National Park Service
U.S. Department of the Interior

Pictured Rocks National Lakeshore
Michigan

PICTURED ROCKS NATIONAL LAKESHORE

Personal Watercraft Use Environmental Assessment

PICTURED ROCKS NATIONAL LAKESHORE

Personal Watercraft Use Environmental Assessment

July 2002

SUMMARY

Pictured Rocks National Lakeshore was authorized in 1966 and encompasses a 42-mile stretch of the Lake Superior shoreline on Michigan's Upper Peninsula. The lakeshore is noted for its multicolored sandstone cliffs, beaches, sand dunes, waterfalls, inland lakes, wildlife, and forested shoreline. Attractions include a lighthouse and former Coast Guard life-saving stations, along with old farmsteads and orchards. The lakeshore is a year-round recreational destination where hiking, camping, hunting, nature study, and winter activities abound. Personal watercraft (PWC) were first used in Lake Superior off the national lakeshore about 1990.

The purpose of and the need for taking action is to evaluate a range of alternatives and strategies for managing PWC use at Pictured Rocks National Lakeshore in order to ensure the protection of park resources and values while offering recreational opportunities as provided for in the national lakeshore'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 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 stunt-like maneuvers, and they are designed for speeds up to 70 mph. PWC recreation is the fastest growing segment of the boating industry, representing over one-third of total sales. 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 National Park Service had grouped personal watercraft with all vessels; thus, PWC use was allowed when the unit's superintendent's compendium allowed the use of other vessels. Later the 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 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 Park Service envisioned the servicewide regulation as an opportunity to evaluate impacts from PWC use before authorizing the use. On March 21, 2000, the National 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 National Park Service's decision to allow continued PWC use in 21 units while prohibiting PWC use in other units. In response to the suit, the National 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 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.

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, Pictured Rocks National Lakeshore closed for 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 the use of personal watercraft at Pictured Rocks National Lakeshore.

- Alternative A would continue PWC use as it is currently managed under a special NPS regulation in accordance with NPS *Management Policies 2001,* park practices, and state regulations.
- Alternative B would continue PWC use under a special regulation, but specific limits and use areas would be defined.
- The no-action alternative would eliminate PWC use entirely.

Based on the environmental analysis prepared for PWC use at Pictured Rocks National Lakeshore, alternative B is 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 of 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.* The *Director's Order #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 estab-

lished 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 considered a 10-year period (2002–2012).

TABLE A: SUMMARY OF THE IMPACT ANALYSIS

Impact Topic	Alternative A. Continue PWC Use as Currently Managed under a Special NPS Regulation	Alternative B. Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative
Water Quality	Negligible to minor adverse impacts. Cumulative effects: Negligible to moderate. By 2012 impacts reduced substantially through improved emission controls.	Negligible to minor adverse impacts. No impacts in the Beaver Basin segment. Cumulative effects: No impacts in the Beaver Basin segment; negligible to moderate impacts in other segments, with impacts reduced substantially by 2012 through improved emission controls (similar to alternative A).	Negligible to minor beneficial impacts from banning PWC use. Cumulative effects: No impacts from PWC use. Negligible to moderate adverse impacts from other uses, with impacts reduced substantially by 2012 through improved emission controls.
Air Quality			
•**Impacts to Human Health from Airborne Pollutants Related to PWC Use**	Negligible adverse impacts for all pollutants. Cumulative effects: Moderate short- and long-term impacts for CO; negligible impacts for other pollutants.	Negligible adverse impacts for all pollutants, with PWC use excluded in the Beaver Basin segment. Cumulative effects: Moderate short- and long-term impacts for CO; negligible impacts for other pollutants (similar to alternative A).	Negligible beneficial impacts from banning PWC use within the lakeshore. Cumulative effects: Minor to moderate short- and long-term impacts for CO; negligible impacts for other pollutants, but no contribution from PWC emissions within the lakeshore.
•**Impacts to Air Quality Values from Pollutants Related to PWC Use**	Negligible to moderate impacts. Cumulative effects: Negligible to moderate impacts; increased NO_x emissions would continue to contribute to ozone-related injury of plants.	Negligible to moderate impacts. Cumulative effects: Negligible to moderate impacts; increased NO_x emissions would continue to contribute to ozone-related injury of plants (similar to alternative A).	Negligible to moderate beneficial impacts because PWC use no longer be allowed within the lakeshore boundary. Cumulative effects: Negligible to moderate impacts (with ozone-related injury to plants), but no contribution from PWC emissions within the lakeshore.
Soundscape	Short-term, negligible impacts at most locations, and short-term, minor impacts near the Sand Point launch and at backcountry locations Cumulative effects: Minor impacts, with natural sounds predominating at most locations; highest sound impacts near the Sand Point boat launch facility.	Short-term, negligible impacts at most locations, and short-term minor impacts near the Sand Point launch (similar to alternative A). Negligible beneficial impacts from eliminating PWC use in the Beaver Basin segment since other motorized watercraft could still be heard but farther away and less frequently. Cumulative effects: Minor impacts, with natural sounds still predominating at most locations; highest sound impacts near the Sand Point launch facility (similar to alternative A).	Negligible to minor beneficial impacts from eliminating PWC use within the lakeshore. Cumulative effects: Minor impacts, particularly near the Sand Point launch, but no contribution to impacts from PWC use within the lakeshore.
Wildlife and Wildlife Habitat	Negligible impacts at most locations. Cumulative effects: Negligible to minor temporary impacts.	Negligible impacts at most locations; negligible beneficial impacts in the Beaver Basin segment. Cumulative effects: Negligible to minor temporary impacts (similar to alternative A).	Negligible beneficial impacts from eliminating PWC use within the lakeshore. Cumulative effects: Negligible to minor adverse impacts. with no contribution from PWC use within the lakeshore.

Impact Topic	Alternative A: Continue PWC Use as Currently Managed under a Special NPS Regulation	Alternative B. Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative
Threatened or Endangered Species or Species of Special Concern	No effect on piping plover and not likely to adversely affect other federal or state listed species. Cumulative effects: Not likely to adversely affect these species.	No effect on piping plover and not likely to adversely affect other federal or state listed species (similar to alternative A). Cumulative effects: Not likely to adversely affect these species.	No effect on federal or state listed species. Cumulative effects: Not likely to adversely affect these species; no PWC contribution to impacts.
Shoreline Vegetation	Negligible adverse impacts. Cumulative effects: Negligible impacts.	Negligible adverse impacts throughout most of the lakeshore, negligible beneficial impacts in the Beaver Basin segment. Cumulative effects: Negligible impacts.	Negligible, beneficial impacts as a result of banning PWC use. Cumulative effects: Negligible adverse impacts, but no contribution from PWC use in the lakeshore.
Visitor Experiences	Negligible to minor adverse impacts on experiences for most visitors; long-term moderate adverse impacts on those visitors desiring backcountry experiences but affected by PWC noise. Cumulative effects: Potential negligible adverse impacts since there would be little noticeable change in visitor experiences.	Negligible adverse impacts on visitor experiences in most areas; moderate, beneficial impacts from PWC restrictions in the Beaver Basin segment for visitors desiring backcountry experiences. Cumulative effects: Negligible, adverse impacts since there would be little noticeable change in visitor experiences.	Negligible beneficial impacts on the experiences of most lakeshore visitors because of banning PWC use. Moderate, adverse impacts on PWC users no longer able to ride in the lakeshore. Cumulative effects: Negligible, beneficial impacts for most visitors. Negligible adverse impacts to PWC use levels at other nearby waterbodies.
Visitor Conflicts and Safety	Minor adverse impacts in the Sand Point area due to the number of visitors and boats on high use days; negligible impacts at other locations. Cumulative effects: Negligible to minor impacts for all user groups, (minor near Sand Point; negligible in other segments).	Minor, adverse impacts in the Sand Point area due to the number of visitors and boats on high use days (similar to alternative A); negligible impacts at other locations. Negligible, beneficial impacts due to eliminating PWC use in the Beaver Basin segment. Cumulative effects: Negligible impacts for all user groups.	Minor, beneficial impacts by reducing visitor conflicts and enhancing safety. Cumulative effects: Negligible impacts, with no PWC-related contribution.
Cultural Resources (Archeological Sites, Submerged Cultural Resources, Ethnographic Resources)	Minor adverse impacts on potentially listed archeological sites and submerged cultural resources due to possible illegal collection and vandalism. Moderate, adverse impacts during the permitted use of ethnographic resources. Cumulative effects: Minor to major adverse impacts to archeological and submerged cultural resources due to the potential for illegal collection or destruction. Moderate adverse impacts during the permitted use of ethnographic resources.	Minor adverse impacts on potentially listed archeological sites and submerged cultural resources, but beneficial impact on those resources in the Beaver Basin segment. Due to boat patrols, minor, adverse impacts during the permitted use of ethnographic resources. Cumulative effects: Minor to major adverse impacts on archeological and submerged cultural resources (similar to alternative A). Due to additional boat patrols, minor adverse impacts during the permitted use of ethnographic resources.	Minor beneficial impacts on archeological sites, submerged resources, and ethnographic resources from prohibiting PWC use within the lakeshore. Cumulative effects: Minor to major impacts, depending on the accessibility of the resource and the potential for illegal collection or damage. Additional boat patrols could reduce the potential for such impacts, as well as intrusions during permitted uses of ethnographic resources.
Socioeconomic Effects	Negligible to minor economic / social impacts overall to user groups and businesses.	Minor to moderate economic / social impacts overall to user groups and businesses.	Minor to moderate economic / social impacts overall to user groups and businesses.
Conflicts with State and Local Regulations	Negligible impacts.	Negligible impacts.	Negligible impacts.
Preserve Operations	Moderate adverse impacts because more staff, funding, and equipment needed.	Moderate adverse impacts (similar to alternative A) because more staff, funding, and equipment needed to ensure full compliance with use restrictions in the Beaver Basin segment and during the permitted use of ethnographic resources.	Moderate adverse impacts because more staff, funding, and equipment needed to enforce no PWC use ban.

No natural or cultural resources would be impaired by implementing any of the alternatives being considered.

CONTENTS

Maps

Tables

PURPOSE OF AND NEED FOR ACTION

Pictured Rocks National Lakeshore was authorized in 1966 and encompasses a 42-mile stretch of the Lake Superior shoreline on Michigan's Upper Peninsula. The lakeshore is noted for its multicolored sandstone cliffs, beaches, sand dunes, waterfalls, inland lakes, wildlife, and forested shoreline. Attractions include a lighthouse and former Coast Guard life-saving stations, along with old farmsteads and orchards. The lakeshore is a year-round recreational destination where hiking, camping, hunting, nature study, and winter activities abound. Personal watercraft (PWC) were first used in Lake Superior off the national lakeshore about 1990.

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 stunt-like maneuvers, and they are designed for speeds up to 70 mph. PWC recreation is the fastest growing segment of the boating industry, representing over one-third of total sales.

The National Park Service (NPS) maintains that personal watercraft 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 the 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 use 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 the use and operation of personal watercraft (63 FR 49314). Similarly, various federal agencies, including the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Agency, have managed personal watercraft differently than other classes of motorized watercraft.

Specifically, the National Oceanic and Atmospheric Agency regulate 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.

---

* 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.

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 recognition of its duties under its Organic Act and its *Management Policies,* as well as increased awareness and public controversy, the National Park Service reevaluated its methods of PWC regulation. Historically, the National Park Service had grouped personal watercraft with all vessels; thus, people could use personal watercraft when the unit's superintendent's compendium allowed the use of other vessels. Later the 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, a private, independent, nonprofit organization, filed a petition urging the National Park Service to initiate the 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 use can occur but where the use 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 49312–17, Sept. 15, 1998).

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 15077–90, Mar. 21, 2000). 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 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 unit's 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 PWC 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 superintendents' compendiums, 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 can 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; Gateway National Recreation Area; Gulf Islands National Seashore; and Cape Lookout National Seashore. 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 managing PWC use at Pictured Rocks National Lakeshore in order to ensure the protection of park resources and values while offering recreational opportunities as provided for in the national lakeshore's enabling legislation, purpose, mission, and goals. Upon completion of the NEPA process, the National Park Service may either take action to adopt special NPS regulations by April 2002 to manage PWC use at Pictured Rocks National Lakeshore, or it may discontinue PWC use at this park unit, as allowed for in the March 2000 rule.

This environmental assessment evaluates three alternatives concerning the use of personal watercraft at Pictured Rocks National Lakeshore. The alternatives include:

- *Alternative A* — Continue PWC use as it is currently managed under a special NPS regulation in accordance with NPS *Management Policies 2001,* park practices, and state regulations.
- *Alternative B* — Continue PWC use under a special regulation but specifying limits and zones.
- *No-Action Alternative* — Eliminate PWC use entirely.

SCOPE OF THE ANALYSIS

Motorcraft and other watercraft use in Pictured Rocks National Lakeshore has occurred since the unit was established in 1966. PWC use started around 1990 and has been very limited (see Location map), with use estimated to be approximately 10% of all boating use in the national lakeshore. 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. However, while the

settlement agreement and need for action have defined the scope of this environmental assessment, NEPA regulations require 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). Therefore, the scope of this 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 PICTURED ROCKS NATIONAL LAKESHORE

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."

Pictured Rocks National Lakeshore's enabling legislation, its purpose and significance, and its broad mission goals are summarized in this section and are taken from the national lakeshore's *Strategic Plan* and the *Draft General Management Plan / Wilderness Study / Environmental Impact Statement.* In addition, the enabling legislation, purpose and significance, and management objectives are all linked to the impairment findings that are made through the NEPA process (as addressed in the "Environmental Consequences" chapter), as stated in NPS *Management Policies 2001* (sec. 1.4.5).

Establishment

> In order to preserve for the benefit, inspiration, education, recreational use, and enjoyment of the public a significant portion of the diminishing shoreline of the United States and its related geographic and scientific features . . . [Congress] establish[es] the Pictured Rocks National Lakeshore.

Administration, Protection, Development

> The administration, protection, and development of the Pictures Rocks . . . shall be exercised by the Secretary [of the Interior] subject to the provisions of sections 1, 2, 3, and 4 of this title. . . . [F]or the conservation and management of natural resources [the Secretary may use] . . . such authority [to] fulfill the purposes of this subchapter (16 USC 460s-5(a)).
>
> In the administration, protection, and development of the lakeshore the Secretary shall prepare and implement a land and water use management plan [including] . . . protection of scenic, management, and historic features contributing to public enjoyment (16 USC 460s-5(b)(2)-(3)).

Inland Buffer Zone

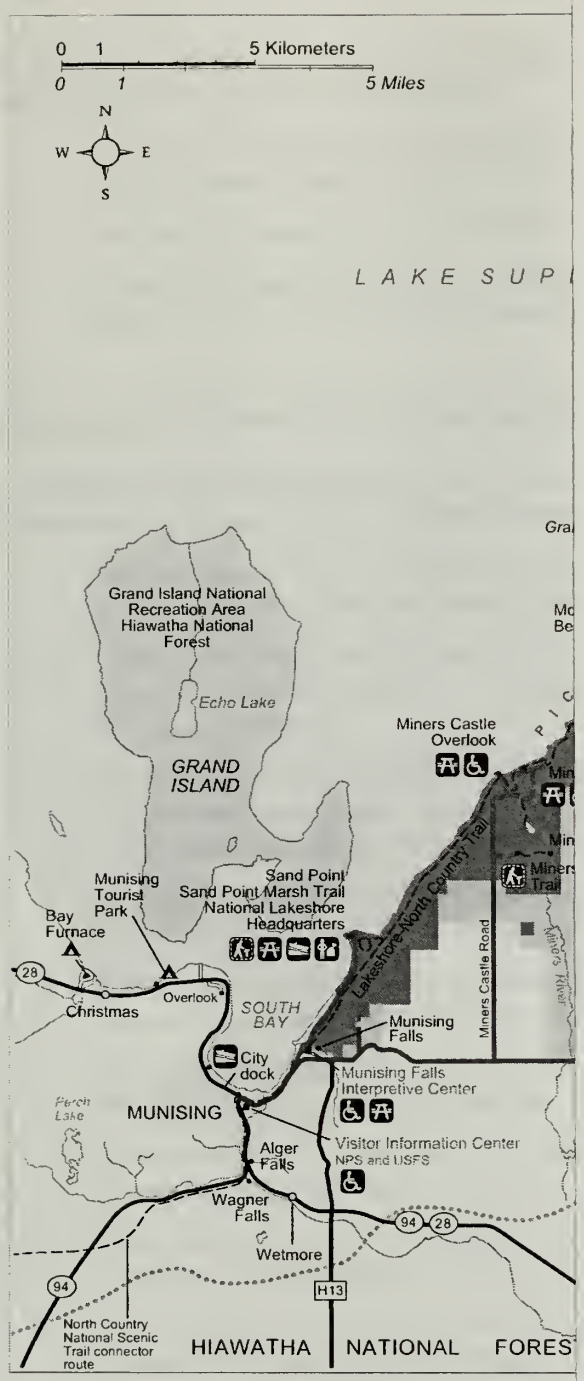
> The area . . . is established as an inland buffer zone in order to stabilize and protect the existing character and uses of the lands, waters, and other properties within the zone for the purpose of preserving the setting of the shoreline and lakes [and] protecting the watersheds and streams (16 USC 460s-8(a)).

According to park staff, the primary purpose of the inland buffer zone is to protect the quality of waters entering the park. The inland buffer zone is approximately 35,000 acres of federal, state, and privately owned land. The National Park Service monitors land use to ensure that zoning is enforced by working with Alger County and the Burt Township Planning Commission. The National Park Service has a land use/land protection plan for the inland buffer, which the county and township have generally followed in their planning and zoning decisions. Sustainable yield timber harvesting is practiced within the buffer zone to provide economic benefits for landowners while maintaining the resource base.

Pictured Rocks National Lakeshore

Michigan

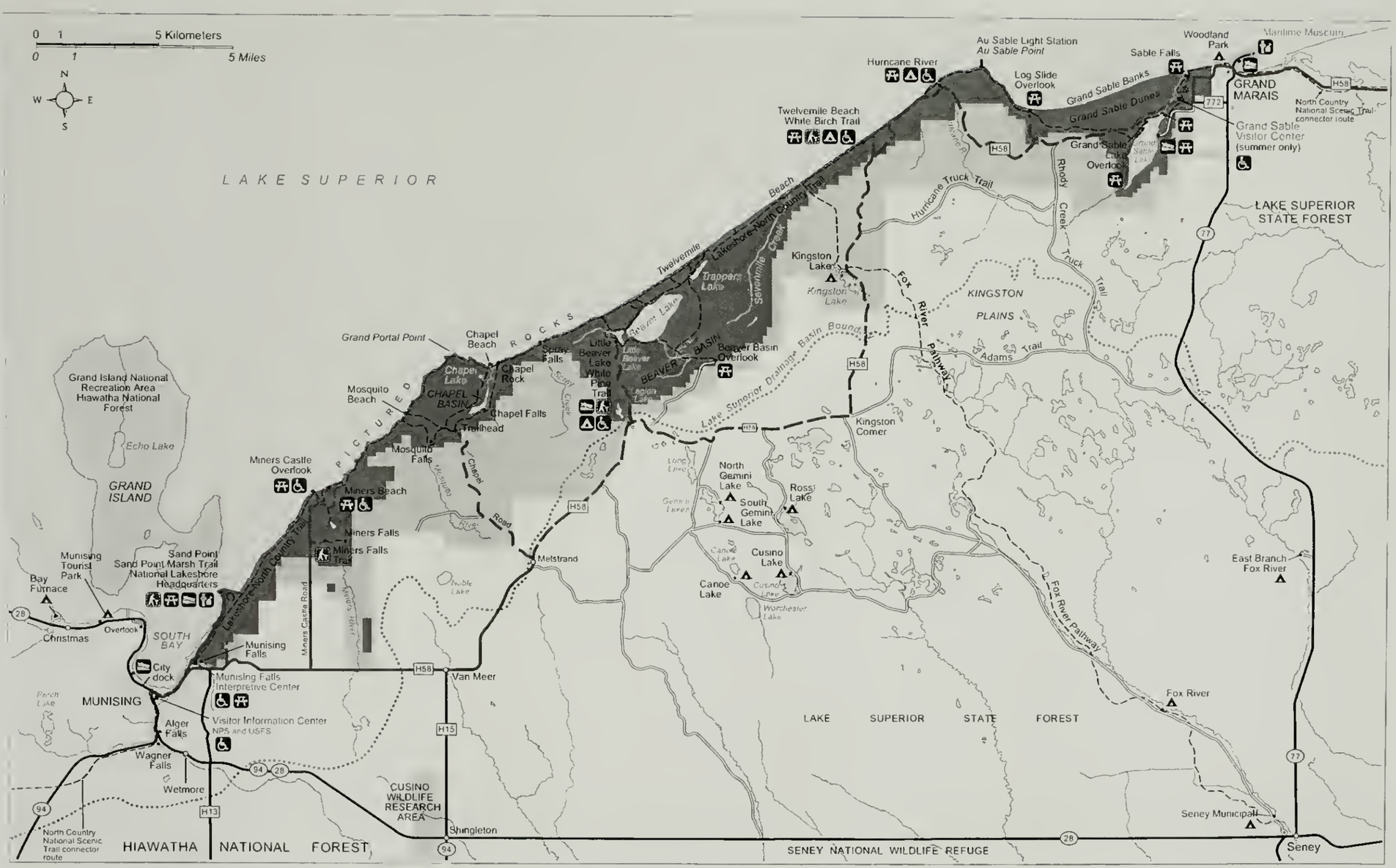
Location



Pictured Rocks National Lakeshore

Michigan

Location



United States Department of the Interior / National Park Service WASO / May '02 / 625/20082

- National Park Service campground
- Other public campground
- Boat launch
- Picnic area
- Interpretive trail
- Wheelchair accessible
- Ranger station
- Lakeshore Zone (NPS)
- Inland Buffer Zone (mixed ownership)
- Paved lakeshore access road
- Unpaved lakeshore access road
- Other unpaved road
- Trail

Purpose of Pictured Rocks National Lakeshore

As formulated during the Pictured Rocks general management planning process, the purpose of the national lakeshore includes the following:

- Preserve a portion of the Great Lakes shoreline for its geographic, scientific, scenic, and historic features, and its associated ecological processes.
- Provide opportunities for public benefit in recreation, education, enjoyment, and inspiration.
- Protect the character and use of the shoreline zone while allowing economic utilization of the inland buffer zone's renewable resources.

Significance of Pictured Rocks National Lakeshore

As stated in the national lakeshore's *Draft General Management Plan / Wilderness Study / Environmental Impact Statement,* Pictured Rocks National Lakeshore is significant because:

- Pictured Rocks National Lakeshore preserves and affords public access to a spectacular and diverse segment of the Lake Superior shoreline.
- Unmatched in their scenic value, the 200-foot high Pictured Rocks cliffs rise perpendicularly from Lake Superior, creating a rock mosaic of form, color, and texture, which is enhanced by cascading waterfalls.
- Grand Sable Dunes, perched atop 300-foot-high sand banks above Lake Superior, is one of two perched dune systems on the Great Lakes; within these dunes live unique plant communities resulting from geomorphic processes.
- Twelve miles of unspoiled and undeveloped Lake Superior beach contrast with the Pictured Rocks cliffs and Grand Sable Dunes.
- Bedrock geology and glacial landforms provide significant topographic relief marked by streams, inland lakes, and a diversity of associated vegetation.
- The shoreline offers extraordinary and inspirational scenic vistas of Lake Superior, the largest body of surface area of fresh water on earth.
- Pictured Rocks National Lakeshore offers a variety of affordable year-round recreational opportunities for appropriate public use.
- Within a distinct area, the lakeshore contains a spectrum of cultural resources focused on the human use of Lake Superior and its shoreline.
- Lying in a transition zone between boreal and eastern hardwood forest, the lakeshore's scientifically recognized assemblage of flora and fauna is representative of associations unique to the Lake Superior Basin.
- Pictured Rocks is the only national park system area with a legislated buffer zone.

BACKGROUND

NPS ORGANIC ACT AND MANAGEMENT POLICIES

The National Park Service Organic Act of 1916 directs the U.S. Department of the Interior and the National Park Service to manage units of the national park system "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). The Redwood National Park Expansion Act of 1978 reiterates this mandate 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 1 a-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 that "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. However, the Park Service has discretion to allow negative impacts when necessary (*Management Policies 2001,* sec. 1.4.3). While some actions and activities cause impacts, the National Park Service cannot allow an adverse impact that constitutes a resource impairment (*Management Policies 2001,* 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 1 a-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" (*Management Policies 2001,* sec. 1.4.4). To determine impairment, the National 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" (*Management Policies 2001,* 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 may impair resources in another unit. Thus, this environmental assessment analyzes the context, duration, and intensity of impacts related to PWC use at Pictured Rocks National Lakeshore, 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).*

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).

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

Water Pollution

The vast majority of PWC in use today are two-stroke, non-fuel-injected engines, which discharge as much as 30% of their gas and oil emissions directly into the water (NPS 1998; California Air Resources Board 1999). Hydrocarbons, benzene, toluene, and xylene 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 (ODEQ), every waterbody has different conditions (e.g., water temperature, air temperature, 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 (California Air Resources Board 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, benzene, toluene, ethylbenzene, and xylene [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 outboards and personal watercraft. Emission controls provide for increasingly stricter standards beginning in model year 1998 (US EPA 1996a). As a result of the rule, the agency expects a 50% reduction in hydrocarbon emissions from marine engines from present levels by 2020 and a 75% reduction in hydrocarbon emissions by 2025 (US EPA 1996a).

Discharges of MTBE and polyaromatic hydrocarbons (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 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 (Tahoe Regional Planning Agency 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.

Air Pollution

Two-stroke engines that have been conventionally used in personal watercraft emit pollutants such as nitrogen oxides (NO_x) and volatile organic compounds (VOC) that may adversely affect air quality. In areas with high PWC use some air quality degradation likely occurs (UE EPA 1996c, 2000). Kado et al. (2000) found that two-stroke engines had considerably higher emissions of airborne particulates and PAHs than four-stroke engines tested. 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).

Noise

Noise levels emitted by PWC engines vary from vessel to vessel, depending on many factors. 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.

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 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 complaints against PWC use seem to focus as much or more on frequent changes in pitch and sound energy levels due to rapid acceleration, deceleration, jumping into the air, and change of direction, as on noise levels themselves. 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.

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 (e.g., if identical boats emit 75 dB, two such boats together would emit 76 dB, three together 77 dB, etc.). 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).

Several manufacturers have introduced technology to reduce PWC noise on newer models (Sea-Doo 2001b; Hayes 2002). Additionally, by 2006 the EPA requirements will reduce PWC noise, in association with improvements to engine technology (US EPA 1996b).

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 Schweikert 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.

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. The majority of 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.

Erosion Effects

Some studies have examined the erosion effects of personal watercraft waves, 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.

Health and Safety Concerns

While industry representatives report that PWC accidents decreased in some states in the late 1990s, no other research supports their contention. To the contrary two national PWC studies of accidents and injuries report that personal watercraft pose a clear health and safety risk, primarily to the operators. In the 1990s PWC accidents increased as the popularity of the craft increased. 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). 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 Pictured Rocks National Lakeshore

PWC use in Pictured Rocks National Lakeshore began around 1990. Use is only allowed on Lake Superior, and it is relatively low. Weekly use estimates range from a low of 6–10 watercraft to a high of 20–25. Restrictions on inland lakes preclude PWC use on those lakes. Pictured Rocks National

Lakeshore has jurisdiction on the surface water of Lake Superior extending 0.25 mile from the shoreline. PWC operation on Lake Superior is concentrated between Sand Point and Chapel Beach, along the Lake Superior shoreline. The eastern side of the park has little PWC use. Rivers and streams within Pictured Rocks National Lakeshore are not accessible to personal watercraft due to extremely small size, shallow depths, and rocky bottoms.

The average PWC trip lasts between three and five hours. State regulations restrict operations to the hours of 8 A.M. to one hour before sunset. Most PWC use is day use; only a few users occasionally ask about PWC camping opportunities.

Most PWC users are local. Personal watercraft are launched from the Munising boat ramp (the primary launch site), Sand Point (the national lakeshore's launch site), and Grand Marais. PWC rentals are not available within the park or the adjacent towns of Munising and Grand Marais. Most PWC users probably own their craft.

Private motorboat use during the prime visitor season (July and August) is estimated to range from a low of 50 boats to a high of 150. Large tour boats holding 120–180 passengers powered by twin diesel engines and originating in Munising also conduct up to 10 scheduled tours along the lakeshore throughout the summer.

Nonmotorized uses, such as sea kayaking and some canoeing, also occur within the national lakeshore. Sea kayaking is gaining popularity on Lake Superior. There are no estimates of the number of nonmotorized boat users.

OBJECTIVES IN TAKING ACTION

Objectives define what must be achieved for an action to be considered a success. Alternatives selected for detailed analysis must meet all objectives and must also resolve purpose of and need for action.

Using the national lakeshore's enabling legislation, mandates and direction in the *Draft General Management Plan / Wilderness Study / Environmental Impact Statement,* issues, and servicewide objectives, park staff identified the following management objectives relative to PWC use:

WATER QUALITY

- Manage PWC emissions that enter the water in accordance with antidegradation policies and goals.
- Protect aquatic organisms from PWC emissions so species' population viability is maintained.

AIR QUALITY

- Manage PWC activity so that PWC emissions do not degrade air quality or affect visitors' health and safety.

SOUNDSCAPES

- Manage noise from PWC use so that visitors' experiences are not adversely affected.

- Manage effects on wildlife behavior from PWC-generated noise.

WILDLIFE AND WILDLIFE HABITAT

- Protect fish and wildlife species and their habitat from PWC disturbances.
- Protect fish and wildlife from bioaccumulation of PWC emissions.

THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

- Protect listed species and other species of special concern from PWC disturbances or contaminants.

SHORELINE VEGETATION

- Manage PWC use to protect vegetation from visitor impacts related to PWC use.

VISITOR EXPERIENCE

- Provide park visitors with a high-quality experience.
- Manage potential conflicts between PWC use and other park visitors.

VISITOR CONFLICTS AND SAFETY

- Minimize or reduce the potential for PWC user accidents.
- Improve safety between PWC users and other water recreationists.

CULTURAL RESOURCES

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

NATIONAL LAKESHORE MANAGEMENT AND OPERATIONS

- Minimize inputs to park operations from increased enforcement needs.
- Cooperate with the state of Michigan to manage or regulate PWC use.

ISSUES AND IMPACT TOPICS

Issues associated with PWC use at Pictured Rocks 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 17.

WATER QUALITY

The vast majority of personal watercraft in use today are two-stroke, non-fuel-injected engines, which discharge as much as 30% of their gas and oil emissions directly into the water (NPS 1998; California Air Resources Board 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 Pictured Rocks National Lakeshore. However, emissions would be predominantly concentrated in waters where boat launch ramps are located (Munising, Sand Point, and Grand Marais), thus containing the most adverse impacts within a localized area.

AIR QUALITY

Pollutant emissions such as nitrogen oxides and volatile organic compounds from PWC use may adversely affect air quality. Although air quality within the national lakeshore is currently good and meets state standards, 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.

SOUNDSCAPES

Personal watercraft have been measured to emit 85 to 105 dB per unit, which may disturb visitors on both the land and the water. 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.

Soundscape disturbances in Pictured Rocks National Lakeshore are limited to (1) nearshore areas where people are present at beaches, (2) backcountry locations where PWC noise is noticeable, and (3) the North Country National Scenic Trail, where hikers are present. Michigan regulations limit the potential effects of personal watercraft on sensitive soundscapes, because they restrict the types of activities and PWC speeds within 200 feet of the shoreline. Disturbances are most likely to occur when PWC users do not follow state regulations.

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 personal watercraft may have a greater impact on wildlife than other types of watercraft. Flight response is the most likely impact of PWC use; the most likely occurrence of PWC-induced flight would be on Lake Superior.

THREATENED, ENDANGERED, AND SPECIAL CONCERN SPECIES

Species at Pictured Rocks such as piping plovers, peregrine falcons, and loons would be considered sensitive to disturbance. Piping plovers may occur in the Grand Marais area, but have not been seen in this area since 1992. An active peregrine falcon nest has been confirmed in the national lakeshore during the current breeding season. Behavior of other state or federally listed species (e.g., the common loon) may be affected by PWC use. PWC use could have an effect on these sensitive species if it disrupted them during feeding or nesting. Additionally, PWC users who land on the beach have access to shoreline areas where sensitive species may occur.

SHORELINE VEGETATION

The natural shoreline along Pictured Rocks National Lakeshore is made up of spectacular sandstone cliff faces, long sandy beaches, and natural dune environments with no inlets or coves. These features, combined with a rather steep drop-off of water depth, do not provide the calm, shallow water conditions necessary to support the growth of sensitive aquatic vegetation on the shoreline. PWC users do not operate within 200 feet of the shoreline unless traveling at no-wake speeds, and they do not access streams or small rivers within the lakeshore. Lakeshore streams are small and very shallow, with rocky or sandy bottoms, and they typically end with a waterfall at the Lake Superior interface. PWC use does not have a perceptible or quantifiable impact to sensitive aquatic 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.

VISITOR EXPERIENCE

PWC use is viewed by some segments of the public as a nuisance due to their noise, speed, and overall environmental effects. Others believe personal watercraft are 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.

A preliminary wilderness suitability assessment has identified portions of Chapel Basin and Beaver Basin as meeting the definition of wilderness, which includes "outstanding opportunities for solitude." The current *Draft General Management Plan* proposes that only Beaver Basin be designated as wilderness. The Lake Superior shoreline (0.25-mile surface water jurisdiction) adjacent to the proposed Beaver Basin wilderness would be managed as primitive. PWC use adjacent to designated wilderness may conflict with wilderness qualities, depending on the noise level and location. Concern was also expressed over the impacts of other watercraft and tour boats operating near the boundary of the wilderness suitable area.

