	Moderate	Moderate

* NPS Air Resources Division.

Visibility impact levels would be negligible for years 2002 and 2012, as $PM_{2.5}$ emissions would be below 50 tons/year, with a slight reduction by 2012. The impact levels to plants from ozone exposure would be moderate in years 2002 and 2012. The SUM06 ozone values of 19–25 ppm-hours for the Texas Panhandle area indicate that sources outside of the unit are elevating ambient ozone levels in the area of Lake Meredith.

Conclusion. Under alternative B there would be a negligible impact to visibility from personal watercraft in both 2002 and 2012 and a minor adverse impact from ozone exposure in 2002 and 2012.

On a cumulative basis there would be negligible impact levels to visibility from all motorized watercraft in both 2002 and 2012, although $PM_{2.5}$ emissions would be reduced slightly. The impact level for ozone exposure in 2002 and 2012 is expected to remain moderate. As described for the no-action alternative, SUM06 ozone monitoring data indicate that Lake Meredith is influenced by the transport of ozone and its precursor pollutants from south and east Texas.

This alternative would not impair air quality related values.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Banning PWC use would result in a long-term beneficial impact on air-quality related values. Currently, there are no perceptible qualitative visibility impacts or observed ozone-related injury on plants at Lake Meredith.

Cumulative Impacts. While PWC use would no longer be allowed within the unit, other motorized watercraft would operate at the use levels assumed for alternatives A and B, and the area would continue to be influenced by other sources of $PM_{2.5}$ and ozone (see Table 35).

TABLE 35: AIR QUALITY RELATED IMPACTS FROM MOTORIZED BOATS, NO-ACTION ALTERNATIVE

Air Quality Related Value (indicator)	Emission Level (tons/year)/ Local Ozone Data		Visibility Threshold / SUM06 Index Value		Impact Level	
	2002	2012	2002	2012	2002	2012
Visibility ($PM_{2.5}$)	6.6	3.6	No perceptible visibility impacts	No perceptible visibility impacts	Negligible	Negligible
Ozone injury to plants (injury symptoms and ozone monitoring data)	No park specific effects documented	Unknown	SUM06 index value: 19–25 ppm-hrs (rural monitoring sites for year 2000)	SUM06 index value: less than or equal to 19–25 ppm-hrs (assumed to be no greater than year 2002)	Moderate	Moderate

SOURCE: NPS Air Resources Division.

$PM_{2.5}$ emissions would be reduced slightly, but visibility impact levels would be negligible in both 2002 and 2012. The ozone impact levels from air emissions of all activities under the no-action alternative for both 2002 and 2012 would be moderate, with continued transportation of pollutants from south and east Texas.

Conclusion. Under the no-action alternative there would be a small beneficial impact for visibility and ozone exposure, as there would be no emissions from personal watercraft.

For cumulative impacts, there would be a negligible impact to visibility in 2002 and 2012 from all motorized watercraft use, although $PM_{2.5}$ emissions would be reduced slightly. A moderate impact from ozone is expected to continue. As described for the no-action alternative, SUM06 ozone monitoring data indicate that Lake Meredith is influenced by the transport of ozone and its precursor pollutants primarily from south and east Texas.

This alternative would not impair air quality related values.

SOUNDSCAPES

The primary soundscape issue relative to PWC use is that other visitors may perceive the sound as an intrusion or nuisance, thereby disrupting their experiences. This disruption is generally short term because PWC users travel along the shore to outlying areas. However, as PWC use increases and concentrates at beach areas, related noise becomes more of an issue, particularly during certain times of the day. Additionally, visitor sensitivity to PWC noise varies from backcountry users (more sensitive) to boaters in popular areas of the lake (less sensitive).

GUIDING REGULATIONS AND POLICIES

The national park system includes some of the quietest places on earth, as well as a rich variety of sounds intrinsic to park environments. These intrinsic sounds are recognized and valued as a park resource in keeping with the NPS mission (*Management Policies 2001,* sec. 1.4.6), and are referred to as the park's natural soundscape. The natural soundscape, sometimes called natural quiet, is the aggregate of all the natural sounds that occur in parks, absent human-caused sound, together with the physical capacity for transmitting natural sounds (*Management Policies 2001,* sec. 4.9). It includes all

of the sounds of nature, including such "non-quiet" sounds as birds calling, waterfalls, thunder, and waves breaking against the shore. Some natural sounds are also part of the biological or other physical resource components of parks (e.g., animal communication, sounds produced by wind in trees, thunder and running water).

NPS policy requires the restoration of degraded soundscapes to the natural condition whenever possible, and the protection of natural soundscapes from degradation due to noise (undesirable human-caused sound) (*Management Policies 2001,* sec. 4.9). The National Park Service is specifically directed to "take action to prevent or minimize all noise that, through frequency, magnitude, or duration, adversely affects the natural soundscape or other park resources or values, or that exceeds levels that have been identified as being acceptable to, or appropriate for, visitor uses at the sites being monitored" (*Management Policies 2001,* sec. 4.9). Overriding all of this is the fundamental purpose of the national park system, established in law (e.g., 16 USC 1 et seq.), which is to conserve park resources and values (*Management Policies 2001*, sec. 1.4.3). NPS managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values (*Management Policies 2001,* sec 1.4.3).

Noise can adversely affect park resources, including but not limited to natural soundscapes. It can directly impact them, for example by modifying or intruding upon the natural soundscape. It can also indirectly impact resources, for example by interfering with sounds important for animal communication, navigation, mating, nurturing, predation, and foraging functions.

Noise can also adversely impact park visitor experiences. The term "visitor experience" can be defined as the opportunity for visitors to experience a park's resources and values in a manner appropriate to the park's purpose and significance, and appropriate to the resource protection goals for a specific area or management zone within that park. In other words, visitor experience is primarily a resource-based opportunity appropriate to a given park or area within a park, rather than a visitor-based desire. Noise impacts to visitor experience can be especially adverse when management objectives for visitor experience include solitude, serenity, tranquility, contemplation, or a completely natural or historical environment. Management objectives (also called desired conditions) for resource protection and visitor experience are derived through well-established public planning processes from law, policy, regulations, and management direction applicable to the entire national park system and to each specific park unit.

Visitor uses of parks will only be allowed if they are appropriate to the purpose for which a park was established, and if they can be sustained without causing unacceptable impacts to park resources or values (*Management Policies 2001,* sec. 8.1 and 8.2). While the fundamental purpose of all parks also includes providing for the "enjoyment" of park resources and values by the people of the United States, enjoyment can only be provided in ways that leave the resources and values unimpaired for the enjoyment of future generations (*Management Policies 2001,* sec. 1.4.3). Unless mandated by statute, the National Park Service will not allow visitors to conduct activities that, among other things, unreasonably interfere with "the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park" (*Management Policies 2001,* sec. 8.2). While many visitor activities are allowed or even encouraged in parks consistent with the above policies, virtually <u>all</u> visitor activities are limited or restricted in some way (e.g., through carrying capacity determinations, implementation plans, or visitor use management plans), and on a park- or area-specific basis, some visitor activities are not allowed at all.

The degree to which a given activity (e.g., PWC use) is consistent with, or moves the condition of a resource or a visitor experience toward or away from a desired condition, is one measure of the impact of the activity.

The federal regulation pertaining to noise abatement for boating and water use activities (36 CFR 3.7) prohibits operating a vessel on inland waters "so as to exceed a noise level of 82 decibels measured at a distance of 82 feet (25 meters) from the vessel" and specifies that testing procedures to determine such noise levels should be in accordance with or exceed those established by the Society of Automotive Engineers (SAE) in "Exterior Sound Level Measurement Procedure for Pleasure Motorboats" (J34). This SAE procedure specifies that sound level measurements be taken 25 meters perpendicular to the line of travel of the vessel at full throttle (SAE 2001). It is important to note that this NPS regulation and the SAE procedure were developed for enforcement purposes, not impact assessment purposes. The level in the regulation does not imply that there are no impacts to park resources or visitor experiences at levels below 82 dB; it just indicates that noise levels from vessels legally operating on NPS waters will be no "louder" than 82 dB. As explained elsewhere in this document, a single decibel value does not provide much information for impact assessment purposes.

In addition to NPS policies, Texas has adopted legislation that regulates PWC operation. The following elements of Texas PWC regulations have impacts on soundscapes in the national recreation area:

- Timing restrictions — Personal watercraft cannot be used between sunset and sunrise.
- Location restrictions — Personal watercraft in Texas cannot operate within 50 feet of another vessel, platform, person, object, or shore except at headway speed without creating a swell or wake.

Natural noise sources at Lake Meredith National Recreation Area include wind, waves, recreational activities, road traffic, oil and gas production, and compressors associated with natural gas production and transport.

METHODOLOGY AND ASSUMPTIONS

The methodology used to assess PWC-related noise impacts in this document is consistent with NPS *Management Policies 2001, Director's Order #47: Soundscape Preservation and Noise Management,* and the methodology being developed for the reference manual for DO #47. Specific factors at Lake Meredith related to context, time, and intensity are discussed below and are then integrated into a discussion of the impact thresholds used in this analysis.

Context: Existing background noise levels at Lake Meredith National Recreation Area are influenced by wave action, wind, oil and gas production, visitor activities, other boats, and automobile traffic. Lake Meredith is not known for its natural quiet, although numerous natural quiet areas exist within the recreation area. Measured sound levels range from 34 dBA to 50 dBA (see the "Affected Environment" chapter). These levels are considered quiet.

Soundscape disturbances in Lake Meredith National Recreation Area are located closest to the lake in areas near swimmers, boats, personal watercraft, and in some locations vehicles. Texas regulations mandate that PWC users must operate at such speed as to not cause a swell or wake when 50 feet from the shoreline. Disturbances are most likely to occur when PWC users do not follow state regulations.

Time Factors: *Time Periods of Interest* — PWC use occurs primarily during midday during the summer months on weekends, and in evenings after work on weeknights. Use is high in

spring and fall, but decreases to almost zero in winter months. State law restricts use to the hours between sunrise and sunset. Use generally stops during periods of inclement weather (e.g., cold and thunderstorms).

Time periods of greater sensitivity to noise impacts include sunset, sunrise, and night time when boaters are in camp, and when wildlife may be more active, such as coming to the lake for water.

Duration and Frequency of Occurrence of Noise Impacts — In areas of concentrated PWC use, noise from personal watercraft (and other motorized craft) can be present intermittently from early morning to near sunset. In areas of low use, such noise can be occasional, usually lasting a few minutes. On average days, 14 personal watercraft are used for four hours each, and on peak days, a maximum of 70 personal watercraft are used for four hours each within the reservoir.

Intensity: Some literature states that all recently manufactured watercraft emit fewer than 80 dB at 50 feet from the vessel, while other sources attribute levels as high as 102 dB without specifying distance.

Noise limits established by the National Park Service are 82 dB at 82 feet. PWC noise travels in relationship to the speed of the craft, the distance from shoreline, and other influences. Outdoor noise levels usually decrease with increasing distance from the source because of geometrical spreading of the noise over a bigger surface and absorption of the noise by the atmosphere and the ground (Bruer and Kjaer 2002). According to Komanoff and Shaw (2000), PWC noise dissipates by 5 dBA across water for each doubling of distance from a 20-foot circle around the source and by 6 dBA across land. A PWC engine in the water produces 80 dB of sound within a 20-foot radius, and 73 dB within a 50-foot radius (Komanoff and Shaw 2000). This is close to estimates provided by the Personal Watercraft Industry Association (PWIA 2002), which state that one PWC operating 50 feet from an on-shore observer is heard at 71 dBA, and two would be heard at 74 dBA.

The National Park Service contracted for noise measurements of personal watercraft and other motorized vessels in 2001 at Glen Canyon National Recreation Area (Harris Miller Miller & Hanson, Inc. 2002). The results show that maximum PWC noise levels at 50 feet ranged from 68 to 76 dBA. Noise levels for other motorboat types measured during that study ranged from 65 to 86 dBA at 50 feet. However, PWC-generated noise may be more disturbing due to rapid changes in acceleration and direction of noise than noise from a constant source at 90 dB (US EPA 1974, cited in Izaak Walton League 1999).

Vegetation can also decrease noise. According to the U.S. Department of Transportation (2000), vegetation must be so high, wide, and dense that it cannot be seen through, and must be at least 61 meters (186 feet) wide to reduce noise by 10 dB. Lake Meredith has very little shoreline vegetation due to fluctuating lake levels, so vegetation is not an attenuating factor. Based on Komanoff and Shaw's more conservative projections, PWC noise levels at Lake Meredith would reach approximately 39 dBA (which is quieter than the sound of bird calls) at 3,200 feet (slightly less than 0.75 mile) from the source of the sound.

In response to public complaints, the PWC industry has employed new technologies to reduce sound by about 50% to 70% on 1999 and newer models (Sea-Doo 2000; Hayes 2002). Additionally, by 2006 the EPA emission standards will reduce PWC noise, in association with improvements to engine technology (US EPA 1996b).

Context, time, and intensity together determine the level of impact for an activity. For example, noise for a certain period and intensity would be a greater impact in a highly sensitive context, and a given intensity would result in a greater impact if it occurred more often, or for longer duration. It is usually necessary to evaluate all three factors together to determine the level of noise impact. In some cases an analysis of one or more factors may indicate one impact level, while an analysis of another factor may indicate a different impact level, according to the criteria below. In such cases, best professional judgment based on a documented rationale must be used to determine which impact level best applies to the situation being evaluated.

PWC noise travels in relationship to the speed of the craft, the distance from shore, and other influences. To estimate the relative impacts of PWC use at Lake Meredith, the following methodology was applied:

1. National literature was used to estimate the average decibel levels of personal watercraft.
2. Areas of shoreline use by other visitors were identified in relation to where PWC users launch and operate offshore. Personal observation from park staff and monthly use reports were used to identify these areas, as well as determine the number of personal watercraft and the time of use.
3. Other considerations, such as topography and prevailing winds, were then used to identify areas where PWC noise levels could be exacerbated or minimized.

Sound levels generated by motorized craft using the recreation area are expected to affect recreational users differently. For example, visitors participating in less sound-intrusive activities, such as back-country camping, would likely be more adversely affected by PWC noise than another PWC or motorboat user. Therefore, impacts to soundscape must take into account the effect of noise levels on different types of recreational users within the impact analysis area. The following is a list of other considerations for evaluating sound impacts:

- The average number of personal watercraft now operating is 14 per day, and the maximum number on a peak weekend day is 70 per day, which is expected to remain constant through 2012. These watercraft are dispersed over a 15–20 mile shoreline (depending on water levels) and would be in operation for only a portion of each day (approximately four hours average).
- Operators within 50 feet of shore are required to travel at no-wake speed; noise levels from this activity are low and for short duration.
- Ambient noise levels at most locations include wind, waves, other visitors, and other motorboats. Other motorboats outnumber personal watercraft 5 to 1.

All of these factors combine to lessen the overall impact of noise from PWC use.

IMPACT ANALYSIS AREA

The impact analysis area for soundscapes is the 0.75-mile inland shore area. This is based on a determination that a visitor would have to be approximately 0.75 mile from the shore to experience natural quiet when a PWC user was passing at full throttle outside of the 50-foot no-wake zone.

IMPACT TO VISITORS FROM NOISE GENERATED BY PERSONAL WATERCRAFT

After estimating the number of personal watercraft, the range of relative noise generated by them, and the potential areas where noise concentrations and effects on other visitors may be of concern, the following thresholds were used as indicators of the magnitude of impact for each of the PWC management alternatives:

> *Negligible:* Natural sounds would prevail; motorized noise would be very infrequent or absent, mostly unmeasurable.
>
> *Minor:* Natural sounds would predominate in areas where management objectives call for natural processes to predominate, with motorized noise infrequent at low levels. In areas where motorized noise is consistent with park purpose and objectives, motorized noise could be heard frequently throughout the day at moderate levels, or infrequently at higher levels, and natural sounds could be heard occasionally.
>
> *Moderate:* In areas where management objectives call for natural processes to predominate, natural sounds would predominate, but motorized noise could occasionally be present at low to moderate levels. In areas where motorized noise is consistent with park purpose and objectives, motorized noise would predominate during daylight hours and would not be overly disruptive to noise-sensitive visitor activities in the area; in such areas, natural sounds could still be heard occasionally.
>
> *Major:* In areas where management objectives call for natural processes to predominate, natural sounds would be impacted by human noise sources frequently or for extended periods of time at moderate intensity levels (but no more than occasionally at high levels), and in a minority of the area. In areas where motorized noise is consistent with park purpose and zoning, the natural soundscape would be impacted most of the day by motorized noise at low to moderate intensity levels, or more than occasionally at high levels; motorized noise would disrupt conversation for long periods of time and/or make the enjoyment of other activities in the area difficult; natural sounds would rarely be heard during the day.
>
> *Impairment:* The level of noise associated with PWC use would be heard consistently and would be readily perceived by other visitors throughout the day, especially in areas where such noise would potentially conflict with the intended use of that area. In addition, these adverse, major impacts to park resources and values would
>
> > contribute to deterioration of the park's soundscape to the extent that the park's purpose could not be fulfilled as established in its enabling legislation;
> >
> > affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or
> >
> > affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. As stated in the assumptions, daily PWC use levels are projected to average 14 craft on an average day, with a maximum of 70 on a peak weekend day over the next 10 years. PWC use is generally more concentrated in the northern portion of the lake near the marinas and boat launches. As sound travels over the bluffs surrounding the lake, noise levels are reduced substantially. Where the shoreline is substantially higher than the water level, the increased distance, combined with the attenuating properties of the ground, would likely reduce the noise level by at least 5 dB at the bluff

edge. As sound travels farther inland, the attenuating properties of the terrain and foliage would further reduce noise levels.

Texas boating regulations consider 50 feet from the shoreline a no-wake zone. PWC users operating at no-wake speeds do not generate substantial noise. At 50 feet from the shoreline personal watercraft generate less than 75 dB of sound, with two personal watercraft generating a total 78 dB (Komanoff and Shaw 2000), which is below the noise limit established by the Park Service (82 dB at 82 feet). Five personal watercraft operating together would result in a sound level up to 82 dB at 50 feet from the shoreline (Komanoff and Shaw 2000). At 200 feet from the shoreline the sound level would decrease to just under 68 dB, which is an acceptable level of sound for recreation areas per federal noise abatement measures (FHWA 2000). Also, some four-stroke models are reported to be quieter than their two-stroke counterparts (Sea-Doo 2001b; Yamaha Motor 2001); some reports use 5 dBA as the reduction in noise levels that can be obtained with the new equipment (Komanoff and Shaw 2000). Over the long term, the use of new PWC models would help lessen noise levels.

In most cases, personal watercraft would be dispersed along the shoreline so that watercraft would be infrequent at any given location and would operate for short periods of time. Locations having negligible adverse impacts would be areas of concentrated use, especially marinas and beaches, where PWC sounds occur along with noise from wind, waves, other visitors, automobiles, and motorboats. This would include the boat launches, beach, and marina areas at Sanford-Yake, Fritch Fortress, Blue West, Cedar Canyon, and Harbor Bay.