VISITOR CONFLICTS AND SAFETY

In 1996 personal watercraft comprised 7.5% of the registered vessels in the United States, but were involved in 36% of all boating accidents. While no PWC accidents have been reported at Pictured Rocks National Lakeshore, several incident reports have been written up, most involving personal watercraft and swimmers or other boaters. Staff receive infrequent calls for assistance in locating a PWC operator who is overdue or "missing." Running out of gas is also a concern and may be hazardous because of the water temperatures and lack of landing areas along the rock cliffs.

Divers may be present in the park at shipwreck locations. No conflicts between personal watercraft and divers have been observed. Divers set buoys to identify their location, so PWC users should be able to avoid conflicts.

PWC speeds, wakes, and proximity to other users can pose conflicts and hazards to these recreationists, such as canoeists and sea kayakers. Sea kayaks and canoes are the primary nonmotorized boats used in the lakeshore, and sea kayaking is becoming more prevalent. Conflicts between PWC users and sea kayakers could occur, particularly if PWC use increased. To date, few conflict have been reported.

ETHNOGRAPHIC/SACRED SITES

The lakeshore has ethnographic resources (for example, sacred sites), which may be affected by PWC use. Specifically, PWC access may affect the resources because riders can get to shoreline areas that are less accessible to other watercraft. American Indians use these areas of the park for ceremonial purposes (cliffs, creek mouths, and dunes). American Indians are concerned about possible crowding at some of these areas, and more PWC use could contribute to increased visitor access and crowding at these sites. The University of Arizona completed an ethnographic study for Pictured Rocks National Lakeshore in 1999.

SOCIOECONOMIC ENVIRONMENT

PWC sales are one of the fastest growing segments of the boating industry in the country. Nationally, PWC rentals have also increased exponentially compared to other types of motorcraft. Pictured Rocks National Lakeshore experiences relatively low rates of PWC use. However, some businesses may be affected by actions to manage PWC use.

NATIONAL LAKESHORE 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 their increased accident rates and visitor conflicts.

Pictured Rocks National Lakeshore currently has three permanent and two seasonal law enforcement staff; they do not conduct daily boat patrols. If PWC use increased significantly, additional seasonal staff would be required to adequately address enforcement.

Conflict with State and Local Ordinances and Policies Regarding PWC Use

The state of Michigan has taken action to manage PWC use (see page 53). State regulations address age requirements, education requirements, timing restrictions, and types of operations (no wake within 200 feet of shore, etc.). The National Park Service is in the process of adopting these regulations within the national lakeshore.

ISSUES ELIMINATED FROM FURTHER CONSIDERATION

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

Impacts to Cultural Landscapes from PWC Use — Only one cultural landscape within Pictured Rocks National Lakeshore, the Au Sable Light Station, has been surveyed and documented to date; however, several potential landscapes have been identified and are awaiting further study. These include the coast guard stations at Munising (Sand Point) and Grand Marais, various farmsteads and apple orchards, and the MI-WI Consolidated Pipeline camp. Given that the potential cultural landscapes within the park are either outside the study area or in areas already experiencing heavy visitor use from both land and water vehicles, the impacts (if any) resulting from the proportionately low number of PWC users would be extremely difficult to distinguish or quantify.

Impacts to Historic Structures from PWC Use and Access to Sites — Two structures within the national lakeshore have been listed on the National Register of Historic Places: the Au Sable Light Station (in 1978) and the Schoolcraft Blast Furnace (in 1977). Two additional properties have been determined to be eligible for listing but have not yet been nominated: the Grand Marais Coast Guard Station (determined eligible in 1990) and the Munising (Sand Point) Coast Guard Station (determined eligible in 1999). Currently, 19 structures are on the national lakeshore's List of Classified Structures, all of which relate to the structures already listed or determined eligible for listing on the national register. Given that the majority of historic structures within the park are either located outside the study area or in areas already experiencing heavy visitor use from both land and water vehicles, the impacts (if any) resulting from the proportionately low number of personal watercraft would be extremely difficult to distinguish or quantify.

Impacts to Shorelines from PWC Use and Access to Sites — Natural wave action is the dominant force for shoreline erosion and shoal formation at Pictured Rocks. Offshore winds are from the northwest and perpendicular to much of the shoreline, and they have contributed to the ever-changing shoreline cliff features and beach areas. Additionally, winter storm winds and ice action have major effects on the Pictured Rocks shoreline. These natural processes are ongoing and have a greater impact on shoreline erosion and stability at Pictured Rocks than does PWC use. Personal watercraft do not operate within 200 feet of the shoreline, unless traveling at no-wake speeds in accordance with state of Michigan regulations. Rivers or streams are small and very shallow, with rocky or sandy bottoms typically ending with a waterfall at the Lake Superior interface and are therefore not accessed by PWC users. PWC use at Pictured Rocks National Lakeshore does not have a perceptible or quantifiable impact to shoreline erosion or shoal formation.

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 in the alternatives; thus, no flooding would result as a result of PWC use and cause 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 Pictured Rocks National Lakeshore, 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, such as Indian Lake State Park, are available to all PWC users. Inland lakes outside the park boundary tend to be more heavily used because they are more suitable for PWC operations. There are no small business owners who rent personal watercraft as a primary source of income. Park actions would not disproportionately affect minority or low-income populations.

RELATIONSHIP TO OTHER PLANS, POLICIES, AND ACTIONS

The following plans, policies, and actions could affect the alternatives being considered for personal watercraft.

PICTURED ROCKS NATIONAL LAKESHORE POLICIES, PLANS, AND ACTIONS

Draft General Management Plan / Wilderness Study / Environmental Impact Statement

The national lakeshore's present *General Management Plan* was completed in 1981. Much has changed since then, including a change in visitor use patterns, the addition of former Coast Guard property in Grand Marais, and the prohibition by recent legislation of development of a scenic drive. In addition, revised NPS *Management Policies* would allow for the recommendation of wilderness designation for some of the lakeshore's lands and waters. Each of these changes has major implications on visitor access and visitor use of the lakeshore, visitor facilities required to support those uses, resource management, and NPS operations.

The *Draft General Management Plan / Wilderness Study / Environmental Impact Statement* is scheduled for public review during the late summer to early fall of 2002. The planning process includes opportunity for agency, organization and public comment. The plan presents five alternatives for managing the lakeshore for the next 15 years. It also analyzes the impacts of implementing each of the alternatives.

Although the *Draft General Management Plan* is scheduled for review in 2002, the public comments received and the alternatives being considered have ramifications for PWC use in the lakeshore. Specifically, the *Wilderness Study* indicates that 18,400 acres within Pictured Rocks National Lakeshore are suitable for wilderness designation. Currently, this area has little development, with the exceptions of backcountry campsites and access roads. The National Park Service is considering the potential for wilderness designation of approximately 11,740 acres in Beaver Basin, with the remaining 6,660 acres in Chapel Basin being managed to preserve wilderness values. The potential wilderness designation is being reviewed as part of the *Draft General Management Plan.* Final recommendations have not yet been completed. This potential designation was incorporated into the PWC management alternatives for the purpose of evaluating impacts.

Backcountry Management Plan

In the 1993 *Backcountry Management Plan* most of the shoreland zone of the lakeshore is defined as backcountry. This includes areas identified as a natural zone in the 1981 *General Management Plan.* The backcountry management strategy is to provide quality nonconsumptive, resource-related recreation that is consistent with the protection of the natural ecosystems; to promote understanding and appreciation of lakeshore values through interpretation; and to enhance recovery of the lands to their natural conditions by appropriate means. According to the 1981 *General Management Plan,* motorized boats and snowmobiles are allowed only on Grand Sable Lake and Lake Superior. The *Backcountry Management Plan* divides the natural zone into five opportunity classes in order to provide a framework for determining what types of activities and facilities would be provided in the different parts of the park. PWC activity may affect the visitor experience of backcountry users.

Other Policies, Plans, and Actions

Sweetwater Trail — The Sweetwater Trail is a proposed tour route promoted by the Michigan Historic Preservation Network. The marketing theme of the tour is to encourage visitation of lighthouses, ships, Coast Guard stations, and other water-based historic sites. The tour route would not be affected by the management of personal watercraft at Pictured Rocks National Lakeshore.

Sleeping Bear Dunes National Lakeshore — Sleeping Bear Dunes National Lakeshore was recently closed to PWC use. Since this park unit is relatively close to Pictured Rocks National Lakeshore, there may be some displacement of PWC users to Pictured Rocks.

Alger County Underwater Preserve — Michigan Public Act 452 of 1988 and Public Act 184 of 1980 (amended by Public Act 173 of 1992) were implemented to protect and preserve aboriginal records and antiquities and abandoned property on the bottomlands of the Great Lakes (Michigan State University Extension 1998). These acts also created a process for establishing state bottomland preserves. The Alger County Underwater Preserve covers approximately 113 square miles and contains eight wrecks. Three of the shipwrecks can be viewed from boat tours run by Pictured Rocks Cruises, Inc. Management of personal watercraft at Pictured Rocks National Lakeshore would not affect the Alger County Underwater Preserve.

ALTERNATIVES

All alternatives must be consistent with the purpose and significance of the Pictured Rocks National Lakeshore, 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; no other alternatives were considered.

The alternatives analyzed in this document in accordance with the National Environmental Policy Act are the result of agency and public scoping input, and as stipulated in the settlement agreement between the Bluewater Network and the National Park Service. The action alternatives address continued PWC use under a special regulation for new management strategies and mitigation measures. The no-action alternative would discontinue PWC use as of April 2002.

Table 1 at the end of this chapter summarizes the alternatives being considered, and Table 2 summarizes the impacts of each alternative.

ALTERNATIVE A: CONTINUE PWC USE AS CURRENTLY MANAGED UNDER A SPECIAL NPS REGULATION

A special NPS regulation would be written to continue PWC use after April 2002 with the following stipulations:

- PWC use would continue as currently provided and managed within Pictured Rocks National Lakeshore. PWC use would be unrestricted on Lake Superior from the lakeshore's 0.25-mile jurisdictional boundary to the lakeshore's shoreline.
- Launch and retrieval of personal watercraft would be permitted only at the Sand Point boat ramp on Lake Superior. PWC users would be able to land anywhere along the shoreline.
- PWC users would continue to abide by Michigan's Personal Watercraft Safety Act of 1998 (Public Act 116) and related regulations. Specific state regulations that are incorporated as part of this alternative include:
    - Timing restrictions: Personal watercraft can only be used between 8:00 A.M. and one hour before sunset.
    - Age restrictions: Children 7 or younger must be accompanied by a parent or guardian; children under the age of 12 cannot operate personal watercraft; children between 12 and 14 may operate personal watercraft if they have a boating safety certificate, etc.
    - Wake restrictions: PWC operation on Lake Superior cannot occur within 200 feet of the shore unless operating at a slow, no-wake speed and traveling perpendicular to the shore.
    - Location restrictions: PWC operation on Lake Superior cannot occur within 200 feet of the shore unless operating at a slow, no-wake speed and traveling perpendicular to the shore.
    - Depth restrictions: Personal watercraft cannot be operated within 200 feet of the shore unless operating at a slow, no-wake speed and traveling perpendicular to the shore.
    - Dangerous behavior: Personal watercraft cannot be operated within 150 feet of other watercraft, and users are required to observe restrictions related to speed, wake jumping, and other actions, which would be enforced per state regulations.

- Water patrols and enforcement would continue to occur on an irregular basis, with a less than daily occurrence.
- PWC users would be restricted from operating on inland lakes within the park boundary due to horsepower restrictions. Operation would be permitted only on Lake Superior. (PWC users cannot access or operate within streams and rivers in the lakeshore.)

This alternative would allow unrestricted PWC use along Lake Superior. The numbers of personal watercraft and landing locations would also be unrestricted.

ALTERNATIVE B: CONTINUE PWC USE UNDER A SPECIAL NPS REGULATION WITH MANAGEMENT RESTRICTIONS

Under alternative B a special NPS regulation would continue PWC use after April 2002 with the following stipulations:

- PWC use would continue as currently provided and managed within Pictured Rocks National Lakeshore, except use would be discontinued in the areas designated as primitive under a draft or final general management plan. (According to legislation, a primitive area is closed to all motorized vehicles; at Pictured Rocks the potential primitive area extends 0.25 mile into Lake Superior from the shoreline, between Spray Falls and 1.25 miles east of Sevenmile Creek.)
- PWC use would be restricted at specific locations during the permitted use of ethnographic resources. Boat patrols would be conducted in the vicinity of the ethnographic resource use in order to reduce the potential for PWC-related intrusion into the ceremonial activity.
- PWC users would continue to abide by Michigan's Personal Watercraft Safety Act of 1998 (Public Act 116) and related regulations, as identified in alternative A.

This alternative would allow unrestricted PWC use along the Lake Superior shoreline within most of the park, with the exception of the Beaver Basin area between Spray Falls and 1.25 miles east of Sevenmile Creek. The numbers of personal watercraft would not be restricted, but no landing would be allowed within the primitive area of the national lakeshore. Alternative B is the lakeshore's preferred alternative and the environmentally preferred alternative.

NO-ACTION ALTERNATIVE

The no-action alternative would discontinue PWC use at Pictured Rocks National Lakeshore. The National Park Service would not take action to adopt a special NPS regulation allowing PWC use to continue. Thus, there would be no further PWC operations within the lakeshore under this alternative.

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 a 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.

The environmentally preferred alternative is the alternative that causes the least damage to the biological and physical environment — the alternative that best protects, preserves, and enhances historic, cultural, and natural 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 for 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 lakeshore 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 lakeshore's natural resources similar to those under alternative A. However, alternative B would better meet park goals with respect to the protection of visitor experience and ethnographic resource use by prohibiting PWC use adjacent to the proposed primitive area and by restricting PWC activities during the permitted use of ethnographic resources. In the long term, this alternative would help visitors enjoy a beneficial use by allowing access to national lakeshore amenities by PWC users while accommodating passive outdoor recreationists and meeting resource management objectives. This alternative would accommodate recreational opportunities for visitors while protecting sensitive natural and ethnographic resources. 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 lakeshore by PWC operators.

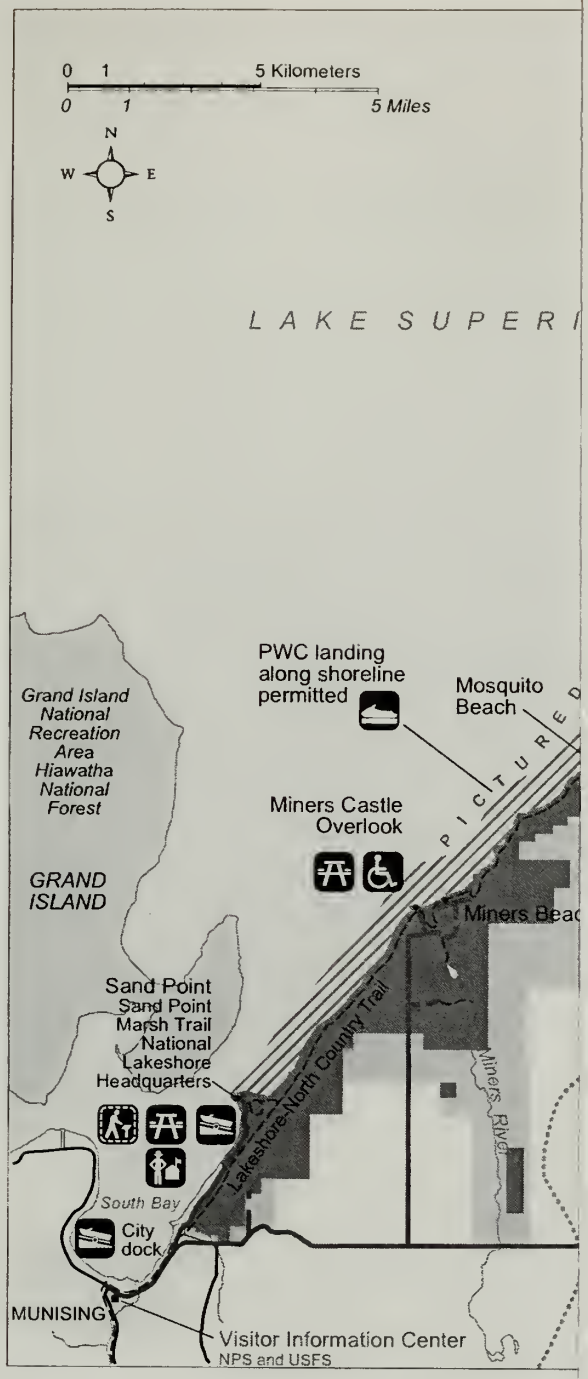
The no-action alternative would ensure a safe, healthful, productive, and aesthetically and culturally pleasing area for visitors to access without the threat of PWC users introducing noise and safety concerns. The no-action alternative would attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences by removing the PWC use from the national lakeshore 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 Pictured Rocks National Lakeshore, 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.

Pictured Rocks National Lakeshore

Michigan

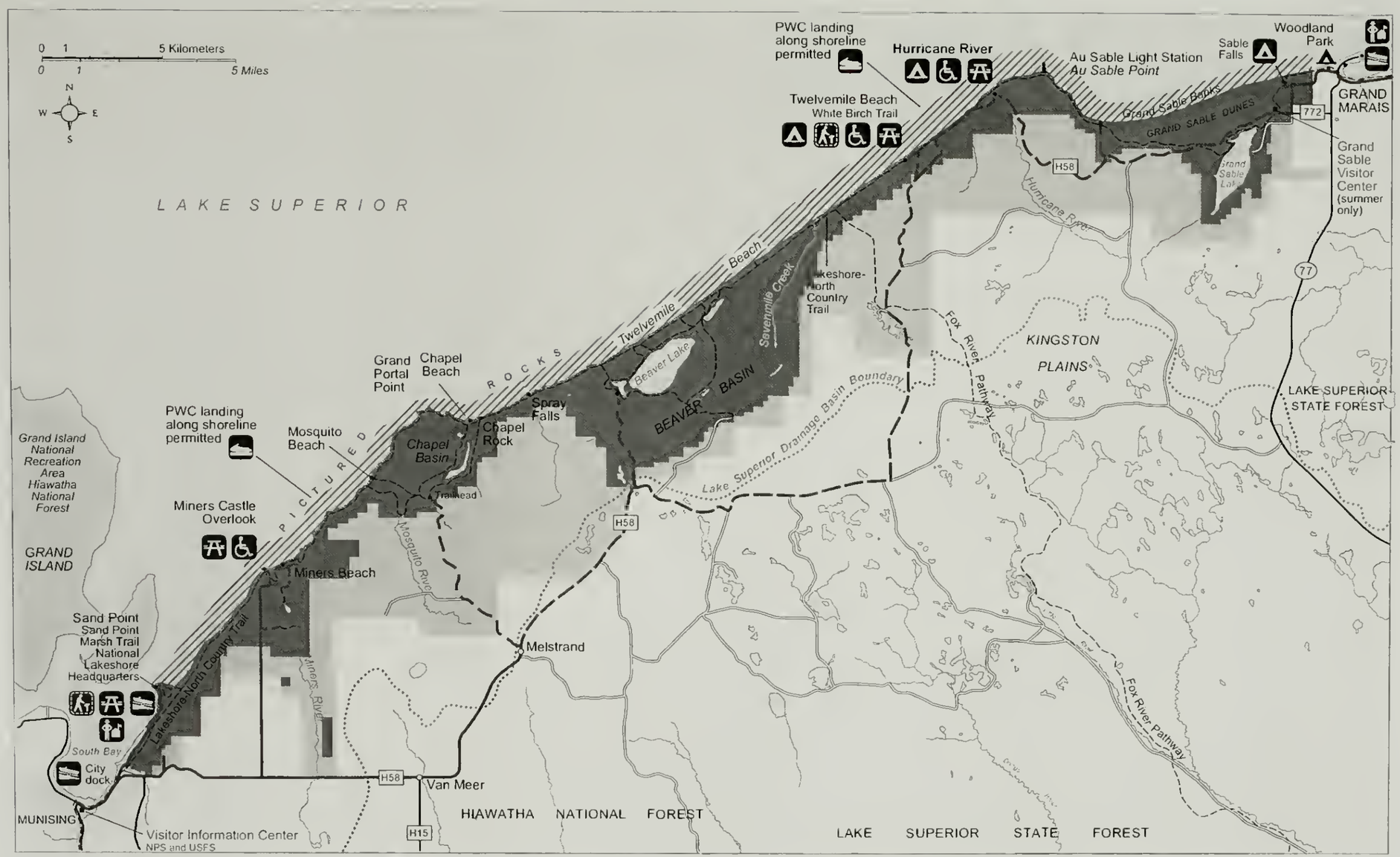
Alternative A -- Continue PWC Use under a Special Regulation



Pictured Rocks National Lakeshore

Michigan

Alternative A -- Continue PWC Use under a Special Regulation



United States Department of the Interior / National Park Service WASO / May '02 / 625/20085

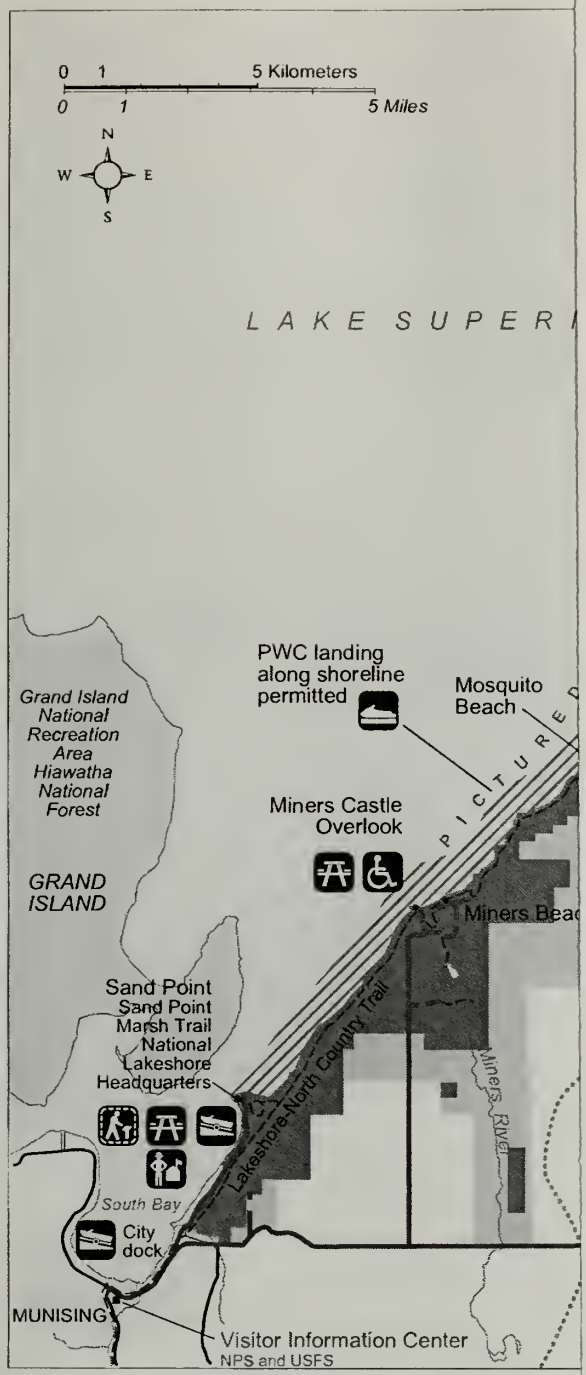
- Boat launch
- National Park Service campground
- Other public campground
- Interpretive trail
- Wheelchair accessible
- Picnic area
- Ranger station
- PWC shoreline landing permitted
- Lakeshore Zone (NPS)
- Inland Buffer Zone (mixed ownership)
- PWC use area *
- Other unpaved road
- Trail
- Paved lakeshore access road
- Unpaved lakeshore access road

* Note: Extent of PWC use within the NPS boundary (0.25 mile from the shoreline into Lake Superior) is not to scale.

Pictured Rocks National Lakeshore

Michigan

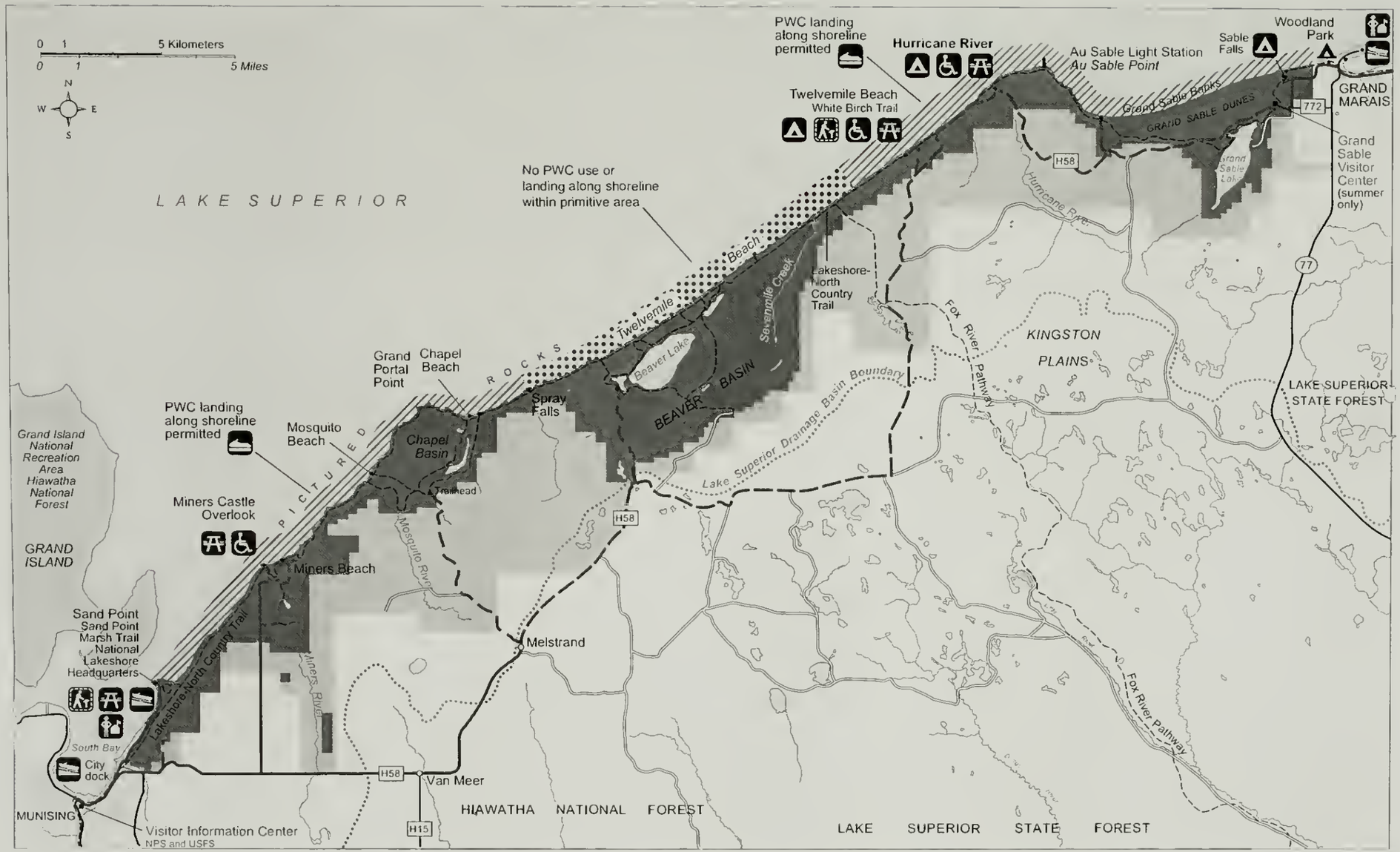
Alternative B -- Continue PWC Use under a Special Regulation with Management Restrictions



Pictured Rocks National Lakeshore

Michigan

Alternative B -- Continue PWC Use under a Special Regulation with Management Restrictions



United States Department of the Interior / National Park Service WASO / May '02 / 625/20086

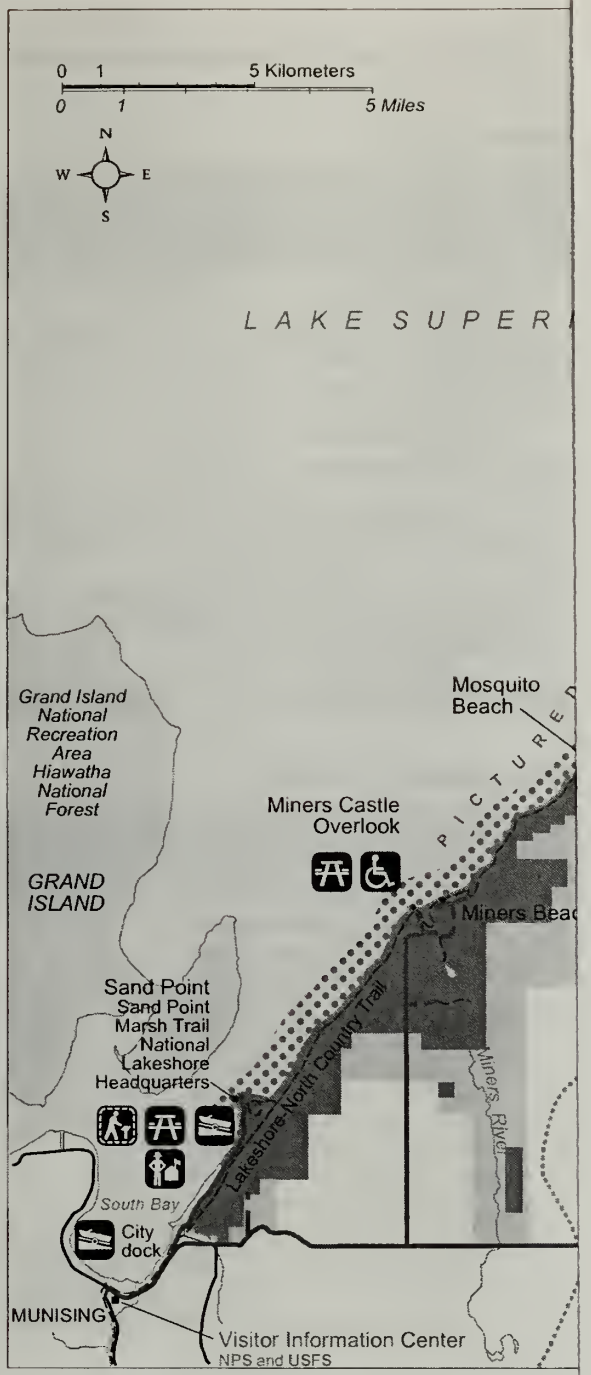
- Boat launch
- National Park Service campground
- Other public campground
- Interpretive trail
- Wheelchair accessible
- Picnic area
- PWC shoreline landing permitted
- Ranger station
- PWC use area *
- PWC use prohibited within primitive area *
- Lakeshore Zone (NPS)
- Inland Buffer Zone (mixed ownership)
- Other unpaved road
- Trail
- Paved lakeshore access road
- Unpaved lakeshore access road

* Note: Extent of PWC use within the NPS boundary (0.25 mile from the shoreline into Lake Superior) is not to scale.

Pictured Rocks National Lakeshore

Michigan

No-Action Alternative -- No PWC Use after April 22, 2002



Boat launch

National Park Service campground

Other public campground

Interpr

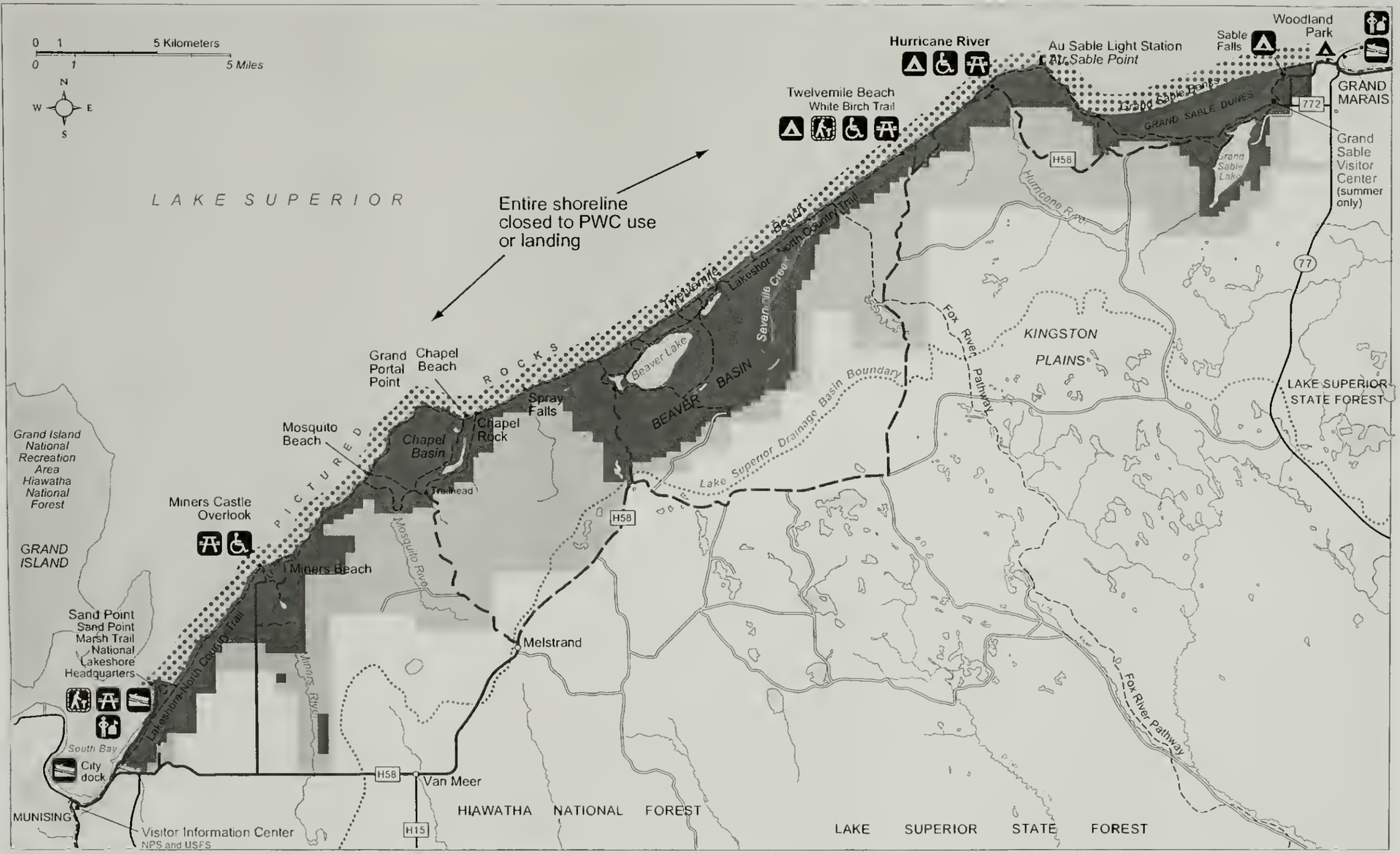
Wheel access

Picnic

Pictured Rocks National Lakeshore

Michigan

No-Action Alternative -- No PWC Use after April 22, 2002



United States Department of the Interior / National Park Service WASO / May '02 / 625/20084

Boat launch

National Park Service campground

Other public campground

Interpretive trail

Wheelchair accessible

Picnic area

Ranger station

PWC use prohibited within NPS boundary *

Lakeshore Zone (NPS)

Inland Buffer Zone (mixed ownership)

Other unpaved road

Trail

Paved lakeshore access road

Unpaved lakeshore access road

* Note: NPS boundary (0.25 mile from the shoreline into Lake Superior) is not to scale.

TABLE 1: SUMMARY OF ALTERNATIVES

	Alternative A: Continue PWC Use as Currently Managed under a Special NPS Regulation	Alternative B: Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative
PWC Management	Allow PWC use under a special NPS regulation.	Allow PWC use under a special NPS regulation.	Discontinue PWC use
Use Area	Permit PWC use within the 0.25-mile NPS boundary in Lake Superior, with operation at a slow, no-wake speed and traveling perpendicular to the shore.	Same as alternative A, except discontinue use in primitive area adjacent to potential wilderness (Beaver Basin area); and restrict use during the permitted use of ethnographic resources.	Not applicable.
Engine Type	No restrictions.	No restrictions.	Not applicable.
Use Hours	8 A.M. to one hour before sunset.	8 A.M. to one hour before sunset.	Not applicable.
PWC Numbers	No limits.	No limits.	Not applicable.
PWC User Education	None, except children 12 to 14 years of age require a safety certificate.	None, except children 12 to 14 years of age require a safety certificate.	Not applicable.
State Regulations	Enforce all state regulations.	Enforce all state regulations.	Not applicable.

TABLE 2: SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Impact Topic	Alternative A: Continue PWC Use as Currently Managed under a Special NPS Regulation	Alternative B: Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative
Water Quality	Alternative A would have negligible adverse effects on water quality due to continued PWC use. All pollutant loads would be well below benchmarks and criteria. Cumulative impacts from PWC and motorized boat use would range from negligible to moderate. Total PAH concentrations would be a concern for aquatic life, due to potential phototoxicity. Benzene concentrations could be detectable, but are expected to remain below the human health criterion. By 2012 impacts would be reduced substantially through improved emission controls. This alternative would not impair water quality.	Alternative B would have negligible to minor adverse effects on water quality due to continued PWC use. No impacts would occur in the Beaver Basin segment. While all pollutant loads would be well below benchmarks and criteria, PAH concentrations in the Sand Point segment could have negligible to minor adverse phototoxic effects on aquatic life. Cumulative impacts from PWC and motorized boat use would range from negligible to moderate. No impacts would occur in the Beaver Basin segment. Total PAH concentrations would be a concern for aquatic life, due to potential phototoxicity. Benzene concentrations could be detectable, but are expected to remain below the human health criterion. By 2012 impacts would be reduced substantially through improved emission controls. This alternative would not impair water quality.	Discontinuing PWC operations would have a negligible to minor beneficial impact on water quality. Pollutant loads from personal watercraft would be eliminated. Decreased PAH concentrations, in particular, could be beneficial for aquatic life. PWC contribution to overall cumulative water quality impacts would be eliminated. Pollutant loads from other motorized boats would have negligible to moderate adverse impacts on water quality. Pollutant loads would be below water quality benchmarks and criteria, and potential adverse impacts would be short term. By 2012 impacts would be reduced substantially through improved emission controls. This alternative would not impair water quality.

Impact Topic	Alternative A: Continue PWC Use as Currently Managed under a Special NPS Regulation	Alternative B: Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative
Air Quality			
•Impacts to Human Health from Airborne Pollutants Related to PWC Use	Continuing PWC use at Pictured Rocks National Lakeshore at existing levels would result in negligible adverse impacts for all pollutants. Overall, PWC emissions are a small part of cumulative boating emissions at the national lakeshore. Cumulative emission levels would be negligible for PM_{10}, HC, VOC, and NO_x. Cumulative CO emissions would be moderate adverse for both the short and long term. Over the long term NO_x emissions would increase slightly, with a negligible impact. This alternative would maintain existing air quality conditions, with future reductions in PM_{10}, HC, and VOC emissions due to improved emission controls. This alternative would not impair air quality.	Continuing PWC use at Pictured Rocks National Lakeshore at existing levels, with PWC use excluded in the Beaver Basin segment, would result in negligible adverse impacts for all pollutants. Overall, PWC use is a small part of the cumulative boating traffic at the national lakeshore. Cumulative emission levels would be negligible for PM_{10}, HC, VOC, and NO_x, and moderate for CO in the short and long term. Over the long term NO_x emissions would increase slightly, with a negligible impact. This alternative would maintain existing air quality conditions, with future reductions in PM_{10}, HC, and VOC emissions. This alternative would not impair air quality.	The no-action alternative would have negligible beneficial impacts on air quality because PWC use would be banned within the lakeshore, resulting in decreased emissions. Because PWC contribution to cumulative air quality impacts would be eliminated, cumulative impacts would be reduced, as compared to alternative A, ranging from negligible to minor. Future emission levels would remain relatively stable, with increased CO emissions (moderate level of impact) and slightly increased NO_x emissions. With improved emission controls, future emissions of most pollutants would gradually decline, but impacts would still be negligible to moderate and adverse. This alternative would not impair air quality.
•Impacts to Air Quality Values from Pollutants Related to PWC Use	Alternative A would continue existing PWC-related air quality impacts, with impact levels ranging from negligible to moderate. Overall, PWC emissions are a small part of the cumulative boating emissions at the national lakeshore. Cumulative emissions would result in negligible to moderate adverse impacts. This alternative would maintain existing air quality conditions, with future reductions in VOC and $PM_{2.5}$ emissions due to required improvements in engine technology. NO_x emissions would increase and would continue to contribute to a moderate impact level related to ozone injury of plants. This alternative would not impair air quality related values.	The number of personal watercraft operating within Pictured Rocks National Lakeshore would be the same as alternative A, even though no use would be allowed in the Beaver Basin segment. PWC-related air quality impact levels would range from negligible to moderate. Overall, PWC emissions are a small part of the cumulative boating emissions at the national lakeshore. Cumulative emissions would result in negligible to moderate adverse impacts. This alternative would maintain existing air quality conditions, with future reductions in VOC and $PM_{2.5}$ emissions due to required improvements in engine technology. NO_x emissions would increase and would continue to contribute to a moderate impact level related to ozone injury of plants. This alternative would not impair air quality related values.	The no-action alternative would have negligible to moderate beneficial impacts on air quality because PWC use would no longer be allowed within the lakeshore boundary. Cumulative impacts from other boating activity would be reduced, as compared to alternative A, but would still result in negligible impacts for visibility and moderate adverse impacts for ozone injury of plants due to the SUM06 ozone index. PWC contribution to overall cumulative air quality impacts would be eliminated. This alternative would not impair air quality related values.
Soundscapes	Noise from personal watercraft would continue to have short-term, negligible, adverse impacts at most locations, and short-term, minor adverse impacts near the Sand Point launch and at backcountry locations. Impact levels would be related to the number of personal watercraft operating, as well as the sensitivity of other visitors. Cumulative noise impacts from personal watercraft, motorboats, and other visitors would be minor because these sounds would be heard occasionally throughout the day. For the most part, natural	Noise from personal watercraft would continue to have short-term, negligible, adverse impacts at most locations, and short-term minor adverse impacts near the Sand Point launch. Eliminating PWC use in the Beaver Basin segment would have negligible beneficial impacts, since watercraft could still be heard but would be farther away and less frequent. Cumulative noise impacts from personal watercraft, motorboats and other visitors would be minor, with these sounds heard occasionally throughout the day. For the most	The overall decrease in noise generated by personal watercraft would be a negligible to minor beneficial impact because PWC users would have to operate at least 0.25 mile from the shoreline. Cumulative noise impacts from motorboats and other visitors would be minor and adverse, particularly near the Sand Point launch. This alternative would not impair the national lakeshore's soundscape.

Impact Topic	Alternative A: Continue PWC Use as Currently Managed under a Special NPS Regulation	Alternative B: Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative
	sounds would still predominate at most locations within the lakeshore. The highest sound impacts would occur near the Sand Point boat launch. This alternative would not impair the national lakeshore's soundscape.	part, natural sounds would still predominate at most locations within the lakeshore. The highest impacts would occur near the Sand Point boat launch. This alternative would not impair the national lakeshore's soundscape.	
Wildlife and Wildlife Habitat	Due to the distance that PWC users are required to be from the shoreline, impacts on wildlife and wildlife habitat would be negligible at most locations. The effects from PWC speed or proximity to wildlife would be limited because PWC users would operate at least 200 feet from the beach and access the beach at slow speeds. Also, the amount of wildlife on the water is low. On a cumulative basis all visitor activities would continue to have negligible to minor adverse impacts. All wildlife impacts would be temporary and short term. This alternative would not impair wildlife or wildlife habitat.	Due to the distance that PWC users are required to be from the shoreline, impacts on wildlife and wildlife habitat would be negligible at most locations. Closing the Beaver Basin segment to PWC use would have negligible beneficial impacts. On a cumulative basis all visitor activities would continue to have negligible to minor adverse impacts. All impacts would be temporary and short-term. This alternative would not impair wildlife or wildlife habitat.	PWC users would not be allowed to operate within the national lakeshore, resulting in a negligible beneficial impact on wildlife and wildlife habitat due to the elimination of interactions between PWC users and wildlife. On a cumulative basis there would be negligible to minor adverse impacts from other shoreline visitors and activities. PWC contribution to overall impacts to wildlife and wildlife habitat would be eliminated. This alternative would not impair wildlife or wildlife habitat.
Threatened or Endangered Species or Species of Special Concern	PWC use would have no effect on the piping plover and would not likely adversely affect other federal or state listed species since interactions would be extremely limited. 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. This alternative would not impair threatened, endangered, or special concern species.	PWC use would have no effect on the piping plover and would not likely adversely affect other federal or state listed species since interactions would be extremely limited. Cumulative effects from PWC use and other visitor activities would not likely adversely affect state or federally listed species. Generally, the identified species are not present or are not accessible during the course of normal visitor activities. This alternative would not impair threatened, endangered, or special concern species.	Because PWC users would no longer have access to the national lakeshore, there would be no effect on federal or state listed species. Cumulatively, the activities of other visitors and other boaters would not likely adversely affect federal or state listed animals and plants because generally, the species are not present or are not accessible during the course of normal visitor activities. PWC contribution to overall impacts to federal and state listed species would be eliminated. This alternative would not impair threatened, endangered, or special concern species.
Shoreline Vegetation	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). On a cumulative basis other visitor activities are more prevalent than PWC use. However, there are no obvious impacts now 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 now or by 2012. This alternative would not impair shoreline vegetation.	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, and none are expected in the future. PWC restriction in the Beaver Basin segment would result in negligible beneficial impacts over the short and long term. On a cumulative basis other visitor activities are more prevalent than PWC use. However, there are no obvious impacts now, 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 on shoreline vegetation would be negligible and beneficial as a result of banning PWC use. Cumulative impacts from other visitors would continue, but are expected to be negligible in the short and long term. PWC contribution to overall impacts to vegetation would be eliminated. There would be no perceptible changes to plant community size, integrity, or continuity now or by 2012. This alternative would not impair shoreline vegetation.

Impact Topic	Alternative A. Continue PWC Use as Currently Managed under a Special NPS Regulation	Alternative B. Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative
Visitor Experience	Continued PWC use would have negligible to minor adverse impacts on the experiences of most visitors in the short and long term. PWC operations would have long-term, moderate, adverse impacts on those visitors desiring backcountry experiences with natural "quiet." The level of PWC use is relatively low at most lakeshore locations. When related to other visitor activities, PWC use would not appreciably limit the critical characteristics of the 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 Pictured Rocks National Lakeshore.	Continued PWC use would have negligible adverse impacts on the experiences of most visitors in the short and long term. PWC restrictions within the Beaver Basin segment would have long-term, moderate, beneficial impacts on those visitors desiring backcountry experiences with natural "quiet." The level of PWC use would remain relatively low at other lakeshore locations. When related to other visitor activities, 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 Pictured Rocks.	The no-action alternative would have negligible beneficial impacts on the experiences of most lakeshore visitors because PWC use would be banned. Impacts on PWC users who would no longer be able to ride in the national lakeshore would be long term, moderate, and adverse. Cumulative impacts would be negligible and beneficial, as compared to alternative A. Most visitors would continue to be satisfied with their experiences at Pictured Rocks National Lakeshore. On a regional scale, the no-action alternative would result in a negligible adverse effect to other waterbodies in the state as a result of PWC users going to other locations to enjoy this activity.
Visitor Conflicts and Safety	Continued PWC use would have short- and long-term, minor, adverse impacts on visitor conflicts and safety in the Sand Point area due to the number of visitors and boats on high use days. Conflicts at other locations would remain negligible because use is lower and conflicts would be less likely. Cumulative impacts related to visitor conflicts and safety would be minor for all user groups in the short and long term near Sand Point and negligible in the other segments.	Continued PWC use would have short- and long-term, minor, adverse impacts on visitor conflicts and safety, particularly in the Sand Point area, due to the number of visitors and boats present on high use days. Conflicts at other locations would remain negligible. Conflicts would be eliminated in the Beaver Basin segment, resulting in negligible, beneficial impacts. Cumulative impacts would be minor for all user groups in the short and long term near Sand Point and negligible in the other segments.	Discontinuing PWC use would result in short- and long-term, minor, beneficial impacts by reducing visitor conflicts and enhancing safety. PWC-related contribution to overall cumulative impacts to visitor safety would be eliminated. Impacts from other sources of visitor conflict and safety would be negligible.
Cultural Resources (Archeological Sites, Submerged Cultural Resources, Ethnographic Resources)	PWC use in the national lakeshore could have minor adverse impacts on potentially listed archeological sites and submerged cultural resources due to possible illegal collection and vandalism. PWC-related intrusions during the permitted use of ethnographic resources would result in short-term, moderate, adverse impacts. Cumulative impacts on archeological and submerged cultural resources that are readily accessible could be minor to major adverse, due to the number of visitors and the potential for illegal collection or destruction. In the case of ethnographic resources, visitor activities could cause short-term interruption in their use, resulting in moderate adverse impacts. This alternative would not impair cultural resources.	PWC use within the Sand Point, Cliffs, and Grand Sable segments could have minor adverse impacts on potentially listed archeological sites and submerged cultural resources due to possible illegal collection and vandalism. There would be a beneficial impact on those resources in the Beaver Basin segment, where PWC use would be discontinued. Boat patrols would limit potential PWC-related intrusions during the permitted use of ethnographic resources, resulting in possible short-term, minor, adverse impacts. Cumulative impacts of other activities on archeological and submerged cultural resources that are readily accessible could be minor to major and adverse due to the number of visitors and the potential for illegal collection. In the case of ethnographic resources, visitor activities could cause short-term, minor, adverse impacts. Additional boat patrols could reduce these impacts. This alternative would not impair cultural resources.	Prohibiting PWC use would have minor beneficial impacts on archeological sites, submerged resources, and ethnographic resources. Cumulative impacts from all visitor activities would continue to be minor to major, depending on the accessibility of the resource and the potential for illegal collection or damage. Additional boat patrols could reduce the potential for such impacts, as well as intrusions during the permitted use of ethnographic resources. This alternative would not impair cultural resources.

Impact Topic	Alternative A: Continue PWC Use as Currently Managed under a Special NPS Regulation	Alternative B: Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative
Socioeconomic Effects	There would be negligible to minor economic and social impacts overall to user groups and businesses.	There would be minor to moderate economic and social impacts overall to user groups and businesses.	There would be minor to moderate economic and social impacts overall to user groups and businesses.
Conflicts with State and Local Regulations	PWC and boating regulations within the national lakeshore 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. PWC and boat regulations within the national lakeshore would be similar to the regulations currently in place for nearby U.S. Forest Service properties. The restrictions would apply only within the lakeshore's jurisdictional boundary. Impacts related to conflicts with federal or state requirements or policies would be negligible.	Discontinuing PWC use within the lakeshore would not result in conflict with state PWC regulations or with U.S. Forest Service policies. There are no local PWC regulations. Therefore, impacts related to such conflicts (including cumulative impacts) would be negligible.
Preserve Operations	This alternative would have moderate adverse impacts on park operations. More staff, funding, and equipment would be necessary to regulate existing PWC as well as boating use.	Similar to alternative A, this alternative would have moderate adverse impacts on park operations. More staff, funding, and equipment would be needed to ensure full compliance with PWC and motorized use restrictions in the Beaver Basin segment and during the permitted use of ethnographic resources, as well as to regulate motorized uses in other portions of the lakeshore.	This alternative would have moderate adverse impacts on park operations. More staff, funding, and equipment would be needed to ensure compliance with the PWC ban and to regulate existing boating use.

AFFECTED ENVIRONMENT

Pictured Rocks National Lakeshore is situated in the north-central section of Michigan's Upper Peninsula, along the southern shore of Lake Superior (see the Location map). The eastern half of the Upper Peninsula is bounded by Lakes Superior, Michigan, and Huron, hence the term "peninsula." There are a variety of other national parks in the upper Great Lakes, including Apostle Islands National Lakeshore and Isle Royal National Park on Lake Superior, and Sleeping Bear Dunes and Indiana Dunes National Lakeshores on Lake Michigan. Canadian provincial parks are also located on Lake Superior.

The national lakeshore stretches from Munising to Grand Marais, approximately 40 miles to the northeast. The shoreline consists of narrow sandy beaches, sandstone cliffs, and a perched sand dune system. The sandy shoreline is susceptible to erosion from natural weather conditions.

WATER QUALITY

Physical Characteristics of Lake Superior

Lake Superior is the most pristine of the Great Lakes because its surrounding watershed is relatively undeveloped and the quantity of water is so huge. The lake covers an area of approximately 31,700 square miles, with a maximum depth of 1,335 feet and an average depth of 489 feet. Estimated retention for water within the lake is 191 years (MDEQ n.d.).

Lake Superior's shoreline varies from a relatively shallow shelf along sandy beaches to steep dropoffs along cliffs and ridges. Bathymetric maps for the Pictured Rocks National Lakeshore shoreline indicate that nearshore depths (within 50 feet or less) are 4 to 6 feet. Depths of 10 feet or more are common within 100 feet of the shoreline. Offshore depths (beyond 200 feet) range from approximately 30 to 100 feet or more. The only exception is the Sand Point area, where shallow depths of 4 to 12 feet extend more than 1,000 feet from shore.

Prevailing winds are from the northwest, sending waves directly toward the shoreline of the national lakeshore. With the exception of the Sand Point area, the shoreline has no well-defined bays that are normally secluded from wind and wave action. Additionally, there are no submergent or emergent vegetation zones along the lakeshore.

Lake Superior is an oligotrophic lake, meaning that it has a limited nutrient supply in relation to the volume of water it contains. Generally, oligotrophic lakes tend to be deep with clear water. Due to the low nutrient supply, they have limited biological activity, aquatic plant growth, and fish production (Limnetics, Inc., 1970). The biological community within Lake Superior is comprised of several distinct communities, including plankton, littoral (rooted plants), benthos (organisms living in the bottom sediments), and fish. The plankton community includes both phytoplankton and zooplankton that are indicative of oligotrophic conditions (Limnetics, Inc., 1970). At Pictured Rocks National Lakeshore, there are limited littoral and benthic communities. The wave action and low nutrients available along the shoreline preclude plant establishment. The bottom sediments are also low in organic matter, limiting benthos productivity. High oxygen content and cold water makes oligotrophic lakes habitat for prized fish such as lake trout, whitefish, and walleye. Water temperatures in midsummer are approximately 60°F, with variations depending on water depth and currents (NPS 1995a).

WATER QUALITY DATA

The Michigan Department of Environmental Quality (MDEQ) prepares a biennial report summarizing water quality in the state. The report is required under section 305(b) of the federal Water Pollution Control Act (PL 92-500), also known as the Clean Water Act. Generally, the 2000 report indicates that the open waters of Lake Superior have excellent water quality (MDEQ 2000b).

As part of Michigan's water quality standards, waterbodies are designated for specific uses. Michigan's protected designated uses are for aquatic life (either cold water or warm water) and wildlife support; agricultural, industrial, and municipal water supply; navigation; and total body contact recreation. According to the section 305(b) report for 2000, Lake Superior fully supports its designated uses for recreation (both swimming and secondary contact), water supply (including drinking water, agriculture and industrial), and navigation. None of the Great Lakes, including Lake Superior, supports the designated use for aquatic life and wildlife. This is due to the high levels of polychlorinated biphenyls (PCBs) in some Great Lakes fish. Even though PCBs were banned in the 1970s, PCB levels in some fish warrant consumption advisories (MDEQ 2000b).

The portion of Lake Superior within Pictured Rocks National Lakeshore is designated as an outstanding state resource water by the Michigan Department of Environmental Quality (MDEQ 1999a). Michigan's *Administrative Rules* include antidegradation rules for outstanding state resource waters ("Part 4. Water Quality Standards," section R323.1098). Waters designated as outstanding state resource waters are considered high quality, and controls on pollutant sources are required so that the water quality is not lowered. A short-term, temporary (weeks or months) lowering of water quality in the outstanding state resource waters may be permitted by the state on a case-by-case basis.

Both Canada and the United States have jurisdiction over water quality in Lake Superior. The Great Lakes Water Quality Agreement of 1978, signed by the United States and Canada, provides consistency for the management and use of the waters of Lake Superior (US EPA 2000a). As part of this agreement, a *Lake Superior Lakewide Management Plan* was completed in 2000. This plan includes an assessment of impaired uses and the causes of impairment, as well as recommended actions necessary to restore beneficial uses. The *Lakewide Management Plan* does not identify any of the PWC-related emissions as a priority pollutant.

The *Lakewide Management Plan* also identifies the locations of watersheds that contribute significant pollutants to Lake Superior. The watershed nearest to the lakeshore that is of concern is the Deer Lake watershed, approximately 50–80 miles west of the lakeshore. The only potential pollutant sources near the lakeshore are Munising's sewage treatment plant and a paper mill just west of the lakeshore. There are no water intakes within or near the national lakeshore.

For a 1970 water quality study of Lake Superior conducted by the National Park Service, eight Lake Superior locations were sampled for nitrogen, phosphorus, dissolved oxygen, turbidity, and metals. According to this study, the levels of nutrients and metals, along with low turbidity, are indicative of high water quality. The sediments of Munising Bay showed a higher level of organic matter than other locations, though the water was still clear and of high quality (Limnetics, Inc. 1970).

In 1995 the NPS Water Resources Division and Servicewide Monitoring Program compiled additional water quality data (NPS 1995a). While the constituents analyzed did not include PWC-related pollutants, they did illustrate that the overall water quality in the lake is very good. Water analyses included a large variety of nutrients (nitrogen and phosphorous compounds), metals, fecal coliform, mercury, and turbidity. For example, the standard for turbidity is listed as 50 Formazin turbidity units

(FTU); at one station, the measured values were between 0.2 and 0.55 FTU. Other analyses had similar results, with no exceedances of standards noted.

MOTORCRAFT AFFECTING WATER QUALITY CONDITIONS

Boating activity within Pictured Rocks National Lakeshore includes tour boats, fishing and speedboats, and personal watercraft. All of these watercraft contribute pollutants of concern to the waters within the national lakeshore. The quantity of pollutants contributed depends on the type and number of watercraft and the length of time they operate within the lakeshore.

The primary pollutants of concern that may be emitted from marine engines include MTBE, PAHs, BTEX, and heavy metals such as copper. In Michigan, MTBE is not expected to be present in engine emissions because it is not required or consistently used in gasoline formulation (MDEQ 2000a). Fuels sold around the state were sampled by the Michigan Department of Agriculture in 1998, which found that only 5% contained MBTE. Most samples contained less than 2.2% MTBE, indicating contamination during fuel transport.

Available information indicates that concentrations of the pollutants of concern would be relatively low in Lake Superior. The large size of the lake, nearshore water depths of 4 or more feet, moderate wind and wave conditions, and lack of well-defined bays tend to promote the rapid dilution of engine emissions. Additionally, there are relatively few emission sources within the lakeshore and region.

AIR QUALITY

Pictured Rocks National Lakeshore is in a sparsely populated area of Michigan's Upper Peninsula. Timber production is one of the primary industries in the area, and there is a paper mill in Munising, just west of the lakeshore. Air quality within the national lakeshore is currently good and meets state standards. Prevailing winds are generally from the northwest.

The Air Quality Division of the Michigan Department of Environmental Quality is responsible for monitoring and evaluating air quality in the state. Air quality standards for the pollutants of concern are the same as the national ambient air quality standards.

Air quality is monitored using a statewide air quality surveillance network. Air quality data are provided in annual reports, with the most recent data available for 1999. Generally, monitoring sites are near metropolitan areas since these areas have the highest pollutant levels; no monitoring sites are in or near Pictured Rocks National Lakeshore. According to the 1999 *Air Quality Report,* the nearest stations are Traverse City (226 miles away), where particulate matter is monitored; Frankfort for ozone monitoring; and Grand Rapids for carbon monoxide monitoring (MDEQ 1999b). The state is currently in attainment for the following pollutants:

- carbon monoxide (CO) — in attainment since August 30, 1999
- nitrogen dioxide (NO_2) — in attainment since March 3, 1978
- ozone — the Upper Peninsula is in attainment; portions of the Lower Peninsula are identified as attainment maintenance areas
- particulate matter (PM_{10}) — in attainment since October 4, 1996
- sulfur dioxide (SO_2) — in attainment since October 20, 1982

Michigan has experienced a decline in air pollutants over the past 15–20 years. Additionally, the current levels for all pollutants of concern are well below the national ambient air quality standards, except for ozone in the larger metropolitan areas.

An air quality study that measured particulate matter and sulfur dioxide was completed in Pictured Rocks National Lakeshore in 1970. Fourteen sites were monitored within the national lakeshore. Sulfur dioxide levels were very low (less than 0.03 parts per million), and long-term particulate matter (less than 2 micrograms per liter [µg/L]) reflected the very good quality of air in the park (Limnetics, Inc., 1970). The local air quality levels observed in 1970 are expected to have remained relatively stable, due to the overall lack of metropolitan development in the vicinity of the national lakeshore. However, on a larger scale, many pollutant sources within the Lake Superior basin have been addressed and reduced such that air deposition has become a more significant source. Long-range atmospheric transport is now considered to be of greater significance in the Lake Superior basin than are local sources (US EPA 2000a).

SOUNDSCAPES

Pictured Rocks National Lakeshore is relatively undeveloped, with few roads and visitor amenities. The most dominant natural sounds are the waves of Lake Superior and wind blowing through trees. On calm days boats on Lake Superior can be heard at long distances. Automobile noise is very limited because most roads are south of the park.

Natural and Human Noise Levels

A noise study was conducted in Pictured Rocks National Lakeshore for evaluation of the Beaver Basin Rim Road (NPS 1992). The study measured ambient noise levels, which include the natural and human made sounds heard at specific locations. On-site monitoring was conducted at 12 locations within the national lakeshore, several of which were within the vicinity of PWC use areas. The summer noise monitoring was completed June 19–30, just prior to the peak visitor season. Even though this study is nearly 10 years old, it still provides a representative measure of ambient sound levels at the national lakeshore. Ambient sound levels may have increased slightly since the 1992 study due to somewhat higher visitation, particularly in heavily used areas. It is assumed that the 1992 study included few to no PWC sounds, since personal watercraft were not commonly used within lakeshore waters at that time.

The 1992 noise study found that ambient noise levels in the national lakeshore are typically very low. The primary factors affecting noise levels include weather conditions (wind), location with respect to a noise source, topography/terrain, and foliar coverage. In wooded areas ambient noise levels are higher on windy days than on calm days. Beaches tend to be noisier than inland areas because of the ambient sound from wave action. The lowest ambient noise levels occur during calm days and during night and early morning. The study also indicated that noise travels better when the source is near the rim edge because it is not attenuated by ground or foliage absorption. Likewise, it can be inferred that sound from boats and personal watercraft on Lake Superior can be expected to travel farther because of this same lack of attenuation, especially on calm days.

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. These "A-weighted" sounds are measured using the decibel unit dBA. Table 3 illustrates common sounds and the measured sound level.

TABLE 3: 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).

Table 4 presents the ambient noise level measurements at several locations within Pictured Rocks. Sound levels are measured over a period of time. In the following table, "L" represents the length of time that the sound was measured. The lowest and highest sound levels recorded are indicated as L_{min} and L_{max}, while the L_{10}, L_{50}, and L_{90} descriptors represent the highest sounds 10%, 50%, and 90% of the measuring time, respectively. Generally, all of the locations are near the Lake Superior shoreline.

TABLE 4: 1992 MEASURED SOUND LEVELS AT VARIOUS LOCATIONS WITHIN PICTURED ROCKS NATIONAL LAKESHORE

Measurement Location	Recreational Use	Sound Level (dBA)				
		L_{max}	L_{10}	L_{50}	L_{90}	L_{min}
Beaver Creek	Backcountry camping	32	36	37	44	46
Sevenmile Creek	Backcountry camping	44	47	49	51	53
Twelvemile Beach	Frontcountry camping	36	42	47	51	55
Au Sable Lighthouse	Historic site	40	44	47	49	54
Log Slide Overlook	Frontcountry developed	26	27	30	35	44
Trappers Lake	Backcountry camping	22	23	26	30	37

Source: Mestre Greve Associates 1992.

Both natural and human sounds are included in the ambient sound levels monitored. The lowest sound levels occurred at Trappers Lake, which is an interior wooded area with backcountry camping. The Log Slide Overlook provides an example of sound levels on the bluff of Lake Superior. Measurements at Twelvemile Beach indicate the sounds from a developed campground on the bluff above Lake Superior, while those at Beaver Creek indicate the sounds from a backcountry camp near the shore. Typical sounds at Pictured Rocks National Lakeshore include waves, wind in trees, visitors talking, chainsaws, and motorboats on Lake Superior. High use areas, such as the Sand Point boat launch, would have higher ambient noise levels, particularly for boats launching and landing. Vessels from Pictured Rocks Cruises, Inc., which travel near the cliffs, typically produce engine noise as they move at low speeds, and loudspeakers are used for interpretive programs.

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.

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 lakeshore 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 (approximately 80 to 90 dBA at 50 feet). 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.

During the planning process for the *Draft General Management Plan,* the public was given an opportunity to provide input on the management alternatives for the park. Many comments were received about the effects of PWC noise on other visitors. Most suggestions were made that personal watercraft should be banned within the 0.25-mile NPS boundary in Lake Superior to preserve the natural quiet.

WILDLIFE AND WILDLIFE HABITAT

Pictured Rocks National Lakeshore contains predominantly mixed maple/beech hardwood and coniferous forests and cedar swamps. The area is interspersed with lakes, streams, beaver ponds, and wetlands and is bounded by rocky escarpments, beach ridges, and Lake Superior. Some forest stands exhibit old-growth characteristics that, in combination with diverse physiography, add to the area's diversity. Remaining forests are maturing and will likely become old growth. Nonnative invasive plant species are not widespread, but efforts are underway to control what species do exist.

The forest, dune, and lake communities provide a variety of habitats for diverse wildlife populations in Pictured Rocks National Lakeshore. The number of mammals, birds, and fish in the national lakeshore are quite extensive, while the numbers of amphibians and reptiles are low, as one would expect in a colder, northern climate. Nevertheless, because the national lakeshore is in a relatively remote and undeveloped part of the country, it contains a wide diversity of wildlife.

MAMMALS

The Michigan Biological Station estimates that 54 species of mammals occur in Pictured Rocks National Lakeshore (NPS 1980). The most abundant large mammals are white-tailed deer. Of all the lakeshore mammals, only the gray wolf and the moose are rare throughout the entire Upper Peninsula (see "Threatened, Endangered, or Special Concern Species" below).

Black bears are common in the lakeshore area. They prefer heavily wooded areas and swamps. Other mammals include beaver, otter, mink, muskrat, raccoon, snowshoe hare, fox, and bobcat. The marten

and fisher became extinct in Michigan by the early 1940s, but they have since been reintroduced to the Upper Peninsula. These two species have migrated into the park and have stable breeding populations. Other notable mammals are the coyote and striped skunk.

The habitats of most mammals listed are away from the shoreline, and animals move to the interior if disturbed by noise or watercraft activities. No critical habitat occurs within 200 feet of the shore.

BIRDS

Due to the rich diversity of habitats within the Pictured Rocks National Lakeshore, over 100 species of birds are present. Upland game birds include ruffed, spruce, and sharp-tailed grouse; American woodcock; and turkey. Of all the lakeshore birds, only 14 are rare throughout the entire Upper Peninsula, including sharp-tailed grouse, American bittern, common loon, bald eagle, osprey, cooper's hawk, northern goshawk, red-shouldered hawk, merlin, peregrine falcon, cerulean warbler, dickcissel, and loggerhead shrike.