Boaters who camp along the shoreline may be more sensitive to sound levels and PWC activity. Camping areas on or near the shore that would be most affected by PWC use include Blue West, Cedar Canyon, and Harbor Bay. However, PWC use adjacent to shoreline campers would have negligible adverse impacts to the soundscape because related noise would be heard only during daytime hours, when boating campers may have left the campsite to move to another location. Non-boaters who remain at the campgrounds during the day would be negatively impacted by both PWC and boat noise. Campground areas along the southern part of the lake would not be affected because lake levels are currently low, but they could be affected if levels rose.

Overall, noise levels from personal watercraft would be expected to have temporary, negligible to moderate, adverse impacts over the short and long term at certain locations along the lake on days when use was relatively heavy. Negligible impacts would occur when use was infrequent and distanced from other park users, for example, as PWC users operated far from shore. Moderate impacts could occur from concentrated use in one area, particularly in the canyons in the northern third of the lake, where the level of noise could be relatively high. This would occur mainly where PWC use would conflict with other quieter uses, especially fishing, as well as windsurfing, swimming, picnicking, or backcountry camping. In general, the impact to those seeking a quiet visitor experience would most likely be short term and minor to moderate because PWC use would not be constant throughout the day, and enjoyment of the typical visitor activities in the area would not be compromised. Over the long term impacts could be reduced as a result of new technologies to reduce sound levels.

Cumulative Impacts. Other noise sources in the Lake Meredith National Recreation Area include wave action on the shore, wind, other boats operating on Lake Meredith, oil and gas operations, and other visitor activities. Other motorized boating activities on the lake are capable of generating noise levels as high as personal watercraft due to their number and their potential area of operation. Many motorboats can generate higher sound levels than personal watercraft, but they are generally not perceived to be as annoying due to their more typical steady rate of speed and direction.

Numerous variables affect the perceived noise levels of other boats, just as they do for personal watercraft, including the number of boats and their proximity to other lake users. Additionally, motorboat activity is an expected occurrence on Lake Meredith and is generally more acceptable to park visitors. The cumulative effect of PWC and boating noise would continue to have a minor to moderate adverse impact because it would be heard occasionally throughout the day. All impacts would be short term, since noise would usually be of limited duration.

Other visitors would also contribute to the soundscape, including off-road vehicle users, picnickers, and campers. Off-road vehicle users are only permitted in two areas within the recreation area, both of which are away from the lake. Noise generated from picnickers and campers are considered more acceptable and compatible with typical uses within the recreation area. Visitor noise would have a negligible adverse effect on the soundscape at Lake Meredith National Recreation Area. All impacts would be short term, since noise would usually be present for limited duration.

Conclusion. Noise generated by PWC use would continue to have temporary, negligible, adverse impacts at most locations over the short and long term, and minor to moderate, adverse impacts in the canyons on the northern portion of the lake and at backcountry locations. Impact levels would be related to the number of personal watercraft operating, as well as the sensitivity of other visitors. Over the long term PWC noise levels would be reduced with the introduction of newer engine technologies.

Cumulative noise impacts from personal watercraft, motorboats, and other visitors would be temporary, minor to moderate, and adverse in some locations over the short and long term because these sounds would be heard occasionally throughout the day. For the most part, natural sounds would still predominate at most locations within the national recreation area. The highest sound impacts would occur near boat launches and marinas.

This alternative would not result in an impairment of soundscapes.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC use areas would remain the same as under alternative A except 11 no-wake zones would be established. Enhanced educational programs could discuss the potential noise impacts that PWC use may have on other park visitors; however, the effectiveness of such programs would be difficult to measure. Also, some four-stroke models are reported to be quieter than their two-stroke counterparts (Sea-Doo 2001b; Yamaha Motor 2001); some reports use 5 dBA as the reduction in noise levels that can be obtained with the new equipment (Komanoff and Shaw 2000). Over the long term, the use of new PWC models would help lessen noise levels.

Daily PWC use levels would be the same as for alternative A, but use would be restricted in the lake arms, where no-wake zones would be established. PWC use would not be prohibited in any new areas of the lake. Average daily PWC use would remain constant at 14 over the next 10 years, with 70 craft on a peak-use day.

Generally, PWC use would continue to be dispersed along the lake so that operating craft would be infrequent at any given location. At the areas that have the highest visitor use, such as Sanford-Yake, and Fritch Fortress, PWC noise would be heard occasionally and would have minor adverse impacts. However, sounds from wind, waves, other visitors, and motorboats would also occur in these areas. In general, PWC use would result in negligible adverse impacts in other portions of the lake.

Backcountry users, campers, and anglers using the back coves tend to be more sensitive to sound levels and PWC activity. Establishing no-wake zones in back coves would minimize disturbance to backcountry users and anglers in these areas. Speed restrictions for PWC users in the area of the mouth of the lake arms would also reduce sound levels on the lake.

Overall, alternative B would have a beneficial impact in the back coves and minor adverse impacts at other locations on days when PWC use was relatively heavy. Minor impacts would occur when PWC use was frequent in heavily used areas. Overall, this alternative would result in a beneficial to minor adverse impact on the soundscape of Lake Meredith National Recreation Area. All impacts would be short term, since noise would usually be for limited times. Over the long term impacts could be reduced as a result of new technologies to reduce sound levels.

Cumulative Impacts. The cumulative effect of PWC and boating noise would have a minor adverse impact because it would be heard occasionally throughout the day. In the back coves there would be a beneficial impact, since these areas would be designated no-wake zones. Visitor noise would continue to have a negligible adverse effect on the soundscape at Lake Meredith National Recreation Area. All impacts would be short term, since noise would usually be for a limited duration.

Conclusion. Noise from PWC use would have temporary, minor, adverse impacts at most locations over the short and long term. However, there would be beneficial impacts in the back coves where no-wake restrictions would be in effect. Impact levels would be related to the number of PWC operators, as well as the sensitivity of other visitors. Over the long term PWC noise levels would be reduced with the introduction of newer engine technologies.

Cumulative noise impacts from PWC and motorboat use, as well as other visitor activities, would be temporary, minor, and adverse over the short and long term, with these sounds heard occasionally throughout the day. In the back coves there would be a beneficial impact, since these areas would be designated no-wake zones. For the most part, natural sounds would still predominate at most locations within the recreation area. The highest sound impacts would occur near the boat launches and marinas.

This alternative would not impair soundscapes.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Banning PWC use would result in beneficial impacts on shoreline visitors in all areas of the lake because noise from personal watercraft would be eliminated.

Cumulative Impacts. Cumulative impacts for the no-action alternative would be similar to alternative A. While there would be no contribution to noise levels from PWC use, other motorized boating activities would continue to cause minor adverse noise impacts throughout the day. The highest level of impact would occur near the boat launch and marinas.

Other recreation area uses also contribute to the area's soundscape, including beach activities, picnicking, and camping. However, these sounds are considered more acceptable and compatible with other uses. Visitor noise would continue to have a negligible adverse effect on the soundscape at Lake Meredith National Recreation Area.

Conclusion. No longer allowing PWC use at Lake Meredith would have beneficial impacts on other visitors with the elimination of this noise source.

Cumulative noise impacts from motorboats and other visitor activities would be temporary, minor, and adverse over the short and long term, particularly near the boat launches and marinas, but there would be no contribution to noise from PWC use within Lake Meredith.

This alternative would not result in an impairment of soundscapes.

WILDLIFE AND WILDLIFE HABITAT

Some research suggests that PWC use affects wildlife by interrupting normal activities. This is thought to be caused by PWC speed, noise, and access. Flight response is the most likely impact of PWC use.

Impacts to listed threatened or endangered species, such as peregrine falcons, bald eagle, interior least tern, whooping crane and mountain plovers, are documented under "Threatened, Endangered, or Special Concern Species" (see page 105).

GUIDING REGULATIONS AND POLICIES

The NPS Organic Act, which directs parks to conserve wildlife unimpaired for future generations, is interpreted by the agency to mean that native animal life should be protected and perpetuated as part of the park's natural ecosystem. Natural processes are relied on to control populations of native species to the greatest extent possible; otherwise they are protected from harvest, harassment, or harm by human activities. According to NPS *Management Policies 2001,* the restoration of native species is a high priority (sec. 4.1). Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and the ecological integrity of plants and animals.

There are no additional federal, state, or local regulations or policies for wildlife and wildlife habitat at Lake Meredith National Recreation Area.

METHODOLOGY AND ASSUMPTIONS

For the purposes of this analysis, it was assumed that most personal watercraft would be operated in a lawful manner (i.e., 50 feet from shore unless landing or launching and no operation between sundown and sunrise). The maximum number of PWC users is estimated to be 70 per day during busy summer weekends, for an average of four hours of operation. Impacts in 2012 would be similar to those occurring in 2002 since PWC use is projected to remain constant over the 10-year period. The NPS staff biologist, the U.S. Fish and Wildlife Service, and the Texas Parks and Wildlife Department provided wildlife information.

IMPACT ANALYSIS AREA

The impact analysis area includes all portions of Lake Meredith open to PWC use until November 6, 2002, and extending inland approximately 200 feet. This 200-foot inland area is assumed to provide a more encompassing range of assessment based on the distance of PWC operation from the shoreline and wildlife responses to PWC activity.

IMPACT OF PWC USE AND NOISE ON WILDLIFE AND HABITAT

The following thresholds were used to determine the magnitude of effects on wildlife and wildlife habitat:

Negligible: No wildlife species are present; no impacts or impacts with only temporary effects are expected.

Minor: Nonbreeding animals are present, but only in low numbers. Habitat is not critical for survival; other habitat is available nearby. Occasional flight responses by wildlife are expected, but without interference with feeding, reproduction, or other activities necessary for survival.

Moderate: Breeding animals are present; animals are present during particularly vulnerable life-stages such as migration or juvenile stages; mortality or interference with activities necessary for survival are expected on an occasional basis, but are not expected to threaten the continued existence of the species in the park.

Major: Breeding animals are present in relatively high numbers, and/or wildlife are present during particularly vulnerable life stages. Habitat targeted by PWC use or other actions has a history of use by wildlife during critical periods and is somewhat limited. Mortality or other effects are expected on a regular basis and could threaten the continued survival of the species in the park.

Impairment: Some of the major impacts described above might be an impairment of park resources if their severity, duration, and timing resulted in the elimination of a native species or significant population declines in a native species. In addition, these adverse, major impacts to park resources and values would

contribute to deterioration of the park's wildlife resources and values to the extent that the park's purpose could not be fulfilled as established in its enabling legislation;

affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. Under this alternative the maximum number of personal watercraft on the lake during a high-use day is projected to remain at the current level of 70. Most PWC use occurs between mid-May and mid-September. PWC use is most frequent during weekends, followed by weekday evenings. While PWC use would be distributed throughout the lake, the primary location for potential impacts would be where use is most prevalent, particularly the northern area of the lake where water is deepest and the most popular and accessible boat launches exist.

Wildlife are most likely to occur near the shoreline due to habitat constraints, with few nonaquatic species present on the water surface far from shore (other than bats and birds). When a PWC user travels to a shoreline destination, the speed of the watercraft must be slowed to a no-wake speed, thus allowing wildlife to easily move out of the way. There have been no documented cases of PWC operators deliberately harassing or chasing birds or other wildlife on Lake Meredith, and no documented collisions with waterfowl or wildlife.

As noted in the "Water Quality" section, continued PWC use would create pollutant loads that are below water quality criteria and ecological benchmarks, so there would likely be no or negligible impacts to fish related to water contamination. Also, fish will avoid direct impacts from personal watercraft, and use is not expected to disrupt any spawning areas, given speed restrictions near shorelines. (The Arkansas River shiner, a federally threatened species, is discussed below under "Threatened, Endangered or Special Concern Species.")

PWC use tends to be concentrated in the northern portion of the lake, while wildlife habitat such as cottonwood/tallgrass galleries and wetland/floodplain areas remain mostly upstream from the reservoir in the southern portion of the recreation area. Because of Lake Meredith's low water level, much of this wildlife habitat is inaccessible to PWC users. The majority of the lake is surrounded by steep, rocky hillsides, although lower-lying areas containing wildlife habitat exist in the shallow creek beds within the arms of the lake.

There can be considerable variation in flush distances of waterbirds in response to PWC use among individuals within the same species and among different species (Rodgers and Schwikert 2002). Waterfowl migrate to Lake Meredith during the winter when there is less PWC use due to colder water. Since most personal watercraft are not used in the early spring due to water and air temperatures, it is unlikely that most wildlife would be disturbed during the breeding season. During rearing, PWC use could cause short-term temporary effects when they land on shores. Due to the steep, rocky canyon walls bordering the majority of the lake, most waterfowl and shorebirds breeding near the shore would be restricted to shallow creeks within the arms of the lake and wetland areas not accessible to watercraft. Upland birds and songbirds nesting within the recreation area would not likely be affected by PWC use. Therefore, impacts to wildlife and wildlife habitat would be negligible at most locations.

Continued PWC use at Lake Meredith National Recreation Area would have negligible or no adverse impacts to fish, and negligible impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. All impacts to fish, wildlife, and habitat due to PWC use would be temporary and short term. The intensity or duration of impacts is not expected to increase substantially over the next 10 years, since PWC numbers are not expected to increase.

Cumulative Impacts. Potential cumulative effects on wildlife and wildlife habitat are related to activities that could occur in proximity to wildlife species. These activities include other visitors accessing the shoreline and other boaters traveling on the water or accessing the shoreline. Approximately 98,000 visitors have access to the Lake Meredith shoreline every year. Wildlife routinely exhibit movement or flight response due to visitor proximity. However, visitor interactions would not interfere with feeding, reproduction, or other activities necessary for the survival of the wildlife species. Interactions between wildlife and human visitors would be limited because of the low abundance of wildlife within the impact analysis area and the dispersion of visitors along the shoreline. The habitat along the shoreline of the main stem of the lake is not as crucial as the shallow creek beds and wetland areas, which are inaccessible to PWC and many other users, so current and future impacts by PWC users and other visitors would not have a noticeable effect on wildlife along the shoreline. Overall, visitors (including PWC users) at Lake Meredith National Recreation Area would have negligible to minor adverse impacts to wildlife that are dispersed over a large area along the shoreline. All wildlife impacts would be temporary and short term.

Conclusion. Impacts on wildlife and wildlife habitat would be short term and negligible at most locations because PWC users must operate at least 50 feet from the shoreline and access the shore at no-wake speeds. In addition, few wildlife use the open water, where speeds are higher.

On a cumulative basis, all visitor activities would continue to have short term, negligible to minor, adverse effects on wildlife and wildlife habitat. All impacts would be temporary.

This alternative would not impair wildlife or wildlife habitat.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. The effect of PWC use on wildlife would be the same as for alternative A, except no-wake zones would be established in back coves, and speed restrictions would be created from the mouth of the lake arms, shifting use slightly to the main stem of the lake. This would result in a beneficial impact to species in back coves and lake arms due to decreased PWC use in these areas.

Alternative B would also prohibit PWC fueling on the lake except at the marina fuel dock, which could reduce pollution, improve water quality, and reduce negative impacts to birds, fish, invertebrates, and other water species. The extent to which PWC users voluntarily switched to personal watercraft that were less polluting and quieter would have a beneficial effect.

Continued PWC use at Lake Meredith National Recreation Area would have short-term, negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. All impacts to fish, wildlife, and habitat due to PWC use would be temporary and short term. The intensity or duration of impacts is expected to remain constant over the next 10 years, since PWC numbers are anticipated to remain steady.

Cumulative Impacts. The contribution to cumulative impacts from non-PWC sources would be the same as described for alternative A. Under alternative B there would be a negligible reduction in overall impacts caused by PWC use due to limitations on areas of their use and a positive impact in coves and upstream areas. Visitor interactions would not interfere with feeding, reproduction, or other activities necessary for the survival of the wildlife species. Water quality would be improved due to PWC fueling restrictions on the lake. Overall, PWC use and other sources of cumulative impacts would have negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. All impacts to fish, wildlife, and habitat due to PWC use would be temporary and short term. Over the next 10 years, impacts would continue to be negligible since PWC numbers are projected to remain steady.

Conclusion. Under alternative B there would be a reduction in overall impacts caused by PWC use because of no-wake zones. Impacts on wildlife and wildlife habitat would be short term, negligible, and adverse at most locations because PWC users would operate at least 50 feet from the shoreline and access the shore at no-wake speeds. In addition, few wildlife use the open water, where PWC speeds are higher.

On a cumulative basis, all visitor activities would continue to have short-term, negligible to minor, adverse effects on wildlife and wildlife habitat. All wildlife impacts would be temporary.

This alternative would not impair wildlife or wildlife habitat.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Banning PWC use within the national recreation area would eliminate any potential impacts to wildlife or habitats, including direct contact, noise disturbances, air or water toxicity from exhaust, or shore access gained from personal watercraft. Impacts would be beneficial, although PWC use compared to other motorized boating, is relatively small.

Cumulative Impacts. Cumulative impacts would be similar to those described for alternative A, except that PWC contribution to these impacts would be eliminated. Overall, cumulative impacts would have negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. Impacts from wind-generated waves and non-PWC motorboats would continue to have negligible adverse impacts to shoreline habitat. All impacts would be short term and temporary.

Conclusion. Prohibiting PWC use at Lake Meredith would eliminate any associated impacts to wildlife and habitat, a beneficial impact.

Cumulative impacts from other visitor uses would continue and would have short-term, negligible or no adverse impacts to fish, and negligible to minor impacts to waterfowl and other wildlife. There would be no perceptible changes in wildlife populations or their habitat community structure. All impacts would be temporary.

This alternative would not impair wildlife or wildlife habitat.

THREATENED, ENDANGERED, OR SPECIAL CONCERN SPECIES

GUIDING REGULATIONS AND POLICIES

The Endangered Species Act (16 USC 1531 et seq.) mandates that all federal agencies consider the potential effects of their actions on species listed as threatened or endangered. If the National Park Service determines that an action may adversely affect a federally listed species, consultation with the U.S. Fish and Wildlife Service is required to ensure that the action will not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat.

State and federally listed species were identified through discussions with park staff, informal consultation with the U.S. Fish and Wildlife, and project review by the Texas Parks and Wildlife Department (lists of rare species). The U.S. Fish and Wildlife Service was contacted regarding federal threatened, endangered, and special concern species, as was the Texas Parks and Wildlife Department regarding state species. (Appendix C includes copies of letters received by the time this document was printed.)

An analysis of the potential impacts to each species listed in the USFWS letter is included in this section. At Lake Meredith National Recreation Area it has been determined that none of the alternatives would adversely affect any of the listed species. The completed environmental assessment will be submitted to the U.S. Fish and Wildlife Service for its review. If the agency concurs with the finding of the National Park Service, no further consultation will be required.

Formal consultation would be initiated if the National Park Service determined that actions in the preferred alternative would be likely to adversely affect one or more of the federally listed threatened or endangered species identified in the recreation area. At that point a biological assessment would be prepared to document the potential effects. From the date that formal consultation was initiated, the Fish and Wildlife Service would be allowed 90 days to consult with the agency and 45 days to prepare a biological opinion based on the biological assessment and other scientific sources. The Fish and Wildlife Service would state its opinion as to whether the proposed PWC activities would be likely to jeopardize the continued existence of the listed species or to result in the destruction or adverse modification of critical habitat. Such an opinion would be the same as a determination of impairment if the impact to listed species and their habitat would be affected to the point that the park's purpose (enabling legislation, *General Management Plan*, or *Strategic Plan)* could not be fulfilled and resources could not be experienced and enjoyed by future generations. To ensure that a species would not be jeopardized by PWC activities, the National Park Service would confer with the Fish and Wildlife Service to identify recommendations for reducing adverse effects and would integrate those into the preferred alternative.

NPS *Management Policies 2001* state that potential effects of agency actions will also be considered on state or locally listed species. The National Park Service is required to control access to critical habitat of such species, and to perpetuate the natural distribution and abundance of these species and the ecosystems upon which they depend.

The species at Lake Meredith National Recreation Area that have the potential to be affected by proposed PWC management alternatives include the federally listed bald eagle and the Arkansas River shiner.

ASSUMPTIONS AND METHODOLOGIES

Primary steps in assessing impacts on listed species were taken to determine the following:

1. which species are found in areas likely to be affected by management actions described in the alternatives
2. current and future use and distribution of PWC by alternative
3. habitat loss or alteration caused by the alternatives
4. displacement and disturbance potential of the actions and the species' potential to be affected by PWC activities

As related to threatened or endangered species at Lake Meredith, the following restrictions apply:

- The stilling basin below Sanford Dam is closed to all boating.
- Operating a vessel in excess of 5 mph or creating a wake is prohibited in all marked "No Wake" areas of the lake.
- Boat launching is permitted only at developed launch ramps.

Two basic assumptions were made regarding PWC and visitor activities, as follows:

- Most visitors use existing trails and do not walk off trail.
- PWC and boat users who access the shore do not stray far from their craft and are likely to stay within eye contact when visiting the shore.

The information in this analysis was obtained through best professional judgement of park staff and experts in the field (as cited in the text), and by conducting a literature review. The PWC and visitor use trends data were used to evaluate potential impacts to threatened or endangered species. Additional information was obtained from park staff. Wildlife information was provided by the park's natural resources specialist, the *Lake Meredith National Recreation Area Oil and Gas Management Plan* (NPS 2002b), the U.S. Fish and Wildlife Service, and Texas Parks and Wildlife Department (see appendix C).

IMPACT ANALYSIS AREA

The impact analysis area includes all portions of Lake Meredith that were open to PWC use until November 6, 2002, extending inland approximately 200 feet. This 200-foot inland area is assumed to provide a more encompassing range of assessment based on the distance of PWC operation from the shoreline and the potential for wildlife responses to PWC activity.

IMPACT OF PWC USE ON SUCH SPECIES

The Endangered Species Act defines the terminology used to assess impacts to listed species as follows:

> *No effect:* When a proposed action would not affect a listed species or designated critical habitat.
>
> *May affect / not likely to adversely affect:* Effects on special status species would be discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or would be completely beneficial.
>
> *May affect / likely to adversely affect:* When an adverse effect to a listed species might occur as a direct or indirect result of proposed actions and the effect either would not be discountable or would be completely beneficial.
>
> *Is likely to jeopardize proposed species / adversely modify proposed critical habitat (impairment):* The appropriate conclusion when the National Park Service or the U.S. Fish and Wildlife Service identifies situations in which PWC use could jeopardize the continued existence of a proposed species or adversely modify critical habitat to a species within or outside park boundaries.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. This alternative would allow continued PWC use within the recreation area, with an average of 14 craft per day (and 70 on high-use days); no increase in use is projected by 2012. PWC users within 50 feet of the shoreline would be required to operate at no-wake speeds. Potential effects from personal watercraft would mostly be limited to interactions with wildlife farther than 50 feet from shore or where PWC users land on shore.

> *Bald Eagle* (federal and state threatened species) — The bald eagle resides as a winter resident in the Canadian River's upper reaches, primarily in the Bonita Creek area. This area of the lake has experienced low water levels for several decades and also experiences low visitor use. This portion of the recreation area is also inaccessible to personal watercraft. Most wintering bald eagles migrate north February through March, and there is no known summer nesting of bald eagles in the area. The PWC season occurs mid-May through September, when bald

eagles no longer reside in the area. Because bald eagles are winter residents that utilize only the southern portion of the lake (which is inaccessible to personal watercraft and boats), this alternative would have no effect on bald eagles.

Arkansas River Shiner (federal threatened species) — Critical habitat for the Arkansas River shiner has been designated along the Canadian River from the western park boundary downstream to the confluence with Coetas Creek (NPS 2002b). The historic lake level in this portion of Lake Meredith has never been high enough to permit recreational use. During floods, the water level may be high enough to include the critical habitat, although this has not occurred since the lake was created. The largest threat to the shiner is the reduction of streamflows caused by drought, water diversions, and declines in water quality. This alternative would have no effect on the Arkansas River Shiner.

Black-tailed Prairie Dog (federal candidate species) — The black-tailed prairie dog is currently listed as a candidate species under the Endangered Species Act. One black-tailed prairie dog town was documented in Lake Meredith National Recreation Area but was eradicated in April 2001 due to a natural outbreak of bubonic plague. The town was at higher elevations, away from the lake. Therefore, PWC use would have no effect on the black-tailed prairie dog.

Texas Horned Lizard (state threatened species) — Texas horned lizards inhabit arid sandy areas and are not found along the immediate shoreline environment where PWC use occurs. However, this species could exist in the upper edges of cliffs; if PWC riders beached and walked to these areas, they could disturb this species. This would be a very minor impact, and PWC use is not likely to adversely impact this species.

Peregrine Falcon (state endangered species) — Interactions between PWC users and falcons are extremely uncommon. There would be no direct impacts on peregrine falcons, and indirect impacts would be unlikely because watercraft operating within 50 feet of the shore or cliffs would be traveling perpendicular to the shoreline and at no-wake speeds. This restriction would minimize potential disruptions to nesting or perching falcons. This alternative would not likely adversely affect peregrine falcons.

Interior Least Tern (federal and state endangered species) — Because there is no documented evidence of breeding or nesting by the interior least tern within Lake Meredith National Recreation Area, and because the species does not winter in the area, it is unlikely that PWC use would have an effect on this species.

Lesser Prairie Chicken (federal candidate species) — Because the lesser prairie chicken is a potential resident at higher elevations within the national recreation area and is not likely to visit the lake, PWC use would have no effect on this species.

Mountain Plover (federal proposed threatened species) — Because mountain plovers are associated with shortgrass and shrub-step landscapes and are rarely found near water, PWC use would have no effect on this species.

Black-footed Ferret (federal and state endangered species) — The black-footed ferret is an upland species that is highly unlikely to occur in Lake Meredith National Recreation Area and would not occur along the shoreline. PWC use would have no effect on the ferret.

Whooping Crane (federal and state endangered species) — The whooping crane is a potential winter and seasonal migratory species. However, cranes do not breed near Lake Meredith. Since PWC use is limited during the winter, fall and early spring months, PWC use would have no effect on or would not likely affect whooping cranes.

Mexican mud-plantain (state species of concern) — This rare vascular plant occurs along the upper reaches of the Canadian River south of Coetas Creek in an area that is inaccessible to PWC users; therefore, PWC use would not affect this species.

Regarding the species of special concern that may occur in or near areas of PWC use, it is not likely that PWC use would adversely affect any of these species. The cave myotis bat could possibly feed near or over the lake, but this would occur at night when PWC use does not occur. The garter snake, if present, would avoid human noise and disturbance, and the Arkansas River chub would inhabit the more free-flowing, upstream areas of the lake's incoming streams, where personal watercraft cannot operate.

Overall, continued PWC use at the recreation area would have no effect or would not likely adversely affect sensitive species because the identified species are not present or are not normally accessible by personal watercraft. Since several bird species are migratory residents, off-season PWC use could affect, but is not likely to adversely affect, the birds occasionally feeding in the area. While some adverse effects, such as a stress or flight response, could result from PWC use, these impacts would be of sufficient duration or intensity to cause only short-term, temporary effects.

Cumulative Impacts. Cumulative impacts to the animal and plant species discussed above include impacts from additional human presence and other water-based recreational activities (boating, swimming), plus some additional minor disturbance from those visitors that use more upland areas to picnic, camp, hike, and hunt. There are no other major foreseeable planned actions or factors in the area, including other sources of water pollution, that would contribute more than very minor adverse impacts to any of the species, contributing to overall minor to moderate adverse cumulative impacts to these species. Other visitors and non-PWC boaters could affect sensitive species and habitat as a result of trampling or interrupting normal activities because of noise, but most of these visitors would be concentrated in and around areas that have already been disturbed or developed, such as boat ramps, marinas, campgrounds, and the visitor center.

Overall, cumulative effects from all park visitor activities are not likely to adversely affect these species, since the identified species are either not present where the activities occur or are not normally accessible.

Conclusion. Overall, continued PWC use at Lake Meredith would have no effect or would not likely adversely affect any federal or state listed species, since the identified species are either not present as permanent residents, do not have preferred habitat in the areas used by personal watercraft, or are not normally accessible.

Cumulative effects from all park visitor activities would not likely adversely affect these species since the identified species are not present, do not nest in the park, or are not accessible during the course of normal visitor activities, which are primarily water-based recreation.

This alternative would not impair threatened, endangered, or special concern species.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. Under alternative B no-wake zones would be established in the back coves on the lake, and speed restrictions would be created from the mouth of the lake arms; therefore, use would be shifted slightly to the main stem of the lake. Alternative B would also prohibit PWC operators from fueling on

the lake except at the marina fuel dock, which would reduce the potential for pollution and negative impacts to threatened, endangered, or sensitive bird and fish species as a result of accidental spills. Over the long term noise generated from quieter four-stroke engines would lessen chances of disturbance to these species, and fewer emissions from these engines would also benefit sensitive species. PWC users would not be able to access the cottonwood/tallgrass and wetland/floodplain areas located upstream from the reservoir, or the shallow creek beds within the arms of the lake.

Impacts under alternative B would be similar to those described for alternative A, but with fewer potential impacts to species using the upstream or back cove areas. Continued, limited PWC use at Lake Meredith National Recreation Area would have no effect on endangered, threatened or sensitive species since none of the PWC use areas is known to be essential or highly used habitat by any of these species relative to the rest of the reservoir. There would be no perceptible changes in concerned species' populations or their habitat community structure. All impacts to these species and habitat due to PWC use would be temporary and short term. The intensity and duration of impacts are expected to remain constant over the next 10 years, since PWC numbers are anticipated to remain steady.

Cumulative Impacts. Cumulative effects for PWC users and other visitors would be similar to alternative A and would not likely adversely affect concerned species or their habitat. Cumulative effects from all park visitor activities (including PWC use) would not likely adversely affect these species since the identified species are not present or are not normally accessible.

Conclusion. PWC use would have no effect on federal or state listed or sensitive species since potential interactions would be extremely limited, short term, and temporary.

Cumulative effects from all park visitor activities would not likely adversely affect these species since the identified species are not present or are not accessible during the course of normal visitor activities on Lake Meredith.

This alternative would not result in an impairment of threatened, endangered, or special concern species.

Impacts of the No-Action Alternative — No PWC Use

Analysis. No PWC use would be allowed on Lake Meredith, thus eliminating any potential impacts on threatened, endangered, or special concern species. This alternative would have beneficial impacts as compared to alternative A.

Cumulative Impacts. While the contribution of PWC use to overall cumulative impacts to federal or state listed animal and plant species would be eliminated, other visitor activities would continue. However, no species would be likely adversely affected, similar to alternative A. Generally, these species are not present or are not accessible during normal visitor activities.

Conclusion. Because PWC users would no longer have access to Lake Meredith National Recreation Area, there would be beneficial impacts on federal or state listed species as compared to alternative A.

On a cumulative basis the activities of other visitors and other boaters would not likely adversely affect federal or state listed animals and plants because generally these species are not present or are not accessible during the course of normal visitor activities. PWC contribution to overall cumulative impacts to federal or state listed animal and plant species would be eliminated.

This alternative would not result in an impairment of threatened, endangered, or special concern species.

SHORELINE VEGETATION

Personal watercraft provide access to the shoreline, and operators may disembark to explore, sunbathe, or beachcomb. As a result, shoreline vegetation could be trampled during the course of accessing shoreline trails or exploring along the shore. Due to physical characteristics of the shoreline, Lake Meredith does not have submerged aquatic vegetation that could be impacted by PWC use.

GUIDING REGULATIONS AND POLICIES

Natural shoreline processes such as erosion, deposition, overwash, and shoreline migration such as those found at Lake Meredith National Recreation Area should continue without interference. Where the nature or rate of natural shoreline processes has been altered, the National Park Service is directed to identify alternatives for mitigating the effects of such activities or structures and for restoring natural conditions (NPS *Management Policies 2001,* sec. 4.8.1.1). The National Park Service must also comply with the provisions of Executive Order 11990 ("Protection of Wetlands"), which requires federal agencies to avoid short- and long-term adverse impacts associated with the destruction or modification of wetlands whenever possible. The state also has a coastal management plan prepared in accordance with the Coastal Zone Management Act of 1972.

Texas state boating regulations limit PWC operation to no-wake speeds within 50 feet of the shoreline.

METHODOLOGY AND ASSUMPTIONS

Potential impacts to shoreline vegetation and to the shoreline itself (erosion that can affect shoreline communities) were evaluated based on the pattern of motorized watercraft use in Lake Meredith, the nature of the shoreline and vegetation present, and the professional judgment and observations of the project team and members of the park staff. To assess the magnitude of impacts from PWC use on shoreline vegetation, the following assumptions were made:

1. Most PWC users operate their craft in a lawful manner and abide by state laws and the regulations in the "Superintendent's Compendium."
2. PWC users who disembark on the shoreline would travel no more than 100 feet, staying within eyesight of their craft.
3. Impacts in 2012 would be similar to those occurring in 2002 since visitor numbers are projected to remain constant over the next 10 years.

IMPACT ANALYSIS AREA

The impact analysis area is the shoreline along Lake Meredith. Topography limits PWC use in portions of the analysis area. In many areas cliffs rise straight out of the water, thereby limiting access to the shore. For the purposes of this evaluation, the impact analysis area includes the shoreline and a 30-foot inland area where PWC operators may land and explore the shoreline.

IMPACT TO SENSITIVE SHORELINE VEGETATION FROM PWC USE AND VISITOR TRAMPLING

Shoreline vegetation impacts were determined by examining the potential effects of PWC and visitor use on vegetation, according to type and sensitivity. The number of PWC users and visitors and their distribution was based on the analysis provided in the "PWC Use Trends" section. The following impact thresholds were established to describe the relative changes in shoreline vegetation under the various alternatives being considered:

Negligible: Impacts would have no measurable or perceptible changes in plant community size, integrity, or continuity.

Minor: Impacts would be measurable or perceptible but would be localized within a relatively small area. The overall viability of the plant community would not be affected and, if left alone, would recover.

Moderate: Impacts would cause a change in the plant community (e.g. abundance, distribution, quantity, or quality); however, the impact would remain localized.

Major: Impacts to the plant community would be substantial, highly noticeable, and permanent.

Impairment: PWC use would contribute substantially to the deterioration of the shoreline or shallow water environment to the extent that the park's shoreline or submerged vegetation would no longer function as a natural system. In addition, these adverse major impacts to park resources and values would

contribute to deterioration of these resources to the extent that the park's purpose could not be fulfilled as established in its enabling legislation;

affect resources key to the park's natural or cultural integrity or opportunities for enjoyment; or

affect the resource whose conservation is identified as a goal in the park's general management plan or other park planning documents.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. The number of personal watercraft using the reservoir during a high-use day would remain at 70 watercraft through 2012. While personal watercraft would be distributed throughout the reservoir, the primary location for potential impacts would be where PWC use is most prevalent, in the northern portion of the lake near the marinas and boat launches. Personal watercraft cannot access the shallow creek beds in the canyons or the southern portion of the lake due to historic low lake levels, so no direct impacts would occur at these sites. Potential impacts include negligible, short-term wave action and trampling caused by PWC operators landing their craft and walking on the shore. PWC use is not known to contribute substantially to shoreline erosion at Lake Meredith, and according to NPS staff, near-constant winds are the primary contributor to shoreline erosion at Lake Meredith.

Continued PWC use at Lake Meredith National Recreation Area would have negligible adverse impacts to shoreline vegetation over the short and long term, with no perceptible changes in plant community size, integrity, or continuity.

Cumulative Impacts. Visitors can access bluffs and shoreline areas by motorboat and automobile, as well as by personal watercraft. No adverse effects to shoreline vegetation caused by visitor trampling have been documented at the recreation area, although negative adverse impacts could be expected.

Fluctuating water levels and wind have more potential to create short- and long-term erosion and impacts to shoreline vegetation. Fluctuating water levels greatly deter the development of hydrophytic shoreline vegetative or aquatic vegetation, such as nearshore emergent plants and macrophytes, largely preventing development of shoreline vegetation. Where vegetation does exist, the fluctuating water levels have promoted the development of exotic plants, such as salt cedar.

Wave action, which can cause shoreline erosion, is usually caused by winds and other watercraft. Near-constant winds are the primary contributor to shoreline erosion at Lake Meredith. Overall, PWC and visitor use at Lake Meredith has resulted in a negligible adverse effect on shoreline vegetation. No changes to shoreline vegetation are anticipated through 2012 under alternative A.

Conclusion. PWC use and activities would have negligible adverse impacts over the short and long term because there would be no perceptible changes to plant community size, integrity, or continuity, now or in the future (2012).

On a cumulative basis, other visitor activities are more prevalent than PWC use. However, no obvious impacts currently exist, and none are expected in the future, so impacts to shoreline vegetation would continue to be negligible. There would be no perceptible changes to plant community size, integrity, or continuity through 2012.

This alternative would not result in an impairment of shoreline vegetation.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC impacts to shoreline vegetation would be similar to those described for alternative A except under alternative B back coves along Lake Meredith would be established as no-wake zones. The overall number of personal watercraft would remain the same as in alternative A, with an average of 14 per day, and maximum of 70 per day. Adverse effects to vegetation in the back coves would be reduced since users would be required to operate at no-wake speeds, a beneficial impact. Continued PWC use in other segments would have negligible adverse impacts to sensitive shoreline vegetation over the short and long term, with no perceptible changes in plant community size, integrity, or continuity.

Cumulative Impacts. The contribution to cumulative impacts from non-PWC sources would be the same as described for alternative A. Under alternative B there would be a negligible reduction in overall impacts caused by PWC use due to limitations on areas of their use.

Overall, PWC and other sources of cumulative impacts would create negligible, short- and long-term, adverse effects on the shoreline, shoreline vegetation, and aquatic plants. There would be no perceptible changes to plant community size, integrity or continuity, now or in the future (2012).

Conclusion. PWC use would have negligible adverse impacts over the short and long term because there would be no perceptible changes to plant community size, integrity or continuity now or in the future (2012). PWC restrictions in back coves would result in beneficial impacts to shoreline vegetation.

On a cumulative basis other visitor activities are more prevalent than PWC use. However, no obvious impacts currently exist, and impacts to shoreline vegetation would continue to be negligible. There would be no perceptible changes to plant community size, integrity, or continuity now or by 2012.

This alternative would not impair shoreline vegetation.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Banning PWC use within the national recreation area would eliminate any potential impacts to shoreline vegetation as a result of access gained from personal watercraft. Impacts to shoreline vegetation would be beneficial for the short and long term compared to alternative A. No perceptible changes to plant community size, integrity, or continuity are expected now or by 2012.