Because of their high mobility, waterfowl common to the Mississippi flyway may migrate through the lakeshore region or remain as summer residents. Common nesting waterbirds are the common loon, several species of grebe and merganser, the great blue heron, the wood duck, the pintail, the blue and green-winged teal, the widgeon, the redhead, and the ring-necked duck. These waterfowl can be found along the Lake Superior shoreline, as well as nesting and feeding around the inland lakes and ponds.

Most of the birds identified as having habitat within the study area have the ability to move from the shoreline if temporarily disturbed by noise or watercraft activities.

FISH

The Michigan Department of Natural Resources (MDNR) estimates that up to 30 species of fish representing 17 families may be present in Lake Superior waters adjacent to Pictured Rocks National Lakeshore. Game fish common to Lake Superior are coho salmon, lake trout, brook trout, rainbow trout, whitefish, northern pike, smallmouth bass, walleye, and several species of sunfish. Several of these fish are exotics (e.g., coho salmon). A wide variety of minnow and other small fish are used as food by the larger fish. These include smelt, which may be netted at the mouths of major rivers during their spring spawning runs, redbelly dace, shiner, bluntnose minnow, creek chub, and log perch.

A nuisance species of fish in Lake Superior is the sea lamprey, which is parasitic during the adult stage of its life cycle. In Lake Superior it preys on lake trout, whitefish, and large chubs.

AMPHIBIANS AND REPTILES

Only 16 species of amphibians and 8 species of reptiles are known to exist in the shoreline area. One of the most abundant amphibians in the Pictured Rocks region is the American toad. Reptiles in the region are represented by a variety of turtles and snakes. Painted turtles are quite common, as are the eastern garter snake and northern water snake. Wood turtles, which are rare in Michigan, are also found in the national lakeshore.

AQUATIC INVERTEBRATES

Pictured Rocks National Lakeshore has not been surveyed for aquatic invertebrates. Generally, the abundance and type of organisms present depend on the water quality and habitat conditions within Lake Superior. Because Lake Superior is oligotrophic, it has relatively low productivity, as compared to the other Great Lakes or inland lakes. The Lake Superior shoreline has little to no aquatic vegetation, so little habitat is available for aquatic invertebrates. Thus, at Pictured Rocks National Lakeshore the diversity and abundance of invertebrates along the Lake Superior shoreline is expected to be low, with most organisms associated with creek mouths and interior wetlands.

THREATENED, ENDANGERED, OR SPECIAL CONCERN SPECIES

WILDLIFE SPECIES

Wildlife species listed by the U.S. Fish and Wildlife Service or the Michigan Department of Natural Resources may occur in or near the Pictured Rocks National Lakeshore are listed in Table 5. Only three of these species have habitat near the shoreline of Pictured Rocks.

TABLE 5: FEDERAL AND STATE LISTED WILDLIFE IDENTIFIED IN THE VICINITY OF PICTURED ROCKS NATIONAL LAKESHORE

Common Name	Scientific Name	Federal Status	State Status*	Observed in National Lakeshore	Habitat Present at Shoreline
BIRDS					
Cooper's Hawk	*Accipiter cooperil*		SC	X	
Northern Goshawk	*Accipiter gentilis*		SC	X	
American Bittern	*Botaurus lentiginosus*		SC	X	
Red-shouldered Hawk	*Buteo lineatus*		SC	X	
Piping Plover	*Charadrius melodus*	E	E	X	X
Cerulean Warbler	*Dendroica cerulea*		SC	X	
Kirtland's Warbler	*Dendroica kirtlandi*	E	E		
Merlin	*Falco columbarius*		T	X	
Peregrine Falcon	*Falco peregrinus*		E	X	X
Common Loon	*Garia immer*		T	X	X
Bald Eagle	*Haliaeetus leucocephalus*	T	T	X	
Loggerhead Shrike	*Lanius ludovicianus*		E	X	
Osprey	*Pandion haliaetus*		T	X	
Dickcissel	*Spiza americana*		SC	X	
Sharp-tailed Grouse	*Tympanuchus phasianellus*		SC	X	
MAMMALS					
Moose	*Alces alces*		SC	X	
Gray Wolf	*Canis lupus*	E	E	X	
Canada Lynx	*Lynx canadensis*	T	E		
AMPHIBIANS					
Wood Turtle	*Clemmys insculpta*		SC	X	
FISH					
Redside Dace	*Clinostomus elongatus*		E	X	

Source: U.S. Fish and Wildlife Service, Aug. 24, 2001; Michigan Department of Natural Resources, Oct. 4, 2001; U.S. Fish and Wildlife Service, Mike Decapita, pers. comm., n.d.

E = Endangered Species; T = Threatened Species, SC = Special Concern Species

Federal Species. With regard to the federal status species, the piping plover and gray wolf (both listed as endangered) may occur within Pictured Rocks National Lakeshore.

Piping plovers nested within the lakeshore on the beach of Lake Superior near Grand Marais in the past, but there has been no evidence of use since 1992. The national lakeshore provides potential nesting and forage habitat within the main body of the park, and plovers may be reintroduced to this area. Critical piping plover habitat has been designated along a 100-foot section of beachfront on Coast Guard Point within the national lakeshore, near the Maritime Museum in Grand Marais. This area and the non-designated habitat within the main area of the lakeshore are surveyed yearly for piping plovers; no nesting is currently present.

The gray wolf, an endangered species that is proposed for reclassification to threatened by the U.S. Fish and Wildlife Service, is not likely to den in the lakeshore area because of winter conditions. In addition, wolves are not associated with the immediate shoreline. One of the reasons for low wolf activity is that their food source does not stay within the national lakeshore.

With regard to the other federally recognized species, the bald eagle (threatened) nests on interior lakes of the lakeshore area. Habitat for the Canada lynx (recently listed as threatened) may exist within the national lakeshore, but this species has not been observed; the lynx is not known to have a breeding population in Michigan (Mike Decapita, USFWS, pers. comm., n.d.). Habitat for Kirtland's warbler (endangered) may exist within the national lakeshore, but this species also has not been observed. The nearest nest sites for Kirtland's warblers are west of the park.

State Species. The peregrine falcon (recently federally delisted, state listed as endangered) may be occasionally observed on cliff faces in the park. The presence of an active nest within the national lakeshore has been confirmed during the 2002 breeding season. Other confirmed sites are on Grand Island, a national recreation area managed by the U.S. Forest Service.

Moose are classified as a species of special concern in Michigan. Moose move out of the lakeshore area in the winter, but have been documented with young in the national lakeshore. Moose are not associated with Lake Superior due to the lack of habitat along the shoreline.

Adult common loons (state threatened) have been observed feeding along the Lake Superior shoreline and more than 200 feet out. The loon does not have a breeding or rearing population along the shoreline.

PLANT SPECIES

According to the U.S. Fish and Wildlife Service and the Michigan Department of Natural Resources, Pictured Rocks National Lakeshore may provide habitat for one plant listed by the federal government and 21 listed by the state (see Table 6). Not all of these species occur within the study area for shoreline vegetation. Pitcher's thistle and Lake Huron tansy are the only species that potentially occur in areas where personal watercraft may provide access.

TABLE 6: PLANT SPECIES OF CONCERN AT PICTURED ROCKS NATIONAL LAKESHORE

Common Name	Scientific Name	Federal Status	State Status	Habitat Present along the Shoreline
Pitcher's thistle	*Cirsium pitcheri*	T		X
Acute-leaved moonwort	*Botrychium acuminatum*		E	
Prairie moonwort, dunewort	*Botrychium campestre*		T	
Western moonwort	*Botrychium hesperium*		T	
Goblin moonwort	*Botrychium mormo*		T	

Common Name	Scientific Name	Federal Status	State Status	Habitat Present along the Shoreline
Autumnal water-starwort	*Callitriche hermaphroditica*		SC	
Calypso or fairy-slipper	*Calypso bulbosa*		T	
Pitcher's thistle	*Cirsium pitcheri*		T	
Douglas's hawthorn	*Crataegus douglasii*		SC	
Slender cliffbreak	*Cryptogramma stelleri*		SC	
Ram's head ladyslipper	*Cypripedium arietnum*		SC	
Blue wildrye	*Elymus glaucus*		SC	
American dune wildrye	*Elymus mollis*		SC	
Black crowberry	*Empertrum nigrum*		T	
Auricled twayblade	*Listera auriculata*		SC	
Alternate leaved water milfoil	*Myriophyllum alterniflorum*		SC	
Farwell's water milfoil	*Myriophullum farwellii*		T	
Butterwort	*Pinguicula vulgaris*		SC	
Stichwort	*Stellaria longipes*		SC	
Lake Huron tansy	*Tanecetum huronense*		T	X
Lake Huron locust	*Trumertropis huroniana*		T	
Downy oatgrass	*Trisetum spicatum*		SC	
Swarft billberry	*Vaccinium cespitosum*		T	

E = endangered; T = threatened; SC = special concern.

Endemic to the Great Lakes, the pitcher's thistle is dependent on both dune stability and periodic sand disturbance provided by the wind and wave action. Pictured Rocks National Lakeshore is the only place on Lake Superior where the plant has been found, with small communities throughout the Grand Sable Dunes. Pollinated by insects, a plant produces seeds only once during its 7- to 12-year life. Once seeds are mature, they fall or are windblown and germinate the following spring. Trampling can harm and possibly destroy the plants, although no records document such impacts.

Communities of Lake Huron tansy exist throughout the dune community, but they are not likely to occur within the study area (personal communication with staff biologist). Like the pitcher's thistle, the Lake Huron tansy requires a semi-permanent sand dune habitat. The tansy flowers from late June to early August. According to the park biologist, existing impacts to vegetation within the study area are minimal. There are no records of impacts from trampling.

Grand Sable Dunes is designated as a research natural area within the national lakeshore. As such, it is protected for the purposes of maintaining biological diversity, conducting non-manipulative research and monitoring, and fostering education. The protection afforded to research natural areas is a critical step in maintaining a range of biological diversity of native ecosystems and species. Because they are protected in a natural state, research natural areas also provide valuable opportunities for monitoring long-term ecological change and for comparing the effects of resource management activities against unmanaged controls.

Because of human impact, portions of the dunes currently support populations of nonnative species such as spotted knapweed and red clover. Restoration activities are ongoing and will continue in 2002. The goal is to gain control over spotted knapweed populations so that they do not continue to encroach on native plant species, especially pitcher's thistle and Lake Huron tansy, by containing the larger populations and removing the smaller, encroaching populations without applying chemicals. Smaller communities have recently been removed by physically pulling the plants from the ground.

SHORELINE VEGETATION

Overall, the shoreline of Pictured Rocks National Lakeshore is pristine, with little to no development. The inland area is forested and was managed for timber production prior to designation as a national lakeshore in 1966. Portions of the lakeshore have been clear-cut or selectively cut; however, there are still virgin woodland stands. The sandstone cliffs and sandy beaches are highly erodible from wind and wave action, creating a very fragile environment. Because of Lake Superior's large size, internal gravity waves called seiches are an ever-present phenomenon. These waves are produced by wind or air pressure; they generate and maintain currents in the lake and expose nearshore habitat to constant wave action. Surface waves add to this background of physical disturbance (Mac Strand, Northern Michigan University, pers. comm. 2001).

LAKE SUPERIOR AQUATIC PLANT COMMUNITY

In general there is little to no aquatic vegetation in Lake Superior due to natural conditions. Water within 10 feet of the shoreline can be as deep as 10 feet, increasing rapidly farther out from the shoreline. The lake bottom in some places along the shoreline is sandstone. Wave action and lake depths are not conducive to aquatic vegetative communities.

CLIFF COMMUNITIES

Sandstone cliffs tower 50 to 200 feet above the water along a 12-mile portion of the shoreline. Minimal vegetation grows on the sandstone substrate. Some portions of the shoreline are vertical sandstone faces, providing little chance for vegetation to take hold. There is no submerged, floating, or emergent vegetation growing along the cliffs, where the water is at least 4 feet deep. Although the sandstone substrate can support vegetative growth (as seen at higher elevations), the depth of water and wave action are not conducive for growth along the shoreline.

Some parts of the shoreline cliffs have gradual but short sloping cliff bases. Species that may be encountered here include butterwort primrose, bird's-eye primrose, green alder, mountain alder, willow, Labrador tea, showy mountain ash, and two species of blueberries (NPS 1980). But again, establishment of this vegetation would be infrequent due to wave action. Most of these and other plants are found at higher elevations, where there is no disturbance from wave action.

BEACH AND DUNE COMMUNITIES

Some of the most sensitive shoreline areas are the vegetated beach and dune communities. The soil substrate characteristic of the dunes and narrow beaches is comprised mostly of sand. Grasses and forbs dominate the plant community. Species common to this area are slender wheat grass, beach grass, Canada wild rye, dune grass, beach wormwood, horsetail, beach pea, common evening primrose, and sand cherry. While diversity may be lacking, there is substantial vegetative cover at Sand Point; Miners, Chapel and Twelvemile Beaches; and Grand Sable Dunes. Wave action on the immediate shoreline prevents the establishment of vegetation within the sandy substrate.

Grand Sable Dunes are periodically disturbed as sand builds, stabilizes, and erodes away from the dune system. These conditions produce vegetation communities that are constantly changing. The dunes exhibit more species diversity than the beaches and support growth of some unique species. Grand Sable Dunes are the only habitat on Lake Superior where the Pitcher's thistle (federally

threatened) has been reported. A variety of state-listed plant species are also found within the dune plant community, such as Lake Huron tansy. Jack pine occurs on portions of the dunes. Herbaceous plants commonly encountered include little blue stem grass, hoary puccoon, dune willow, starwort, and common bugseed. Orchids may be encountered along the southern and southeastern parts of the dunes.

Twelvemile Beach stretches along the shoreline with an average width of 100 feet. Isolated beaches comprise another 45,000 feet of shoreline with widths varying from 80 to 170 feet. Beach areas include a sandy or rocky shore with sparse to heavy vegetation above the storm tide line. Vegetation on this upper beach may include black spruce, cherry, and blueberry, as well as the grasses and forbs common to the dunes. The beach strand (the transitional sandy shoreline area between the land and the lake, commonly called coastal beach or lakeshore) and dune communities are fragile vegetative areas that will not withstand high visitor use.

Wetland Communities

Most of the wetlands in Pictured Rocks National Lakeshore are outside the PWC use areas. However, two wetlands abut the Lake Superior shoreline, one at Sand Point (less than 100 acres), and one at Au Sable Point (less than 150 acres). Vegetation at Au Sable Point is characteristic of a coniferous bog with species such as white cedar, black spruce, tamarack, balsam fir, and black ash. Common species found in the understory are royal fern, cinnamon fern, orange jewelweed, and bluebead.

The wetland at Sand Point has vegetation characteristic of an unforested bog. With the base dominated by sphagnum moss, common shrubs found here are of the heath family, including leatherleaf, bog rosemary, bog laurel, and cranberries. Several orchid species also grow here.

Forest Community

Forested areas line the shoreline, adjacent to the beach and dune plant communities. Northern hardwood forest is the most common forest type in the national lakeshore. Beech and sugar maple are the predominant deciduous species, with an understory of ferns, moss, spring ephemerals, shrubs, and saplings. Many areas have hemlock mixed with the hardwoods. The northern hardwood forest community tends to be present on sites with loamy soils where water-holding capacity is good. Sandy sites tend to be dominated by red, white, and jack pine forests. Orchid populations usually occur within pine patches.

River Mouth Aquatic Plant Community

Generally, the rivers at Pictured Rocks National Lakeshore have a high gradient and small watershed. The streams and rivers flowing to Lake Superior have numerous rapids and waterfalls, such as those on the Munising, Miners, Bridalveil, Chapel, Spray, and Sable Rivers. All of the streams are small with moderate flow rates and have either sandy or rocky bottoms. Miners River is the largest river in the lakeshore. Due to the gradient, flow characteristics, and substrate, most rivers in the lakeshore do not support significant aquatic vegetation where they flow into Lake Superior.

VISITOR USE AND EXPERIENCE

Pictured Rocks National Lakeshore is in a sparsely populated area of Michigan. Munising (population 2,500) is on the west end of the lakeshore, and Grand Marais (population 350) is on the east end. The nearest cities are Escanaba (65 miles, population 13,700) and Marquette (55 miles, population 22,000). The nearest large metropolitan areas are Detroit (400 miles, population 4.2 million), Chicago (400 miles, population 7.4 million), Milwaukee (300 miles, population 1.4 million), and Minneapolis/St. Paul (425 miles, population 2.5 million).

ANNUAL VISITOR USE

Visitor data for 1995 to 2000 indicate that visitation varies (see Table 7). In fact, over the last five years the lakeshore has had an average annual 1.5% decrease in annual visitation. Lakeshore staff indicate that visitation appears to have leveled off. Based on the data available, as well as discussions with lakeshore staff, no increase in park visitation is anticipated over the next 10 years.

TABLE 7: AVERAGE ANNUAL VISITATION AT PICTURED ROCKS NATIONAL LAKESHORE, 1995–2000

Year	Number of Visitors	Percentage Change from Previous Year
1995	464,537	--
1996	405,534	-12.7%
1997	415,813	+2.5%
1998	456,970	+9.9%
1999	444,766	-2.7%
2000	424,533	-4.6%
Average	435,359	-1.5%

Note: Approximately 40% of the annual visitation occurs during July and August. Based on the six-year annual average of 435,359 visits, an average of 2,900 people visit the lakeshore each day in July and August.

MONTHLY VISITOR USE

Monthly visitor use is documented for specific locations within the lakeshore. The monthly use data collected in July and August of 2000 were used to establish the number of visitors likely to be at specific lakeshore locations. The 2000 data provide the most recent data available and are comparable to the six-year average (1995 to 2000). Table 8 summarizes the July and August 2000 monthly visitor use for specific locations within the lakeshore.

TABLE 8: MONTHLY VISITOR USE FOR JULY AND AUGUST 2000

Location	Number of Visitors			
	July 2000	August 2000	Total	Daily Average
Sand Point	26,660	22,901	49,561	812
Cruises	7,000	18,000	25,000	410
Miners Segment	38,331	35,148	73,479	1,205
Little Beaver	5,466	5,774	11,240	184
Chapel Segment	6,095	6,263	12,358	203
Beaver Basin Segment	100	100	200	3
Backcountry Camps	2,817	3,296	6,113	100
Little Beaver Campground	782	723	1505	25
Twelvemile Segment	7,272	6,066	13,338	219
Grand Sable Segment	23,265	17,849	41,113	674
Sable Falls	13,034	10,230	23,264	381

Location	Number of Visitors			
	July 2000	August 2000	Total	Daily Average
Log Slide	1,562	1,194	2,756	45
Backcountry Camp	1,119	874	1,993	33
Hurricane River Camp	1,580	1,753	3,333	55
Twelvemile Beach Camp	3,145	3,245	6,390	105

Source: July and August 2000 Monthly Use Reports.

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. As previously noted, an average of 2,900 people visit the lakeshore each day in July and August.

Because Pictured Rocks National Lakeshore is a linear park, extending approximately 40 miles along the shoreline of Lake Superior, it was divided into four segments so that PWC activity and visitor use could be evaluated in comparable terms (see the Lakeshore Segments map). The borders of the segments were determined based on the lakeshore's natural features and current/proposed visitor use. Visitor data were assigned to segments based on location of documented use. It was assumed that all of the visitors within a segment would visit the shoreline (either at a bluff overlook or at a beach). Table 9 provides average summer daily visitor distribution for the lakeshore.

TABLE 9: AVERAGE DAILY SUMMER VISITOR DISTRIBUTION, PICTURED ROCKS NATIONAL LAKESHORE

Segment 1 Sand Point Segment (7.0 miles)	Segment 2 Cliffs Segment (8.2 miles)	Segment 3 Beaver Basin Segment (10.2 miles)	Segment 4 Grand Sable Segment (14.3 miles)
800	1,200	500	1,500

Most visitors come from Michigan (61%) and other Midwestern states (NPS 2000). While the national lakeshore is open year-round, approximately 40% of the visits are in July and August.

Most national lakeshore visitors can be categorized as either backcountry or frontcountry users, and each group has different expectations. For example, backcountry users tend to place a higher importance on solitude, wilderness experience, and personal challenges. Frontcountry users tend to place more importance on family togetherness, learning about nature, and cultural history.

VISITOR ACTIVITIES

Pictured Rocks National Lakeshore remains relatively undeveloped. Summer visitors engage in camping, hiking, backpacking, picnicking, and beachcombing. Water-oriented activities include boating, fishing, and swimming. Nearly 75% of the people visiting Pictured Rocks National Lakeshore get out of their vehicles to walk along the shore or beach, sightsee, or take photographs. Many visitors experience the park from commercial tour boats. Water-related activities include the use of speedboats, personal watercraft, sea kayaks, and canoes. Because PWC use may affect visitors at beaches, trails, and campgrounds near the shoreline, these activities are discussed below.

Camping

The national lakeshore provides both drive-in and backcountry campsites for visitors. Drive-in sites at Twelvemile Beach, Hurricane River, and Little Beaver are open May through October. The Twelvemile Beach campground includes 36 sites on a sandy bluff above the Lake Superior shoreline.

Hurricane River campground, which is at the mouth of the Hurricane River (where it cascades into Lake Superior), has 11 sites on the lower loop and 10 sites on the upper loop. Little Beaver has 8 sites. Lakeshore campsites are often full, especially during July and August.

Backcountry camps are spaced 2–5 miles apart and are located in diverse terrain. Each camp contains 3–10 sites. Ten camps along the shoreline are accessible by sea kayak; five camps on the cliffs above the shoreline are within approximately 200 feet of the shore but are not accessible by sea kayak. Backcountry sites are often full during July and August. At other times of the year backcountry users have the opportunity to have a near wilderness experience within the lakeshore.

Hiking/Backpacking

The North Country National Scenic Trail traverses the Lake Superior shoreline from Munising to Grand Marais and provides access to remote locations within the national lakeshore. Over 34 miles of this trail are within approximately 200 feet of the shore. This trail is used by day hikers and backpackers. Approximately 12% of summer visitors participate in backpacking.

Wilderness Experience

A wilderness suitability assessment for lands within the Chapel and Beaver Basins will be included in the *Draft General Management Plan.* While the final determination regarding wilderness designation has not yet been made, the remoteness of these areas currently provides visitors with a wilderness-style experience. Hiking the 42-mile North Country National Scenic Trail provides an opportunity for wilderness-style hiking, as well as providing access to remote areas of Beaver and Chapel Basins. The basins have limited developed facilities and access, while providing hiking trails and backpacking campsites for overnight use. Approximately 12% of visitors experience the backcountry through backpacking trips, and 73% of these visitors identify having a wilderness experience as important or very important, while 58% indicate that experiencing solitude is important or very important (NPS 2000).

Shoreline Use

Roads and hiking trails provide access to most of the Lake Superior shoreline, ranging from sand beaches to rocky beaches to cliffs. The heaviest shoreline use is near the access roads to Sand Point, Miners Beach, Hurricane River, and Sable Falls. Twelvemile Beach, which is more remote, is a favorite for backpackers and day excursions. Beachcombing and swimming are normal activities for beach visitors. However, swimming depends on weather conditions, since the water temperatures are generally cool. The 2000 visitor survey indicates that nearly 37% of national lakeshore visitor groups go swimming during their visit, nearly all of which occurs within Lake Superior. The estimated number of swimmers at Pictured Rocks is 270 per day.

Boat Tours

Pictured Rocks Cruises, Inc., provides shoreline boat tours. The company uses up to four diesel-powered boats and operates up to 10 scheduled tours per day during the peak visitor season. During the tour the boats move close to the shoreline (at no-wake speeds), and guides provide short descriptions of the area using a public address system. Approximately 24% (410 people per day) of lakeshore visitors participate in these tours during their visits (NPS 2000).

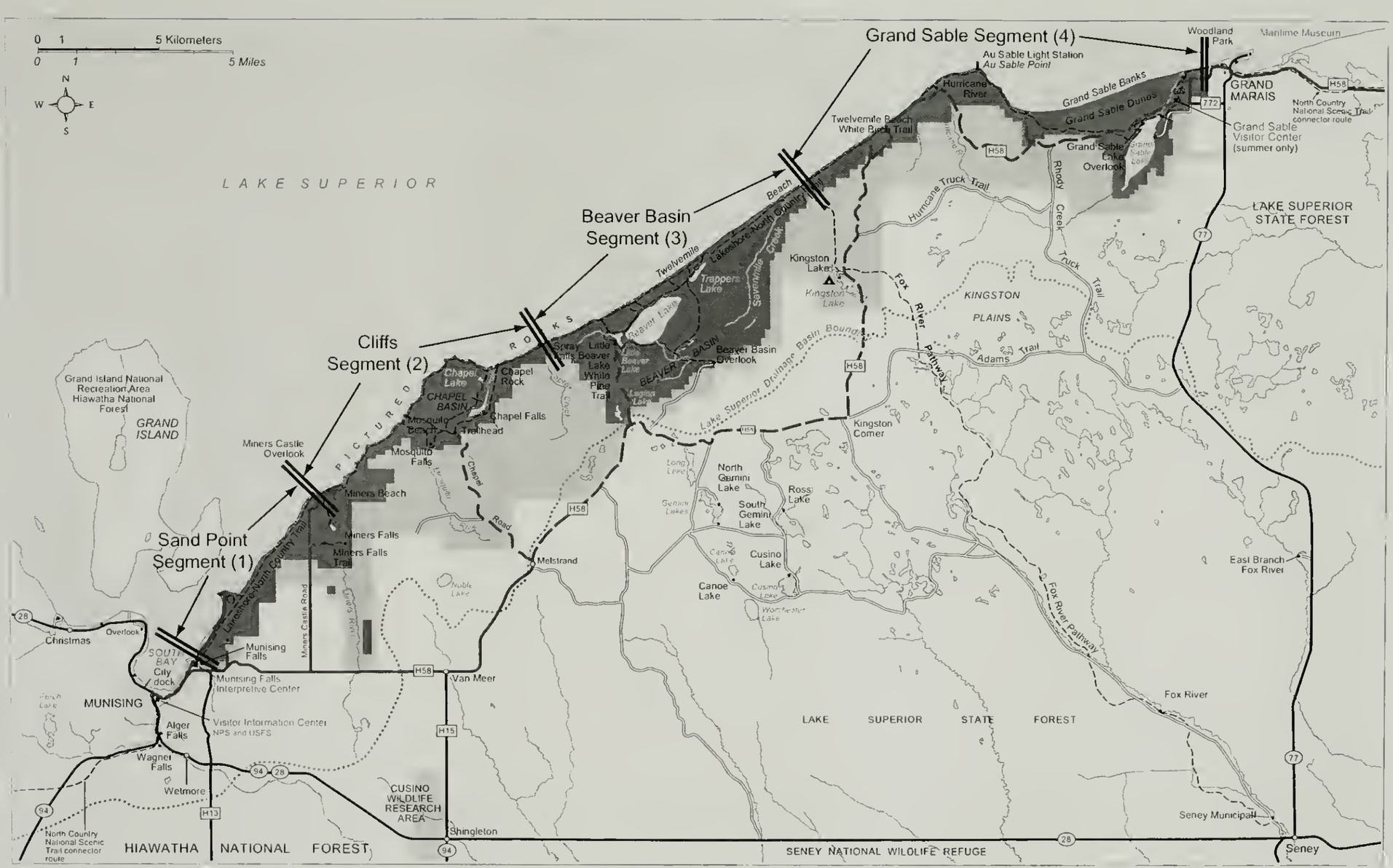
Pictured Rocks National Lakeshore
Michigan

Lakeshore Segments

Pictured Rocks National Lakeshore

Michigan

Lakeshore Segments



United States Department of the Interior / National Park Service WASO / May '02 / 625/20083

- Lakeshore Zone (NPS)
- Inland Buffer Zone (mixed ownership)
- Paved lakeshore access road
- Unpaved lakeshore access road
- Other unpaved road
- Trail

Watercraft Use (Motorboats, Canoes, and Sea Kayaks)

The largest group of motorized watercraft in the lakeshore is motorboats. According to lakeshore staff, there are likely 10 motorboats for every personal watercraft operating in Pictured Rocks National Lakeshore. This assumption is consistent with Michigan boat registration statistics, which indicate that personal watercraft make up 8% to 12% of all boats registered.

Motorboats were assumed to have an average of four occupants. While this is higher than the lakeshore's visitors per-vehicle standard, it is consistent with the average group size identified in the 2000 summer visitor survey. It was assumed that 25% of motorboats would anchor offshore within their segment of use. This percentage seems to be a reasonable estimate based on staff observations. After anchoring, occupants may go ashore for a picnic or beachcombing. Boaters may also engage in fishing, sightseeing, and thrill riding. In addition, boats are used to provide access for divers investigating shipwrecks, some of which are located within the national lakeshore boundary.

Sea kayakers and canoeists also visit the lakeshore. According to the 2000 visitor survey, approximately 6% of the visitor groups participate in sea kayaking and 7% in canoeing on Lake Superior. Based on July and August visitor data (year 2000) and discussions with NPS staff, this amounts to 40 sea kayakers and canoeists per peak day. Sea kayakers and canoeists on Lake Superior are concentrated in the west end of the lakeshore, between Sand Point and Chapel Rock. Sea kayaking has become very popular in the lakeshore, and NPS staff indicate that more sea kayakers visit the lakeshore each year. An annual symposium hosted by the Great Lakes Sea Kayak Club attracted approximately 350 people during July 2001 (pers. comm., <lmerx@nkfm.org> 2001). Canoeing is more popular on inland lakes.

The national lakeshore has one boat launch on Lake Superior at Sand Point. Public access to Lake Superior is also available at launches in Munising and Grand Marais. Watercraft launched at docks range from sea kayaks to speedboats.

PWC Use

Within Pictured Rocks National Lakeshore, PWC use is only allowed on Lake Superior. Most PWC users are from within 100 miles of the lakeshore. Based on staff observations, some users come from other parts of Michigan, Wisconsin, and Minnesota, and perhaps Ohio and Illinois. There are many other areas for water-based recreation in this portion of the Upper Peninsula, including state parks, national forests, and other lakes with public access.

To document actual PWC use and to provide peak usage information, staff conducted a survey at the Sand Point launch July 4–8, 2001. During the five-day survey, small craft warnings prohibited personal watercraft on two days. PWC use for the remaining three days ranged from 8 to 13 personal watercraft each day, or an average of 6.6 per day over the five-day survey.

Because personal watercraft are launched from the Munising boat ramp on the west end of the lakeshore, the city was contacted to determine launch numbers; however, specific data were not available. Based on discussions with lakeshore staff, the number of personal watercraft launched from Munising was assumed to be the same as the number launched from Sand Point. Based on this analysis and assumption, 6.6 personal watercraft would be launched from the Munising boat ramp during July and August weekends. All of these personal watercraft would likely travel within the lakeshore's jurisdiction.

Grand Marais, on the east end of the lakeshore, also has boat launch facilities. According to city staff, very few personal watercraft are launched — perhaps 12 all summer, for an average of 1 personal watercraft every seven days. This analysis assumes that on average no personal watercraft would be launched from Grand Marais during July and August.

Thus, the peak number of personal watercraft currently operating in the lakeshore is 13 per day — 6.6 from the Sand Point launch, and 6.6 from the Munising boat ramp. The low PWC numbers are primarily a result of the cold water temperature, cool ambient air temperature, changeable weather conditions, and heavy winds and wave action. On inland lakes the size of powerboat engines is restricted to two- and four-stroke internal combustion engines of 50 hp or less, essentially eliminating PWC use.

The average PWC trip within Pictured Rocks National Lakeshore lasts between three and five hours, from mid morning to mid or late afternoon. State regulations restrict operations to the hours of 8 A.M. to one hour before sunset. Most PWC users cruise and sometimes race along the shoreline, explore the rock cliffs up close, jump the wakes of tour boats (which make 4–5 foot swells), and travel to beach destinations and spend the day or afternoon on the beach. Fewer PWC users assemble in pontoons and do short trips or go to beach areas. A very small number may do day trips between Munising and Grand Marais (40+ miles), and a very small number fish in Miners River in early season. Only a few users ask about PWC camping opportunities.

PWC users are distributed throughout the lakeshore. According to NPS staff, most personal watercraft are operated on the west end of the lakeshore. This is consistent with the launch locations and predicted launch numbers. Few PWC operators travel the entire length of the lakeshore due to the long distance, rough waters, and potential for changing weather.

Generally, there is very little information specific to PWC use and visitor concerns. Visitor surveys were conducted for the winter of 1999–2000 and for the summer of 2000 (with questions specific to PWC use in the national lakeshore). No PWC accidents have been observed or reported to NPS staff. Five incident reports have been documented, one for operating too close to other motorcraft, two for operating too close to swimmers, and two for operating illegally on inland lakes. There are no observations or reports related to natural resource concerns.

Table 10 summarizes activity groups and visitor numbers at Pictured Rocks National Lakeshore.

TABLE 10: PEAK DAILY VISITOR NUMBERS, JULY AND AUGUST, 2000 AND 2001

Activity Group	Segment 1 Sand Point Segment (7.0 miles)	Segment 2 Cliffs Segment (8.2 miles)	Segment 3 Beaver Basin Segment (10.2 miles)	Segment 4 Grand Sable Segment (14.3 miles)	Total
PWC Users[1]	4	4	3	2	13
Motorboat Users[2]	40	40	30	20	130
Sea Kayakers, Canoeists[3]	15	15	8	7	45
Other Visitors[4]	800	1,200	500	1,500	4,000
Swimmers[5]	80	50	30	60	270
Tour Boat Passengers[6]	410	410	30	0	410

1. PWC numbers are based on a survey completed over the July 4th weekend, 2001. Numbers indicate peak weekend during peak visitor season.
2. Motorboat numbers are based on discussion with park staff. Assumed other motorboats are 10 times as common as personal watercraft.
3. Numbers of sea kayakers and canoeists based on the 2000 visitor survey and discussions with NPS staff.
4. Visitor numbers based on July and August (2000) monthly use reports and include hikers, backpackers, beachcombers, etc.
5. Numbers of swimmers based on the 2000 visitor survey and discussions with NPS staff.
6. Visitor numbers based on July and August (2000) monthly use reports. Note that the same visitors would be in each segment, thus the total is not cumulative.