Cumulative Impacts. Cumulative impacts would be similar to those described for alternative A, except that PWC contribution to these impacts would be eliminated. Ongoing use of the shoreline by other visitors would continue to have negligible adverse impacts. Impacts on shoreline vegetation from other visitor uses would outweigh any benefits related to banning PWC use; however, these impacts would continue to be negligible and adverse. No perceptible changes to plant community size, integrity, or continuity are expected now or by 2012.

Conclusion. Impacts on shoreline vegetation would be beneficial as a result of banning PWC use. There would be no perceptible changes to plant community size, integrity, or continuity now, and none are expected by 2012.

Cumulative impacts from other visitor uses would continue, but are expected to be negligible in the short and long term. PWC contribution to overall vegetation impacts would be eliminated. There would be no perceptible changes to plant community size, integrity, or continuity now or by 2012.

This alternative would not result in an impairment of shoreline vegetation.

VISITOR EXPERIENCE

Some research suggests that PWC use is viewed by some segments of the public as a nuisance due to their noise, speed, and overall environmental effects, while others believe the PWC use is no different from other motorcraft and that people have a right to enjoy the sport. The primary concern involves changes in noise, pitch, and volume due to the way PWC are operated. Additionally, the sound of any watercraft can carry for long distances, especially on a calm day.

GUIDING REGULATIONS AND POLICIES

NPS *Management Policies 2001* state that the enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all parks and that the National Park Service is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Because many forms of recreation can take place outside a national park setting, the National Park Service will therefore seek to

- provide opportunities for forms of enjoyment that are uniquely suited and appropriate to the superlative natural and cultural resources found in a particular unit
- defer to local, state, and other federal agencies; private industry; and non-governmental organizations to meet the broader spectrum of recreational needs and demands that are not dependent on a national park setting

Unless mandated by statute, the National Park Service will not allow visitors to conduct activities that

- would impair park resources or values
- create an unsafe or unhealthful environment for other visitors or employees
- are contrary to the purposes for which the park was established
- unreasonably interfere with the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park; NPS interpretive, visitor service, administrative, or other activities; NPS concessioner or contractor operations or services; or other existing, appropriate park uses

The purpose of Lake Meredith National Recreation area includes "protecting all of the resources . . . in perpetuity for all Americans" (NPS 2000e). Part of its significance lies in the fact that it is the largest body of water within a 200-mile radius and contains the largest public landmass within the Texas Panhandle, providing for hunting and other recreational pursuits. The mission of Lake Meredith National Recreation Area is to "provide public recreational use of lands, facilities, and water areas," while protecting the "scenic, scientific, cultural, natural, and other values that contribute to public enjoyment of the area." To achieve this mission goal, the following long-term (five-year) visitor goal was identified in the park's *Strategic Plan*:

- Visitor Satisfaction — By September 30, 2005, 57% of visitors to Lake Meredith National Recreation Area and Alibates Flint Quarries National Monument are satisfied with appropriate park facilities, services, and recreational opportunities.

METHODOLOGIES AND ASSUMPTIONS

The purpose of this impact analysis was to determine if PWC use at Lake Meredith National Recreation Area is compatible or in conflict with the purpose of the park, its visitor experience goals, and the direction provided by NPS *Management Policies*. Thus, these policies and goals were integrated into the impact thresholds.

To determine impacts, the current level of PWC use was calculated for areas of the recreation area. Other recreational activities and visitor experiences that are proposed in these locations were also identified. Visitor surveys and staff observations were evaluated to determine visitor attitudes and satisfaction in areas where personal watercraft are used. Visitor survey data at Lake Meredith National Recreation Area suggest that the majority of visitors are satisfied with their current experiences.

The potential for change in visitor experience was evaluated by identifying projected increases or decreases in both PWC and other visitor uses, and determining whether these projected changes would affect the desired visitor experience and result in greater safety concerns or additional user conflicts.

IMPACT ANALYSIS AREA

In terms of PWC use, all of Lake Meredith and adjacent areas are included in the impact analysis area. PWC use may affect visitors at beaches, trails, and campgrounds near the shoreline, such that visitors within 200 feet of the shore are considered to be within the affected area.

IMPACT OF PERSONAL WATERCRAFT ON VISITOR EXPERIENCE GOALS

The following thresholds were defined:

> *Negligible:* Visitors would not likely be aware of the effects associated with changes proposed for visitor use and enjoyment of park resources.
>
> *Minor:* Visitors would likely be aware of the effects associated with changes proposed for visitor use and enjoyment of park resources; however the changes in visitor use and experience would be slight and likely short term. Other areas in the park would remain available for similar visitor experience and use without derogation of park resources and values.
>
> *Moderate:* Visitors would be aware of the effects associated with changes proposed for visitor use and enjoyment of park resources. Changes in visitor use and experience would be readily apparent and likely long term. Other areas in the park would remain available for similar visitor experience and use without derogation of park resources and values, but visitor satisfaction might be measurably affected (visitors could be either satisfied or dissatisfied). Some visitors who desire to continue their use and enjoyment of the activity/visitor experience would be required to pursue their choice in other available local or regional areas.
>
> *Major:* Visitors would be highly aware of the effects associated with changes proposed for visitor use and enjoyment of park resources. Changes in visitor use and experience would be readily apparent and long term. The change in visitor use and experience proposed in the alternative would preclude future generations of some visitors from enjoying park resources and values. Some visitors who desire to continue their use and enjoyment of the activity / visitor experience would be required to pursue their choices in other available local or regional areas.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC operators under alternative A would have unrestricted use along the Lake Meredith shoreline, remaining at the current average of 70 personal watercraft on a high-use day by 2012.

Impacts on PWC Users — There would be no change to PWC use or activity as compared to existing conditions. Alternative A would have no additional effect on the visitor experience of PWC users at Lake Meredith National Recreation Area.

Impacts on Other Boaters — Other boaters visiting Lake Meredith National Recreation Area would continue to interact with PWC operators. All watercraft share the same boat launches. Due to low lakes levels in 2002, only the South Canyon, Cedar Canyon, and Blue West boat launches were open. Of the boat launches that remained open, the Cedar Canyon area serves the highest number of visitors (195,218 during five summer months in 2000). The most common area for PWC / boater interaction is near the popular boat launches such as Cedar Canyon. However, visitors are also attracted by the picnicking, camping, and fishing opportunities at this location.

Nonmotorized watercraft users, including canoeists, kayakers, and rafters who travel the Canadian River and side tributaries, may also interact with PWC users. The 7-mile stretch of the Canadian River is inaccessible to most motorboats and PWC users, so interactions between these different user groups are infrequent. Sailing is the most popular nonmotorized activity due to the wind conditions at the lake. Sailboaters would be the most likely nonmotorized boat group to interact with PWC users. However, there have been no PWC/boat incidents in the past three years and visitation has been decreasing, which could reduce the likelihood of interactions between PWC users and other boaters. Based on this

analysis, alternative A would have negligible adverse effects on the visitor experience of other boaters for existing and future conditions.

Impacts on Other Visitors — Swimmers, hikers, anglers, and other visitors to Lake Meredith's visitor use areas would continue to have contact with PWC users. Monthly visitor use reports for the national recreation area indicate that the Sanford-Yake, Cedar Canyon, Fritch Fortress, and Harbor Bay areas accommodate the vast majority of visitors during summer months (when water levels are normal), ranging from 128,109 (Fritch Fortress) to 199,411 (Harbor Bay) over a five-month period. The next highest visitor use area is Blue West, with only 57,292 visitors in comparison. In addition to camping and picnic sites, the four most popular locations also include boat launching ramps and fishing docks or piers, and anglers are the most likely user group to have adverse experiences related to PWC use. Popular fishing locations exist throughout the lake depending on the type of fish desired, and bank fishing is also permitted in certain areas. Anglers have said that PWC users disrupt fishing in some of the backwater coves — a minor adverse impact. However, given the relatively high visitor numbers at the popular boat launch and fishing dock areas, it is likely that visitor expectations for solitude are lower than for other locations of the recreation area, such as backwater coves.

Visitors like to swim at beaches adjacent to waterfront campsites. Areas where swimming takes place are Bugbee, Chimney Hollow, Harbor Bay, Cedar Canyon, and Blue East. No boat launch facilities exist at these locations, which may help separate PWC use and swimming (although launch ramps exist nearby in some cases). Areas that receive a large number of swimmers are marked with "No Boats Permitted" buoys. Both PWC and other boat users comply with the buoys, and the park has no documented complaints from swimmers about personal watercraft (B. Briggs, NPS, pers. comm., L. Pine, URS, Oct. 17, 2002).

Camping and picnicking are popular at several locations throughout the park. The four most popular boat launch areas also have campgrounds and picnic facilities. It is likely that those PWC users who camp would use one of the campgrounds near the launch areas and would not be bothered by PWC use. The park also has 10 additional campgrounds that have no boat launches and that may provide more solitude for campers seeking natural quiet. These campers would not experience as much exposure to PWC use.

Several areas of the park are open to off-road vehicles. It is unlikely that off-road users would be bothered by or even interact with PWC users due to the noise generated by off-road engines and the distance they would operate from the lake (most off-road use is in the southern end of the park along the Canadian River and away from Lake Meredith).

Hunting is permitted throughout the park. Hunting season begins September 1 and continues through May 10 each year. Because the majority of PWC use occurs between May and September, there is likely to be little to no interaction between PWC users and hunters.

In summary, continued PWC use, at existing and predicted levels, would have no effect on PWC users. PWC use would not result in a noticeable change in visitor experiences. Based on this analysis, PWC activity at Lake Meredith would have negligible to minor adverse impacts on the experiences of swimmers, hikers, anglers, and other visitors.

Cumulative Impacts. The primary activities at Lake Meredith National Recreation Area that may affect visitor experiences include the number and activities of other visitors, and noise from vehicles and motorboats. No other actions are currently planned that would affect PWC use or visitor experiences within the national recreation area. According to visitor surveys, most visitors are satisfied with their experiences at the park. Cumulative impacts related to the use of personal watercraft, motorized

boats, and other visitor activities would be negligible over the short and long term because there would be little noticeable change in visitor experiences.

Conclusion. Continued PWC use at Lake Meredith National Recreation Area would have negligible to minor adverse impacts on visitor experiences in the short and long term. When related to other visitor activities, such as off-road vehicle use, PWC use would not appreciably limit the critical characteristics of visitor experiences.

Cumulative effects of PWC use, other watercraft, and other visitors would continue to result in long-term, negligible adverse impacts, since there would be little noticeable change in visitor experiences. Most visitors would continue to be satisfied with their experiences at Lake Meredith National Recreation Area.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. Under alternative B no-wake zones would be established in lake arms and back coves, and visitor education would be enhanced. PWC operators would be prohibited from fueling on the lake (except at the marina fuel dock) and from carrying extra fuel onboard.

Impacts on PWC Users — No-wake restrictions established under this alternative would be limited only to the arms of the lake and back coves. Because PWC operators often prefer large bodies of open water, these restrictions would have a negligible adverse effect on PWC users. Fueling watercraft away from the water surface would result in only a minor inconvenience.

Impacts on Other Boaters — Impacts to other boaters would be similar to those under alternative A because restrictions under alternative B would not affect areas or hours of operation or the number of users permitted on the lake. However, anglers who fish from boats would experience a beneficial impact due to PWC speed and no-wake restrictions in lake arms and coves, as would canoeists and kayakers who may prefer these areas. Impacts to other boaters would continue to be negligible to minor, long term, and adverse for existing and future conditions.

Impacts on Other Visitors — Impacts to other shoreline users would be similar to those under alternative A. Other visitors, particularly swimmers, might notice a beneficial impact due to PWC operators refueling their watercraft in parking areas away from the shoreline. Anglers, particularly those who fish in back coves or from shorelines where such fishing is permitted, would experience beneficial impacts due to PWC speed and no-wake restrictions. Other visitors would continue to experience negligible to minor adverse impacts.

Cumulative Impacts. Motorized boaters and other visitors would continue to interact with PWC users, with impacts similar to those described for alternative A, resulting on negligible, short- and long-term, adverse impacts for most visitors because there would be little noticeable change in experiences. Most visitors would continue to be satisfied with their experiences at Lake Meredith National Recreation Area.

Conclusion. Some visitors, particularly anglers, would experience beneficial impacts as a result of no-wake zones established in back coves and lake arms. Most other visitors would experience negligible to minor adverse impacts in the short and long term. When related to other visitor activities, PWC use would not appreciably limit the critical characteristics of visitor experiences.

Cumulative impacts would be moderate for PWC users but negligible over the short and long term for most other visitors because there would be little noticeable change in visitor experiences.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Lake Meredith is a major site of water-based recreation in the Panhandle region, averaging more than 1.5 million visits per year from 1992 to 1999. No comparable large bodies of water provide such recreational diversity in this area. The largest nearby recreation area is Palo Duro Canyon State Park, but it lacks the water resources of Lake Meredith. According to the PWC use analysis, approximately 14,260 visitors (4,075 personal watercraft with 3.5 riders per party) would no longer be allowed to participate in this form of recreation in the national recreation area. This constitutes only about 1% of the total Lake Meredith yearly visitation. However, PWC use comprises about 20% of the boat use on the lake. Current use projections estimate that by 2012 the number of PWC users will not change.

Impacts on PWC Users — Discontinuing PWC use would not necessarily preclude a visit to the recreation area by PWC owners. Approximately 68% of PWC users previously owned powerboats (NTSB 1998). Current PWC users could still use a motorboat or other watercraft and could continue to experience activities such as hiking, sightseeing, and off-road driving. However, PWC users who wished to continue PWC use in the area would have a difficult time finding comparable waterbodies closeby. The level of impact to PWC users who could no longer recreate at Lake Meredith is expected to be moderate adverse for the short and long term, since Lake Meredith is the largest body of water in a 200-mile radius. Palo Duro Reservoir, approximately 50 miles north of Lake Meredith, is the closest large waterbody where personal watercraft can be used. Visitors who used to ride personal watercraft at Lake Meredith would still be able to enjoy the park through other recreational activities, and it is not expected that park visitation would decrease as a result of prohibiting PWC use.

Impacts on Other Boaters — Banning PWC use within Lake Meredith National Recreation Area would eliminate interactions between other boaters and PWC operators. Between 1997 and 2001, 122 written violations were issued to PWC users, although it is not known if these violations were the result of interactions with other boaters. However, it is assumed that this alternative would eliminate any possible conflicts between PWC and other users within the recreation area. Other boaters would not have to watch out for PWC users, resulting in a beneficial impact.

Impacts on Other Visitors — According to the summer 2002 visitor survey, 73% of all respondents indicated overall satisfaction with facilities, services, and recreational opportunities at Lake Meredith. Restricting PWC use within the recreation area would have a beneficial effect on these users.

In summary, a small percentage of PWC operators would experience moderate adverse effects, while a large number of other users would experience beneficial effects.

Cumulative Impacts. The cumulative impacts for the no-action alternative would be beneficial as compared to alternative A. The experiences of other shoreline users would be beneficial because no PWC use would be allowed within the recreation area. Conversely, the experiences of PWC users would be adversely affected because of these same restrictions. Most visitors would continue to be satisfied with their experiences at Lake Meredith National Recreation Area. On a regional basis the no-action alternative would result in a negligible adverse effect to PWC activities on other waterbodies in the region as a result of PWC users going to other locations to enjoy this activity.

Conclusion. The no-action alternative would have a beneficial impact on the experiences of most park visitors because PWC use would be banned. Impacts on PWC users who would no longer be able to ride in the national recreation area would be short and long term, moderate, and adverse.

Cumulative impacts would be beneficial as compared to alternative A. Most visitors would continue to be satisfied with their experiences at Lake Meredith National Recreation Area. On a regional scale the no-action alternative would result in a negligible adverse effect on visitor experiences at other water-bodies in the region as a result of PWC users displaced from Lake Meredith.

VISITOR CONFLICTS AND SAFETY

Industry representatives report that PWC accidents decreased in some states in the late 1990s. The National Transportation Safety Board reported that in 1996 personal watercraft represented 7.5% of state-registered recreational boats but accounted for 36% of recreational boating accidents. In the same year PWC operators accounted for more than 41% of people injured in boating accidents. PWC operators accounted for approximately 85% of the persons injured in accidents studied in 1997 (NTSB 1998). Between 1997 and 2001 Lake Meredith park staff issued 122 written violation notices to PWC users, conducted 5 search-and-rescue operations for personal watercraft, and towed 12 personal watercraft. In the same time period six PWC-related accidents occurred, although the only PWC-related injury recorded by park staff happened when one operator attempted to jump-start another craft. Proactive boat patrols in the past five years have resulted in increased safety — prior to 1997, there were two water-related deaths at the park every year for 30 years (although the types of watercraft involved were not documented). Boating regulations are enforced by NPS rangers and Texas Parks and Wildlife officers. The Coast Guard Auxiliary also helps with boat patrols. NPS law enforcement staff focus 75% of their time on land activities and 25% on water activities.

PWC speeds, wakes, and operations near other users can pose hazards and conflicts, especially to canoeists and sea kayakers. Sailboaters are the primary nonmotorized boats used in the national recreation area, and conflicts could occur with PWC. To date, few conflicts have been reported between PWC and nonmotorized boaters.

GUIDING REGULATIONS AND POLICIES

In addition to the guiding regulations and policies discussed in the "Visitor Experience" section, the NPS *Management Policies 2001* state that the National Park Service is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. The policies also state, "While recognizing that there are limitations on its capability to totally eliminate all hazards, the Service and its concessioners, contractors, and cooperators will seek to provide a safe and healthful environment for visitors and employees" (sec. 8.2.5.1). Further, the National Park Service will strive to protect human life and provide for injury-free visits (sec. 8.2.5).

Lake Meredith National Recreation Area abides by the Texas Parks and Wildlife regulations for personal watercraft. The regulations, as stated on page 59, stipulate safety requirements for PWC use throughout the state of Texas.

Until November 6, 2002, personal watercraft were permitted in Lake Meredith in all areas where other vessels were allowed. The only area off limits to all boaters is the stilling basin below Sanford Dam. All motorboaters, including PWC operators, are required to purchase permits. PWC operators are subject to all federal and state laws. There are no local ordinances regarding PWC operation.

The following long-term (five-year) visitor goal related to visitor safety was identified in the park's *Strategic Plan*:

- Visitor Safety — By September 30, 2005, the visitor/incident rate at Lake Meredith National Recreation Area and Alibates Flint Quarries National Monument is maintained at its low baseline rate from FY-92 through FY-96 five-year annual average of 2.4.

METHODOLOGY AND ASSUMPTIONS

The methodology for visitor conflicts and safety is similar to that used for visitor experience. The potential visitor-related impacts attributable to personal watercraft — a higher rate of accidents than for other watercraft, conflicts with other park users, negative effects on some types of visitor experiences — could potentially affect the NPS policy to provide for injury-free visits. Potential impacts were identified based on the number and activities of PWC operating within the area, the number and activities of other visitors in an area, and the proximity of these user groups.

It is assumed that Texas PWC regulations are enforced within the national recreation area. These regulations govern PWC activities near the shore, the timing of use, and the age and educational requirements of operators.

IMPACT ANALYSIS AREA

In terms of visitor safety, all areas of Lake Meredith are included in the impact analysis area. PWC use may also affect visitors at beaches, trails, and campgrounds near the shoreline, such that visitors within 200 feet of the shore are considered to be within the affected area.

IMPACT OF PWC USE AND CONFLICTING USES ON VISITOR SAFETY

The impact intensities for both visitor conflicts and safety follow. Where impacts to visitor experience or visitor safety become moderate or minor, it is assumed that current visitor satisfaction and safety levels would begin to decline and the park would not be achieving some of its long-term visitor goals.

Negligible: The impact to visitor safety would not be measurable or perceptible.

Minor: The impact would be measurable or perceptible, but it would be limited to a relatively small number of visitors at localized areas. Impacts to visitor safety could be realized through a minor increase or decrease in the potential for visitor conflicts in current accident areas.

Moderate: The impact to visitor safety would be sufficient to cause a permanent change in accident rates at existing low accident locations or to create the potential for additional visitor conflicts in areas that currently do not exhibit noticeable visitor conflict trends.

Major: The impact to visitor safety would be substantial either through the elimination of potential hazards or the creation of new areas with a high potential for serious accidents or hazards.

Impacts of Alternative A —— Continue PWC Use under a Special NPS Regulation

Analysis. This alternative assumes that PWC operations would continue the same as they occur under existing conditions, remaining at the current number of 70 personal watercraft on a peak day now and

in 2012. Because of more proactive boat patrols, there have been only four PWC accidents in the last three years.

PWC User / Swimmer Conflicts — Over 10 years it is estimated that 70 PWC would be in use in Lake Meredith during peak use days. Although park visitation has decreased in the past 10 years, total visitation is expected to increase in the next 10 years to equal 1999 yearly visitation rates of 1,779,238.

Many visitors prefer to swim at beaches adjacent to waterfront campsites. The greatest potential for conflicts between PWC users and swimmers would be at swim areas near boat launches. When water levels are normal, the boat launches that experience the heaviest visitor use are Harbor Bay, Cedar Canyon, Sanford-Yake, and Fritch Fortress (during low water periods only Cedar Canyon is open). All of these launch areas are on the eastern side of the lake. However, the four most popular swim areas exist at other locations, including Bugbee, Chimney Hollow, the stilling basin (which has the park's only designated swim beach), and South Canyon, which are primarily on the north and west sides of the lake. These areas receive substantially less visitation (for example, only 24,963 visitors at Bugbee compared to 199,411 at Harbor Bay in the summer of 2000). Of these swim locations, only Bugbee offers boat launching, and only from the shoreline. Therefore, this separation of popular boat launches and swim areas has reduced the potential for conflicts between PWC users and swimmers. In addition, swim areas are located in or near the arms of the lake, and PWC users tend to favor open water. The park has also installed "No Boats Permitted" buoys at areas that receive a large number of swimmers, and both PWC users and boaters have complied with these buoys (B. Briggs, NPS, pers. comm., L. Pine, URS, Oct. 17 2002, re: park questions). However, the park issued 122 written violations to PWC users between 1997 and 2001, the majority of which (37) involved no-wake violations, which could negatively impact shoreline swimmers. For these reasons, impacts to swimmers from PWC use are predicted to be negligible to minor adverse.

PWC Users / Other Boater Conflicts — Between 1997 and 2001 the park recorded 19 watercraft accidents, 13 involving boats and 6 involving personal watercraft. It is unknown as to how many (if any) of these accidents involved both boats and personal watercraft. However, in the past five years the park has recorded only one PWC-related injury, which did not involve non-PWC boaters. The four popular boat launches mentioned above are the most likely areas for potential conflicts between PWC users and motorized boat operators. These boat launches have substantially more use than launches at other areas (for example, nearly 200,000 visitors at Harbor Bay compared to approximately 60,000 at McBride Canyon). Of the estimated 250 motorized boats and 70 personal watercraft expected to be active on high-use summer days, most could be expected to begin and end their trips at one of these four launches. This would create a relatively high amount of motorboat traffic and potential for conflicts, resulting in a minor adverse impact.

Canoeists and kayakers tend to favor creeks, tributaries, or the shoreline. The Canadian River and its tributaries are popular with canoeists, kayakers, and rafters. A sand bar prohibits PWC and motorboats from accessing this 7-mile stretch of river, so user conflicts in this area would be negligible. Lake Meredith is also a prime location for sailboat use due to windy conditions. Because all boats use the same boat ramps, conflicts could arise between PWC users and sailboaters at launch locations as well as on open water. However, the park has no documented information about conflicts between sailboaters and PWC users. Overall, PWC use would result in a negligible adverse impact for nonmotorized boat users at Lake Meredith.

PWC Users / Other Visitors — Fishing is permitted on the lake and in coves where visitors can find access; public fishing piers are located at Sanford-Yake and the stilling basin. The majority of PWC-related conflicts at Lake Meredith involve anglers. Anglers have expressed that PWC users disrupt

fishing in some backwater coves, most likely as a result of speeding in no-wake zones along the shore. Continued PWC use could result in minor adverse impacts to anglers if operators did not adhere to regulations.

Cumulative Impacts. The Lake Meredith shoreline is used by a variety of visitors, including swimmers, motorboat users, sailboaters, and canoeists. All of these user groups interact with each other and occasionally come into conflict. Most user groups are widely distributed. For example, sea kayakers, canoeists, and swimmers tend to stay close to the shore, whereas PWC and motorboat operators tend to stay at least 200 feet offshore. This separation of use reduces the potential for conflicts between the various groups. For this reason, the cumulative impact of the various user groups on visitor conflicts and safety would be minor over the short and long term.

Conclusion. Continued PWC use would have short- and long-term, minor, adverse impacts on visitor conflicts and safety at Lake Meredith due to the number of visitors and boats present on high use days, particularly at popular boat launches. Conflicts at other locations would remain negligible because use is lower, and conflicts would be less likely to occur, although violations of the no-wake zones along the shore could continue to adversely impact anglers.

Cumulative impacts related to visitor conflicts and safety would be minor for all user groups in the short and long term.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. Under alternative B no-wake zones would be established in lake arms and back coves, and PWC user education would be enhanced.

PWC User / Swimmer Conflicts — Impacts would be similar to alternative A since the number of personal watercraft operating within the recreation area is expected to remain constant. No-wake zones in lake arms could have a beneficial impact to swimmers, since many popular swimming locations occur in such areas. Enhanced PWC education could benefit all visitors by decreasing the potential for conflicts. Overall, PWC use would continue to have negligible to minor adverse impacts on most swimmers at Lake Meredith National Recreation Area.

PWC Users / Other Boater Conflicts — Impacts would be similar to alternative A. No-wake zones would benefit nonmotorized boaters and anglers who fish from boats. Therefore, PWC use would continue to have minor adverse impacts on other motorized boaters and negligible adverse impacts to nonmotorized boaters at Lake Meredith.

PWC Users / Other Visitor Conflicts — Establishing no-wake zones in back coves could benefit anglers who have complained about speed violations in these areas. Even though Texas boating regulations require no-wake speeds within 50 feet of the shoreline, some PWC users could be unaware of the regulations. Enhanced PWC education under this alternative would help remedy this situation. PWC use would have negligible adverse impacts to other visitors.

Cumulative Impacts. Cumulative impacts would be similar to alternative A. The natural separation of use between the various visitors would reduce the potential for conflicts. The cumulative impact of the different user groups on visitor conflicts and safety would be minor over the short and long term.

Conclusion. Continued PWC use would have short- and long-term, minor, adverse impacts on visitor conflicts and safety due to the number of visitors and boats present on high use days. Establishing no-wake zones in back coves could benefit anglers who have complained about speed violations in these areas.

Cumulative impacts related to visitor conflicts and safety would be minor for all user groups in the short and long term.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Under the no-action alternative all PWC use would be banned, eliminating any conflicts between PWC operators and other visitors. Based on the number of boating-related deaths and accidents that have occurred at the park, as well as complaints from some park users, eliminating PWC operation in the recreation area would yield a perceptible change for a variety of visitors. No PWC-related incidents would occur involving other park visitors, and safety would increase. This would be a beneficial impact compared to alternative A.

Cumulative Impacts. Cumulative impacts would be similar to those described for alternative A, except PWC use would be eliminated. Overall, conflicts would be eliminated and safety would improve as compared to alternative A because eliminating PWC use within the recreation area would remove the potential for conflicts between PWC users and other visitors. Cumulative impacts to visitor conflict and safety would be reduced to negligible adverse.

Conclusion. Discontinuing PWC use would result in beneficial impacts by reducing visitor conflicts and enhancing safety.

PWC-related contributions to overall cumulative impacts to visitor safety would be eliminated. Visitor safety impacts from other sources would be negligible.

CULTURAL RESOURCES

GUIDING REGULATIONS AND POLICIES

The National Park Service's primary interest in these places stems from its responsibilities under the following legislation:

> *The NPS Organic Act* — responsibility to conserve the natural and historic objects within parks unimpaired for the enjoyment of future generations
>
> *National Historic Preservation Act* — responsibility to preserve, conserve, and encourage the continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions that underlie and are a living expression of our American heritage
>
> *American Indian Religious Freedom Act* — responsibility to protect and preserve for American Indians access to sites, the use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites
>
> *Archeological Resources Protection Act* — responsibility to secure, for the present and future benefit of the American people, the protection of archeological resources and sites that are on public lands

> *Native American Graves and Repatriation Act* — responsibility to assign ownership or control of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony that are excavated or discovered on federal lands or tribal lands to lineal descendants or affiliated Indian tribes
>
> *Executive Order 13007* — responsibility to (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and (2) avoid adversely affecting the physical integrity of such sacred sites

In accordance the *Management Policies 2001*, the National Park Service must be respectful of these ethnographic resources, and carefully consider the effects that NPS actions may have on them (*Management Policies 2001,* sec. 5.3.5.3). Specific guidance for the management of cultural resources is provided in *NPS-28: Cultural Resource Management Guideline* (NPS 1997).

ASSUMPTIONS AND METHODOLOGIES

Cultural resources analyzed in this environmental assessment include archeological resources, submerged cultural resources and ethnographic resources (see page 21 for a list of issues that were eliminated from further analysis). Impacts are described in terms of type, context, duration, and intensity, which is consistent with the CEQ regulations. These impact analyses are intended to also comply with the requirements of section 106 of the National Historic Preservation Act. In accordance with the Advisory Council on Historic Preservation's regulations implementing section 106 (36 CFR Part 800, "Protection of Historic Properties"), impacts to cultural resources were identified and evaluated by

1. determining the area of potential effects
2. identifying cultural resources present in the area of potential effects that were either listed on or eligible to be listed on the National Register of Historic Places
3. applying the criteria of adverse effect to affected cultural resources either listed on or eligible to be listed on the national register
4. considering ways to avoid, minimize, or mitigate adverse effects

Under the advisory council's regulations, a determination of either adverse effect or no adverse effect must be made for affected, national register eligible cultural resources.

> An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion on the national register. Examples include diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association. Adverse effects also include reasonably foreseeable effects that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5).
>
> A determination of no adverse effect means there may be an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion in the National Register.

The CEQ regulations and *Director's Order #12* and its handbook call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact (e.g., reducing the intensity of an impact from major to moderate or minor). Any resultant reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under the National Environmental Policy Act only. It does

not suggest that the level of effect as defined by section 106 is similarly reduced. Although adverse effects under section 106 may be mitigated, the effect remains adverse.

A section 106 summary is included at the end of the analysis section and is intended to meet the requirements of the National Historic Preservation Act. It also is intended to provide an assessment of the effect of the undertaking (implementation of the alternative) on cultural resources, based on the criteria found in the advisory council's regulations.

IMPACT ON ARCHEOLOGICAL SITES AND SUBMERGED CULTURAL RESOURCES

Certain important research questions about human history can only be answered by the actual physical material of cultural resources. Archeological resources have the potential to answer, in whole or in part, such research questions. An archeological site can be eligible to be listed on the National Register of Historic Places if the site has yielded, or may be likely to yield, information important in prehistory or history.

Negligible: The impact would be at the lowest levels of detection or barely measurable, with no perceptible consequences, either adverse or beneficial, to archeological resources. For purposes of section 106, the determination of effect would be *no adverse effect*.

Minor: Adverse impact — The disturbance of a site would be confined to a small area with little, if any, loss of important information potential. For purposes of section 106, the determination of effect would be *no adverse effect*.

Beneficial impact — A site would be preserved in its natural state. For purposes of section 106, the determination of effect would be *no adverse effect*.

Moderate: Adverse impact — Disturbance of a site would not result in a substantial loss of important information. For purposes of section 106, the determination of effect would be *adverse effect*.

Beneficial impact — The site would be stabilized. For purposes of section 106, the determination of effect would be *no adverse effect*.

Major: Adverse impact — Disturbance of a site would be substantial and would result in the loss of most or all of the site and its potential to yield important information. For purposes of section 106, the determination of effect would be *adverse effect*.

Beneficial impact — There would be active intervention to preserve the site. For purposes of section 106, the determination of effect would be *no adverse effect*.

Impairment: A major, adverse impact to a resource or value whose conservation is

necessary to fulfill specific purposes identified in the park's establishing legislation;

key to the natural or cultural integrity of the park; or

identified as a goal in the park's general management plan or other relevant NPS planning documents

Impact Analysis Area

The impact analysis area is the shoreline along Lake Meredith. Topography limits PWC use in portions of the analysis area. In many areas cliffs rise straight out of the water, thereby limiting access to

the shore. For the purposes of this evaluation, the impact analysis area includes the shoreline and a 30-foot inland area where PWC operators may land and explore the shoreline.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC users would continue to have access to archeological and submerged cultural resources located along the shoreline under this alternative. The most likely impact to archeological and submerged cultural sites would result from PWC users landing in areas otherwise inaccessible to most other visitors and illegally collecting or damaging artifacts. According to park staff, looting and vandalism of cultural resources is not a substantial problem. A direct correlation of impacts attributed to PWC users is difficult to establish, since many of these areas are also accessible to backcountry hikers or other watercraft users. Under this alternative the low number of PWC users within the national recreation area would have only minor adverse impacts on potentially listed archeological resources.

Continuing PWC use under a special regulation would not negatively affect the overall condition of archeological resources because project-by-project inventories and mitigation would still be conducted.

Cumulative Impacts. PWC users, other boaters, and land-based user groups would continue to have access to remote areas with archeological sites and submerged cultural resources potentially eligible for the National Register of Historic Places. On a cumulative basis all visitor activities could result in minor to moderate adverse impacts on those resources that are readily accessible, due to the number of visitors and the potential for looting and vandalism. Resources in more remote areas that are not as readily accessible to visitors would likely still experience minor adverse impacts on a cumulative basis. All impacts would continue at existing levels.

Conclusion. PWC use within the recreation area could result in minor adverse impacts on potentially listed archeological sites and submerged cultural resources as a result of illegal collection and vandalism.

Cumulative impacts on archeological and submerged cultural resources that are readily accessible could be minor to moderate adverse, due to the number of visitors and the potential for illegal collection or destruction.

This alternative would not impair any archeological or submerged cultural resources.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC users would continue to have access to archeological and submerged cultural resources under this alternative, resulting in minor adverse impacts, similar to those under alternative A. A user education program and no-wake zones could limit some of these effects.

Cumulative Impacts. On a cumulative basis impacts would be similar to alternative A. All visitor activities could result in minor to moderate adverse impacts on those resources that are readily accessible, due to the number of visitors and the potential for looting and vandalism. Resources in more remote areas that are not as readily accessible to visitors could likely still be affected to a minor degree. All impacts would continue at existing levels.

Conclusion. PWC use within the recreation area could have minor adverse impacts on archeological sites and submerged cultural resources from possible illegal collection and vandalism. However, under this alternative a user education program and no-wake zone could limit these effects.

Cumulative impacts on archeological and submerged cultural resources that are readily accessible would be minor to moderate adverse, similar to alternative A.

This alternative would not impair any archeological or submerged cultural resources.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Discontinuing PWC use at Lake Meredith would result in minor beneficial impacts on archeological sites and submerged cultural resources by reducing the potential for illegal collection or damage attributable to PWC users.

Cumulative Impacts. Even without the potential for PWC users to access remote areas, activities by other watercraft users and land-based user groups would still have the potential to cause minor to moderate adverse cumulative impacts. On a cumulative basis the potential for visitor impacts from illegally collecting or damaging resources that are readily accessible would continue. Resources in more remote areas that are not as readily accessible to park visitors could still be affected to a minor degree, but there would be no contribution from PWC users.

Conclusion. Prohibiting PWC use would have minor beneficial impacts on archeological sites and submerged cultural resources.

Cumulative impacts from all visitor activities would continue to be minor to moderate, depending on the accessibility of the resource and the potential for illegal collection or damage.

This alternative would not impair any archeological sites and submerged cultural resources.

IMPACT ON ETHNOGRAPHIC RESOURCES

Certain important questions about human culture and history can only be answered by gathering information about the cultural content and context of cultural resources. Questions about contemporary peoples or groups, their identity, and heritage have the potential to be addressed through ethnographic resources. As defined in the *Cultural Resource Management Guideline,* an ethnographic resource is a site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it (NPS 1997). Some such specific places of traditional cultural use may be eligible for inclusion on the National Register of Historic Places if they meet criteria for traditional cultural properties.

For purposes of analyzing potential impacts to ethnographic resources, the thresholds of change for the intensity of an impact are defined below:

> *Negligible:* The impact would be barely perceptible and would neither alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of beliefs and practices. There would be no change to a group's body of beliefs and practices. For purposes of section 106, the determination of effect would be *no adverse effect.*

Minor: Adverse impact — The impact would be slight but noticeable and would neither appreciably alter resource conditions, such as traditional access or site preservation, nor the relationship between the resource and the affiliated group's body of beliefs and practices. For purposes of section 106, the determination of effect would be *no adverse effect.*

Beneficial impact — The action would allow traditional access and/or accommodate a group's traditional practices or beliefs. For purposes of section 106, the determination of effect would be *no adverse effect.*

Moderate: Adverse impact — The impact would be apparent and would alter resource conditions. Something would interfere with traditional access, site preservation, or the relationship between the resource and the affiliated group's beliefs and practices, even though the group's beliefs and practices would survive. For purposes of section 106, the determination of effect would be *adverse effect*.

Beneficial impact — The action would facilitate a group's beliefs and practices. For purposes of section 106, the determination of effect would be *no adverse effect.*

Major: Adverse impact — The impact would alter resource conditions. Something would block or greatly affect traditional access, site preservation, or the relationship between the resource and the affiliated group's body of beliefs and practices, to the extent that the survival of a group's beliefs and/or practices would be jeopardized. For purposes of section 106, the determination of effect would be *adverse effect.*

Beneficial impact — The action would encourage a group's beliefs or practices. For purposes of section 106, the determination of effect would be *no adverse effect.*

Impairment: A major, adverse impact to a resource or value whose conservation is

necessary to fulfill specific purposes identified in the park's establishing legislation;

key to the natural or cultural integrity of the park; or

identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impact Analysis Area

The impact analysis area for ethnographic resources is the shoreline area extending 0.75-mile inland. This is based on a determination that a person participating in a traditional use would have to be approximately 0.75 mile from the shore to experience natural quiet when a PWC user was passing at full throttle outside the 50-foot no-wake zone.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. PWC use would continue in all areas of Lake Meredith and would not be restricted during they use of any ethnographic resources.