VISITOR SATISFACTION

Generally, visitors to Pictured Rocks National Lakeshore are very satisfied with their experiences. According to the 2000 visitor survey, more than 90% of all respondents (both frontcountry and backcountry) agreed or strongly agreed that they

- enjoyed their time at Pictured Rocks National Lakeshore
- were satisfied with their trip
- enjoyed the natural quiet
- thought the area and its surroundings were in good condition

When asked about problems encountered, respondents indicated that they had few or no problems, overall. Only three problems were rated as serious or very serious by more than 5% of the respondents. These problems included

- motorized boats on Lake Superior disturbing one's backcountry experience
- personal watercraft disturbing one's backcountry experience
- too many personal watercraft on the Lake Superior shoreline

However, 80% of the respondents did not rate these as problems.

VISITOR CONFLICTS AND SAFETY

RELATED FEDERAL AND STATE PWC REGULATIONS

Pictured Rocks National Lakeshore is in the process of adopting the state PWC regulations and is responsible for monitoring enforcement within the lakeshore. Michigan's Personal Watercraft Safety Act of 1998 (Public Act 116) stipulates the following regulations for PWC use:

- no operating within 150 feet of another vessel unless at no-wake speed
- no operating within 100 feet of a dock, a swim area, a person in the water, an anchored or drifting vessel
- no operating within 200 feet of a diver, a dive boat, or a personal flotation device with a diving flag
- no operating in less than 2 feet of water unless either at no-wake speed or launching/landing
- no weaving in heavy traffic
- no playing chicken
- no operating personal watercraft at a speed that endangers people or property
- no operating personal watercraft within 200 feet of the shoreline unless traveling perpendicular to shoreline at no-wake speed

The Michigan Department of Natural Resources and the U.S. Coast Guard can also enforce PWC regulations within the lakeshore. There are no local ordinances regarding personal watercraft operation.

The U.S. Forest Service currently has no-landing restrictions for personal watercraft at Grand Island National Recreation Area. The Hiawatha National Forest includes two nearby wilderness areas — Rock River Canyon and Big Island Lake. Nearby Seney National Wildlife Refuge includes a 25,000-acre wilderness area. There are no state-designated wilderness areas nearby. Motorized vehicles are prohibited in designated wilderness areas.

Lake Superior is known for its dramatic weather changes and extreme conditions, as evidenced by the numerous shipwrecks in the lakeshore area. Small craft advisories and warnings are relatively common throughout the year, due to high winds and storms.

PWC-RELATED CONFLICTS WITH OTHER VISITORS

Conflicts between PWC operators and other visitors have been documented through incident reports and visitor surveys. Three incident reports have been recorded regarding personal watercraft operating in Lake Superior. A September 1999 report indicates that a Pictured Rocks National Lakeshore boat patrol stopped a PWC user for operating within 150 feet of another vessel, traveling at greater than no-wake speed, and operating too close to a beach. Two reports in 1998 indicate that PWC operators were traveling too close to swimmers and were operating at high rates of speed. No PWC-related accidents have been documented at the national lakeshore. When PWC users comply with Michigan regulations, there are few conflicts between PWC operators and other visitors.

Many of the activities undertaken by visitors in the nearshore area of Pictured Rocks National Lakeshore are extremely compatible. For example, swimming, picnicking, and beachcombing are all possible along the shoreline and produce little or no conflict between 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.

In addition to visitor conflict concerns, PWC use within the national lakeshore has resulted in the need for assistance to locate "missing" or overdue operators. While these occurrences are infrequent, there is the potential that a missing PWC operator could be in serious trouble. Thus far, missing or overdue operators have either arrived on their own or received NPS assistance (receiving fuel or being towed to the boat launch).

CULTURAL RESOURCES

HISTORICAL BACKGROUND

Evidence for human occupation in the vicinity of the park is present for all three temporal periods — Paleoindian, Archaic, and Woodland — prior to European contact. The lifeways of these early inhabitants continued in much the same way through the Paleoindian (6,000 to 5,000 B.C.) and Archaic (5,000 to 500 B.C.) periods and was characterized by continued low population density and seasonal exploitation of the lakeshore area. Archaic period sites recorded along the south shore of Lake Superior occur at or slightly above the present lake level, suggesting that the majority of sites dating to this period have likely been inundated, buried, or eroded away. The Woodland period (ca. 200 B.C. to A.D. 1650) saw the introduction of rudimentary agriculture, increased population growth, the use of burial mounds, and the making of ceramic vessels. Archeological sites dating to the Woodland period occur primarily at the mouths of streams and along the shores of lakes and rivers and indicate a shift to increased exploitation of resources along waterways in the spring, summer, and fall with reliance on hunting in inland areas during the winter.

At the time of initial contact by French traders and missionaries in the 17th century, the dominant indigenous group was the Ojibwe who began occupying the Lake Superior area by A.D. 1100. Permanent Euro-American settlement in the area did not occur until after the Ojibwe ceded their lands in the Upper Peninsula to the United States in 1836. Prior to this cession, the Ojibwe had documented settlements in the area of the park on Grand Island and near Old Munising. They were known to have established a cemetery in the vicinity of Sand Point and used the Grand Sable Dunes for special ceremonies, fasts, and gravesites. Abandoned lodges were also noted along the shore of Grand Marais in 1826. By the late 1850s, the U.S. Government attempted to relocate the Ojibwe onto reservations scattered across Minnesota, Wisconsin, and Michigan. Many Ojibwe remain dispersed within the region, including what is now the lakeshore area (for example, Old Munising, Thomasville, and Grand Marais).

In the 1840s iron and copper mining began on the Upper Peninsula, along with ore-processing facilities such as the Schoolcraft Blast Furnace and company town, Old Munising, operated near Munising Falls from 1867 to 1877. In response to the rise in shipwrecks from increased traffic created by the completion of St. Mary's Channel in 1855 and hazardous weather, the Federal Lighthouse Service completed a lighthouse complex at Au Sable Point in 1874. Commercial logging of pine trees in the area also began in the 1840s and lasted until roughly 1900. Logging within the current NPS boundaries began with Thomas Sullivan's logging camp that operated from 1880 to 1883, at what is now Sullivan's Landing near Twelvemile Beach. One well known logging feature within the park is a wooden chute, called the Log Slide, built near the Grand Sable Dunes where log booms were towed to the mills at Grand Marais. The early 20th century also saw a boom in hardwood logging that lasted until the 1930s. As early as the 1930s, recreation and tourism began playing greater roles in the local economy, and in 1966 Congress authorized Pictured Rocks National Lakeshore and its corresponding inland buffer zone.

ARCHEOLOGICAL RESOURCES

Archeological resources within Pictured Rocks National Lakeshore represent all periods of human occupation since the late Paleoindian precontact period. A total of 38 archeological sites have been recorded within the national lakeshore. Currently, no archeological sites are listed on the National Register of Historic Places. The majority of precontact period sites are associated with Woodland and Archaic period seasonal habitations and are primarily along the shoreline, on high sand bluffs overlooking Lake Superior, in sandstone bedrock coves along the lakeshore, near streams and the mouths of creeks and rivers, and along inland lake shorelines. The vast majority of these sites along water are located in subsurface contexts, with very few sites found in the interior upland areas. Historical archeological sites within the park are primarily associated with extraction industries (such as iron and logging), shipping, small homesteads and farms, and later recreational use of the area. A total of 11 previously recorded sites are within the vicinity of PWC use areas for this environmental assessment.

The first major archeological survey of the shoreline and river mouths occurred shortly after the establishment of Pictured Rocks National Lakeshore in 1966 (NPS 1968). Numerous smaller compliance-related surveys occurred in site-specific areas within the park during the next decade in response to the proposed construction of parking lots, comfort stations, visitor centers, and other improvements. It was not until 1985–1990 that the NPS Midwest Archeological Center conducted a multi-year archeological survey of the national lakeshore. Other archeological survey work of note includes testing at the Old Munising blast furnace (NPS 1990a) and testing at the Au Sable Light Station (NPS 1990b). Evaluative testing occurred at two sites at Hurricane River and Miner's Beach. One new site was recorded and two previously recorded sites were surveyed (NPS 1993a).

SUBMERGED CULTURAL RESOURCES

The submerged cultural resources in this district, primarily shipwrecks, are owned by the state and are managed by the National Park Service to preserve their historical and recreational value. In 1980 the Michigan Legislature authorized the designation of the Alger Underwater Preserve, extending from Au Train Point to Au Sable Point and including all of Grand Island and the national lakeshore area to the 150-foot-deep contour line. All of the national lakeshore lies within these limits. In 1989 the National Park Service undertook a study to gather survey information on the history, location, and nature of shipwrecks within the lakeshore and underwater preserve for management and interpretive purposes (NPS 1989).

There are 116 reported shipwrecks in the general vicinity of the national lakeshore, of which 54 wrecks have been identified, roughly half of which are within the actual boundaries of the lakeshore. The 54 wrecks include 25 sailing craft, 10 bulk freighters, 8 tugs/fishing craft, 5 passenger vessels, 4 steamboats, and 2 general (package) cargo ships. Out of the 116 reported incidents, weather was found to be the predominant cause. A breakdown by location reveals several clear geographical clusters, including 22 at Grand Island, 7 in the West Channel, 14 in the East Channel / Sand Point vicinity, 17 along Pictured Rocks, 10 at the west end of Pictured Rocks, 5 at the east end of Pictured Rocks, 2 at Twelvemile Beach, and 21 at Au Sable Point. Outside the lakeshore there were 3 at Sable Banks, 17 at Grand Marais harbor, and 13 additional offshore wrecks.

The 1989 study surveyed 24 wreck sites, 14 of which are within the lakeshore boundaries, extending from the immediate shoreline to over 3,300 feet offshore and at depths from 3 to 40 feet. The average distance of these wrecks from shore is 320 feet with an average depth of 12 feet.

ETHNOGRAPHIC RESOURCES

Ethnographic resources are defined as the natural and cultural materials, features, and places that are linked by a subject community to the traditional practices, values, beliefs, history, and/or ethnic identity of that community. The Bureau of Applied Research in Anthropology at the University of Arizona-Tucson conducted a study of ethnographic resources within the national lakeshore in 1999. The Ojibwe have a cultural affiliation to the lands within Pictured Rocks National Lakeshore, having occupied the Upper Peninsula region from the 1400s until the first land cessions in the 1820s. Six Ojibwe bands may rightfully claim cultural affiliation with national lakeshore lands; five additional bands along the north shore of Lake Superior may also have close ties.

Ethnographic resources identified in the 1999 study include 11 activity complexes, 488 plants, 79 animals, 7 minerals, and 16 landform types. Several areas or landform types within the national lakeshore have religious and/or cultural significance to the Ojibwe. The Grand Sable Dunes, considered a sacred place, was used for burials and vision quests. Other known burial grounds are reported at Sand Point and near Munising. Lake Superior is also significant because it is intrinsically linked to Ojibwe lifeways and was used for shoreline canoe routes and fishing. The area of Pictured Rocks and other high prominences such as Miners Castle are significant as ceremonial places. Areas where land and water merge (the shoreline, along streams, the mouths of rivers, and sheltered coves) are also important. Given the Ojibwe's dependence on the lake for food and transportation, the Ojibwe generally established camps and seasonal settlements away from the unprotected shoreline along river mouths and creeks that were more sheltered and still provided access to the lake.

SOCIOECONOMIC ENVIRONMENT

The Upper Peninsula is sparsely populated and rather remote. The nearest sizable cities are Detroit, Milwaukee, and Minneapolis/St. Paul. Resource-based tourism and industry (primarily lumber and manufacturing) are the mainstays of the local economy.

As previously discussed, Pictured Rocks National Lakeshore experiences relatively low rates of PWC use. Almost all of the PWC users in the national lakeshore are believed to be local residents or owners of summer homes in the area who are using their personal machines. PWC rentals are not available within the park or adjacent towns of Munising and Grand Marais. There were three local PWC rental shops in the Munising area before 1999. All three shops eliminated PWC rentals, likely due to liability insurance costs. PWC rentals may be available in Marquette or Escanaba, which are about 70 miles from Pictured Rocks. The only business that sells personal watercraft in the area indicated that the majority of its sales are to local residents.

There are other areas near Pictured Rocks National Lakeshore where personal watercraft may be used, such as inland lakes in Lake Superior State Forest, Hiawatha National Forest, and Indian Lake State Park, as well as other locations on Lake Superior.

NATIONAL LAKESHORE MANAGEMENT AND OPERATIONS

Pictured Rocks National Lakeshore currently has three permanent law enforcement staff positions and two seasonal staff positions. Boat patrols on Lake Superior are not conducted regularly, with primary consideration given to high use days or for search-and-rescue operations. Search-and-rescue patrols are infrequent and have generally been required for overdue boaters. Search patrols are conducted for various park users, including PWC operators, motorboaters, sea kayakers, and canoeists. Occasionally, rescue patrols are required during rough weather, when waves can be 4 to 5 feet.

The Michigan Department of Natural Resources provides infrequent patrols and is primarily focused on enforcing fishing regulations and PWC regulations. Marquette is the location of the nearest U.S. Coast Guard station. Coast Guard patrols are rare at Pictured Rocks National Lakeshore, unless a search-and-rescue operation is necessary.

According to lakeshore staff, the lack of routine boat patrols limits their effectiveness for enforcing boating regulations and overseeing water-related activities. Although no accidents have been reported to date, there is the potential for conflicts to occur between visitors who use Lake Superior. The three incident reports involving personal watercraft that are on file indicate that conflicts between PWC users and swimmers or motorboaters have occurred within Pictured Rocks National Lakeshore.

Water-based recreation requires assistance and enforcement by lakeshore staff. Currently, the staff focuses most of its enforcement time on land-based recreation. Approximately one to two staff days per week are dedicated to water-based enforcement, as well as contacts with lakeshore backcountry campsites. According to lakeshore staff, the current level of enforcement dedicated to water-based recreation is not adequate. Given the number of watercraft operating within the lakeshore, both man-powered and motorized, daily boat patrols would be needed to meet existing and future needs. This would require the addition of three permanent staff positions and the acquisition of a boat for the Grand Marais District. Daily patrols could then be conducted from each end of the park.

ENVIRONMENTAL CONSEQUENCES

SUMMARY OF LAWS AND POLICIES

Three overarching environmental protection laws and policies guide the National Park Service — the National Environmental Policy Act (NEPA) of 1969, and its implementing regulations; the National Parks Omnibus Management Act of 1998 (NPOMA); 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 *Director's Order #12: Conservation Planning, Environmental Impact Analysis, and Decision-making* (2001), and its accompanying handbook.

2. The National Parks Omnibus Management Act of 1998 (NPOMA) (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 the ultimate resource management decision 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 *Director's Order #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 *Director's Order #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 upon 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 ESTABLISHING IMPACT THRESHOLDS AND MEASURING EFFECTS

While much has been observed and documented about the overall effects of personal watercraft 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 and 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. With interpretation, one can ascertain whether a certain impact intensity to a park resource is "minor" compared to "major" and what criteria were used to base that conclusion.

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, of the various management alternatives.

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 personal watercraft use and current management projected over the next 10 years (alternative A). In the absence of quantitative data, best professional judgment prevailed. In general, the thresholds used come from existing literature on personal watercraft, federal and state standards, and consultation with subject matter experts and appropriate agencies.

In addition to establishing impact thresholds, the national lakeshore'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 personal watercraft management, the lakeshore'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 personal watercraft on park resources, and modified the alternatives accordingly.

For the purposes of analysis, the following assumptions are used for all impact topics:

Short-term impacts: Those impacts occurring from PWC use in the immediate future (per trip 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.

Cumulative impacts: Those impacts resulting from continued PWC use at the park, when considered in context with other site-specific, local, or regional past, present, and reasonably foreseeable actions/activities that could affect the same resources or conditions, both inside and outside park boundaries.

Study 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 a study area relative to the resource being assessed, and it is further defined in the impact methodology.

Unless otherwise noted in the impact analysis, impacts would be adverse.

IMPAIRMENT ANALYSIS

The National Park Service is prohibited from impairing park resources and values by its Organic Act. The NPS *Management Policies 2001* (sec. 1.4.5) state "an impairment . . . is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values." In addition, the *Management Policies* state "whether an impact meets this definition depends on 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."

The *Management Policies* also state "an impact to any park resource or value may constitute an impairment . . . to the extent that it affects 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 to opportunities for enjoyment of the park; or identified as a goal in the park's general management plan or other relevant NPS planning documents."

The determination of impairment is closely tied to the outcome of the resource impact analysis. This determination is also made with a parallel consideration of the park's legislative mandates (purpose and significance), and resource management objectives as defined in its general management plan or other relevant plans.

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

1. The national lakeshore's enabling legislation, the *Draft General Management Plan / Wilderness Study / Environmental Impact Statement,* the existing *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 AND OTHER VISITOR USE TRENDS

PWC use trends were identified to determine direct and indirect impacts of PWC management strategies on lakeshore resources. Other visitor use trends were identified to help assess cumulative effects. Use trends were determined using data available from the lakeshore records, discussions with lakeshore staff, discussions with city staff in Munising and Grand Marais, discussions with state agencies, Michigan boat statistics, and the 2000 summer visitor survey for Pictured Rocks. While the visitor survey data represent only those respondents surveyed, it provides the best data for general visitor trends. All visitor data, unless otherwise indicated, is presented as daily numbers.

PWC Use

Most (61%) of the Pictured Rocks National Lakeshore visitors are from Michigan. Future PWC use in the lakeshore was determined based on Michigan registration statistics (see Table 11).

TABLE 11: MICHIGAN JET SKI AND JETBOAT REGISTRATION STATISTICS, 1995–2001

Year	Jet Skis	Jetboats	Total	Percentage Increase
1995	57,790	5,702	65,487	
1996	70,844	4,901	77,741	19%
1997	78,897	6,500	87,394	12%
1998	83,950	6,982	92,930	6%
1999	88,272	7,288	97,559	5%
2000	108,998	53,563	164,561	Not Applicable*
2001	109,765	53,771	163,536	-1%

* In 2000 the parameters for counting Jetboats were changed. Thus, the change in registration (compared to 1999) is not applicable. Prior to 2000, Jetboats included personal watercraft measuring 13 to 16 feet. After 2000, Jetboats included personal watercraft measuring 13 to 22 feet.

According to data provided by the Michigan Department of State, PWC registration has leveled off in recent years, and it even decreased between 2000 and 2001. Lakeshore staff indicate that PWC use still appears to be increasing slightly in the lakeshore. Based on the Michigan data available and staff comments, PWC numbers were assumed to increase by 2% each year for the next 10 years. Within Pictured Rocks National Lakeshore current PWC use is approximately 13 craft per day; by 2012 use is projected to increase to 16 craft per day.

The number of personal watercraft operating in each of the four national lakeshore segments will vary by alternative. For example, no personal watercraft would be operated between Spray Falls and 1.25 miles east of Sevenmile Creek under alternative B. It was assumed that personal watercraft would be distributed into the adjacent segments for this alternative. Table 12 illustrates the existing and future distribution of personal watercraft in the lakeshore by alternative.

According to the safety study conducted by the National Transportation Safety Board (1998), 68% of personal watercraft are occupied by a single rider. For the purposes of this analysis, the remaining 32% are assumed to be equally divided between two and three people. Based on this determination, the average number of riders per personal watercraft is 1.5. For this analysis, it is further assumed that all of these riders would land at available beaches within their segment of use.

OTHER WATERCRAFT AND SWIMMERS

Michigan boat registration statistics for 1995 to 2000 show a 1.7% average annual increase in motorboat numbers. Based on this average annual increase, future motorboat numbers would continue to outnumber personal watercraft by approximately 10 to 1. Currently, Pictured Rocks National Lakeshore has an estimated 130 motorboats per day; by 2012 this number is estimated to be 160. Motorboat distribution is predicted to be similar to personal watercraft distribution, with most visitors launching from and using the west end of the lakeshore (see Table 12).

Table 12 summarizes visitor use and distribution at Pictured Rocks National Lakeshore; this summary is used for the impact analysis for each issue under review.

TABLE 12: PEAK DAILY VISITOR NUMBERS, JULY AND AUGUST

User Groups	Segment 1 Sand Point Segment (7.0 miles)		Segment 2 Cliffs Segment (8.2 miles)		Segment 3 Beaver Basin Segment (10.2 miles)		Segment 4 Grand Sable Segment (14.3 miles)		Total	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Alternative 1 (No Action)										
Personal Watercraft[1]	0	5	0	5	3	0	2	2	13	16
Other Motorboats[2]	80	80	80	50	30	80	20	20	130	160
Sea kayakers and Canoeists[3]	15	15	15	16	8	8	8	8	45	47
Other Visitors[4]	800	800	1,200	1,200	500	500	1,500	1,500	4,000	4,000
Swimmers[5]	80	80	50	50	60	80	60	80	270	270
Tour Boats Passengers[6]	410	410	410	410	0	0	0	0	410	410
Alternative 2 (Seasonal Ban)										
Personal Watercraft[1]	0	7	0	7	0	0	2	2	13	16
Other Motorboats[2]	55	65	55	65	0	0	20	30	130	160
Sea Kayakers and Canoeists[3]	15	16	16	16	8	8	8	8	45	47
Other Visitors[4]	800	800	1,200	1,200	500	500	1,500	1,500	4,000	4,000
Number of Swimmers[5]	80	80	50	50	60	80	60	80	270	270
Tour Boat Passengers[6]	410	410	410	410	0	0	0	0	410	410
No-Action Alternative (PWC Use Banned after April 2002)										
Personal Watercraft[1]	0	0	0	0	0	0	0	0	0	0
Other Motorboats[2]	55	65	55	65	0	0	20	30	130	160
Sea Kayakers and Canoeists[3]	15	16	15	16	8	8	8	7	45	47
Other Visitors[4]	800	800	1,200	1,200	500	500	1,500	1,500	4,000	4,000
Swimmers[5]	80	80	50	50	60	80	60	60	270	270
Tour Boat Passengers[6]	410	410	410	410	0	0	0	0	410	410

Note: Based on visitor use statistics, as well as discussions with national lakeshore staff, no overall increase in park visitation is anticipated over the next 10 years.

1. Existing and future (2012) PWC numbers based on survey completed over July 4th weekend, 2001. Numbers indicate peak weekend during peak visitor season. Assume 1.5 persons per PWC, all of which would land on shore.
2. Existing and future (2012) motorboat numbers based on discussion with NPS staff. Assume other motorboats are 10 times as common as personal watercraft. Assume 4 people per motorboat, 25% of which would land on shore.
3. Numbers of sea kayakers and canoeists based on the 2000 visitor survey and discussions with NPS staff. Assumed 5% increase over 10-year period.
4. Visitor numbers based on July and August (2000) monthly use reports. Includes hikers, backpackers, beachcombers.
5. Number of swimmers based on 2000 visitor use survey and discussions with NPS staff.
6. Number of tour boat passengers based on July and August (2000) monthly use reports. Note that the same visitors would be in each segment, thus the total is not cumulative.

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. A common gasoline additive, methyl tertiary butyl ether (MTBE) is not used in Michigan.

A typical conventional (i.e., carbureted) two-stroke PWC engine discharges as much as 30% of the unburned fuel mixture through the exhaust into the water (NPS 1998; California Air Resources Board 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). The Bluewater Network (2001) states that personal watercraft can discharge between 3 and 4 gallons of fuel over the same time period.

As described below, hydrocarbon (HC) discharges to water are expected to decrease significantly over the next 10 years due to mandated improvements in engine technology (US EPA 1996a, 1997).

Guiding Regulations and Policies

The Environmental Protection Agency has developed national recommended water quality criteria for priority pollutants in ambient water for the protection of aquatic life and human health (US EPA 1999a). These criteria have been adopted as enforceable standards by most states. No aquatic life criteria have been established for any of the PWC-related compounds. Human health criteria have been established for several of these compounds. These include benzene, ethylbenzene, toluene, and 12 of the 16 priority pollutant PAH compounds. The Michigan Department of Environmental Quality is responsible for water quality in the state, and it administers provisions of the Clean Water Act under the supervision of the U.S. Environmental Protection Agency. Michigan has set human health standards for benzene and toluene, two of the PWC-related compounds.

Michigan identifies the waters of Lake Superior as high quality waters and designates waters in the national lakeshore as outstanding state resource waters. This means that controls shall be applied on pollutant sources to outstanding state resource waters or tributaries so that the water quality is not lowered. A short-term, temporary (weeks or months) lowering of water quality in outstanding state resource waters may be permitted by the department on a case-by-case basis.

Pictured Rocks National Lakeshore does not have quantified 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 park-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 (NPS, WRD, pers. comm. 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. Of these pollutants, the state has established water quality standards only for benzene, based on the "Final Water Quality Guidance for the Great Lakes System" (US EPA 1995). The state human health surface water standard for benzene (cancer, drinking water) is 12 micrograms per liter (µg/L or parts per billion) (Michigan DEQ Surface Water Quality Division General Rules R323.1057, Toxic Substances). As described on page 68, the EPA benzene criterion of 1.2 µg/L was used for the calculation of water quality impacts since it is an order of magnitude more protective than the state standard. Ecological and human health toxicity benchmarks and criteria for the remaining pollutants were acquired from various literature sources. The classification of park waters by the state was defined, and the overall sources of water pollutants, both internal and external to park boundaries, were identified in relation to the standards and classification.
3. Baseline water quality data (if available), especially for pollutants associated with two-stroke engines (PAHs, hydrocarbons), were examined. In Michigan MTBE is not required or consistently used in gasoline; therefore, it was not analyzed.
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 A. 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 principal mechanisms that result in 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. Table 13 shows the criteria and benchmarks used to assess impacts.

TABLE 13: ECOLOGICAL BENCHMARKS AND HUMAN HEALTH CRITERIA FOR ORGANIC POLLUTANTS

Chemical	Ecological Benchmark (µg/L)	Source	Human Health Criteria** (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	19-34*	USFWS 2000	--	--
Benzene	130	Suter and Tsao 1996	1.2	US EPA 1999a

* 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).

** Based on the consumption of water, fish and aquatic organisms.

7. 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.

8. 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 contribute very 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.

9. Reductions in emissions from personal watercraft and outboards are outlined by the U.S. Environmental Protection Agency over the next 10 years (see Table 14).

TABLE 14: 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).
2005	Estimated 25% reduction in HC emissions overall as a result of newer models being gradually used (US EPA 1996a; date modified in US EPA 1997).
2006	EPA fully implements 75% HC reduction in new outboards and personal watercraft (US EPA 1996a).
2012	Estimated 50% reduction in HC emissions overall (US EPA 1996a; date modified in US EPA 1997).

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 testing for 75% HC reduction in personal watercraft was required. By 2006 all new personal watercraft and outboards manufactured in the United States must have a 75% reduction in HC emissions. In 2005 and 2012 overall reductions in HC emissions are estimated to be 25% and 50%, respectively, in PWC and outboard motors. These estimates are based on interpolations of the emissions reduction percentages and associated years reported by the U.S. Environmental Protection Agency (1996a), but with a one-year delay in the implementation of production line testing (US EPA 1997). The 50% reduction estimated for 2012 was used in the calculations for this assessment.

10. To evaluate water quality impacts at Pictured Rocks National Lakeshore, water volumes and water quality calculations were analyzed for each of the four shoreline segments — Sand Point, Cliffs, Beaver Basin, and Grand Sable. This is very different from a lake condition where the entire lake has a limited size and is within the park's jurisdiction. Michigan has a 200-foot shoreline rule that excludes personal watercraft unless they are landing or launching and traveling at no-wake speeds. Thus, PWC users do not operate frequently or at high speeds within 200 feet of the shoreline if they follow the law. Also, NPS jurisdiction at the national lakeshore extends only 0.25 mile into Lake Superior.

11. PWC numbers and location of operation are provided at the beginning of this chapter (see Table 12). The following describes how PWC operations were evaluated to determine potential water quality impacts at Pictured Rocks National Lakeshore:

    - Personal watercraft launched from Sand Point, Munising, and Grand Marais were assumed to operate within the 0.25-mile lakeshore jurisdiction for their entire time of operation. The assumed time of operation would be four hours a day (based on information from park staff). This operation time was divided into the likely segments of operation based on distance from the launch facility.
    - Other motorboats were assumed to operate within the 0.25-mile lakeshore jurisdiction for approximately 40% of their time of operation. Time of operation for other boats would be five hours, with two hours of operation within the lakeshore.
    - Of the other motorboats operating within the lakeshore, it is assumed that 82% have two-stroke outboard engines (based on 1999 data from the National Marine Manufacturers Association 2000). The evaluation assumed that all two-stroke motorboats on Lake

Superior would have engines of a size similar to or larger than those in personal watercraft. Boats with smaller engines are not used on Lake Superior because of the potential hazards on a lake of that size.

- The area for determining water volumes included the segment length multiplied by a width of approximately 1,120 feet — the 0.25-mile jurisdictional boundary, excluding the 200 feet adjacent to shore where use is restricted by state law. This 200-foot-wide area was excluded due to the very limited and low-speed use of personal watercraft along the shoreline, resulting in very minimal contributions to emissions.
- Activities outside the lakeshore's jurisdiction were not evaluated because of the tremendous water volumes available for dilution and the relatively low PWC activity. Depths just outside the lakeshore's jurisdiction reach more than 300 feet. Average depth in Lake Superior is 489 feet. Water volumes were calculated for each segment (based on USGS topographic maps and lake bathymetric maps), using segment length, width, and three or more depth measurements.
- For a conservative assessment of available volume of water, no lateral mixing of water across the lakeshore's jurisdictional boundary is assumed. In actuality, water and PWC emissions in the jurisdictional boundary will mix with adjacent waters to some unknown extent, thus reducing the concentrations of PWC emissions within the lakeshore. By assuming no mixing across the jurisdictional boundary, the estimated impacts for each alternative are conservative.
- Tour boat emissions were evaluated and dismissed as insignificant. Tour boats utilize twin diesel engines (approximately 440 hp) and operate within the lakeshore's jurisdiction for four to eight hours per day (segments 1 and 2). While operating near the shoreline, the tour boats travel at no-wake speeds. Operation at full throttle occurs outside the 0.25-mile jurisdictional boundary of the national lakeshore. Fuel usage is approximately 10% of normal operating speed for these engines when traveling at no-wake speeds (Cummings Diesel Technical Support, pers. comm. 2001). Emissions calculations for benzo(a)pyrene and benzene indicated that tour boats emit less than 0.2 grams of benzene over an eight-hour period. The amounts were insignificant when compared to other emissions and would not change the results of the analysis.
- Boating activity, and therefore pollutant loads, would be distributed over an entire day, from early morning to dusk. When released to water, benzene is subject to rapid volatilization, with a half-life for evaporation of about 5 hours (US EPA 2001). Based on the time distribution of watercraft activity, a five-hour half-life was utilized in the calculations for benzene concentrations.
- Pollutant loads were calculated for the four segments identified within Pictured Rocks National Lakeshore. The segment boundaries were determined based on likely watercraft use and activities.
- Total PAHs (benzo[a]pyrene, naphthalene, and 1-methyl naphthalene) do not have a water quality standard. Some research indicates that PAHs have phototoxic effects in oligotrophic lakes that have high light penetration (Ortis et al. 1998). At Pictured Rocks National Lakeshore, Lake Superior is oligotrophic, has low suspended solids on which PAHs can attach, and has high light penetration. Limited data indicate that in these conditions, PAHs may have phototoxic effects on fish and zooplankton at very low concentrations (less than 1 µg/L). Based on the data available, this evaluation assumes that potential phototoxic impacts may occur whenever PAH concentrations are greater than 0.1 µg/L (i.e., using the same order of magnitude as data indicate).

- Human health criteria for consumption of water and aquatic organisms are included in this analysis, even though lake water is not routinely used for drinking at the lakeshore or in adjacent towns. As shown in Table 13, the human health criteria for benzo(a)pyrene (0.0044 µg/L) and benzene (1.2 µg/L) are used to assess impacts from PWC use. These criteria were selected for use to be protective of people eating fish from Lake Superior and incidentally ingesting water while swimming. The benzene criterion of 1.2 µg/L is an order of magnitude lower (i.e., more protective) than the state water quality standard of 12 µg/L and is therefore appropriate for screening potential impacts from PWC emissions.

STUDY AREA

The study area for water quality includes the 0.25-mile jurisdictional boundary of the national lakeshore extending into Lake Superior, excluding 200 feet along the shoreline where PWC use is restricted to no-wake speeds and traveling perpendicular to the shoreline.

IMPACT TO WATER QUALITY FROM PWC USE

Given the above water quality issues and methodology and assumptions, the following impact thresholds were established in order to describe the relative changes in water quality (both overall, localized, short and long term, cumulatively, adverse and beneficial) 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 as Currently Managed under a Special NPS Regulation

Analysis. PWC use would continue within the lakeshore with no locational restrictions. Overall numbers of personal watercraft would increase from 13 per day in 2002 to 16 per day in 2012. For 2002, PWC users would operate each day in the peak season for 25 hours in the Sand Point segment, 17 hours in the Cliffs segment, 8 hours in the Beaver Basin segment, and 2 hours in the Grand Sable segment. Daily operation would increase in 2012 to 31 hours in the Sand Point segment, 21 hours in the Cliffs segment, 10 hours in the Beaver Basin segment, and 2 hours in the Grand Sable segment.

Most PWC users would operate near the Sand Point, Cliffs, and Beaver Basin segments because of the proximity to the launch facility. The Sand Point area (segment 1) would have the highest use and highest pollutant concentrations (see Table 15). This location also tends to have shallower waters that extend for some distance offshore. Over the next 10 years PWC use in this segment is projected to increase from four to five machines per day, with additional personal watercraft launching and traveling through the area.