While ethnographic resources have not yet been formally evaluated for their status as traditional cultural properties / sacred sites, any traditional uses of areas within the parks could be disrupted by PWC noise and presence. This alternative would have minor to moderate adverse impacts during the use of ethnographic resources, since the impacts would tend to be indirect, infrequent, and of short

duration. Over the long term PWC noise levels could be reduced as a result of newer engine technologies.

Cumulative Impacts. PWC users, other boaters, and land-based user groups would continue to have access to remote areas with potentially significant ethnographic resources. On a cumulative basis all visitor activities could result in minor to moderate adverse impacts on those resources that are readily accessible, due to the short-term interruption in their use. Resources in more remote areas that are not as readily accessible to visitors would likely still experience minor adverse impacts on a cumulative basis, but to a lesser degree. All impacts would continue at existing levels.

Conclusion. PWC-related intrusions during the use of ethnographic resources would result in short-term, minor to moderate adverse impacts. Over the long term PWC noise levels could be reduced as a result of newer engine technologies.

On a cumulative basis all visitor activities could result in minor to moderate adverse impacts on those resources that are readily accessible, due to possible short-term interruptions in their use. All impacts would continue at existing levels.

This alternative would not impair any ethnographic resources.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. Impacts to ethnographic resources would be similar to those under alternative A. PWC use would not be restricted during the use of ethnographic resources by American Indians, but PWC speed and noise would be decreased in the back coves.

This alternative would have minor to moderate adverse impacts during the permitted the use of ethnographic resources, since the impacts would tend to be indirect, infrequent, and of short duration. A PWC user education program and no-wake zones could further limit some of these effects. Over the long term PWC noise levels could be reduced as a result of newer engine technologies.

Cumulative Impacts. PWC users, other boaters, and land-based user groups would continue to have access to remote areas with potentially significant ethnographic resources. On a cumulative basis all visitor activities could result in minor to moderate adverse impacts on resources that are readily accessible, due to the short-term interruption in their use. Resources in more remote areas that are not as readily accessible to visitors would likely experience minor adverse impacts on a cumulative basis, but to a lesser degree. All impacts would continue at existing levels.

Conclusion. PWC-related intrusions during the use of ethnographic resources would result in short-term, minor to moderate adverse impacts. The introduction of a user education program and the expansion of no-wake zones could further limit some of these effects. Over the long term PWC noise levels could be reduced as a result of newer engine technologies.

On a cumulative basis all visitor activities could result in minor to moderate adverse impacts on those resources that are readily accessible, due to possible short-term interruptions in their use. All impacts would continue at existing levels.

This alternative would not impair any ethnographic resources.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Discontinuing PWC use would have short- and long-term, minor, beneficial impacts on ethnographic resources, as it would eliminate possible PWC-related incidents of noise and visual intrusion on ethnographic resources.

Cumulative Impacts. Even without the potential for PWC users to access remote areas, the effects from other watercraft users and land-based user groups would have the potential for minor to moderate adverse cumulative impacts to ethnographic resources.

Conclusion. Prohibiting PWC use would have minor beneficial impacts on ethnographic resources by limiting the potential for disruptions when ethnographic resources are being used.

Effects from other watercraft users and land-based user groups would have the potential for minor to moderate adverse cumulative impacts to ethnographic resources.

This alternative would not impair any ethnographic resources.

SECTION 106 SUMMARY

This environmental assessment provides detailed descriptions of three alternatives (including the no-action alternative), and it analyzes the potential impacts associated with possible implementation of each alternative. The analysis of potential impacts of personal watercraft at Lake Meredith National Recreation Area also considered access by other types of watercraft.

Visitors access areas of the recreation area by many modes of transportation, including motor vehicles and all types of motorized watercraft (including personal watercraft), as well as by foot. Because of the diverse modes of access, the impacts on archeological and submerged cultural resources and ethnographic resources directly attributable to PWC use are difficult to define. Under alternatives A and B, PWC users could cause minor adverse impacts as a result of possible illegal collection and vandalism on archeological resources that are listed on or eligible to be listed on the National Register of Historic Places.

No-wake zones required by Texas state law within 50 feet of the shore and the addition of no-wake zones under alternative B would slow damage to a few vulnerable archeological resources that are partially submerged, or that are being exposed due to receding lake levels. Because of their small size and the amount of water displacement, PWC-generated wakes would make up an extremely small part of the lake wave action. Thus, beneficial impacts of no-wake zones outlined in alternatives A and B would be slight, resulting in no adverse effects from this source under either alternative. The introduction of a user education program under alternative B could also reduce some of the potential for illegal collection or destruction. Beneficial impacts under alternative B would result in no adverse effects.

The continuation of traditional Native American religious activities is crucial to preservation of tribal cultural values and identity. Visitors using personal watercraft, as well as other means of transport, could deliberately or unknowingly intrude on ceremonial activities or disturb resources and archeological sites valued by tribes. PWC use would not be restricted under any alternative during the use of ethnographic resources, and PWC users would still have access to remote areas with potentially significant ethnographic resources. Over the long term, PWC noise could be reduced as a result of quieter engine technologies, resulting in short-term, minor to moderate, adverse impacts (no adverse effects).

To help reduce the potential for impacts, cultural resources would continue to be monitored. Vulnerable resources listed on or potentially eligible for listing on the National Register of Historic Places would have priority for protective measures, and the recreation area staff would continue to actively work with tribes to protect ethnographic resources and privacy for traditional activities. Previous consultations were held with Native American tribes concerning the exposure of human remains found eroding from along the lakeshore. Any proposed erosion control efforts that relate to PWC use would be planned in consultation with culturally associated tribes.

In cases where it was determined there was a potential for adverse impacts (as defined in 36 CFR 800) to cultural resources listed on or eligible for listing on the National Register of Historic Places, the National Park Service would coordinate with the state historic preservation officer to determine the level of effect on the property, and the needed mitigation measures.

Pursuant to 36 CFR 800.5 (revised regulations effective January 2001), the National Park Service finds that the implementation of any PWC management alternative at Lake Meredith National Recreation Area, with identified mitigation measures, would not result in any new adverse effects (no adverse effect) to cultural resources currently identified as eligible for or listed on the National Register of Historic Places.

SOCIOECONOMIC EFFECTS

This section summarizes the socioeconomic impacts associated with the proposed alternatives for PWC use in Lake Meredith National Recreation Area. A detailed description of these impacts and a complete list of references is provided in the report "Economic Analysis of Personal Watercraft Regulations in Lake Meredith National Recreation Area" (LAW et al. 2002).

The primary economic impacts associated with the proposed PWC restrictions would be potential reductions in the sales, profits, and employment of businesses that serve PWC users visiting the park. The total regulatory cost of each alternative would depend on how the affected individuals and firms responded to changes under alternative B or the no-action alternative. To the extent that affected local retailers could provide substitute products and services, they might be able to reduce the negative impact on their profits. For instance, some current PWC users might continue to visit the park to participate in other recreational activities, which would decrease the financial impact on local businesses. It is also possible that visitation by non-PWC users to the national recreation area would increase following restrictions on PWC use if the restrictions made park visitation more enjoyable for other users.

Under alternative A it is expected that there would be no change in visitation. Under alternative B PWC users who previously traveled above no-wake speed in restricted areas or who refueled on the lake could decrease their park visits to some degree as a result of the regulation, but it is unlikely that a substantial number would stop visiting entirely. Under the no-action alternative, PWC users would no longer be able to participate in this activity at the recreation area. However, some of these PWC users could continue to visit the park to enjoy other recreational activities.

BENEFIT-COST ANALYSIS

The purpose of benefit-cost analysis is to determine whether an alternative being considered would generate more benefits or costs, which would accrue directly to households that use personal watercraft or who are indirectly affected by PWC use (e.g., those who benefit from reduced noise).

The resulting changes in PWC use might also impose costs on those who own or work for PWC-related businesses.

Even individuals who do not visit this national recreation area could benefit from the knowledge that resources were being protected and preserved. Evidence of "nonuse" values for resources like Lake Meredith has been established in the economics literature (Pearce and Moran 1994). Restrictions on PWC use could therefore provide benefits to both users and nonusers by protecting the national recreation area's ecological and other resources.

Alternative A, which would continue PWC use, would have no additional effect on any user group (visitors, suppliers, local residents and general public).

Alternative B could benefit all park visitors and the general public as a result of use restrictions; however, these same restrictions could adversely affect some park users. Some PWC users who may consider the no-wake zones and mandatory refueling at the designated marina to be a negative impact. Alternative B is not likely to substantially change the pattern of PWC use between Lake Meredith and waters outside of the park.

Under the no-action alternative, beneficial effects could be expected for all park visitors and the general public as a result of discontinuing PWC use. However, PWC users and the businesses that cater to them would be adversely affected. Adverse impacts of PWC use on anglers, swimmers, canoeists, and other visitors within the park would be eliminated under the no-action alternative. In addition, banning PWC use would reduce the probability of accidents between boaters and PWC users and would decrease noise levels. However, there is some overlap between people who use personal watercraft and those who use other types of boats. Users of houseboats, powerboats, and other motorized watercraft who may enjoy using personal watercraft as part of their boating trips would be adversely affected.

COSTS TO PWC USERS

Two main groups of PWC users may be affected by the proposed regulations: those who currently ride in Lake Meredith National Recreation Area, and those who ride in areas outside the park and who could be affected by users displaced from Lake Meredith.

Under alternative A no change in PWC use is expected, with no additional cost to any user group.

Because the recreation area would still be open to PWC use with only minor restrictions on use, alternative B would result in minor adverse impacts to PWC users.

Discontinuing PWC use under the no-action alternative would adversely affect PWC users, potentially causing them to no longer visit the park. In addition, some people who use houseboats or powerboats as their primary form of water recreation and who also ride personal watercraft during their trip would be adversely affected. These visitors might decide to cancel trips to Lake Meredith. Others might still visit, but the value of their trip could be diminished by their inability to use personal watercraft. To the extent that other suitable areas for PWC use are nearby, adverse impacts would be mitigated.

COSTS TO LOCAL AREA BUSINESSES

If PWC use decreased as a result of the regulation, then the suppliers of PWC rental, sales, service, and storage services would be directly affected. In addition, lodging establishments, restaurants, gas

stations, and other businesses that serve PWC riders could experience a reduction in business from the proposed regulation.

Six firms own and operate one or more PWC sales, service, or rental shops near Lake Meredith. Five of these firms sell new or used PWC (these shops generally also provide PWC service) and one provides PWC rentals.

Purchases made by PWC users contribute to total economic activity in the area surrounding Lake Meredith. It is possible that tourist-related businesses near the park could be affected if PWC restrictions resulted in reduced visitation to the recreation area.

Based on the existing data and interviews with local businesses, alternative A is not expected to result in revenue losses to firms, management restrictions under alternative B could result in some reductions in PWC revenues, and alternative C would reduce PWC related revenues. However, given the relatively low levels of PWC use at Lake Meredith, impacts on the local and regional economies are not expected to be measurable.

NATIONAL RECREATION AREA MANAGEMENT AND OPERATIONS

CONFLICT WITH STATE AND LOCAL PWC ORDINANCES AND POLICIES

Boating regulations are enforced by NPS rangers and Texas Parks and Wildlife officers. The Coast Guard Auxiliary also patrols the lake, but has no enforcement authority. The national recreation area has adopted the state PWC regulations. No local regulations affect PWC operations within the recreation area. PWC users at the recreation area would be required to follow all applicable state regulations, as well as NPS regulations.

Impacts related to conflicts with state and local ordinances have been analyzed qualitatively using professional judgment to define thresholds or impact magnitude.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. Under this alternative NPS rangers and Texas Parks and Wildlife officers would enforce all state regulations within the national recreation area, and there would be no conflicts between park regulations and other regulations. Impacts for alternative A would be negligible since no conflicts with state regulations would occur.

Cumulative Impacts. Cumulative impacts would be negligible under this alternative since management of PWC and boating use would not be in conflict with any agency, state, or local regulations.

Conclusion. PWC and boating regulations within the national recreation area would be the same as state regulations. Continued PWC use under alternative A would not result in conflicts with state regulations. Therefore, impacts (including cumulative impacts) would be negligible.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC use under alternative B would be managed under current state regulations, with additional management restrictions. These additional restrictions would include establishing no-wake zones in lake arms and back coves, and prohibiting fueling on the lake (except at the marina fuel dock) and carrying extra fuel onboard. These restrictions are within the National Park Service's right to regulate activities that can adversely affect resources within the recreation area. The additional restrictions would be more restrictive than state PWC regulations, but they would not conflict with state provisions or jurisdiction. Therefore, impacts related to conflicts with federal, state, or local requirements or policies would be negligible.

Cumulative Impacts. Cumulative impacts would be negligible under this alternative since management of PWC use would not be in conflict with any agency, state, or local regulations. Impacts related to conflicts with federal or state requirements or policies would be negligible.

Conclusion. PWC use restrictions under alternative B would not result in conflicts with state PWC regulations or policies. Impacts (including cumulative impacts) related to conflicts with federal or state requirements or policies would be negligible.

Impacts of the No-Action Alternative — No PWC Use

Analysis. The no-action alternative would ban PWC use within the recreation area, in accordance with the National Park Service's right to regulate the types of activities that take place under its jurisdiction. Texas does not currently ban PWC use at any locations within Lake Meredith, but it does define regulations guiding how PWC can be operated. State PWC regulations do not have provisions that forbid additional controls or bans, thus the implementation of additional restrictions would not be in conflict with state regulations or policies. The no-action alternative would not be in conflict with federal or state regulations or polices, and conflicts would be negligible.

Cumulative Impacts. Other waterbodies in the vicinity of the recreation area are subject to state PWC regulations. Implementation of the no-action alternative would not be in conflict with any agency policies or state regulations. Cumulative impacts relating to regulation conflicts would be negligible.

Conclusion. Discontinuing PWC use within the national recreation area would not result in conflict with state PWC regulations and there are no local PWC regulations. Therefore, impacts (including cumulative impacts) related to such conflicts would be negligible.

IMPACT TO PARK OPERATIONS FROM INCREASED ENFORCEMENT NEEDS

Director's Order #9: Law Enforcement Program (NPS 2000a), in conjunction with *Reference Manual 9: Law Enforcement,* establishes and defines standards and procedures for NPS law enforcement. Along with education and resource management, law enforcement is an important tool in achieving this mission. Commissioned rangers perform resource stewardship, education, and visitor use management activities, including law enforcement. They provide for tranquil, sustainable use and enjoyment of park resources while simultaneously protecting these resources from all forms of degradation. The objectives of the law enforcement program are to (1) prevent criminal activities through resource education, public safety efforts, and deterrence, (2) detect and investigate criminal activity, and (3) apprehend and successfully prosecute criminal violators.

Impacts to park operations from increased enforcement needs have been analyzed qualitatively using professional judgment to define thresholds or impact magnitude.

Impacts of Alternative A — Continue PWC Use under a Special NPS Regulation

Analysis. Boating regulations are enforced by both NPS rangers and Texas Parks and Wildlife officers. Lake Meredith National Recreation Area currently has six permanent law enforcement staff and one seasonal staff member. On weekends NPS patrols are routinely on the lake 8 hours a day, while weekday patrols are more sporadic, with no set number of hours. On holidays park staff members maintain full lake coverage from early morning until well after dark, and two other permanent law enforcement rangers assist with enforcement activities. Texas Park and Wildlife patrols consist of one to six officers on summer weekends for 10 to 16 hours per day, and 4 hours per day on weekdays. Also, Coast Guard Auxiliary officers (no enforcement authority) provide additional patrols on holidays and busy weekends. An interagency scuba team conducts underwater search and recovery when necessary.

Between 1997 and 2001 Lake Meredith park staff issued 122 written violation notices to PWC users, conducted 5 search-and-rescue operations for personal watercraft, and towed 12 personal watercraft. In the same time period 6 PWC-related accidents and one injury occurred. Proactive boat patrols in the past five years have resulted in increased safety. According to park staff, the current level of enforcement dedicated to water-based recreation is not adequate. At least one additional full time permanent staff member is necessary to provide quality law enforcement for the park and more control of PWC operations (Briggs, NPS, pers. comm., L. Pine, URS, Oct. 3, 2002). Therefore, this alternative would have moderate adverse impacts on park operations.

Cumulative Impacts. Park staff would continue to provide assistance to the various user groups to resolve conflicts and ensure safety. According to park staff, existing park operations are not sufficient to adequately monitor and assist current visitors. One additional permanent staff member would be required to meet existing and future (2012) needs. The staffing requirements to implement the PWC restrictions would be adequate for handling cumulative impacts related to park operations.

Conclusion. This alternative would have moderate adverse impacts on park operations. Additional staff would be needed to regulate existing PWC use.

Impacts of Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions

Analysis. PWC use under alternative B would be managed under state regulations, with additional NPS management restrictions. The additional restrictions would include only allowing PWC fueling at the marina fuel dock or onshore out of the water, prohibiting the carrying of extra fuel, and establishing no-wake zones in lake arms and back coves. This alternative would require increased education and enforcement actions by park staff. Additional buoys would have to be placed to indicate the new no-wake zones. Park staff would have to monitor the new no-wake zones and PWC fueling practices, but enforcement needs would decrease as visitors adjusted to the new restrictions. Enforcement activities could be completed using the existing boat patrols and one additional staff member. Therefore, this alternative would have moderate adverse impacts on park operations.

Cumulative Impacts. Cumulative impacts would be similar to those described for alternative A. Current staffing levels and boat patrol frequency are not adequate to enforce existing regulations. One

additional permanent staff member would be required to meet existing and future (2012) needs. The staffing requirements to implement the PWC restrictions would be adequate for handling cumulative impacts related to park operations.

Conclusion. Similar to alternative A, this alternative would have moderate adverse impacts on park operations. More staff would be needed to ensure full compliance with PWC and use restrictions in the lake, and park staff would have to spend more time initially enforcing and educating visitors about the new regulations.

Impacts of the No-Action Alternative — No PWC Use

Analysis. Prohibiting PWC operation within Lake Meredith National Recreation Area would eliminate potential conflicts between PWC recreationists and other user groups, but park staff would have to initially increase visitor educational and enforcement programs. Signs would be posted at the boat launch sites to indicate PWC use restrictions. Information programs would also be required at the most popular launch sites in order to ensure compliance. Enforcement actions to ensure that PWC use restrictions were not violated could be completed using the existing boat patrols, with the anticipation that PWC users would sometimes operate illegally within the recreation area. To ensure full compliance with the ban, daily boat patrols would be required. This could be accomplished through one additional permanent staff member.

Cumulative Impacts. Cumulative impacts would be similar to alternative A. Even with a ban on PWC use, existing staff and boat patrol frequency are not adequate to enforce current regulations. One permanent staff member would be required to meet existing and future (2012) needs.

Conclusion. This alternative would have moderate adverse impacts on park operations. More staff would be needed to ensure compliance with the PWC ban.

UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts are impacts that cannot be avoided and cannot be mitigated, and therefore would remain throughout the duration of the action. The following list describes potential adverse impacts related to the alternatives being considered:

- PWC use would continue to cause pollutant emissions into national recreation area water and air under alternatives A and B. These impacts would decrease in the long term due to the required improvements in engine emission technology.
- PWC use and landing along the shoreline under alternatives A and B would have adverse impacts to the park's natural soundscape and could occasionally cause flight response in wildlife that are present along the shore.
- Shoreline vegetation could be adversely affected by PWC users landing their craft under alternatives A and B and walking along the shore. These impacts would not be noticeable and would not cause long-term changes in vegetation.
- Continued PWC use under alternatives A and B would have adverse impacts on the experiences of other visitors, through occasional noise and visual intrusions. Under the no-action alternative, PWC users who could no longer ride within the national recreation area would be adversely affected.

- Continued PWC use under alternatives A and B could result in minor impacts to archeological sites, submerged cultural resources, and ethnographic sites by providing additional access and the potential for illegal collection, destruction, or disruption of activities related to ethnographic resources.

LOSS IN LONG-TERM AVAILABILITY OR PRODUCTIVITY TO ACHIEVE SHORT-TERM GAIN

As noted above, some resources would be degraded to some extent with the implementation of either alternative A or B. None of these resources would be impacted to the degree of "impairment" or long-term permanent loss.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irretrievable commitments of resources are those that can be reversed, that is, the commitment of a renewable resource or the short-term commitment of any resource. These include the commitment of water quality and air quality by allowing all mobile sources desiring to do so, including PWC, to continue using the national recreation area under alternatives A and B. The use of fossil fuels to power PWC would be an irretrievable commitment of this resource; however, this use is minor.

CONSULTATION AND COORDINATION

PUBLIC SCOPING COMMENTS

Park staff used a press release and a newsletter to announce and describe the PWC planning process and to solicit public input. The press releases were distributed on August 6, 2002, to the following media outlets:

- Eagle Press
- Canton News
- Pampa News
- Moore County News
- Borger News Harold
- Amarillo Global News

COMMENTS RECEIVED PRIOR TO THE NEWSLETTER

A total of 977 comments were received supporting continued PWC use on Lake Meredith. Comments ranged from a large number of petition signatures with the heading "do not ban personal watercraft" to letters and notes stating that the authors were not in favor of banning personal watercraft. Summary of comments received (all comments are paraphrased except for the one that is in quotation marks):

- It would be unfair to ban one type of boat over another type of boat.
- There is no environmentally hazardous activity going on at Lake Meredith.
- Spent all kinds of money for our personal watercraft and it would be unfair to ban them.
- Jet skis don't pollute as much as some other boats do.
- Why single out only one type of boat, other boats have 2-cycle engines too.
- Start enforcing the laws that are already on the books.
- Responsible PWC owners should not be penalized for the actions of irresponsible PWC owners.
- Would like to suggest that certain areas be set aside for jet skis only.
- Rights as a tax payer are being infringed upon by this possible ban.
- Environmental groups who have never even been to Lake Meredith should not be allowed to eliminate legitimate recreation activities in our State.
- "I feel that as a Texan and a United States citizen I should be able to take my personal watercraft on Lake Meredith."
- Don't think personal watercraft should be banned
- Don't ban jet skis on the largest lake in the area.

Six comments were received against continuing PWC use:

- Concern that continuing PWC use will violated the Park Service's Organic Act mandate by impairing park resources.
- Strongly support totally banning jet skis.
- Personal watercraft are very noisy.
- There are more accidents with personal watercraft than other boats.
- Personal watercraft pollute waters of Lake Meredith.

COMMENTS RECEIVED ON THE AUGUST 2002 SCOPING NEWSLETTER

A mailing list of individuals and groups likely to be interested in PWC use at the park was used to distribute the August 2002 newsletter. This list was compiled from the mailing list currently maintained by the Lake Meredith National Recreation Area staff. The list contains 361 names, including the federal, state, local agencies, environmental groups, and American Indian tribes listed on page 142.

The scoping newsletter asked the following two questions.

- Do you feel that personal watercraft use at Lake Meredith should continue, and if so what additional resource protection and visitor safety management would you consider, if any?
- In addition to the ideas presented in alternative B, do you have any other suggestions?

Alternative A — Implement a Special Regulation to Continue PWC Use as Currently Managed

A total of 133 comments were received, many of which were identical and were in support of alternative A. Based on their comments these people seemed to object to alternative B because personal watercraft would be banned from back coves but other boats would not be. (However, no-wake zones would apply to all watercraft.) Comments are summarized below:

- As responsible PWC owners, we should be able to go where other boats go on the lake.
- Any regulations regarding resource protection should address all boats, not just personal watercraft.
- If no-wake zones are implemented, they should apply to all boats, not just personal watercraft.
- Strongly support user education for PWC owners, including more information such as maps, safe riding techniques, and other boater education materials.

Alternative B — Implement a Special Regulation to Continue PWC Use with Additional Management

Altogether 18 comments were received. Alternative B as presented in the newsletter had a provision to require that by 2015 all personal watercraft would have to meet the EPA emissions standards (see page 31 for an explanation of why this management strategy was dropped from further consideration). All comments were in favor of alternative B; however, it was apparent that some did not totally understand this alternative as their comments did not relate to any of the management strategies listed. Comments are summarized below:

- "A real enforced application of Alternatives A + B is much preferable to a total ban."

- Might want to consider allowing jet skis only on Fridays and Saturdays.
- Alternative B is a great idea, suggest regulating them as to how many are on the lake at any one time.
- No-wake zones should apply to all boats.
- Strongly support user education for PWC owners, including more information such as maps, safe riding techniques, and other boat education materials.
- The ban of personal watercraft on the lake is a very bad idea
- Two-stroke engines on a bass boat will pollute just as much as a one on a personal watercraft.
- "Alternative B provides a reasonable expansion of visitor safety and resource protection beyond what is currently in place on the lake."
- Suggest increased enforcement of current PWC regulations.
- Support a process wherein the use of personal watercraft at Lake Meredith National Recreation Area is evaluated in the context of other activities, including other motorized boating. Would be very arbitrary and discriminatory to single out personal watercraft for unique restrictions.
- Like alternative B method as compared to having no PWC access at all.
- Many PWC users are already in compliance with 2006 EPA standards.

No-Action Alternative — No Special Regulation Would Be Implemented to Continue PWC Use

Twenty-six comments were received on this alternative, many of which were standardized and from people not living in Texas.

- Concern that continuing PWC use will violate the Park Service's Organic Act mandate by impairing park resources.
- Strongly support the no-action alternative, which would essentially ban PWC use at Lake Meredith.
- Research indicates that new "cleaner and quieter" personal watercraft are still causing significant damage to the environment and wildlife.
- Courts consistently rule that the NPS Organic Act requires the Park Service to leave the resources and wildlife of the park system "unimpaired" for future generations.

COMMENTS FROM THE UNITED STATES CONGRESS

On March 21, 2001, Congressman Mac Thornberry from the 13th District of Texas sent a letter to Secretary of the Interior Gale Norton. In the letter he expressed his concern about the banning of personal watercraft at Lake Meredith. He also indicated that he was writing at the request of hundreds of owners of personal watercraft in the Texas Panhandle who felt that they would be adversely affected by any PWC ban.

CONSULTATION WITH INDIAN TRIBES

Letters requesting comments were sent to:

- Wichita and Affiliated Tribes
- Kiowa Indian Tribe of Oklahoma
- Comanche Indian Tribe, Oklahoma
- Cheyenne-Arapaho Tribe, Oklahoma
- Caddo Indian Tribe of Oklahoma
- Jicarilla Apache Tribe, NM
- Mescalero Apache Tribe, NM
- Apache Tribe of Oklahoma
- Fort Sill Apache Tribe of Oklahoma

To date no comments have been received from any of the Indian Tribes.

CONSULTATION WITH OTHER AGENCIES

In accordance with the Endangered Species Act, the U.S. Fish and Wildlife Service was consulted about the presence of threatened, endangered, and candidate species, as well as species of concern within the area of PWC use in Lake Meredith National Recreation Area. Their response is included in appendix C. The Texas Department of Natural Resources was also contacted to determine if state listed rare species and unique natural features are present in the area of PWC use; no response had been received from them at the time this document was printed.

A copy of this document will be provided to the Texas State Historic Preservation Office for review and comment, and consultation with that office will be completed upon issuance of this environmental assessment to the public.

REVIEWING AGENCIES FOR THE ENVIRONMENTAL ASSESSMENT

The following agencies and organizations will be sent a copy of this *Environmental Assessment:*

Federal Agencies

Department of the Army
  Corps of Engineers
Department of the Interior
  Bureau of Land Management
  Bureau of Reclamation
  U.S. Fish and Wildlife Service
Department of Transportation
  U.S. Coast Guard Auxiliary

Native American Tribes

Apache Tribe of Oklahoma
Caddo Tribe of Oklahoma
Cheyenne-Arapaho Tribe
Comanche Tribe of Oklahoma
Fort Sill Apache Tribe of Oklahoma
Jicarilla Apache Tribe
Kiowa Tribe of Oklahoma
Mescalero Apache Tribe
Wichita and Affiliated Tribes

State Agencies

Texas Advisory Council on Historic Preservation
Texas Archaeological Society
Texas Historical Commission
Texas Natural Resources
Texas General Land Office
Texas Parks and Wildlife

Canadian River Municipal Water Authority
Red River Water Authority

Local and Regional Agencies

City of Lubbock Water Utilities
Groundwater Conservation District #3
Hutchinson County Historical Commission
Panhandle Regional Planning Center
Panhandle Archaeological Society

Organizations

Archeology Conservancy
Bluewater Network
National Wild Turkey Federation
Personal Watercraft Industry Association
PWC Watch
Texas Nature Conservancy
Texas Panhandle Audubon
Wilderness Society

APPENDIX A: SECTIONS OF THE SUPERINTENDENT'S COMPENDIUM RELATING TO PWC USE

In accordance with regulations and the delegated authority provided in Title 36, *Code of Federal Regulations* ("36 CFR"), Chapter 1, Parts 1-7, authorized by Title 16, *United States Code,* Section 3, the following regulatory provisions are established for the proper management, protection, government and public use of those portions of Lake Meredith National Recreation Area under the jurisdiction of the National Park Service. Unless otherwise stated, these regulatory provisions apply in addition to the requirements contained in 36 CFR, Chapter 1, Parts 1–7.

I. 36 CFR §1.5 – VISITING HOURS, PUBLIC USE LIMITS, CLOSURES, AND AREA DESIGNATIONS FOR SPECIFIC USE OR ACTIVITIES

(a)(1) The following visiting hours and public use limits are established for all or for the listed portions of the park, and the following closures are established for all or a portion of the park to all public use or to a certain use or activity:

- Closed to public access
  - Canadian River Municipal Water Authority structures and facilities.
  - Waters of Lake Meredith within 750 feet of the intake tower.
  - The pond below the Canadian River Municipal Water Authority pumping station.
  - The steel devices at the Marina at Lake Meredith extending from the marina slip to the Lake shoreline and commonly referred to as "stiff-arms".
  - Alibates Flint Quarries National Monument except for NPS guided programs or by authorization of the Superintendent.
  - Backcountry areas across the Canadian River at the Mullinaw Crossing are closed to access by motor vehicle(s).
  - Mullinaw Crossing maybe closed due to:
    - periods of high fire danger
    - periods of high water, inclement weather and other conditions that threaten visitor safety during hunting season
    - improvement of public hunting or when necessary to protect and improve the natural resource.
    - a determination that closure is necessary to protect wildlife numbers from over harvest or other threats to optimum population numbers.

- Public Use Limits:
  - The stilling basin below the Sanford Dam is closed to all boating and hunting use including the use of any vessel or device propelled by hand, sail, or machinery or rigid or inflatable vessel.
  - During the Annual Small Fry Fishing Tournament fishing will be restricted to registered participants only.

* * *

(a)(2) The following areas have been designated for a specific use or activity, under the conditions and/or restrictions as noted:

- Camping:

- No person shall be permitted to camp at any location within the Lake Meredith National Recreation Area for more than 14 days in a calendar year.
- Camping and picnic sites shall not be reserved. These sites will be occupied on a first come first serve basis.
- Camping is prohibited in all parking lots and the swimming beach at Spring Canyon and launching ramps, except camping is authorized in the lower parking lot at Cedar Canyon.
- Camping is permitted on the lakeshore.

* * *

- All devices capable of flotation with a person aboard or of transporting a person on or through the water, including sailboards but excluding aircraft, must comply with the following requirements: no person may use such device, or permit the use of such a device on the waters of Lake Meredith National Recreation Area unless it is equipped with a U.S. Coast Guard approved PFD of a wearable type for each person aboard or being transported. Each PFD must be serviceable, readily accessible, and of the proper size for the person intended. This requirement shall not apply to such devices being used along the shoreline in an area, or in a manner, consistent with use for typical recreational swimming. This requirement shall apply to such device being used in an area that causes them to be in company with motor boats being operated above idle speed.

III. GENERAL REGULATIONS

36 CFR §2.3 – FISHING

(d)(8) Fishing within 200 feet of the following swimming beaches, surfing areas, public boat docks, rafts or floats for water sports, or from motor road bridges is permitted:

- All launch ramp courtesy docks are open to fishing except when being used by vessels and/or pedestrian traffic (i.e. lines must be brought in).

36 CFR §2.23 — RECREATION FEES

(b) Recreation fees, in accordance with 36 CFR part 71, are established for the following:

Daily Site Use Fee Areas: Lake Meredith National Recreation Area requires a boat permit on all vessels that require state registration. $40.00 annual permit good from January 1st to December 31st , $10.00 for three consecutive days or a $4.00 per day permit. Golden Age or Golden Access Passports are honored.

(c) The collection of recreation fees will be suspended during the following periods:

- National Park Free Fee Day

36 CFR §3.6 — BOATING OPERATIONS

(h) The following areas/sites are designated for the launching of vessels:

- Harbor Bay Launch Ramp
- Fritch Fortress Launch Ramp
- Cedar Canyon Launch Ramp
- Marina Launch Ramp
- Blue West Launch Ramp

- Alibates Launch Ramp
- Plum Creek Launch Ramp
- Undeveloped launch ramps: Bugbee, Chimney Hollow and Dolomite Point .

(l) Vessels must meet the following size, length or width restrictions:

- Under 75 feet in length. Total length will be determined straight line measurement from the foremost part of the vessel to the aft most park of the vessel, measured end to end over the deck, and measured parallel to the centerline, with all appurtenances, (excluding gangplanks) in a fully extended position.
- Under 22 feet beam. Total beam will be determined by a straight-line measurement from the outer most sides of the vessel at its widest point with all appurtenances in a fully extended position.

36 CFR §3.20 — WATER SKIING

(a) The towing of persons by vessels is permitted in the following areas under the terms and conditions noted:

- Upon the waters of Lake Meredith National Recreation Area in accordance with the provisions of 36 CFR 3.20(b)

36 CFR §3.21 — SWIMMING AND BATHING

(a)(1) The following areas are closed to swimming and bathing:

- Launching, docking or mooring areas.
- Waters below Sanford Dam except in the portion of the stilling basin designated as the Spring Canyon Swimming area.

(b) The use of glass containers is not permitted on the Spring Canyon Swimming beach.

36 CFR §3.23 — SCUBA AND SNORKELING

(a) SCUBA diving and snorkeling is permitted in the following swimming, docking, and mooring areas under the terms and conditions noted:

- Approved salvage or recovery operations under the provisions approved by the Superintendent specifying purpose, exact location, time and conditions of the dive.

36 CFR §3.24 — PERSONAL WATERCRAFT (PWC)

(b) PWC use is permitted in the following areas under the terms and conditions noted:

- Waters of Lake Meredith except
  - within 750 feet of the intake tower.
  - the Canadian River

APPENDIX B: APPROACH TO EVALUATING SURFACE WATER QUALITY IMPACTS

Objective

Using simplifying assumptions, estimate the minimum (threshold) volume of water in a reservoir or lake below which concentrations of gasoline constituents from PWC or outboards would be potentially toxic to aquatic organisms or humans. Using the estimated threshold volumes, and applying knowledge about the characteristics of the receiving waterbody and the chemical in question, estimate if any areas within the waterbody of interest may present unacceptable risks to human health or the environment.

Overall Approach

Following are the basic steps in evaluating the degree of impact a waterbody (or portion of a waterbody) would experience based on an exceedance of water quality standards / toxicity benchmarks for PWC- and outboard-related contaminants.

1. Determine concentrations of polycyclic aromatic hydrocarbons (PAHs), benzene, and methyl tertiary-butyl ether (MTBE) in gasoline (convert from weight percent to mg/L, as needed) and PAHs in exhaust. The half-life of benzene in water is five hours at 25°C (Verschuren 1983; US EPA 2001).
2. Estimate loading of PAHs, benzene, and MTBE for various appropriate PWC-hour levels of use for one day (mg/day)
3. Find/estimate ecological and human health toxicity benchmarks (risk-based concentrations [RBCs]) (micrograms per liter [µg/L]) for PAHs, benzene, and MTBE.
4. Divide the estimated loading for each constituent (µg) by a toxicity benchmark (µg/L) to determine the waterbody threshold volume (L) below which toxic effects may occur (convert liters to ac-ft).

Estimated reductions in hydrocarbon (HC) emissions from PWC and outboards will be substantially reduced in the near future, based on regulations issued by the U.S. Environmental Protection Agency and California Air Resources Board (see the estimated reductions on page 72).

Assumptions and Constants

Several assumptions must be made in order to estimate waterbody threshold volumes for each HC evaluated. Each park should have park-specific information that can be used to modify these assumptions or to qualitatively assess impacts in light of park-specific conditions of mixing, stratification, etc. and the characteristics of the chemicals themselves. The assumptions are as follows:

- BTEX (benzene, toluene, ethyl benzene, and xylene) are volatile and do not stay in the water column for long periods of time. Because benzene is a recognized human carcinogen, it is retained for the example calculations below and should be considered in each environmental assessment or environmental impact statement (Verschuren 1983; US EPA 2001).

- MTBE volatilizes slightly and is soluble in water. MTBE may accumulate in water from day to day, but this is not factored into the calculation and should be considered qualitatively in the assessment.
- PAHs volatilize slightly (depending on structure and molecule size) and may adhere to sediment and settle out of the water column or float to the surface and be photo-oxidized. They may accumulate in water from day to day, but this is not factored into the calculation and should be considered qualitatively in the assessment.
- The toxicity of several PAHs increases (by several orders of magnitude) when the PAHs are exposed to sunlight. This was not incorporated because site-specific water transparency is not known, and should be discussed qualitatively.
- The threshold volume of water will mix vertically and aerially with contiguous waters to some extent, but the amount of this mixing will vary from park to park and location to location in the lake, reservoir, river, etc. Therefore, although the threshold volume calculation assumes no mixing with waters outside the "boundary" of the threshold volume of water, this should be discussed in the assessment after the threshold volume is calculated. The presence or absence of a thermocline should also be addressed.
- Volume of the waterbody, or portion thereof, is estimated by the area multiplied times the average depth.

In addition to these assumptions, several constants required to make the calculations were compiled from literature and agency announcements. Gasoline concentrations are provided for benzene, MTBE and those PAHs for which concentrations were available in the literature. Constants used are:

- Gasoline emission rate for two-stroke PWC: 3 gal/hour at full throttle (CARB 1998)
- Gasoline emission rate for two-stroke outboards: estimated at approximately the same as for PWC for same or higher horsepower outboards (80–150 hp); approximately twice that of PWC for small (e.g. 15 hp) outboards. (Note: Assume total hours of use for the various size boats/motors, and that smaller 15 hp motors that exhaust relatively more unburned fuel would probably be in use for a much smaller amount of time than the recreational speedboats and PWC). This estimate is based on data from Allen et al. 1998 (Fig. 5). It is noted that other studies may show different results, e.g. about the same emissions regardless of horsepower, or larger horsepower engines having more emissions than smaller engines (e.g., CARB 2001); the approach selected represents only one reasonable estimate.
- 1 gallon = 3.78 liters
- Specific gravity of gasoline: 739 g/L
- 1 acre-foot = 1.234×10^6 L
- Concentration of benzo(a)pyrene (B[a]P) in gasoline: 2.8 mg/kg (or 2.07 mg/L) (Gustafson et al. 1997)
- Concentration of naphthalene in gasoline: 0.5% or 0.5 g/100 g (or 3,695 mg/L) (Gustafson et al. 1997)
- Concentration of 1-methyl naphthalene in gasoline: 0.78% or 0.78 g/100 g (or approx. 5,760 mg/L) (estimated from Gustafson et al. 1997)
- Concentration of benzene in gasoline: 2.5% or 2.5 g/100 g (or 1.85×10^4 mg/L) (Hamilton 1996)

- Concentration of MTBE in gasoline: 15% or 15 g/100 g (or approx. 1.10×10^5 mg/L) (Hamilton 1996). (Note: MTBE concentrations in gasoline vary from state to state. Many states do not add MTBE.)
- Estimated emission of B(a)P in exhaust: 1080 µg/hr (from White and Carroll, 1998, using weighted average B(a)P emissions from 2-cylinder, carbureted two-stroke liquid cooled snow mobile engine using gasoline and oil injected Arctic Extreme injection oil, 24-38:1 fuel:oil ratio. Weighted average based on percentage of time engine was in five modes of operation, from full throttle to idle).
- Estimated amount of B(a)P exhaust emissions retained in water phase = approximately 40% (based on value for B(a)P from Hare and Springer, quoted in North American Lake Management Society 2001).

Toxicity Benchmarks

A key part of the estimations is the water quality criterion, standard, or toxicological benchmark for each contaminant evaluated. There are no EPA water quality criteria for the protection of aquatic life for the PWC-related contaminants (US EPA 1999a). There are, however, a limited number of EPA criteria for the protection of human health (via ingestion of water and aquatic organisms). Chronic ecotoxicological and human health benchmarks for contaminants were acquired from various sources.

Ecological benchmarks for benzo(a)pyrene, naphthalene, and benzene are from *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision* (Suter and Tsao 1996). The ecological benchmarks for benzo(a)pyrene (0.014 µg/L) and benzene (130 µg/L) are Tier II Secondary Chronic Values in Table 1 of Suter and Tsao (1996), which were calculated using methods in the Great Lakes Water Quality Initiative (U.S. EPA 1993). The ecological benchmark for naphthalene (62 µg/L) is the EPA Region 4 chronic screening value (Table 3 of Suter and Tsao 1996). This screening value was chosen for use as a conservative mid-range value considering the wide range of chronic values for naphthalene (12-620 µg/L) shown in Suter and Tsao (1996). The ecological benchmarks for 1-methyl naphthalene (19 and 34 µg/L) are based on LC_{50} values of 1900 and 3400 µg/L for the marine invertebrate, dungeness crab (*Cancer magister*), and the fresh water/estuarine fish, sheepshead minnow (*Cyprinodon variegatus*) (USFWS 1987). The MTBE benchmarks of 18,000 and 51,000 µg/L are for marine and fresh water, respectively and are based on the preliminary chronic water quality criteria presented in Mancini et al. (2002).

State water quality standards (including the numeric standards and descriptive text) must be reviewed and applied, as appropriate for each park being evaluated. Be sure to use the standards or criteria that fit the designated uses for the waters in the park – e.g., is it designated as a drinking water source or used only for support of aquatic life (fishing)? This will determine whether you use a "water plus organism" benchmark or the benchmark for ingestion of aquatic organisms only. Also be sure you are using the correct benchmark for either freshwater or marine/estuarine locations if there are different numbers provided for these two environments. Following are the toxicity benchmarks for the PAHs, benzene, and MTBE having gasoline concentration information:

Chemical	Ecological Benchmark (µg/L)	Source	Human Health Benchmark** (µg/L)	Source
Benzo(a)pyrene	0.014	Suter and Tsao 1996	0.0044** 0.049***	US EPA 1999a
Naphthalene	62	Suter and Tsao 1996	--	--
1-methyl naphthalene	19–34*	USFWS 1987	--	--

Chemical	Ecological Benchmark (µg/L)	Source	Human Health Benchmark** (µg/L)	Source
Benzene	130	Suter and Tsao 1996	1.2** 71***	US EPA 1999a**
MTBE	18,000 53,000	Mancini et al. 2002	13****	--

* Based on LC_{50}s of 1900 and 3400 µg/L for dungeness crab and sheepshead minnow, respectively (34 µg/L used for freshwater calculations; 19 µg/L used for marine and estuarine calculations).

** Based on the consumption of water and aquatic organisms.

*** Based on the consumption of aquatic organisms only.

**** Ecological benchmarks considered preliminary chronic water quality criteria for marine and freshwater, respectively. Human health toxicological information for MTBE is currently under review. There is no EPA human health benchmark, but California has established a public health goal of 13 µg/L, which is used in the calculations below.

Example Calculations

Calculations of an example set of waterbody volume thresholds are provided below for the chemicals listed above together with their concentrations in gasoline and available toxicity benchmarks.

Loading to Water

Loadings of the five contaminants listed above are calculated for one day assuming 10 PWC operate for four hours (40 PWC-hours), each discharging 11.34 L gasoline per hour and having concentrations in fuel or exhaust as listed.

Benzo(a)pyrene (from the fuel): 40 PWC-hrs × 11.34 L gas/hr × 2.07 mg/L = 939 mg

Benzo(a)pyrene (from the gas exhaust): 40 PWC-hrs × 1080 µg/hr × 1/1000mg/µg × 0.40 = 17 mg

Total B(a)P = 956 mg

Naphthalene: 40 PWC-hrs × 11.34 L gas/hr × 3695 mg/L = 1.68×10^6 mg

1-methyl naphthalene: 40 PWC-hrs × 11.34 L gas/hr × 5764 mg/L = 2.62×10^6 mg

Benzene: 40 PWC-hrs × 11.34 L gas/hr × 1.85×10^4 mg/L = 8.39×10^6 mg

MTBE: 40 PWC-hrs × 11.34 L gas/hr × 1.10×10^5 mg/L = 4.99×10^7 mg

Loadings of contaminants from two-stroke outboards should be estimated based on the estimated loading based on the horsepower of the outboards involved (see "Assumptions and Constants" above) and the estimated hours of use, based on the types of boats and the pattern of use observed.

Threshold Volumes

Threshold volumes of water (volume at which a PWC- or outboard-related contaminant would equal the thresholds listed above) are calculated by dividing the estimated loadings (mg of contaminant) for the number of operational hours (e.g., 40 PWC-hours) by the listed toxicity benchmark concentrations (µg/L), correcting for units (1 mg = 10^3 µg), and converting from liters to acre-feet (1 acre-foot = $1.234 \text{ X } 10^6$ L):

Protection of Aquatic Organisms

Benzo(a)pyrene: 956 mg B(a)P × 10^3 µg/mg / 0.014 µg/L = 6.8×10^7 L or 55 ac-ft

Naphthalene: 1.68×10^6 mg naphthalene $\times 10^3$ µg/mg / 62 µg/L = 2.71×10^7 L or 22 ac-ft

1-methyl naphthalene: 2.62×10^6 mg 1-methyl naphthalene. $\times 10^3$ µg/mg / 34 µg/L = 7.69×10^7 L or 62 ac-ft

Benzene: 8.39×10^6 mg benzene $\times 10^3$ µg/mg / 130 µg/L = 6.45×10^7 L or 52 ac-ft

MTBE (chronic): 4.99×10^7 mg MTBE $\times 10^3$ µg/mg / 18,000 µg/L = 2.77×10^6 L or 2.2 ac-ft

MTBE (acute): 4.99×10^7 mg MTBE $\times 10^3$ µg/mg / 53,000 µg/L = 9.42×10^5 L or 0.76 ac-ft

Based on these estimates and assumptions, 1-methyl naphthalene appears to be the contaminant (of those analyzed) that would be the first to accumulate to concentrations potentially toxic to aquatic organisms (i.e., it requires more water [62 ac-ft] to dilute the contaminant loading to a concentration below the toxicity benchmark); however, the threshold volumes are very similar among 1-methyl naphthalene, benzo(a)pyrene, and benzene.

Protection of Human Health

Benzo(a)pyrene: 956 mg B(a)P $\times 10^3$ µg/mg / 0.0044 µg/L = 2.17×10^8 L or 176 ac-ft

Benzene: 8.39×10^6 mg benzene $\times 10^3$ µg/mg / 1.2 µg/L = 6.99×10^9 L or 5,670 ac-ft

Note: If CA public health goal of 13 µg/L used: *MTBE:* 4.99×10^7 mg MTBE $\times 10^3$ µg/mg / 13 µg/L = 3.83×10^9 L or 3,110 ac-ft

The California public health goal for MTBE is a drinking water–based goal and is not directly comparable to the other criteria used in this analysis. However, it may be of interest, since MTBE is very soluble, and MTBE concentration could be an issue if the receiving body of water is used for drinking water purposes and MTBE is not treated. Using the numbers provided above, benzene would be the first PWC-related contaminant in these example calculations that would reach unacceptable levels in surface water; however, volatilization of benzene from water to air was not included in the calculation. MTBE would be the next contaminant to reach unacceptable concentrations. If human health water quality criteria for ingestion of aquatic organisms only were used for benzo(a)pyrene and benzene (0.049 µg/L and 71 µg/L, respectively), the corresponding threshold volumes would be 15.8 acre-feet and 95.8 acre-feet.

As a result of the estimated reductions in HC emissions (from the unburned fuel) in response to EPA regulations (listed above), additional PWC and/or outboards may be used in the parks without additional impacts to water quality. For example, based on the expected overall reductions from EPA (1996, 1997), up to 75% additional PWC/ outboards may be used in a given area in 2025 without additional impacts to water quality over current levels. Effects on noise levels, physical disturbance, or hydrocarbon emissions that are products of combustion (e.g., B(a)P) may not be similarly ameliorated by the reduced emission regulations.

Application of Approach

Use of the approach described above for evaluating possible exceedance of standards or other benchmarks must be adapted to the unique scenarios presented by each park, PWC use, and waterbody being evaluated. *State water quality standards (including the numeric standards and descriptive text) must be reviewed and applied, as appropriate.*

Factors that would affect the concentration of the contaminants in water must be discussed in light of the park-specific conditions. These factors include varying formulations of gasoline (especially for MTBE); dilution due to mixing (e.g., influence of the thermocline), wind, currents, and flushing; plus loss of the chemical due to volatilization to the atmosphere (Henry's Law constants can help to predict volatilization to air; see Yaws et al. 1993); adsorption to sediments and organic particles in the water column (e.g., PAHs), oxidation, and biodegradation (breakdown by bacteria). Toxicity of phototoxic PAHs may be of concern in more clear waters, but not in very turbid waters.

The chemical composition of gasoline will vary by source of crude oil, refinery, and distillation batch. No two gasolines will have the exact same chemical composition. For example, B(a)P concentrations may range from 0.19 to 2.8 mg/kg, and benzene concentrations may range from 0 to 7% (2%–3% is typical). MTBE concentrations will vary from state to state and season to season, with concentrations ranging from 0% to 15%. The composition of gasoline exhaust is dependent on the chemical composition of the gasoline and engine operating conditions (i.e., temperature, rpms, and oxygen intake). If site-specific information is available on gasoline and exhaust constituents, they should be considered in the site-specific evaluation. If additional information on the toxicity of gasoline constituents (e.g., MTBE) become available, they should be considered in the site-specific evaluation.

Lastly, results of the studies included in the collection of papers entitled "Personal Watercraft Research Notebook" provided by the NPS staff, can be used to provide some framework for your analysis. The following table summarizes some of the results presented in various documents on the collection for benzene, benzo(a)pyrene, and MTBE.

Table B-1: Pollutant Concentrations Reported in Water

Pollutant	Source(s)	Levels Found	
		"Lower Use" (e.g. open water, offshore locations; reduced motorized watercraft use)	"Higher Use" (e.g., nearshore, motorized watercraft activity high)
Benzene	*Lake Tahoe Motorized Watercraft Report* (Allen et al. 1998); several studies reported 1. USGS 2. Miller and Fiore 3. U of CA	1. <0.032 µg/l 2. ≤0.3 µg/l 3. <0.1 µg/l	1. 0.13 – 0.33 µg/l 2. just over 1 µg/l 3. 0.1 – 0.9 µg/l
PAHs	A. Mastran et al. B. Oris et al.	A. All below detection limits (<0.1 µg/l for pyrene and naphthalene; <2.5 µg/l for B(a)P, B(a)A, chrysene) B. Experiment #1 – 2.8 ng/l phototoxic PAHs	A. Total PAHs – up to 4.12 µg/l in water column; total PAHs – up to 18.86 µg/l in surface sample at marina, with naphthalene at 1 µg/l; B(a)P – ≥2.3 µg/l B. Experiment #1 – ± 45 ng/l photo-toxic PAHs; 5–70 ng/L total PAHs
MTBE	A. *Lake Tahoe Motorized Watercraft Report* (Allen et al. 1998); several studies reported 1. USGS 2. Miller and Fiore 3. U of CA 4. U of Nevada – Fallen Leaf Lake 5. Donner Lake (Reuter et al. 1998) B. NPS, VanMouwerik and Hagemann 1999 6. Lake Perris 7. Shasta Lake 8. 3-day Jet Ski event 9. Lake Tahoe	1. 0.11 – 0.51 µg/l 2. ≤3 µg/l 3. less than nearshore area 4. -- 5. <0.1 µg/l 6. 8 µg/l (winter)	1. 0.3 – 4.2 µg/l 2. 20 µg/l (up to approx. 31 µg/l) 3. up to 3.77 µg/l 4. 0.7 – 1.5 µg/l 5. up to 12 µg/l (Dramatic increase from 2 to 12 µg/l from July 4 to 7) 6. up to 25 µg/l 7. 9–88 µg/l over Labor Day weekend 8. 50–60 µg/l 9. often within range of 20–25 µg/l, with max of 47 µg/l

APPENDIX C: CONSULTATION WITH THE U.S. FISH AND WILDLIFE SERVICE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
WinSystems Center Building
711 Stadium Drive, Suite 252
Arlington, Texas 76011

2-12-03-I-044

November 7, 2002

Memorandum

To: Karren C. Brown, NPS, Lake Meredith National Recreation Area/Alibates Flint Quarries National Monument, Fritch, TX

From: Field Supervisor, FWS, Ecological Services, Arlington, TX

Subject: Preparation of Environmental Assessment for personal watercraft use at Lake Meredith National Recreation Area (D18)

This memorandum responds to your October 24, 2002, request for a list of federally threatened and endangered species and their critical habitats that could occur at Lake Meredith National Recreation Area in Hutchinson, Moore, and Potter Counties, Texas. The information provided by this office is necessary for the preparation of an Environmental Assessment for management policy regarding personal watercraft use at the park.

The following is a list of the threatened (T), endangered (E), proposed (P), and candidate (C) species that have been documented, or are known to occur in Hutchinson, Moore, and Potter Counties:

interior least tern (*Sterna antillarum*) - E, Hutchinson
whooping crane (*Grus americana*) - E, Potter
bald eagle (*Haliaeetus leucocephalus*) T, Hutchinson, Moore, Potter
Arkansas River shiner (*Notropis girardi*) T, Hutchinson, Potter
mountain plover (*Charadrius montanus*) PT, Potter
black-tailed prairie dog (*Cynomys ludovicianus*) C, Hutchinson, Moore, Potter

The Arkansas River shiner has designated critical habitat in Potter County. The critical habitat includes the Canadian River, as well as 300 feet on both sides of the river at bankfull width, from the Potter/Oldham County line to the confluence with Coetas Creek. Candidate species are currently being studied to assess the need to list them under the Endangered Species Act as threatened or endangered. Candidate species are not afforded federal protection under the Act; however, we recommend that potential impacts to these species be considered during project planning.

We appreciate the opportunity to provide information for the Environmental Assessment. If you have any questions, please contact Mr. Omar Bocanegra of this office at (817) 277-1100.

Craig M Pugh
Acting Field Supervisor

2

GLOSSARY

BTEX — benzene, toluene, ethylbenzene, and xylene

national ambient air quality standards (NAAQS) — Concentrations of criteria pollutants in ambient air (outdoor air to which the public may be exposed) below which it is safe for humans or other receptors to be permanently exposed. The Clean Air Act establishes two types of national air quality standards. **Primary standards** set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. **Secondary standards** set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

Nonroad model — An air quality emissions estimation model developed by the U.S. Environmental Protection Agency to estimate emissions from various spark-ignition type "nonroad" engines. The June 2000 draft of the nonroad model was used to estimate air pollutant emissions from PWC. It is available at <http://www.epa.gov/otaq/ nonrdmdl.htm>.

personal watercraft (PWC) — As defined in 36 CFR §1.4(a) (2000), refers to a vessel, usually less than 16 feet in length, which uses an inboard, internal combustion engine powering a water jet pump as its primary source of propulsion. The vessel is intended to be operated by a person or persons sitting, standing, or kneeling on the vessel, rather than within the confines of the hull. The length is measured from end to end over the deck excluding sheer, meaning a straight line measurement of the overall length from the foremost part of the vessel to the aftermost part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments, are not included in the measurement. Length is stated in feet and inches.

stilling basin — A 14-acre area formed by concrete structures at the upper end of the outlet channel, which is intended to carry water discharged from the spillway and flood control outlet works back to the river. The water level in the outlet channel is maintained by groundwater seepage when no releases have been made recently.

SUM06 — The cumulation of instances when measured hourly average ozone concentrations equal or exceed 0.06 part per million (ppm) in a stated time period, expressed in ppm-hours.

thermocline — The region in a thermally stratified body of water that separates warmer, oxygen-rich surface water from cold, oxygen-poor deep water. In a thermocline, temperature decreases rapidly with depth.

wake — Moving waves, track, or path that a boat leaves behind when moving across the waters.

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AWA	American Watercraft Association
CARB	California Air Resources Board
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration, U.S. Department of Transportation
IWL	Izaak Walton League of America
NALMS	North American Lake Management Society
NPS	National Park Service, U.S. Department of the Interior
NTSB	National Transportation Safety Board
ODEQ	Oregon Department of Environmental Quality
PWIA	Personal Watercraft Industry Association
SPMA	Southwest Parks and Monuments Association
TCEQ	Texas Commission on Environmental Quality
TNRCC	Texas Natural Resource Conservation Commission
TPWD	Texas Parks and Wildlife Department
TRPA	Tahoe Regional Planning Agency
USGS	U.S. Geological Survey, U.S. Department of the Interior

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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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