TABLE 15: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC EMISSIONS, ALTERNATIVE A

		Calculated Threshold Volumes (acre-feet)							
		Sand Point (Segment 1)		Cliffs (Segment 2)		Beaver Basin (Segment 3)		Grand Sable (Segment 4)	
Parameter	Pollutant	2002	2012	2002	2012	2002	2012	2002	2012
Volume Available		24,006		27,972		29,716		21,354	
Ecological Benchmark	Benzo[a]pyrene	35	21	24	15	11	6.9	2.8	1.4
	Naphthalene	14	8	9.3	5.8	4.4	2.7	1.1	0.5
	1-methyl naphthalene	39	24	26	16	12	7.8	3.1	1.6
	Total PAH Concentration (µg/L)	0.09	0.06	0.05	0.03	0.02	0.01	0.01	0.00
	Benzene	16	10	11	6.9	5.2	3.3	1.3	0.7
Human Health Criteria	Benzo[a]pyrene	110	68	75	46	35	22	8.8	4.4
	Benzene	1,800	1,100	1,200	740	570	350	140	71

The calculated threshold volumes to meet ecological benchmarks range from 1 acre-foot for naphthalene in the Grand Sable segment to 39 acre-feet for 1-methyl naphthalene in the Sand Point segment. These volumes are extremely small in relation to the volume of water available (greater than 21,000 acre-feet), indicating that these pollutant loads would be well below the ecological benchmarks, and there would be a negligible adverse impact.

None of the pollutant levels would exceed the human health criteria for drinking water. In the Sand Point segment benzene loads would require approximately 1,800 acre-feet for dilution, while the volume available is more than 24,000 acre-feet. This is less than 8% of the threshold volume of water available. Therefore, personal watercraft would have a negligible adverse impact on human health.

As described in the methodology section, some literature indicates that small PAH concentrations may have toxic effects on aquatic organisms, particularly in oligotrophic lakes. Total PAH concentrations in all segments would be less than 0.1 µg/L. These concentrations are below the range for potential adverse effects to aquatic life (Ortis et al. 1998). Alternative A would have a negligible impact on water quality. By 2012 impacts would be less because of required improvements in engine technology.

The number of personal watercraft are projected to increase in 2012 by approximately 20%. However, pollutant loads would be lower than 2002 conditions because of the 50% reduction in engine emissions estimated by the Environmental Protection Agency (1997).

Cumulative Impacts. Other activities that could contribute pollutants to the Pictured Rocks shoreline and Lake Superior include recreational boating, commercial fishing, tour boats, and commercial boating. Of these activities, recreational boating is the most prominent source of additional pollutant loading (for pollutants of concern). For daily use in 2002, other boats with two-stroke engines would operate for an estimated 103 hours in the Sand Point segment, 86 hours in the Cliffs segment, 57 hours in the Beaver Basin segment, and 33 hours in the Grand Sable segment. For 2012 daily operations would increase to 127 hours in the Sand Point segment, 107 hours in the Cliffs segment, 74 hours in the Beaver Basin segment, and 33 hours in the Grand Sable segment.

The calculated threshold volumes for pollutants emitted by personal watercraft and boats would range from 10 to 200 acre-feet for the ecological benchmarks (see Table 16). The 1-methyl naphthalene threshold volume (200 acre-feet) would be less than 1% of the volume available. Concentrations due to these pollutant loads are well below the water quality benchmarks and would likely not be detectable. Cumulative ecological impacts would be negligible.

TABLE 16: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC AND MOTORIZED BOAT EMISSIONS, ALTERNATIVE A

		Calculated Threshold Volumes (acre-feet)							
		Sand Point (Segment 1)		Cliffs (Segment 2)		Beaver Basin (Segment 3)		Grand Sable (Segment 4)	
Parameter	Pollutant	2002	2012	2002	2012	2002	2012	2002	2012
Volume Available		24,006		27,972		29,716		21,354	
Ecological Benchmark	Benzo[a]pyrene	180	110	140	89	90	58	48	24
	Naphthalene	70	93	56	35	36	23	19	10
	1-methyl naphthalene	200	120	160	100	100	65	54	27
	Total PAH Concentration (µg/L)	0.46	0.29	0.32	0.20	0.19	0.12	0.14	0.07
	Benzene	84	52	67	42	43	28	23	11
Human Health Criteria	Benzo[a]pyrene	560	350	450	280	290	180	150	77
	Benzene	9,000	5,600	7,300	4,500	4,600	3,000	2,500	1,200

Threshold volumes for the human health criteria range from 77 to 9,000 acre-feet. Benzene emissions in the Sand Point segment would have the highest concentrations and would require 37% of the total water volume available within the 0.25-mile jurisdictional boundary for dilution. However, dilution with adjacent waters and volatilization would also occur, so that benzene levels would be below the human health criterion. If the state water quality standard for benzene was used in place of the EPA criterion, estimated human health impacts from benzene would be even lower. Cumulative human health based impacts would be negligible to minor, based on consumption of water and aquatic organisms.

Total PAH concentrations would exceed 0.1 µg/L in all four segments with boating activity. Although the calculated levels are well below aquatic life criteria, the concentrations could have moderate adverse impacts to aquatic life due to potential phototoxic effects.

Pollutant loads would decrease in 2012, despite increased boating traffic, due to reductions in engine emission rates. Future impact levels for cumulative actions would be negligible to moderate, depending on the location and pollutant type. All effects would be short term and would occur during the times of heaviest use.

Conclusion. Alternative A would have negligible to minor adverse effects on water quality due to continued PWC use. All pollutant loads would be well below benchmarks and criteria.

Cumulative impacts from PWC and motorized boat use would range from negligible to moderate. Total PAH concentrations would be a concern for aquatic life, due to potential phototoxicity. Benzene concentrations could be detectable, but are expected to remain below the human health criterion. By 2012 impacts would be reduced substantially through improved emission controls.

Implementation of this alternative would not result in an impairment of the water quality resource.

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

Analysis. PWC use would continue within the lakeshore, with a shift in location due to restrictions in the Beaver Basin segment. Overall numbers of personal watercraft would remain the same as alternative A, with maximum use projected to increase from 13 per day in 2002 to 16 per day in 2012. For 2002 PWC users would operate for 31 hours per day in the Sand Point segment, 17 hours in the Cliffs segment, and 2 hours in the Grand Sable segment. Daily operation times would increase in 2012 to 37 hours in the Sand Point segment, 23 hours in the Cliffs segment, and 2 hours in the Grand Sable segment. Water quality impacts in the Beaver Basin segment would be reduced compared to alternative A, since PWC use would not be allowed in this area.

Most PWC users would operate near the Sand Point and the Cliffs segments because of the closure of Beaver Basin and proximity to the launch facility. The Sand Point area (segment 1) would have the highest use and highest pollutant loads (see Table 17). This location also tends to have shallower waters that extend for some distance offshore. Over the next 10 years PWC use in this segment is projected to increase from six to seven machines per day.

TABLE 17: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC EMISSIONS, ALTERNATIVE B

		Calculated Threshold Volumes (acre-feet)							
		Sand Point (Segment 1)		Cliffs (Segment 2)		Beaver Basin (Segment 3)		Grand Sable (Segment 4)	
Parameter	Pollutant	2002	2012	2002	2012	2002	2012	2002	2012
Volume Available		24,006		27,972		29,716		21,354	
Ecological Benchmark	Benzo[a]pyrene	43	26	24	16	0	0	2.8	1.4
	Naphthalene	17	10	9.3	6.3	0	0	1.1	0.5
	1-methyl naphthalene	48	29	26	18	0	0	3.1	1.6
	Total PAH Concentration (µg/L)	0.11	0.07	0.05	0.04	0	0	0.01	0.0
	Benzene	20	12	11	8	0	0	1.3	0.7
Human Health Criteria	Benzo[a]pyrene	140	81	75	51	0	0	8.8	4.4
	Benzene	2,200	1,300	1,200	810	0	0	140	71

The calculated threshold volumes to meet ecological benchmarks range from 0 acre-feet in the Beaver Basin segment to 48 acre-feet for 1-methyl naphthalene in the Sand Point segment. These volumes are extremely small in relation to the volume of water available (greater than 24,000 acre-feet), indicating that these pollutant loads would be well below the ecological benchmarks, and there would be a negligible adverse impact.

None of the pollutant levels would exceed the human health criteria for water (ingestion of aquatic organisms and water). In the Sand Point segment, benzene loads would require approximately 2,200 acre-feet for dilution, less than 10% of the threshold volume of water available. Therefore, PWC use would have a negligible adverse impact on human health.

As described in the methodology section and for alternative A, some literature indicates that small PAH concentrations may have toxic effects on aquatic organisms, particularly in oligotrophic lakes. Total PAH concentrations in the Sand Point segment could be greater than 0.1 µg/L. This concentration is within the range for potential adverse effects to aquatic life, particularly on sunny days when phototoxicity can occur. For this reason, alternative B could have a negligible to minor impact on water quality. By 2012 impacts would be less because of required improvements in engine technology, and the impact to aquatic life would be negligible.

The number of personal watercraft are projected to increase in 2012 by approximately 20%. However, pollutant loads would be lower than 2002 conditions because of the estimated 50% reduction in engine emissions. All segments would see reduced pollutant loads by 2012.

Cumulative Impacts. As described for alternative A, other activities that could contribute pollutants to the Pictured Rocks shoreline and Lake Superior include recreational boating, commercial fishing, tour boats, and commercial boating. Of these activities, recreational boating is the most prominent source of additional pollutant loading (for pollutants of concern). Hours and location of operation would be shifted slightly, as compared to alternative A due to Beaver Basin restrictions. Pollutant loads would be more concentrated near Sand Point because of the proximity to launching facilities (see Table 18).

TABLE 18: THRESHOLD WATER VOLUMES NEEDED TO DILUTE PWC AND MOTORIZED BOAT EMISSIONS, ALTERNATIVE B

		Calculated Threshold Volumes (acre-feet)							
		Sand Point (Segment 1)		Cliffs (Segment 2)		Beaver Basin (Segment 3)		Grand Sable (Segment 4)	
Parameter	Pollutant	2002	2012	2002	2012	2002	2012	2002	2012
Volume Available		24,006		27,972		29,716		21,354	
Ecological Benchmark	Benzo[a]pyrene	200	120	150	91	0	0	48	35
	Naphthalene	80	47	60	36	0	0	19	14
	1-methyl naphthalene	230	130	170	100	0	0	54	40
	Total PAH Concentration (µg/L)	0.53	0.31	0.34	0.21	0	0	0.14	0.10
	Benzene	95	56	71	43	0	0	23	17
Human Health Criteria	Benzo[a]pyrene	640	380	480	290	0	0	150	110
	Benzene	10,000	6,100	7,700	4,700	0	0	2,500	1,800

The calculated threshold volumes for pollutants emitted by personal watercraft and boats would range from 0 to 230 acre-feet for the ecological criteria. The 1-methyl naphthalene volume for Sand Point (230 acre-feet) would be less than 1% of the volume available. These pollutant loads are well below the water quality benchmarks and would likely not be detectable. Cumulative ecological impacts would be negligible.

Threshold volumes for the human health criteria range from 0 to 10,000 acre-feet. Benzene emissions in the Sand Point segment would have the highest concentrations and would require 42% of the total water volume available within the 0.25-mile jurisdictional boundary for dilution. Benzene levels would be below the human health criterion. As described for alternative A, dilution with adjacent

waters and volatilization would also occur, so that benzene concentrations would be further decreased. If the state water quality standard for benzene was used in place of the EPA criterion, estimated human health impacts from benzene would be even lower. Cumulative human health based impacts would be negligible to minor.

Total PAH concentrations in all three segments with boating activity would exceed 0.1 µg/L. Although the calculated levels are well below aquatic life benchmarks, the concentrations could have a minor to moderate adverse impact to aquatic life due to phototoxic effects.

Future (2012) pollutant loads would decrease, despite increased boating traffic, due to reductions in engine emissions. Impact levels for cumulative actions would be negligible to moderate, depending on the location and pollutant type. All effects would be short term and would occur during the times of heaviest use.

Conclusion. Alternative B would have negligible to minor adverse effects on water quality due to continued PWC use. No impacts would occur in the Beaver Basin segment. While all pollutant loads would be well below benchmarks and criteria, PAH concentrations in the Sand Point segment could have negligible to minor adverse phototoxic effects on aquatic life.

Cumulative impacts from PWC and motorized boat use would range from negligible to moderate. No impacts would occur in the Beaver Basin segment. Total PAH concentrations would be a concern for aquatic life, due to potential phototoxicity. Benzene concentrations could be detectable, but are expected to remain below the human health criterion. By 2012 impacts would be reduced substantially through improved emission controls.

Implementation of this alternative would not result in an impairment of the water quality resource.

Impacts of the No-Action Alternative

Analysis. No PWC use would be allowed within the 0.25-mile lakeshore jurisdiction after April 2002; therefore, personal watercraft would not contribute pollutants to lakeshore waters. The no-action alternative would have negligible to minor beneficial impacts on water quality at Pictured Rocks National Lakeshore.

Cumulative Impacts. Boating activity would be the same as described under alternative A, ranging from 130 boats in 2002 to 160 boats in 2012. Cumulative emissions in the Sand Point, Cliffs, and Grand Sable segments would be lower than under alternative A because of the elimination of PWC use (see Table 19). While the ecological benchmarks would not be exceeded, there could be minor to moderate impacts to aquatic life due to potentially phototoxic PAH concentrations. These concentrations would decrease over the long term because of improvements in motorboat engine technology, but they would continue to have potential adverse effects on aquatic life. None of the benzene concentrations would exceed the human health criterion. The calculated threshold volume in the Sand Point segment to dilute benzene would be 34% of the volume available at this location, and other mechanisms such as volatilization and dilution with adjacent waters would reduce benzene concentrations even further. The Cliffs and Grand Sable segments would have lower threshold volumes and benzene concentrations.

TABLE 19: THRESHOLD WATER VOLUMES NEEDED TO DILUTE MOTORIZED BOAT EMISSIONS, NO-ACTION ALTERNATIVE

Parameter	Pollutant	Calculated Threshold Volumes (acre-feet)							
		Sand Point (Segment 1)		Cliffs (Segment 2)		Beaver Basin (Segment 3)		Grand Sable (Segment 4)	
		2002	2012	2002	2012	2002	2012	2002	2012
Volume Available		24,006		27,972		29,716		21,354	
Ecological Benchmark	Benzo[a]pyrene	160	93	130	75	0	0	46	34
	Naphthalene	63	37	50	30	0	0	18	13
	1-methyl naphthalene	180	100	140	85	0	0	51	38
	Total PAH Concentration (µg/L)	0.42	0.24	0.29	0.17	0	0	0.13	0.10
	Benzene	75	44	60	36	0	0	22	16
Human Health Criteria	Benzo[a]pyrene	510	300	400	240	0	0	140	110
	Benzene	8,100	4,800	6,500	3,900	0	0	2,300	1,700

Cumulative impacts of other boats would have a negligible to moderate adverse impact on water quality. Most pollutant levels would be well below the standards. PAH and benzene are the primary pollutants of concern for aquatic life and human health, respectively. Pollutant loads would be below water quality benchmarks, and any potential adverse impacts would be short term.

Conclusion. Discontinuing PWC operations would have a negligible to minor beneficial impact on water quality. Pollutant loads from personal watercraft would be eliminated. Decreased PAH concentrations, in particular, could be beneficial for aquatic life.

PWC contribution to overall cumulative water quality impacts would be eliminated. Pollutant loads from other motorized boats would have a negligible to moderate adverse impact on water quality. Pollutant loads would be below water quality benchmarks and criteria, and potential adverse impacts would be short term. By 2012 impacts would be reduced substantially through improved emission controls.

Implementation of this alternative would not result in an impairment of the water resource.

AIR QUALITY

Personal watercraft emit various compounds that pollute the air. Up to one third of the fuel delivered to the engine is unburned and discharged; 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 (California Air Resources Board 1997; US EPA 2000b). NO_x also contributes 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 insignificant.

Guiding Regulations and Policies

Clean Air Act. The Clean Air Act established national ambient air quality standards (NAAQS) to protect the public health and welfare from air pollution. The act also established 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 (42 USC 7401 et seq.). The program also includes a classification approach for controlling air pollution.

> Class I areas are afforded the greatest degree of air quality protection. Very little deterioration of air quality is allowed in these areas, 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.
>
> Class II areas include all national park system areas not designated as class I, 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. Pictured Rocks National Lakeshore is designated a class II area.

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. In making decisions regarding PWC use within a designated nonattainment or maintenance area, park managers should discuss their plans with the appropriate state air pollution control agency to determine the applicability of conformity requirements.

Pictured Rocks National Lakeshore 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 1998, 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 50% emission reduction will be achieved by 2020, and a 75% emission reduction by 2025.

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 and wilderness areas. The general mandates of the Organic Act state that the National Park Service 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 National Park Service 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.

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.

Wilderness Act. The Wilderness Act of 1964 (16 USC 1131, *et seq.*) defines wilderness as

> an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain . . . an area of undeveloped Federal Land retaining its primeval character and influence . . . which is protected and managed so as to preserve its natural conditions (16 USC 1131(c)).

The Wilderness Act also states that wilderness areas will be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use. The NPS *Management Policies 2001* state that potential wilderness areas are "to be managed as wilderness to the extent the existing non-conforming conditions allow" (sec. 6.3.1).

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.
2. Air quality designations for the surrounding area were determined. Pictured Rocks National Lakeshore is an attainment area for each pollutant.
3. The nearest monitoring location to Pictured Rocks National Lakeshore is over 100 miles away. Therefore, the first highest maximum concentration for each pollutant is assumed to be below the national ambient air quality standards.
4. Typical use patterns of motorized watercraft use was identified (see "PWC and Other Visitor Use Trends" section). Peak hours of use were estimated assuming that on a high-use day all personal watercraft would operate at the same time.
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 of 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 national lakeshore were reviewed.
8. A calculation referred to as SUM06 (ppm-hours) was used for ozone. 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 would be the same as those described for water quality.
11. For cumulative impacts, the assessment was completed quantitatively with respect to anticipated use of the national lakeshore by other recreational watercraft based on emission factors and assumption in EPA's nonroad model. Types of craft assessed for quantitative cumulative impacts included fishing vessels, with predominantly outboard spark-ignition type engines, and larger vessels and pontoons, with inboard/stern-drive type engines. 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 qualitative (e.g., photos of degraded visibility) or quantitative (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.

Two categories for 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 (negligible, minor, moderate, and major) are discussed for each impact topic.

STUDY AREA

The study area includes the immediate location of PWC use and the surrounding nearshore area where air pollutants may accumulate. For purposes of this review, the study area is the 0.25-mile NPS jurisdictional area in Lake Superior plus a 100-foot-wide strip inland. It is assumed that air pollutants would dissipate beyond 100 feet 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 hydrocarbon (THC), 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 3-year maximum for each pollutant would be less than NAAQS.
Minor:	Emissions would be less than 100 tons/year for each pollutant.	**and**	The first highest 3-year maximum for each pollutant would be less than NAAQS.
Moderate:	Emissions would be greater than or equal to 100 tons/year for any pollutant.	**or**	The first highest 3-year maximum for each pollutant would be greater than NAAQS.
Major:	Emissions levels would be greater than or equal to 250 tons/year for any pollutant.	**and**	The first highest 3-year maximum for each pollutant would be greater than NAAQS.

Impairment: Air emissions would contribute to continued violation of national standards. 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;

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).

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

Analysis. Under this alternative the number of personal watercraft used daily in the lakeshore would follow the same trends as existing conditions, ranging from 13 in 2002 to 16 in 2012. The impacts of continued PWC use within the lakeshore are presented in Table 20. Adverse impact levels in 2002 would be negligible for all pollutants since all emissions would be less than 50 tons/year.

For 2012 impact levels were calculated based on increased boating activity, but with decreased engine emissions due to required technological improvements. Future impact levels would be the same as 2002, although pollutant loads for PM_{10}, HC, and VOC would decrease by more than 50%. CO levels would remain relatively constant in 2012, and NO_x emissions would increase slightly.

TABLE 20: PWC EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, ALTERNATIVE A

	CO		PM.		HC		VOC		NO.	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	21.82	21.72	0.45	0.09	11.37	4.88	11.76	4.56	0.10	0.39
Impact Level	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

Cumulative Impacts. Motorboats are the only other major source of air pollutants within the national lakeshore. Other watercraft are far more abundant within the lakeshore than are personal watercraft, with projections of 130 to 160 motorboats estimated to operate per day within the lakeshore for the peak visitor use season from 2002 through 2012. The cumulative emissions from personal watercraft and other boats are provided in Table 21. Overall, cumulative impact levels for PM_{10}, HC, VOC, and NO_x would be negligible, while levels for CO would be moderate.

TABLE 21: PWC AND MOTORIZED BOAT EMISSIONS AND HUMAN HEALTH IMPACT LEVELS, ALTERNATIVE A

	CO		PM.		HC		VOC		NO.	
	2002	2012	2002	2012	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	108.71	129.29	0.78	0.45	17.39	11.20	17.98	10.45	3.51	4.64
Impact Level	Moderate	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

Future emissions of PM_{10}, HC, and VOC would be reduced by approximately 35% to 42% as a result of technological improvements. Future CO emissions would increase by approximately 18%, but would remain at a moderate level of impact. NO_x emissions would also increase, but only slightly, with the associated impact remaining at a negligible level.

Conclusion. Continuing PWC use at Pictured Rocks National Lakeshore at existing levels would result in negligible adverse impacts for all pollutants.

Overall, PWC emissions are a small part of the cumulative boating emissions at the national lakeshore. Cumulative emission levels would be negligible for PM_{10}, HC, VOC, and NO_x. Cumulative CO emissions would be at a moderate adverse level for both the short and long term. Over the long term NO_x emissions would increase slightly, with a negligible adverse effect. This alternative would maintain existing air quality conditions, with future reductions in PM_{10}, HC, and VOC emissions due to improved emission controls.

Implementation of 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 the number of personal watercraft used daily in the lakeshore would follow the same trends as alternative A, ranging from 13 in 2002 to 16 in 2012. The impacts of continued PWC use within the lakeshore, but with restrictions in the Beaver Basin segment, would be the same as those described for alternative A. All impact levels would be negligible, since the emissions would all be less than 50 tons/year.

Cumulative Impacts. Cumulative impacts would be the same as alternative A, since boating use would not change under this alternative. Cumulative emission levels would be negligible for PM_{10}, HC, VOC, and NO_x. Cumulative CO emissions would be at a moderate adverse level for the short and long terms. This alternative would maintain existing air quality conditions, with future reductions in PM_{10}, HC, and VOC emissions due to improved emission controls.

Conclusion. Continuing PWC use at Pictured Rocks National Lakeshore at existing levels, with PWC use excluded in the Beaver Basin segment, would result in negligible adverse impacts for all pollutants.

Overall, PWC emissions are a small part of the cumulative boating emissions at the national lakeshore. Cumulative emission levels would be negligible for PM_{10}, HC, VOC, and NO_x, and moderate for CO, in the short and long term. Over the long term NO_x emissions would increase slightly, with a negligible adverse effect. This alternative would maintain existing air quality conditions, with future reductions in PM_{10}, HC, and VOC emissions.

Implementation of this alternative would not result in an impairment of air quality.

Impacts of the No-Action Alternative

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

Cumulative Impacts. As described for alternative A, motorized boats are a primary source of air pollutants within the national lakeshore and would continue to emit pollutants. PWC contribution to overall cumulative emissions would be eliminated. Cumulative emissions for all other watercraft would range from negligible to minor (see Table 22) and would be lower than under alternative A due to the elimination of PWC use and decreased emissions from boats as manufacturers met EPA requirements. Emissions in 2012 would remain relatively constant. In particular, CO emissions would increase to a moderate adverse level of impact. Other emission rates would remain relatively stable over the 10-year period.

TABLE 22: 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)	86.89	107.57	0.33	0.36	6.02	6.32	6.23	5.89	3.41	4.25
Impact Level	Minor	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible

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

Because PWC contribution to cumulative air quality impacts would be eliminated, cumulative impacts would be reduced, as compared to alternative A, ranging from negligible to minor. Future emission levels would remain relatively stable, with increased CO emissions (moderate level of impact) and slightly increased NO_x emissions. With improved emission controls, future emissions of most pollutants would gradually decline, but impacts would still be negligible to moderate and adverse.

The no-action alternative would not impair air quality.

Impact to Air Quality Related Values from PWC Pollutants

The following impact thresholds have been defined for analyzing impacts to air quality related values which include visibility and biological resources (specifically ozone effects on plants) from airborne pollutants related to PWC use (O_3, NO_x, $PM_{2.5}$). $PM_{2.5}$ as a fraction of particulate matter is evaluated for visibility impairment. 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.

To assess the impact of ozone on plants, the five-year ozone index value was calculated and is represented as SUM06. National SUM06 values have been developed by the NPS Air Resources Division based on rural and urban monitoring sites.

	Activity Analyzed		Current Air Quality
Negligible:	Emissions would be less than 50 tons/year for each pollutant.	**and**	There would be no perceptible visibility impacts (photos or anecdotal evidence). **and** There would be no observed ozone injury on plants. **and** SUM06 ozone would be less than 12 ppm-hrs.
Minor:	Emissions would be less than 100 tons/year for each pollutant.	**and**	SUM06 ozone would be less than 15 ppm-hrs.
Moderate:	Emissions would be 100–249 tons/year for any pollutant. **or** Visibility impacts from cumulative PWC emissions would be likely (based on past visual observations).	**or**	Ozone injury symptoms would be identifiable on plants. **and** SUM06 ozone would be less than 25 ppm-hrs.
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 would be identifiable on plants. **or** SUM06 ozone would be greater than 25 ppm-hrs.

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;

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.

For the cumulative analysis, an assessment was made based on the SUM06 index values for ozone and best professional judgment.

According to the National Park Service's SUM06 ozone index, the ozone level for the Pictured Rocks area is 12–19 ppm/hr. A recent U.S. Fish and Wildlife Service plant survey at Seney National Wildlife Refuge, which is approximately 20 miles southeast of the lakeshore, documented ozone injury to black cherry, common milkweed, and spreading dogbane (Davis 2000). Because of the proximity of the refuge, it is assumed that similar ozone injury is likely to occur at Pictured Rocks National Lakeshore. Based on these two documents and the threshold impact criteria described above, the lowest impact level that could be obtained for VOC and NO_x would be moderate adverse within Pictured Rocks National Lakeshore.

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

Analysis. Under this alternative daily PWC use within the national lakeshore would range from 13 personal watercraft in 2002 to 16 by 2012. The impacts of continued PWC use within the park are presented in Table 23. Even though all pollutant loads would be less than 20 tons/year, impacts from long-term ozone exposure would be moderate adverse because the SUM06 ozone index is 12 to 19 ppm/hrs. Visibility impacts, calculated as a function of $PM_{2.5}$, would be negligible since $PM_{2.5}$ emissions are predicted to be less than 1 ton/year.

Impact levels for 2012 were calculated based on increased PWC use, but with cleaner boating emissions due to required technological improvements in marine engines. Therefore, emissions are projected to decrease considerably for VOC and $PM_{2.5}$. NO_x emissions would increase over the 10-year period. Impact levels related to ozone injury would remain moderate adverse, based on SUM06 levels. Visibility would not be affected to a great extent, with negligible impacts predicted, based on $PM_{2.5}$ emissions.

TABLE 23: AIR QUALITY RELATED IMPACTS FROM PWC EMISSIONS, ALTERNATIVE A

	VOC		NO_x		$PM_{2.5}$	
	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	11.76	4.56	0.10	0.39	0.41	0.08
Impact Level	Moderate	Moderate	Moderate	Moderate	Negligible	Negligible

Cumulative Impacts. Motorboats are the only other source of air pollutants within the national lakeshore, and they are far more abundant than personal watercraft, with use projected to increase from 130 motorboats in 2002 to 160 in 2012. The cumulative emissions from PWC and other boats are

shown in Table 24. Overall, impact levels related to ozone injury would be moderate due to the SUM 06 ozone index, and impacts related to $PM_{2.5}$ emissions would be negligible. By 2012 emissions would decrease, but impact levels would remain the same since the SUM06 ozone index would be the same.

TABLE 24: AIR QUALITY RELATED IMPACTS FROM PWC EMISSIONS AND MOTORIZED BOATS, ALTERNATIVE A

	VOC		NO_x		$PM_{2.5}$	
	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	17.98	10.45	3.51	4.64	0.71	0.42
Impact Level	Moderate	Moderate	Moderate	Moderate	Negligible	Negligible

Conclusion. Alternative A would continue existing PWC-related air quality impacts, with impact levels ranging from negligible to moderate.

Overall, PWC emissions are a small part of the cumulative boating emissions at the national lakeshore. Cumulative emissions rates would result in negligible to moderate adverse impacts. This alternative would maintain existing air quality conditions, with future reductions in VOC and $PM_{2.5}$ emissions due to required improvements in engine technology. NO_x emissions would increase and would continue to contribute to a moderate impact level related to ozone injury.

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 daily PWC use within the national lakeshore would be the same as alternative A, but with restrictions in the Beaver Basin segment. Emission rates and impact levels would be the same as alternative A because the number of personal watercraft operating within the lakeshore would not change. All pollutant loads would be less than 20 tons/year, with negligible to moderate impact levels.

Cumulative Impacts. Cumulative impacts would be the same as alternative A, since no changes to the number of boats operating in the lakeshore would occur. Overall, cumulative impacts related to ozone injury would be moderate due to the SUM06 ozone index. Visibility impacts from $PM_{2.5}$ emissions would be negligible.

Conclusion. The number of personal watercraft operating within Pictured Rocks National Lakeshore would be the same as alternative A. PWC-related air quality impact levels would range from negligible to moderate.

Overall, PWC emissions are a small part of the cumulative boating emissions at the national lakeshore. Cumulative emissions would result in negligible to moderate adverse impacts. This alternative would maintain existing air quality conditions, with future reductions in VOC and $PM_{2.5}$ emissions due to required improvements in engine technology. NO_x emissions would increase and would continue to contribute to a moderate impact level related to ozone injury.

This alternative would not impair air quality related values.

Impacts of the No-Action Alternative

Analysis. Under the no-action alternative PWC operation would be banned within the national lakeshore. This would result in negligible to moderate beneficial impacts, as compared to alternative A.

Cumulative Impacts. While personal watercraft would no longer be allowed to operate within the lakeshore boundary, other boats would continue at the same use levels, as described under alternative A. Cumulative impacts for boat emissions would decrease, as compared to alternative A (see Table 25). PWC contribution to overall cumulative air quality impacts would be eliminated. Adverse impacts related to ozone injury would be moderate based on the SUM06 ozone index. Adverse impacts to visibility related to $PM_{2.5}$ emissions would be negligible. Future emission levels would remain relatively stable.

TABLE 25: AIR QUALITY RELATED IMPACTS FROM MOTORIZED BOATS, NO-ACTION ALTERNATIVE

	VOC		NO_x		PM	
	2002	2012	2002	2012	2002	2012
Annual Emissions (tons/year)	6.23	5.89	3.41	4.25	0.30	0.33
Impact Level	Moderate	Moderate	Moderate	Moderate	Negligible	Negligible

Conclusion. The no-action alternative would have negligible to moderate beneficial impacts on air quality because PWC use would no longer be allowed within the lakeshore boundary.

Cumulative impacts from other boating activity would be reduced, as compared to alternative A, but would still result in negligible impacts for visibility and moderate adverse impacts for ozone injury of plants due to the SUM06 ozone index. PWC contribution to overall cumulative air quality impacts would be eliminated.

Implementation of this alternative would not result in an impairment of air quality related values.

SOUNDSCAPES

The primary soundscape issue relative to PWC use is that other visitors may perceive the sound made by personal watercraft as an intrusion or nuisance, thereby disrupting their experiences. This disruption is generally short term because personal watercraft 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 swimmers at popular beaches (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 the 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 physical processes such as wind in trees, thunder, 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, Michigan has adopted legislation that regulates PWC operation. The National Park Service is in the process of adopting the state rules and has enforcement responsibility within Pictured Rocks National Lakeshore. The following elements of Michigan PWC regulations have impacts on lakeshore soundscapes:

- Timing restrictions — Personal watercraft can not be used between one hour before sunset and 8:00 A.M.
- Location restrictions — Personal watercraft on the Great Lakes cannot operate within 200 feet of the shore unless operating at a slow, no-wake speed and traveling perpendicular to the shore.

Natural noise sources at Pictured Rocks National Lakeshore include waves of Lake Superior and winds blowing through trees. On calm days, boats on Lake Superior can be heard at long distances. Automobile noise is very limited, since most roads are south of the lakeshore.

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 Pictured Rocks 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 Pictured Rocks National Lakeshore are influenced by wave action, wind, chain saws, visitor activities, other boats (including tour boats with loudspeakers), and light automobile traffic. The soundscape is that of an undeveloped, primitive park. Measured sound levels range from 22 dBA to 55 dBA (see Table 4 in the "Affected Environment"). These levels are considered quiet.

Soundscape disturbances in Pictured Rocks National Lakeshore are localized and are limited to (1) nearshore areas where people are present at beaches, (2) backcountry locations where PWC noise is noticeable, and (3) the North County National Scenic Trail, where hikers are present. Michigan regulations limit the potential effects of personal watercraft on sensitive soundscapes, because they restrict the types of activities and PWC speeds within 200 feet of 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 mid-day through July and August. State law restricts use to the hours of 8:00 A.M. to one hour before 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 boat types) can be present intermittently from early morning to near sunset. In areas of low use, noise from personal watercraft (and other boat types) can be occasional, usually lasting a few minutes. On peak days, an average of 13 personal watercraft are used for four hours (each) within the lakeshore.

Intensity: Personal watercraft have been measured to emit 85 to 105 dB per unit, which may disturb visitors. Noise limits established by the National Park Service are 82 dB at 82 feet. Visitors 100 feet from a personal watercraft may be exposed to approximately 75dB; however, this may be more disturbing due to rapid changes in acceleration and direction of noise from a constant source at 90 dB (US EPA 1974, cited in Izaak Walton League 1999).

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 be 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 shoreline, and other influences. To estimate the relative impacts of PWC use at Pictured Rocks, 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 personal watercraft 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 timeframes 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 lakeshore 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 study area. The following is a list of other considerations for evaluating sound impacts:

- The maximum number of personal watercraft now operating is 13 per day, which under present trends is expected to increase to 16 by 2012. These watercraft are dispersed over a 40-mile shoreline and would be in operation for only a portion of each day (approximately 4 hours average).

- Personal watercraft commonly operate farther than 200 feet from the shoreline (because of state regulations); the farther from shore, the lower the noise level to shoreline visitors.
- Operations within 200 feet of shore are at no-wake speed; noise levels from this activity are very low and for short duration.
- Ambient noise levels at most locations (including backcountry areas) include wind, waves, other visitors, and other motorboats. Other motorboats outnumber personal watercraft 10 to 1.

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

STUDY AREA

The study area for soundscapes is related to the area of PWC use and the distance that PWC noise travels. Personal watercraft are allowed to operate within the 0.25 mile shoreline segment of Lake Superior. PWC noise can travel inland and is expected to dissipate significantly within 0.75 mile of the source. Thus, the study area for soundscapes is the 0.25-mile segment in Lake Superior and the 0.75-mile inland shore area.

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.

Minor: Natural sounds would predominate. Motorized noise could be heard occasionally throughout the day.

Moderate: Natural sounds could be heard occasionally; motorized noise would be the primary noise, especially during daylight hours, but would not be overly disruptive to visitor activities in the study area.

Major: Natural sounds would not be heard for extended periods of time. Motorized noise would disrupt conversation for long periods and/or make enjoyment of other activities in the area difficult.

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 as Currently Managed under a Special NPS Regulation

Analysis. As stated in the assumptions, daily PWC use levels are projected to range from 13 to 16 craft on a typical busy summer day over the next 10 years. The distribution of personal watercraft under this alternative would range from three to five craft in each of the Sand Point, Cliffs and Beaver Basin segments, plus two craft in the Grand Sable segment. According to park staff, PWC users at Pictured Rocks commonly travel in pairs for safety reasons, with the resultant noise level at 82 feet equal to 85 dB, which exceeds the noise limit established by the Park Service (82 dB at 82 feet). These same two watercraft operating 200 feet offshore would have a perceived sound level at the shore equal to approximately 77 dB. As sound travels over the lakeshore bluffs, 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.

A sound level of 77 dB would be an adverse impact to any park user on the shoreline, assuming that the existing ambient sound levels are approximately 55 dBA. However, in most cases, personal watercraft would be dispersed along the lakeshore so that operating craft would be infrequent at any given location. At the areas that have the highest visitor use, such as Sand Point, PWC noise would be diluted by the sounds from wind, waves, other visitors, and motorboats. In general, PWC use would result in negligible adverse impacts where other users are concentrated, such as at overlooks and beaches. At Sand Point, PWC noise would be heard occasionally and would have minor adverse impacts.

Backcountry users, particularly in the Beaver Basin segment and along the North Country National Scenic Trail, tend to be more sensitive to sound levels and PWC activity. The intolerance to PWC noise by backcountry users was documented in the summer 2000 visitor survey. PWC use adjacent to backcountry areas would have minor adverse impacts to the soundscape because related noise would be occasionally heard.

Overall, noise levels from personal watercraft would be expected to have negligible to minor adverse impacts at certain locations along the lakeshore on days when PWC 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. Minor impacts could occur from concentrated use in one area, particularly near Sand Point, where the level of noise could be perceived occasionally. This would occur mainly where PWC use would conflict with other quieter uses, such as fishing, beach uses, or backcountry camping. In general, the impact to those seeking a quiet visitor experience would most likely be short term and minor because PWC use would not be constant throughout the day and because enjoyment of the typical visitor activities in the area would not be compromised. Overall, implementation of this alternative would result in a net negligible to minor adverse impact on the soundscape of Pictured Rocks National Lakeshore. All impacts would be short term, since noise would usually be present for limited times.

Cumulative Impacts. Other noise sources in the Pictured Rocks National Lakeshore include wave action on the shore, wind blowing through trees, other boats operating on Lake Superior, and other visitor activities. Boating activities in the lakeshore are capable of generating noise levels as high as personal watercraft due to the number of motorboats (use is projected to increase from 130 in 2002 to 160 in 2012) 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.

Similar to personal watercraft, numerous variables affect the perceived noise levels of other boats, including the number of boats and their proximity to other national lakeshore users. Additionally, motorboat activity is an expected occurrence on Lake Superior and is generally more acceptable to lakeshore visitors. The cumulative effect of PWC and boating noise would continue to have a minor 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 beach users, picnickers, and campers. However, these sounds are considered more acceptable and compatible with typical uses within the national lakeshore. Visitor noise has a negligible adverse effect on the soundscape at Pictured Rocks National Lakeshore. All impacts are short term, since noise would usually be present for limited duration.

Conclusion. Noise from personal watercraft would continue to have short-term, negligible, adverse impacts at most locations, and short-term, minor, adverse impacts near the Sand Point launch and at backcountry locations. Impact levels would be related to the number of personal watercraft operating, as well as the sensitivity of other visitors.

Cumulative noise impacts from personal watercraft, motorboats, and other visitors would be minor because these sounds would be heard occasionally throughout the day. For the most part, natural sounds would still predominate at most locations within the lakeshore. The highest sound impacts would occur near the Sand Point boat launch.

This alternative would not result in an impairment of the national lakeshore's soundscape.

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

Analysis. Daily PWC use levels would be the same as for alternative A, with a slight change in the area of use. Under this alternative there would be five to seven personal watercraft in each of the Sand Point and Cliffs segments, and two craft in the Grand Sable segment. No PWC use would be allowed in the Beaver Basin segment.

In most cases, personal watercraft would be dispersed along the lakeshore so that operating craft would be infrequent at any given location. At the areas that have the highest visitor use, such as Sand Point, PWC noise would be diluted by the sounds from wind, waves, other visitors, and motorboats. In general, the use of personal watercraft would result in negligible adverse impacts where other users are concentrated, such as at overlooks and beaches. At Sand Point, PWC noise would be heard occasionally and would have minor adverse impacts.

Backcountry users, particularly in the Beaver Basin segment and along the North Country National Scenic Trail, tend to be more sensitive to sound levels and PWC activity. The intolerance to PWC noise by backcountry users was documented in the summer 2000 visitor survey. Under alternative B personal watercraft would be prohibited from the Beaver Basin segment. Backcountry users in this area might still hear PWC noise, since craft could still operate outside of the 0.25-mile boundary and in adjacent segments. Thus, eliminating PWC use from the Beaver Basin segment would have

negligible beneficial impacts to the soundscape because related noise would be less frequent and at a greater distance from shore.

Overall, alternative B would have a negligible beneficial effect in the Beaver Basin segment and minor adverse effects at certain locations along the lakeshore on days when PWC use was relatively heavy. Negligible impacts would occur when use was occasional and distanced from other park users, for example, PWC users operating far from shore. Minor impacts could occur from concentrated use in one area, particularly near Sand Point, where the level of noise could be perceived occasionally. This would occur mainly where PWC use would conflict with other quieter uses, such as fishing, beach uses, or backcountry camping. In general, the impact to those seeking a quiet visitor experience would most likely be short-term and minor because PWC use would not be constant throughout the day and because the enjoyment of the typical visitor activities in the area would not be compromised. Overall, this alternative would result in a net negligible beneficial to minor adverse impact on the soundscape of Pictured Rocks National Lakeshore. All impacts would be short term, since noise would usually be for limited times.

Cumulative Impacts. The cumulative effect of PWC and boating noise would continue to have a minor adverse impact because it would be heard occasionally throughout the day. In the Beaver Basin segment there would be a negligible beneficial impact, since personal watercraft and other motorboats would no longer to be allowed to operate within the lakeshore's jurisdiction. Generally, PWC and boating noise from beyond the 0.25-mile jurisdiction or from adjacent areas would be less intrusive within the Beaver Basin segment. Visitor noise has a negligible adverse effect on the soundscape at Pictured Rocks National Lakeshore. All impacts would be short term, since noise would usually be for a limited duration.

Conclusion. Noise from personal watercraft would continue to have short-term, negligible adverse impacts at most locations, and short-term, minor, adverse impacts near the Sand Point launch. Impact levels would be related to the number of personal watercraft operating, as well as the sensitivity of other visitors. Eliminating PWC use in the Beaver Basin segment would have negligible beneficial impacts, since watercraft could still be heard but would be farther away and less frequent.

Cumulative noise impacts from personal watercraft, motorboats, and other visitors would be minor, with these sounds heard occasionally throughout the day. For the most part, natural sounds would still predominate at most locations within the lakeshore. The highest sound impacts would occur near the Sand Point boat launch.

This alternative would not result in an impairment of the national lakeshore's soundscape.

Impacts of the No-Action Alternative

Analysis. Under the no-action alternative personal watercraft would be banned from operating within 0.25-mile jurisdictional boundary of the national lakeshore. Some users could choose to operate outside the lakeshore's jurisdiction. The sound level for two personal watercraft operating 0.25-mile from shore would be approximately 60 dB for people on the beach. On most days there would be a negligible beneficial impact on shoreline visitors because PWC noise would be barely heard above the waves and noise from other visitors. On calm days, shoreline visitors could still hear personal watercraft operating 0.25 mile away, with a negligible adverse effect.

This alternative could result in PWC use being relocated outside the 0.25-mile boundary of the national lakeshore, resulting in negligible to minor beneficial impacts to soundscapes in the lakeshore.

Cumulative Impacts. Cumulative impacts for the no-action alternative would be similar to alternative A. Although PWC-related noise within the national lakeshore would be eliminated, other motorized boating activities would continue to have negligible to minor adverse noise impacts throughout the day. The highest level of impact would occur near the Sand Point launch.

Other national lakeshore 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 has a negligible adverse effect on the soundscape at Pictured Rocks National Lakeshore.

Conclusion. The overall decrease in noise generated by personal watercraft would be a negligible to minor beneficial impact because PWC users would have to operate at least 0.25 mile from the shoreline.

Cumulative noise impacts from motorboats and other visitor activities would be minor and adverse, particularly near the Sand Point launch, but there would be no contribution from PWC use within the national lakeshore.

This alternative would not result in an impairment of the national lakeshore's soundscape.

WILDLIFE AND WILDLIFE HABITAT

Some research suggests that personal watercraft affect 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; the most likely occurrence of PWC-induced flight would be on Lake Superior.

Impacts to sensitive species at Pictured Rocks, such as loons, peregrine falcons, and piping plovers, are documented under "Threatened, Endangered, or Special Concern Species."

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 Pictured Rocks National Lakeshore.

METHODOLOGY AND ASSUMPTIONS

For the purposes of this analysis, it was assumed that personal watercraft would be operated in a lawful manner (i.e., 200 feet from shore unless landing or launching). The number of PWC users and hours of operation are provided in Table 12, on page 62. Vegetation data were available from GIS

mapping. The staff biologist, the U.S. Fish and Wildlife Service, and the Michigan Department of Natural Resources provided wildlife information.

Study Area

The focus of this study is the Lake Superior shoreline within Pictured Rocks National Lakeshore. The lakeshore jurisdiction extends 0.25 mile into Lake Superior. PWC noise may disturb wildlife along the shore, 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, or they precluded the park's ability to meet recovery objectives for listed 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 as Currently Managed under a Special NPS Regulation

Analysis. Under this alternative PWC use could affect wildlife when operators are traveling to and from the beach or when they were near wildlife more than 200 feet from the shoreline. Wildlife typically stay near the shoreline due to habitat constraints, with few species present on the water surface 200 feet (or more) from shore. When a PWC user travels to the beach, the speed of the craft must be slowed to a no-wake speed, thus allowing any wildlife to easily move out of the way. Since most personal watercraft are not used in the early spring due to water and air temperatures, it is unlikely that wildlife would be disturbed during the breeding season. During rearing, PWC use could cause short-term temporary effects when they landed at the beach. Due to the low habitat productivity and lack of colonial wildlife along the lakeshore, as well as the low number of PWC users, impacts to wildlife and wildlife habitat would be negligible at most locations. Over the next 10 years impacts would continue to be negligible since PWC numbers would not increase substantially. All wildlife impacts due to PWC use would be temporary and short term.

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 2,900 other visitors have access to the Pictured Rocks National Lakeshore shoreline each day during the peak visitor season. 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 study area and the dispersion of visitors along the shoreline. The habitat along the shoreline is not as crucial as the interior habitat, 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 Pictured Rocks National Lakeshore 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. Due to the distance that PWC users are required to be from the shoreline, impacts on wildlife and wildlife habitat would be negligible at most locations. The effects from PWC speed or proximity to wildlife would be limited because PWC users would operate at least 200 feet from the beach and access the beach at slow speeds. In addition, the amount of wildlife on the water is low.

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

Implementation of this alternative would not result in an impairment to wildlife or wildlife habitat.

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

Analysis. The number of PWC users in the lakeshore would be the same as for alternative A, except use would be prohibited in the Beaver Basin segment and would consequently be shifted to other segments. Wildlife impacts under this alternative would be similar to those under alternative A. Due to the low habitat productivity and lack of colonial wildlife along the lakeshore, as well as the low number of personal watercraft in use, impacts to wildlife and wildlife habitat due to PWC activity would be negligible at most locations. Closing the Beaver Basin segment to PWC use would have negligible beneficial impacts. Over the next 10 years impacts would continue to be negligible since

PWC numbers would not increase substantially. All wildlife impacts would be temporary and short term.

Cumulative Impacts. The cumulative impacts of alternative B would be essentially the same as those of alternative A. 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 study area and the dispersion of visitors on the shoreline. Current and future impacts by PWC users and other visitors would not have a noticeable effect on wildlife along the lakeshore. Overall, visitors (including PWC users) at Pictured Rocks National Lakeshore 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. Due to the distance that PWC users are required to be from the shoreline, impacts on wildlife and wildlife habitat would be negligible at most locations. Closing the Beaver Basin segment to PWC use would have negligible beneficial impacts.

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

Implementation of this alternative would not result in an impairment to wildlife or wildlife habitat.

Impacts of the No-Action Alternative

Analysis. PWC users would not be allowed to operate within the 0.25-mile offshore area of the national lakeshore. Compared to alternative A, this alternative could result in a long-term, negligible, beneficial impact to wildlife and wildlife habitat since interactions between PWC users and wildlife would be essentially eliminated.

Cumulative Impacts. Cumulative impacts to wildlife would be the similar to those described for alternative A. While interactions between PWC users and wildlife would be eliminated, other visitors would still have access to the shoreline and could cause temporary flight responses in wildlife. Cumulative impacts would be negligible to minor, and impacts would be temporary.

Conclusion. PWC users would not be allowed to operate in the national lakeshore, resulting in a negligible beneficial impact on wildlife and wildlife habitat due to the elimination of interactions between PWC users and wildlife.

On a cumulative basis there would be negligible to minor adverse impacts on wildlife and wildlife habitat from other shoreline visitor activities. PWC contribution to overall impacts to wildlife and wildlife habitat would be eliminated.

This alternative would not result in an impairment of wildlife or wildlife habitat.

THREATENED, ENDANGERED, OR SPECIAL CONCERN SPECIES

PWC use could potentially modify the behavior of peregrine falcons that occasionally occur along the Chapel area cliffs and piping plovers that may occur in the Grand Marais area. Behavior of other state or federally listed species, for example, the common loon may be affected by PWC use.

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 Michigan Department of Natural Resources (natural heritage database). A letter requesting a current list of federal threatened, endangered, and special concern species was sent to the U.S. Fish and Wildlife Service. The Michigan Department of Natural Resources was also contacted to identify state threatened, endangered, and special concern species. Both letters of response are provided in appendix B.

An analysis of the potential impacts to each species listed in the letter is included in this section. At Pictured Rocks 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 lakeshore. 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. 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 animal species at Pictured Rocks National Lakeshore that have the potential to be affected by proposed PWC management alternatives include the federally listed piping plover and the state listed peregrine falcon and common loon. Plant species include the federally listed pitcher's thistle and the state listed Lake Huron tansy.

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 personal watercraft 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

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.

As related to threatened or endangered species, the following rules apply:

- Personal watercraft must operate no closer than 200 feet from shore unless landing or launching.
- When personal watercraft land or launch, they must operate at no-wake speed and travel perpendicular to the shoreline if within 200 feet of the shore.

Two basic assumptions were made regarding personal watercraft 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 PWC and visitor use trends data were used to evaluate impacts to threatened or endangered species. Additional information was obtained from lakeshore staff. Vegetation data was available on GIS mapping; wildlife information was provided by the staff biologist (Jerry Belant, NPS, pers. comm., 2001) and the U.S. Fish and Wildlife Service and Michigan Department of Natural Resources (see appendix B).

Study Area

The focus of this study is on the Lake Superior shoreline within Pictured Rocks National Lakeshore. The lakeshore jurisdiction extends 0.25 mile into Lake Superior. PWC use could disturb threatened or endangered wildlife or plants along the shore, extending inland to approximately 200 feet. This 200-foot inland segment is assumed to provide a more encompassing range of assessment, based on the distance of PWC operation from the shoreline, wildlife responses to PWC activity, and the likely distance PWC users would travel inland.

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 are discountable (i.e., extremely unlikely to occur and not able to be meaningfully measured, detected, or evaluated) or are completely beneficial.

May affect / likely to adversely affect: When an adverse effect to a listed species may occur as a direct or indirect result of proposed actions and the effect either is not discountable or is 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 as Currently Managed under a Special NPS Regulation

Analysis. This alternative would allow continued PWC use within the lakeshore, with 13 craft per day in 2002 and increasing to 16 craft per day by 2012. PWC users within 200 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 200 feet from shore or to personal watercraft landing on shore.

Piping Plover — PWC users could access designated critical habitat near the Coast Guard Station in Grand Marais. However, there would be no direct impacts since plovers do not currently occupy habitat within the lakeshore. Indirect impacts to critical habitat could occur. Plover habitat includes sandy and rocky beaches. These areas would not be degraded by personal watercraft landing or by visitor trampling, since there is essentially no vegetative component. Thus, PWC activities would have no effect since they would not degrade the habitat condition. Wave action and natural lake conditions are the dominant forces that affect beach habitat. This alternative would have no effect on the piping plover. If the plover ever became established in the lakeshore, mitigating actions could be required to minimize any adverse effect from PWC use.

Common Loon and Peregrine Falcon — Interactions between personal watercraft and loons or falcons are extremely uncommon. Neither species has critical habitat within the study area; however, a falcon nest has been confirmed within the lakeshore during the 2002 nesting period. Personal watercraft do not currently have direct impacts on peregrine falcons or loons. Indirect impacts to falcons and loons would be unlikely because craft operating within 200 feet of the shore or cliffs would have to be traveling perpendicular to the shoreline and at no-wake speeds. This restriction would minimize potential disruptions to nesting or perching falcons or swimming loons. This alternative would not likely adversely affect peregrine falcons or loons. Neither of these species is a federally designated species.

Pitcher's Thistle and Lake Huron Tansy — Very few personal watercraft operate in the Grand Sable segment where these species occur. Most PWC operators would not travel far from their watercraft. These plant species occur within the dunes and are not very accessible. Few if any plants are expected to be within the shoreline study area. Based on this analysis, this alternative would not likely adversely affect the pitcher's thistle or the Lake Huron tansy. Additionally, restoration activities proposed for 2002 would have a beneficial effect to the thistle and the tansy.

Overall, continued PWC use at the lakeshore would have no effect or would not likely adversely affect sensitive species since the identified species are not present or are not normally accessible.

Cumulative Impacts. Other visitors to Pictured Rocks National Lakeshore could affect sensitive species and habitat as a result of trampling and/or interrupting normal activities. Cumulative effects for PWC users and other visitors are described below for each species.

Piping Plover — No direct effect on the piping plover is anticipated from other boating or visitor activities. PWC and visitor activities within the designated habitat would not degrade the habitat, since it is composed of sand and rocky beach. If plovers started using habitat within Pictured Rocks National Lakeshore, then PWC and visitor activity would have the potential for adverse effects, and mitigating measures would have to be taken.

Peregrine Falcon and Common Loon — These species do not have critical habitat and are not frequently found on the shoreline of Lake Superior, although a falcon nest site has been confirmed within the national lakeshore this year. PWC users, motorboaters, and other visitors would continue to have very limited interaction with these species due to the normal operating distance from the shore and cliffs. Based on this analysis, continued activities would not likely adversely affect these species.

Pitcher's Thistle and Lake Huron Tansy — Under this alternative it is unlikely that the pitcher's thistle or Lake Huron tansy would be adversely affected by PWC and other park uses because of the remoteness of these species in relation to trails and access. Also, restoration activities proposed for 2002 would have a beneficial effect.

Overall, cumulative effects from all park visitor activities 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 the piping plover and would not likely adversely affect other federal or state listed species since interactions would be extremely limited.

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.

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

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

Analysis. This alternative would allow continued PWC use except within the Beaver Basin segment. Potential effects would be similar to those described for alternative A and would be limited to interactions with wildlife farther than 200 feet from shore or to personal watercraft landing on shore.

Piping Plover — PWC use would have no effect on the piping plover, as described for alternative A. If plovers ever became established in the lakeshore, mitigating actions could be required to minimize any adverse effect from PWC use.

Common Loon and Peregrine Falcon — Interactions between personal watercraft and loons or falcons would have the same impacts as for alternative A and would not likely adversely affect peregrine falcons or loons.

Pitcher's Thistle and Lake Huron Tansy — Personal watercraft would have same impacts as for alternative A and would not likely adversely affect the pitcher's thistle or the Lake Huron tansy. Additionally, the restoration activities proposed for 2002 would have a beneficial effect on the thistle and the tansy.

Overall, PWC use would have no effect on piping plover and would not likely adversely affect other federal and state listed species since interactions would be extremely limited.

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.

Piping Plover — No direct effect on the piping plover is anticipated. If plovers started using habitat within Pictured Rocks National Lakeshore, then PWC and visitor activity would have the potential for adverse effects, and mitigating measures would be taken.

Peregrine Falcon and Common Loon — PWC, motorboats, and other visitors would not likely adversely affect these species.

Pitcher's Thistle and Lake Huron Tansy — It is unlikely that the pitcher's thistle or Lake Huron tansy would be adversely affected by PWC and other park uses because of the remoteness of these species in relation to trails and access. Additionally, the restoration activities proposed for 2002 would have a beneficial effect.

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 piping plover and would not likely adversely affect other federal or state listed species since interactions would be extremely limited.

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.

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

Impacts of the No-Action Alternative

Analysis. No PWC use would be allowed within the lakeshore boundary, thus eliminating any potential impacts on the piping plover, peregrine falcon, common loon, pitcher's thistle, or Lake Huron tansy. Implementation of this alternative would have beneficial impacts as compared to alternative A.

Cumulative Impacts. PWC contribution to overall cumulative impacts to federal or state listed animal and plant species would be eliminated. The activities of other visitors would not likely adversely affect federal or state listed animal and plant species, similar to alternative A. Generally, the concern species are not present or are not accessible to normal visitor activities.

Conclusion. Because PWC users would no longer have access to Pictured Rocks National Lakeshore, there would be no effect on federal or state listed species.

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 the 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 of Pictured Rocks National Lakeshore, and operators may disembark to explore, sunbathe, or beachcomb. As a result, shoreline vegetation could be trampled in order to access shoreline trails or to explore along the shore. Due to physical characteristics of the shoreline, the lakeshore does not have submerged aquatic vegetation that could be impacted by PWC use.

Guiding Regulations and Policies

Natural shoreline processes such as erosion, deposition, dune formation, overwash, inlet formation, and shoreline migration such as those found at Pictured Rocks National Lakeshore 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.

Michigan's Personal Watercraft Safety Act of 1998 (Public Act 116) limits PWC operation to no-wake speeds within 200 feet on the shoreline. Personal watercraft must be operated at least 200 feet from shore unless they are landing or launching. If they are within 200 feet of the shore, they must be traveling perpendicular to the shoreline at no-wake speeds. Personal watercraft are not allowed to travel through submerged or emergent vegetation or in areas where the water depth is less than 2 feet.

The purpose of the Coastal Zone Management Act is to enable coastal states to develop a coastal management program to improve protection of sensitive shoreline resources, to identify coastal areas appropriate for development, to designate areas hazardous to development, and to improve public access to the coastline.

Michigan was among the first states to have its coastal program approved in 1978. The program is administered by the Michigan Department of Environmental Quality (Great Lakes Shorelands Section in the Land and Water Management Division). The program includes local pass-through grants, administration of coastal related sections of the Natural Resource and Environmental Protection Act of 1994 (Public Act 451), and review of federal agency activities for consistency with Michigan's approved program. There are no coastal zone management regulations or policies that specifically relate to PWC use on Lake Superior (Cathie Cunningham, MDEQ, pers. comm., 2001).

METHODOLOGY AND ASSUMPTIONS

Maps illustrating vegetation cover within Pictured Rocks National Lakeshore and communications with NPS staff were used to identify baseline conditions within the study area. To assess the magnitude of impacts from PWC use on shoreline vegetation, the following assumptions were made:

1. PWC users operate their craft in a lawful manner and abide by state laws.
2. PWC users who disembark at beach areas would travel no more than 100 feet inland and would follow existing trails.
3. Impacts in 2012 would be essentially the same as those occurring in 2002 since visitor numbers are not projected to increase and PWC use is projected to increase only slightly.

These assumptions are based on the following:

- Only three incident reports have been made relating to PWC operation on Lake Superior since 1997.
- Most PWC users would stay within eyesight of their craft when visiting a beach.
- Existing impacts to the shoreline do not indicate that visitors wander off trails.

STUDY AREA

The study area is based on areas personal watercraft may travel within the lakeshore. Topography limits use in portions of the study area. The colorful sandstone cliffs are adjacent to the water or slightly inland for at least 12 miles of the 42-mile shoreline. Some of the cliffs rise up to 200 feet straight out of the water, thereby limiting access to the cliffs. In other areas PWC users may land on beaches and dunes, thus gaining access to shoreline areas. For the purpose of this evaluation, the study area includes the shoreline and a 100-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 personal watercraft and visitors and their distribution was based on the analysis provided in the "PWC and Other Visitor 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 as Currently Managed under a Special NPS Regulation

Analysis. PWC use would continue along the shoreline, with 13 watercraft per day projected in 2002 and increasing to 16 per day by 2012. The primary location for potential impacts would be at beaches where PWC users would be permitted to land and launch. Personal watercraft would be distributed throughout the lakeshore, with concentrated use near the Sand Point boat launch. Both beach and forest communities are near Sand Point. According to the national lakeshore's biologist, there is currently no observable impact to shoreline vegetation in the Sand Point area (Jerry Belant, NPS, pers. comm., 2001). Vegetation along the cliffs is not accessible to PWC users, while the Beaver Basin segment is mostly sand beach. Only two personal watercraft would be used in the Grand Sable segment. Continued PWC use at Pictured Rocks National Lakeshore 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. Trails and other boats provide bluff and shoreline access to approximately 2,900 visitors per day. Most of the shoreline access occurs along the North Country National Scenic Trail, which traverses the entire lakeshore. Visitor trampling has had adverse effects in localized areas of Grand Sable Dunes, but not within the 100-foot study area. Generally, most visitors follow trails and do not trample shoreline vegetation. Overall, PWC and visitor use at Pictured Rocks National Lakeshore has resulted in a negligible adverse effect on shoreline vegetation. There are no perceptible changes in community size, continuity or integrity, now, and none are expected or in the future (2012).

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, there are no obvious impacts now, 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 now or by 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 use under alternative B would continue to be allowed along the shoreline except for the Beaver Basin segment, where use would be prohibited. PWC impacts to shoreline vegetation would be similar to those described for alternative A, since the number of PWC users would not change, although use areas would. Impacts to vegetation in the Beaver Basin segment would be negligible and beneficial since users would no longer have access to shoreline areas. 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. Cumulative impacts related to other visitors would be the same as described for alternative A and would be negligible adverse. Generally, most visitors follow trails and do not trample shoreline vegetation. Overall, PWC and visitor use at Pictured Rocks National Lakeshore would result in a negligible adverse effect on shoreline vegetation. 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 are no perceptible changes to plant community size, integrity or continuity now, and none are expected in the future (2012). PWC restrictions in the Beaver Basin segment would result in negligible beneficial impacts to shoreline vegetation.

On a cumulative basis other visitor activities are more prevalent than PWC use. However, there are no obvious impacts now, 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 result in an impairment of shoreline vegetation.

Impacts of the No-Action Alternative

Analysis. Banning PWC use within the national lakeshore would eliminate any potential impacts to shoreline vegetation as a result of access gained from personal watercraft. Impacts to shoreline vegetation would be negligible and beneficial, compared to alternative A, for the short and long term. 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 negligible and 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 personal watercraft are no different from other motorcraft and that people have a right to enjoy the sport. One of the goals of the *Draft General Management Plan* 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 personal watercraft are operated. Additionally, the sound of any watercraft can carry for long distances, especially on a calm day.

Pictured Rocks National Lakeshore recently completed a wilderness suitability study for the areas of Chapel and Beaver Basins. The study indicates that 18,400 acres in these areas are suitable for wilderness designation. Currently, this area has little development, with the exception of backcountry campsites and access roads. The *Draft General Management Plan* is proposing that only Beaver Basin be designated as wilderness. The Lake Superior shoreline (within the 0.25-mile NPS surface water jurisdiction) adjacent to the proposed Beaver Basin wilderness would be managed as a primitive area. Consequently, no motorized access would be allowed within the NPS jurisdictional boundary on Lake Superior.

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

Part of the purpose of Pictured Rocks National Lakeshore is to offer opportunities for recreation, education, inspiration, and enjoyment. Its significance lies in the spectacular and diverse shoreline of

Lake Superior that visitors enjoy. One of the national lakeshore's mission goals is to ensure that "visitors safely enjoy and are satisfied with the availability, accessibility, diversity, and quality of park facilities, services, and appropriate recreational opportunities." To achieve this mission goal, two long-term (five-year) visitor goals were identified in the *Strategic Plan:*

- *Visitor Satisfaction* — By September 30, 2005, 91% of visitors to Pictured Rocks National Lakeshore are satisfied with appropriate park facilities, services, and recreational opportunities.
- *Visitor Safety* — By September 30, 2005, the number of Pictured Rocks National lakeshore visitor accidents/incidents is not higher than the FY 1992 – FY 1996 five-year annual average of 3.81.

Both goals focus on maintaining high visitor satisfaction by means of appropriate and safe recreational opportunities and experiences.

The lakeshore's enabling legislation identifies preservation, inspiration, education, recreation, and enjoyment as important elements of the visitor experience. The wilderness suitability evaluation of Chapel and Beaver Basins is in accord with this purpose, and the National Park Service is considering potential wilderness designation for approximately 11,740 acres in Beaver Basin, while the remaining 6,660 acres in Chapel Basin would be managed to preserve wilderness values. The potential wilderness designation is being reviewed as part of the *Draft General Management Plan.* The potential wilderness boundary would not extend over the surface water of Lake Superior (within the 0.25-mile surface water boundary). Rather, the Lake Superior shoreline adjacent to the proposed Beaver Basin wilderness would be managed as a primitive area. Final recommendations and designations will be completed once the *Draft General Management Plan* has been finalized.

METHODOLOGIES AND ASSUMPTIONS

The purpose of this impact analysis was to determine if PWC use at Pictured Rocks National Lakeshore 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 segments of the lakeshore (see the "PWC and Other Visitor Use Trends" section). 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. Baseline visitor survey data at Pictured Rocks National Lakeshore suggest that the vast majority of visitors are satisfied with their current experiences.

Two distinct visitor types are present at Pictured Rocks National Lakeshore. They include frontcountry visitors who experience the lakeshore through short day hikes, boating, and tour boats. Most frontcountry visitors are concentrated in the Sand Point, Cliffs, and Grand Sable segments. Backcountry visitors, on the other hand, include visitors who backpack for two or more days within the lakeshore. Most backcountry visitors are concentrated in the Beaver Basin segment and along the North Country National Scenic Trail.

The potential for change in visitor experience was evaluated by identifying projected increases or decreases in both personal watercraft 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.

Study Area

In terms of PWC use, the appropriate boundary for analyzing visitor experience impacts includes the 0.25-mile jurisdiction within Lake Superior. Additionally, 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: There would be little noticeable change in visitor experience or in the defined indicators of visitor satisfaction or behavior.

Minor: Visitors' desired experiences would be changed, but without appreciably limiting or enhancing critical characteristics of those experiences. Visitor satisfaction would remain stable.

Moderate: Critical characteristics of the desired experience (such as natural quiet) would be changed, or the number of participants engaging in an activity would be altered. Visitor satisfaction would begin to decline or increase.

Major: Multiple critical characteristics of the desired experience would be eliminated or detracted from, or greatly enhanced; participation would be greatly reduced or increased. Visitor satisfaction would substantially decline or increase.

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

Analysis. PWC operators under alternative A would have unrestricted use along the Lake Superior shoreline, increasing from 13 personal watercraft per day within the lakeshore boundary to 16 by 2012.

Impact on PWC Users — There would be no change to PWC use or activity as compared to existing conditions. Alternative A would have no effect on the visitor experience of PWC users at Pictured Rocks National Lakeshore.

Impact on Other Boaters — Other boaters to Pictured Rocks National Lakeshore would continue to interact with PWC operators on a very limited basis. Generally, nonmotorized craft (sea kayaks and canoes) are concentrated closer to the shore, so interactions between these user groups are infrequent. Motorboats are more likely to interact with personal watercraft; however, the small numbers of personal watercraft and the large area for operation make these interactions relatively rare. The most common area for personal watercraft / boater interaction is near the Sand Point launch. Only one incident report has been made by national lakeshore staff about personal watercraft and other boaters. Based on this analysis, alternative A would have negligible adverse effects on the visitor experience of other boaters for the existing and future conditions.

Impact on Frontcountry Visitors — Swimmers, hikers, and other visitors to the Sand Point and Miners Castle areas would have occasional contact with PWC users. In 2002 up to 8 personal watercraft are expected in these areas, projected to increase to 10 by 2012. The increased PWC numbers over the 10-year period would not be noticeable in comparison to existing conditions.

Monthly visitor use reports for Pictured Rocks National Lakeshore indicate that Sand Point and Miners Castle are two of the three highest use areas in the lakeshore, with approximately 800 and 1,200 people per day, respectively. Given the relatively high visitor numbers to these areas, it is likely that visitor expectations for solitude and backcountry experiences are lower than for other locations in the lakeshore. Continued PWC use, at existing and predicted levels, would not result in a noticeable change in visitor experiences. Based on this analysis, PWC activity near Sand Point and Miners Castle would have negligible adverse impacts on the experiences of swimmers, hikers, and other visitors.

Visitors to Twelvemile Beach and the eastern end of the lakeshore would experience slightly lower PWC numbers (three to four personal watercraft) than the western half of the lakeshore, which is nearer the Sand Point launch facility. Generally, visitors to Twelvemile Beach expect a quieter visitor experience. The low number of PWC users in this area would result in a negligible adverse impact to visitors in the eastern end of the lakeshore.

Impact on Backcountry Visitors — Based on Pictured Rocks National Lakeshore monthly use reports, approximately 130 people participate in backcountry camping each day. Most of these visitors are associated with campsites along the North Country National Scenic Trail. Experiencing natural quiet is a critical element to backcountry campers. Additionally, backcountry visitors have a lower tolerance to activities that intrude on solitude and the backcountry experience (summer 2000 visitor survey). It is likely that most people who visit backcountry sites spend some time on the shoreline during their stays. Based on this analysis, continued PWC use would have moderate adverse impacts on these visitors over the short and long term because a critical element of their desired experience would be occasionally interrupted.

In summary, continued unrestricted PWC use in the lakeshore would have no effect on PWC users. For visitors who desire a more passive recreational experience, PWC use would have negligible adverse impacts. Backcountry visitors would be most affected by continued PWC use because of their overall sensitivity to man-made noise and expectations for solitude. Overall, most visitors to Pictured Rocks National Lakeshore would have negligible to minor adverse effects on their experiences under this alternative.

Cumulative Impacts. The primary activities at Pictured Rocks National Lakeshore 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 lakeshore. According to visitor surveys, most visitors are satisfied with their experiences at the lakeshore. 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.

Within the region, Sleeping Bear Dunes National Lakeshore recently discontinued PWC use. This could displace a small number of PWC users from Sleeping Bear Dunes to other locations, including Pictured Rocks National Lakeshore; however, this number is expected to be small. Michigan has a large number of inland lakes, as well nearly 3,250 miles of Great Lakes shoreline available for PWC use. PWC users displaced from Sleeping Bear Dunes could be easily accommodated at other locations.

Conclusion. Continued PWC use at Pictured Rocks National Lakeshore would have negligible adverse impacts on experiences for most visitors in the short and long term. PWC use would have long-term, moderate, adverse impacts on those visitors desiring a backcountry experience with natural "quiet." The level of PWC use is relatively low at most lakeshore locations. When related to other visitor activities, 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 Pictured Rocks National Lakeshore.

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

Analysis. PWC users under alternative A would be restricted from operating in the Beaver Basin segment. Of the 13 to 16 personal watercraft operating in the lakeshore during peak use, this would affect three to four users. Additionally, PWC operation would be restricted at certain locations during the permitted use of ethnographic resources.

Impact on PWC Users — By prohibiting PWC use in the Beaver Basin segment, it is anticipated that fewer riders would travel from Munising or Sand Point to Twelvemile Beach. Additionally, more PWC riders would stay within the west end of the park, between Munising and Chapel Rock. Most PWC users would have little or no noticeable change in their visitor experiences or visitor satisfaction, since there would be minimal restrictions on PWC operations. Under this alternative visitors who use personal watercraft at Pictured Rocks National Lakeshore would experience negligible adverse impacts.

Impact on Other Boaters — Other boaters to Pictured Rocks National Lakeshore would continue to interact with PWC operators on a very limited basis. The most common area for PWC and boater interaction is near the Sand Point launch. Based on this analysis, alternative B would slightly increase the number of PWC operators within the Sand Point segment. However, the increase would not be noticeable and would result in impacts similar to those under alternative A. Other boaters would have negligible adverse effects on visitor experiences now and in the future, due to continued PWC use.

Impact on Frontcountry Visitors — Swimmers, hikers, and other visitors to the Sand Point and Miners Castle areas would have slightly more contact with PWC operators than under alternative A because users would be displaced from the Beaver Basin segment. The increased amount of contact would not be noticeable in comparison to existing conditions. PWC activity near Sand Point and Miners Castle would have negligible adverse impacts on the experiences of swimmers, hikers, and other visitors.

Visitors to Twelvemile Beach and the eastern end of the lakeshore would experience slightly lower PWC numbers because of the Beaver Basin restrictions. Visitors to Twelvemile Beach, in particular, tend to look for quieter experiences, and this alternative would have a negligible beneficial impact to visitors in the Beaver Basin segment. Visitors to the Grand Sable segment would not experience a noticeable change, and there would be negligible adverse impacts from continued PWC use.

Impact on Backcountry Visitors — Backcountry visitors within the Beaver Basin segment would have decreased contact with PWC users, resulting in a moderate beneficial impact to their experiences.

Other backcountry visitors along the North Country National Scenic Trail would continue to be occasionally affected by PWC use, with a moderate adverse impact.

Cumulative Impacts. Motorized boats and other visitors would continue to interact, with impacts the same as described for alternative A. 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 the visitor experience for most visitors. Backcountry visitors to the Beaver Basin area would have moderate beneficial impacts because of decreased impacts from PWC use. Most visitors would continue to be satisfied with their experiences at Pictured Rocks National Lakeshore.

Within the region, PWC users displaced from Sleeping Bear Dunes National Lakeshore could be easily accommodated at other locations.

Conclusion. Continued PWC use at Pictured Rocks National Lakeshore would have negligible adverse impacts on the experiences of most visitors in the short and long term. PWC restrictions within the Beaver Basin segment would have long-term, moderate, beneficial impacts on those visitors who desire backcountry experiences with natural "quiet." The level of PWC use would remain relatively low at other lakeshore locations. When related to other visitor activities, 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 Pictured Rocks National Lakeshore.

Impacts of the No-Action Alternative

Analysis. Approximately 2,900 people visit Pictured Rocks National Lakeshore each day during the peak visitor season. According to the personal watercraft use analysis, approximately 20 PWC riders on 13 craft would no longer be allowed to participate in this form of recreation in the national lakeshore. This is less than 1% of the daily visitors during the peak season. Based on current use projections, by 2012 approximately 23 PWC riders on 16 craft would not be able to enjoy this experience in the national lakeshore. This number would continue to be a small percentage of daily peak visitation.

Impact to PWC Users — Discontinuing PWC use would not necessarily preclude a visit to the lakeshore 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 camping. The level of impact to PWC users is expected to be moderate adverse for the short and long term, since the number of visitors using personal watercraft would be altered. However, these visitors would not be precluded from experiencing the lakeshore through other recreational activities, and it is not expected that visitation would decrease.

Impact to Other Boaters — Banning PWC use within Pictured Rocks National Lakeshore would eliminate interactions between other boaters and PWC operators. While there is only one documented incident involving a PWC user and other boaters at Pictured Rocks National Lakeshore, it is assumed that this alternative would eliminate any possible conflicts between various uses within the lakeshore. Other boaters would not have to watch for or come into conflict with PWC users, thus resulting in a long-term, negligible, beneficial impact on other watercraft users.

Impact to Frontcountry Visitors — According to the summer 2000 visitor survey, 73% of all respondents indicated that having a wilderness experience was important (or very important), while 58% indicated that experiencing solitude was important (or very important). Restricting PWC use within the lakeshore would have a negligible beneficial effect on these users.

Impact to Backcountry Visitors — Approximately 18% of respondents to the summer 2000 visitor survey (522 people per day) indicated that PWC use disturbed their backcountry experiences (slight to very serious problem). The degree of the adverse impact related to PWC use is relatively small, because only 8% of those surveyed rated PWC use as a serious or very serious problem. Based on the responses to the survey, the no-action alternative would have a moderate beneficial impact on backcountry visitors at Pictured Rocks National Lakeshore by eliminating PWC use and enhancing opportunities for backcountry experiences or solitude.

In summary, a small number of PWC operators would experience moderate adverse effects while a large number of other users would experience negligible to moderate beneficial effects. Based on this qualitative analysis, the no-action alternative would result in a net negligible beneficial effect on visitor experiences for both the short and long term.

Cumulative Impacts. The cumulative impacts for the no-action alternative would be negligible and beneficial as compared to alternative A. The visitor experience of frontcountry and backcountry users would be beneficial because no PWC use would be allowed within the lakeshore's jurisdiction. Conversely, the visitor experience of PWC users would be adversely affected because of these same restrictions. Most visitors would continue to be satisfied with their experiences at Pictured Rocks National Lakeshore. On a regional basis the no-action alternative would result in a negligible adverse effect to PWC activities on other waterbodies in the state as a result of PWC users going to other locations to enjoy this activity.

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

Cumulative impacts would be negligible and beneficial as compared to alternative A. Most visitors would continue to be satisfied with their experiences at Pictured Rocks National Lakeshore. On a regional scale the no-action alternative would result in a negligible adverse effect to other waterbodies in the state as a result of PWC users going to other locations to enjoy this activity.

VISITOR CONFLICTS AND SAFETY

In 1996 personal watercraft comprised 7.5% of the registered vessels in the United States, but they were involved in 36% of all boating accidents. While no PWC accidents have been reported at Pictured Rocks National Lakeshore, there have been several incident reports, most involving PWC users and swimmers or other boaters. Staff receive infrequent calls for assistance in locating a PWC operator who is overdue or "missing." Running out of gas is also a concern and may be hazardous because of the water temperatures and lack of landing areas along the rock cliffs. The park does not have regular boat patrols, which would be necessary to better identify PWC/visitor safety issues.

Divers may be present within the lakeshore boundary at shipwreck locations. No conflicts between PWC users and divers have been observed. Divers set buoys to identify their location, so PWC users should be able to avoid conflicts.

PWC speeds, wakes, and operations near other users can pose hazards and conflicts, especially to canoeists and sea kayakers. Sea kayaks are the primary nonmotorized boats used in the national lakeshore, and conflicts could occur with personal watercraft, particularly if PWC use increased. To date, few conflicts have been reported.

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 agency is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Further, the National Park Service will strive to protect human life and provide for injury-free visits (NPS *Management Policies 2001,* sec. 8.2.5). The National Park Service will also seek to provide a safe and healthful environment for employees, as well as visitors.

The safe use of personal watercraft is promoted and defined in Michigan's Personal Watercraft Safety Act of 1998 (Public Act 116). This act provides rules for use, safety requirements, and duties and responsibilities concerning PWC operation, as stated on page 53. These include the following:

- no use from one hour before sunset, as determined by the National Weather Service, until 8 A.M.
- no crossing within 150 feet behind another non-personal watercraft vessel
- no operating in less than two feet of water, except at no-wake speed or while launching or docking
- no weaving through congested water traffic
- no jumping the wake of another vessel unreasonably or unnecessarily
- no playing chicken with other personal watercraft

Furthermore, the act stipulates distance and speed requirements for safe operation of personal watercraft. Except at no-wake speed, the operator of a personal watercraft shall

- maintain a distance of at least 200 feet from the shoreline on the Great Lakes, and ride perpendicular to the shoreline if within 200 feet
- maintain a distance of at least 100 feet from a dock, raft, buoyed or occupied swimming area, person in the water or on a floating device on the water, or a drifting or moored vessel
- maintain a distance of at least 200 feet from a submerged diver, a vessel engaged in diving activities, or a float displaying the international diving insignia

No person under the age of 14 may operate a personal watercraft in Michigan waters. Any individual convicted of reckless operation of a personal watercraft may not operate a personal watercraft again for two years, and then only after completion of a boating safety course. Any such person will then be required, while operating a personal watercraft, to have in his or her immediate possession a boating safety certificate.

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 mandate to provide for injury-free visits. Potential impacts were identified based on the number and activities of personal watercraft 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 Michigan PWC regulations are enforced within the national lakeshore. These regulations govern PWC activities near the shore, the timing of use, and the age and educational requirements of operators.

Study Area

In terms of visitor safety, the appropriate boundary for analyzing impacts includes the 0.25-mile jurisdiction within Lake Superior. Additionally, 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 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, and 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 as Currently Managed under a Special NPS Regulation

Analysis. This alternative assumes that PWC operations would continue the same as existing conditions, increasing from 13 personal watercraft on a peak day now to 16 by 2012.

Personal Watercraft/Swimmer Conflicts — Over 10 years it is estimated that no more than 16 personal watercraft would be in use in the lakeshore during peak use days. There is no projected increase in the number of other lakeshore visitors.

The greatest potential for conflict with swimmers is near Sand Point. This is where many of the park's visitors swim, and it is the only boat launch within the national lakeshore. Responsible PWC operation is not a source of conflict within 200 feet of shore, but some swimmers go beyond this point because the waters in this segment are relatively shallow. Beyond 200 feet from shore, PWC users may operate at high speed, and the potential exists for an accident involving a swimmer. An estimated 4 to 5 personal watercraft would be operated in this area during peak use days, with an additional 9 to 11 launching and traveling through the area. Of the estimated 80 swimmers projected to use this same area, only a fraction would venture beyond the 200 foot boundary. Due to the small number of visitors involved, impacts at this location are predicted to be minor adverse.

The remaining lakeshore locations would have little or no conflict between PWC users and swimmers. There are very few swimmers in the Cliffs segment. In the Beaver Basin and Grand Sable segments, most swimmers would not be within the operating area of personal watercraft because of water depths. Thus, conflicts in these segments would constitute negligible, adverse impacts over the short and long term.

Overall, PWC use would continue to have negligible to minor adverse impacts on swimmers at Pictured Rocks National Lakeshore. Impacts would be perceptible to a relatively small number of visitors at localized areas, primarily at the Sand Point beach.

Personal Watercraft/Other Boat Conflicts — The Sand Point segment is the location with the greatest potential for conflicts between PWC users and motorized boat operators. Both the Munising and Sand Point boat launches are on the west end of the lakeshore. Of the estimated 90 motorized boats expected to be active daily in the western end of the lakeshore (Sand Point and Cliffs segments), most could be expected to begin and end their trips in or near Sand Point. This would create a relatively high amount of motorboat traffic and potential for conflicts, with a minor adverse impact.

The remaining two segments of the lakeshore would have negligible conflicts between personal watercraft and other motorboats, due to the small number of watercraft and large area available for operation.

Overall, PWC use would continue to have minor adverse impacts on other motorized boat users at Pictured Rocks National Lakeshore. Impacts would be perceptible to a relatively small number of visitors at localized areas, primarily at the Sand Point beach.

Cumulative Impacts. The Lake Superior shoreline is used by a variety of visitors, including swimmers, motorboat users, sea kayakers, 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 negligible to 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 in the Sand Point area due to the number of visitors and boats present on high use days. Conflicts at other locations would remain negligible because use is lower, and conflicts would be less likely to occur.

Cumulative impacts related to visitor conflicts and safety would continue to be negligible to minor for all user groups in the short and long term, particularly near Sand Point. Cumulative impacts in other segments would be negligible because of reduced use.

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

Analysis. This alternative assumes that PWC operations would continue the same as existing conditions, except that PWC use would be discontinued in the Beaver Basin segment. As a result, the watercraft that normally operate in the Beaver Basin area would be relocated to other parts of the lakeshore.

Personal Watercraft/Swimmer Conflicts — Impacts would be similar to alternative A since the number of personal watercraft operating within the lakeshore would not change. PWC user / swimmer interactions would increase slightly in the Sand Point segment because of a shift in PWC use from the Beaver Basin segment. However, the change in location for PWC operation would not be noticeable to other visitors and would continue to result in minor adverse impacts. In the remaining lakeshore locations there would be little or no conflict between PWC users and swimmers. No conflicts would occur in the Beaver Basin segment, resulting in a negligible beneficial impact to these visitors.

Overall, PWC use would continue to have negligible to minor adverse impacts on most swimmers at Pictured Rocks National Lakeshore. Beneficial impacts would occur in the Beaver Basin segment. Impacts would be perceptible to a relatively small number of visitors at localized areas, primarily at the Sand Point beach.

Personal Watercraft/Other Boat Conflicts — Impacts would be similar to alternative A. Overall, PWC use would continue to have minor adverse impacts on other motorized boat users at Pictured Rocks National Lakeshore. Impacts would be perceptible to a relatively small number of visitors at localized areas, primarily at the Sand Point beach.

Cumulative Impacts. Cumulative impacts would be similar to alternative A. The natural separation of use between the various lakeshore visitors reduces the potential for conflicts. For this reason, the cumulative impact of the various user groups on visitor conflicts and safety would be negligible to minor over the short and long term. Beneficial impacts would occur in the Beaver Basin segment. Impacts would be perceptible to a relatively small number of visitors at localized areas, primarily at the Sand Point beach.

Conclusion. Continued PWC use would have short- and long-term, minor, adverse impacts on visitor conflicts and safety, particularly in the Sand Point area, due to the number of visitors and boats present on high use days. Conflicts at other locations would remain negligible because use is lower and conflicts would be less likely to occur. Conflicts would be eliminated in the Beaver Basin segment, resulting in negligible, beneficial impacts.

Cumulative impacts related to visitor conflicts and safety would continue to be negligible to minor for all user groups in the short and long term, particularly near Sand Point. Cumulative impacts in other segments would remain negligible.

Impacts of the No-Action Alternative

Analysis. Under the no-action alternative all PWC use would be banned, eliminating any conflicts between PWC operators and other lakeshore visitors. Based on the existence of two incident reports involving personal watercraft, as well as visitor responses to the summer 2000 visitor survey, eliminating PWC operation in the lakeshore would yield a perceptible change for a small number of

visitors. No swimmer/personal watercraft incidents would occur. This would be a short- and long-term, minor, 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 and safety would improve as compared to alternative A because eliminating PWC use within the lakeshore would remove the potential for conflicts between PWC users, as well as between PWC users and swimmers or other boaters. Cumulative impacts to visitor conflict and safety would be reduced to negligible adverse. Even without PWC use, more intensive uses around Sand Point would continue to result in the greatest potential for visitor conflicts and safety.

Conclusion. Discontinuing PWC use would result in short- and long-term, minor, 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

Cultural resource in the national lakeshore, specifically ethnographic resources (for example, sacred sites used by American Indians, as documented in a 1999 study by the University of Arizona), could be affected by PWC use. Specifically, PWC access may affect the resources because riders can access shoreline areas less accessible to other watercraft. American Indians, who use cliffs, creek mouths, and dunes in the national lakeshore for ceremonial purposes, are concerned with possible crowding at some of these areas, and potential increased PWC use could contribute to increased visitor access, crowding, and noise at these sites.

Within the lakeshore looting and vandalism of cultural resources is currently not a substantial problem. However, when cultural resources and visitors are present in the same area, there is the potential for illegal collection and damage. Specifically, in relation to the issue of PWC use, PWC users have the ability to access remote areas, such as steep-walled inland coves, that are not as easily accessible to other watercraft users or land-based visitors. However, given the overall low rate of these incidents, as well as the low number of PWC users, it is not thought that this issue would cause any short-term impacts, though the aggregate of these isolated incidents could create long-term impacts.

National lakeshore managers do not employ visitor use surveys or formal special use permits for American Indian group ceremonies; no statistics on the use of ethnographic resources by traditional users are maintained. As a result, the frequency of ceremonies, as well as the number of participants or individual users, is unknown. However, in the 1999 ethnographic study and through individual reports, traditional users have expressed concern over the noise and visual intrusion of watercraft, frequently used trails, and litter (University of Arizona 1999). At present, the lakeshore does not provide boat patrols to control visitor traffic during the ceremonial use of ethnographic resources. The current ceremonial use of these resources has been on an informal basis and has not required formal permitting.

GUIDING REGULATIONS AND POLICIES

Park ethnographic resources are the cultural and natural features that are of traditional significance to traditionally associated peoples. These peoples are the contemporary park neighbors and ethnic or

occupational communities that have been associated with a park for two or more generations (40 years), and whose interests in the park's resources began prior to the park's establishment.

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, 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
>
> *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).

Assumptions and Methodologies

Impacts on cultural resources — archeological sites, submerged cultural resources, and ethnographic resources — were developed based on current regulations and the likely area of PWC use.

The inventory of archeological resources in the national lakeshore is incomplete. Currently 38 archeological sites have been recorded; roughly a third of these sites are within the study area for this assessment, though it is assumed that many more are located within the lakeshore segment. No archeological sites are currently listed on the National Register of Historic Places; however, not all recorded sites have been formally evaluated. For purposes of assessing impacts, all unevaluated and unrecorded resources are considered potentially eligible for listing on the national register.

The park's inventory of submerged cultural resources is fairly complete (NPS 1989). A total of 116 shipwrecks have been reported in the vicinity of the national lakeshore, of which only 54 wrecks have been identified. Nearly half of those wrecks are within the national lakeshore boundary. No submerged cultural resources are currently listed on the national register; however, they have not been formally evaluated. For purposes of assessing potential impacts to these properties, unevaluated and unrecorded submerged sites are assumed to be potentially eligible for listing on the national register.

The park's inventory of ethnographic resources is nearly complete. According to the 1999 study, 11 activity complexes, 488 plants, 79 animals, 7 minerals, and 16 landform types qualify as ethnographic resources (University of Arizona 1999). Many of the activity complexes and landform types are within the study area defined for this assessment. The use of these ethnographic resources has not yet been

formally evaluated for their status as traditional cultural properties / sacred sites as defined for the National Register of Historic Places. For purposes of assessing impacts, these unevaluated resources are considered potentially eligible for listing on the national register.

IMPACT TO CULTURAL RESOURCES FROM PWC USE AND ACCESS TO SITES

In accordance with section 106 of the National Historic Preservation Act, only historic resources that are eligible for or are listed on the National Register of Historic Places are considered in the impact analysis. An impact, or effect, to a property occurs if a proposed action would alter in any way the characteristics that qualify it for inclusion on the register. If the proposed action would diminish the integrity of any of those characteristics, it is considered to be an adverse effect.

In analyzing the PWC management alternatives, the level of impacts to cultural resources was accomplished using the following criteria:

Negligible: There would be no direct or indirect impacts to any property potentially eligible for or listed on the National Register of Historic Places.

Minor: Direct or indirect impacts to a property potentially eligible for or listed on the National Register of Historic Places are anticipated; however, these effects would be minor in number, extent, and/or duration. Minor impacts, for example, could include temporary disturbances that would not alter the character for which the property has been listed, and the site would be returned to its original state following the action.

Moderate: Direct or indirect impacts to a property potentially eligible for or listed on the National Register of Historic Places are anticipated, and these effects would be greater in number, extent, and/or duration than minor impacts. Moderate impacts, for example, could include disturbances (such as the long-term physical alteration of a site that would require mitigation through data recovery techniques) that could alter the character for which the property has been listed, and the site might not resume its original state following the action.

Major: Direct or indirect impacts to a property potentially eligible for or listed on the National Register of Historic Places are anticipated, and these effects would be more substantial in number, extent, and/or duration than moderate impacts. Major impacts could result in the alteration of the character for which the property has been listed, thus potentially disqualifying the property from remaining on the national register. Examples of major impacts include isolation of a property from or alteration of the character of a property's setting, including removal from its historic location; the introduction of visual, audible, or atmospheric elements that are out of character with the property or that alter its setting; and neglect of a property resulting in its deterioration or destruction (36 CFR 800.5).

If it is determined there is potential for impacts to cultural resources listed on or eligible for listing on the National Register of Historic Places, the National Park Service will coordinate with the State Historic Preservation Office to determine the level of effect to the property and any appropriate mitigation measures that need to be taken. An official determination of effect will be issued by the state officer that documents (1) the level of impact to the resource, including any potential for impairment to cultural resources, and (2) the course of action that the National Park Service will be required to perform to mitigate these effects.

In the absence of quantitative data concerning the full extent of actions under a proposed alternative, best professional judgment prevailed.

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

Analysis. PWC users would continue to have access to archeological and submerged cultural resources under this alternative. No cultural resources are currently listed on the National Register of Historic Places, and not all identified sites have been formally evaluated. PWC use would not be restricted during the use of ethnographic resources by American Indians.

Archeological and Submerged Cultural Resources — Potential impacts directly attributable to continued unrestricted PWC use are difficult to quantify. The most likely impact to archeological and submerged cultural sites would result from PWC users landing in areas otherwise inaccessible to most other national lakeshore 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 draw, 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 lakeshore would have only minor adverse impacts on potentially listed archeological resources.

Continuing PWC use under a special regulation is not expected to negatively affect the overall condition of cultural resources because project-by-project inventories and mitigation would still be conducted. However, without a systematic monitoring program and given the potential access concerns, there would continue to be a risk of some unavoidable adverse impacts.

Ethnographic Resources — While ethnographic resources have not yet been formally evaluated for their status as traditional cultural properties / sacred sites, traditional uses of cliffs, beaches, dunes, coves, river mouths, and the shoreline indicate the need for visitors to show reverence and respect. PWC noise level and pitch changes, caused by rapid acceleration, deceleration, and change of direction, are disturbing to the traditional users of these areas and detract from their enjoyment and use. In addition, the often brightly colored personal watercraft, flotation devices, and wetsuits may constitute a visual intrusion to traditional users, who have expressed concern about the disruption that crowds, trash, and frequently used trails already have on their use of these resources. This alternative would have moderate adverse impacts during the permitted the use of ethnographic resources, since the impacts would tend to be indirect, infrequent and of short duration due to the low number of PWC users operating in the lakeshore.

Cumulative Impacts. PWC users, other boaters, and land-based user groups would continue to have access to remote areas with potentially listed archeological sites, submerged cultural resources, and ethnographic resources. On a cumulative basis all visitor activities could result in minor to major adverse impacts on those resources that are readily accessible, due to the number of visitors and potential for looting, vandalism, or (in the case of ethnographic resources) 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 levels would continue at existing levels.

Conclusion. PWC use within the lakeshore could have minor adverse impacts on potentially listed archeological sites and submerged resources from possible illegal collection and vandalism. PWC-related intrusions during the permitted use of ethnographic resources would result in short-term, moderate adverse impacts.

Cumulative impacts on archeological and submerged cultural resources that are readily accessible could be minor to major adverse, due to the number of visitors and the potential for illegal collection

or destruction. In the case of ethnographic resources, visitor activities could cause short-term interruption in their use, resulting in moderate adverse impacts.

Implementation of this alternative would not result in an impairment of 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, except in the Beaver Basin segment where they would be prohibited. PWC use would be restricted during the permitted use of ethnographic resources by American Indians.

Archeological and Submerged Cultural Resources — Impacts to archeological and submerged cultural resources would be similar to those under alternative A. No PWC-related impacts would occur within the Beaver Basin segment, since PWC use would be prohibited. Under this alternative the low number of PWC users within the lakeshore would have only minor adverse impacts on potentially listed archeological resources within the Sand Point, Cliffs, and Grand Sable segments. Prohibiting PWC use within the Beaver Basin segment could have long-term, beneficial impacts on potentially listed archeological sites.

Ethnographic Resources — Boat patrols would be conducted during the permitted use of ethnographic resources to monitor and restrict PWC use in proximity to ceremonies. The implementation of boat patrols would limit potential PWC-related intrusions, resulting in short-term, minor, adverse impacts. Continued impacts would be related to PWC activities outside the lakeshore's 0.25-mile jurisdictional boundary. This alternative would have long-term beneficial impacts to the use of ethnographic resources in the Beaver Basin segment, where PWC use would be discontinued.

Cumulative Impacts. On a cumulative basis all visitor activities could result in minor to major adverse impacts on those resources that are readily accessible, due to the number of visitors and the potential for looting, vandalism, or (in the case of ethnographic resources) short-term interruption in their use. Boat patrols would be conducted during the permitted use of ethnographic resources to monitor and restrict visitor use in proximity to ceremonies. The implementation of boat patrols would limit potential PWC and other boat-related intrusions, resulting in short-term, minor, adverse impacts. 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 due to increased boat patrols. All impact levels would continue at existing levels, with lower impacts in the Beaver Basin segment due to the exclusion of PWC use and during the permitted use of ethnographic resources.

Conclusion. PWC use in the Sand Point, Cliffs, and Grand Sable segments could have minor adverse impacts on potentially listed archeological sites and submerged resources from possible illegal collection and vandalism. There would be a beneficial impact on those resources in the Beaver Basin segment, where PWC use would be discontinued. Boat patrols would limit potential PWC and boat-related intrusions during the permitted use of ethnographic resources, resulting in possible short-term, minor, adverse impacts.

Cumulative impacts of other activities on archeological and submerged cultural resources that are readily accessible could be minor to major and adverse, due to the number of visitors and the potential for illegal collection or destruction. In the case of ethnographic resources, visitor activities could cause short-term, minor, adverse impacts. Additional boat patrols could reduce this level of impact.

Implementation of this alternative would not result in an impairment of cultural resources.

Impacts of the No-Action Alternative

Analysis. Under this alternative PWC use would be discontinued.

Archeological and Submerged Cultural Resources — Implementation of the no-action alternative 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.

Ethnographic Resources — Discontinuing PWC use would have short- and long-term, minor, beneficial impacts on ethnographic resources, as it would eliminate the number of possible incidents of noise and visual intrusion attributable to PWC use.

Cumulative Impacts. Even without the potential for PWC users to access remote areas, the effects of other watercraft users and land-based user groups would still have the potential for minor to major adverse cumulative impacts. Boat patrols would limit impacts during the use of ethnographic resources to a minor level. On a cumulative basis potential 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 would likely still experience minor adverse impacts, but to a much less degree.

Conclusion. Prohibiting PWC use would have minor beneficial impacts on archeological sites, submerged resources, and ethnographic resources.

Cumulative impacts from all visitor activities would continue to be minor to major, depending on the accessibility of the resource and the potential for illegal collection or damage. Additional boat patrols could reduce the potential for such impacts, as well as intrusions during the permitted use of ethnographic resources.

Implementation of this alternative would not result in an impairment of cultural resources.

SOCIOECONOMIC EFFECTS

This section summarizes the socioeconomic impacts associated with the proposed alternatives for PWC use in Pictured Rocks National Lakeshore. A detailed description of these impacts and a complete list of references is provided in the report "Economic Analysis of Personal Watercraft Regulations in Pictured Rocks National Lakeshore" (LAW Engineering and Environmental Sciences, et al. 2001).

Economic Impact Analysis

Pictured Rocks National Lakeshore experiences relatively low rates of PWC visitation. According to national lakeshore officials, almost all PWC users within the lakeshore are believed to be local residents or owners of summer homes in the area using their personal machines. No PWC rental shops were identified in the vicinity of Pictured Rocks, and the one business in the area that sells personal watercraft indicated that the majority of sales are to local residents. This implies that recreational PWC use is not very important in bringing visitors from outside the region to the area.

Other recreation alternatives exist for PWC use outside the national lakeshore. Michigan has a large number of inland lakes, as well nearly 3,250 miles of Great Lakes shoreline available for PWC use. Thus, it is expected that some local PWC owners who might no longer be willing or able to ride in the national lakeshore after a change in regulations would likely shift most of their recreational PWC use to other locations within the region, resulting in little change in regional PWC usage. Nonetheless, the PWC dealership that was contacted by NPS staff expressed concern that banning PWC use in the lakeshore would result in a significant reduction in PWC sales and service. This business does not expect impacts under alternative B, but the respondent predicted a 60% decline in PWC sales revenues and a 75% decline in PWC service revenues if the no-action alternative was implemented.

Although PWC sales and service revenues for the local dealership might decline, it is unlikely that lodging establishments, restaurants, and other local businesses would be affected by any of the proposed alternatives. Given that PWC use in Pictured Rocks is primarily by local residents using their own machines and other recreation alternatives exist within the area, no measurable impacts are expected on the regional economy or the communities of Grand Marais and Munising in which these businesses are located.

BENEFIT-COST ANALYSIS

The purpose of benefit-cost analysis is to determine whether a proposed action (in this case, the regulation of PWC use in Pictured Rocks) would promote an efficient allocation of resources. That is, it is used to assess whether the proposed action would generate more benefits than costs. These costs and benefits accrue directly to households that use personal watercraft, and indirectly to those who are affected by PWC use (e.g., those who benefit from reduced noise). The resulting changes in PWC use may also impose costs on those who own or work for PWC-related businesses.

Even individuals who do not visit this national lakeshore can benefit from the knowledge that resources are being protected and preserved. In other words, protecting the Pictured Rocks environment by not allowing certain uses would be perceived as positive. These "nonuse" values can stem from a desire to ensure the enjoyment of these resources by others (both current and future generations) or from a sense that these resources have intrinsic value and are worth protecting even though they may not get used. Evidence of nonuse value for resources like Pictured Rocks has been established in the economics literature (Pearce and Moran 1994). Restrictions on PWC use could therefore provide benefits to both users and nonusers in a number of ways by protecting the national lakeshore's ecological and other resources.

For purposes of this analysis, six major affected groups have been identified and listed in Table 26, along with the anticipated impacts of the proposed regulatory alternatives. The following definitions apply:

> *Consumer surplus* — the economic measure of net benefits that accrue to individuals from PWC use and the appreciation of Pictured Rocks resources.
>
> *Producer surplus* — the economic measure of net benefits that accrue to businesses that sell or rent personal watercraft and other related businesses. Producer surplus is generally equivalent to business profit.

Increases in consumer surplus and producer surplus represent benefits, while decreases in those measures represent costs.

TABLE 26: IMPACT OF ALTERNATIVES ON USER GROUPS

User Group	Alternative A — Continue PWC Use as Currently Managed under a Special NPS Regulation	Alternative B — Continue PWC Use under a Special NPS Regulation with Management Restrictions	No-Action Alternative
PWC Users	No change in consumer surplus.	Consumer surplus is expected to decrease slightly as a result of spatial restrictions on PWC use in Pictured Rocks.	Total loss of consumer surplus to users in Pictured Rocks as a result of the ban on PWC use. These losses might be mitigated somewhat by users going to nearby areas.
Other Visitors or Potential Visitors (Canoeists, anglers, other boaters, swimmers, hikers and other visitors)	No change in consumer surplus.	Consumer surplus is expected to increase for current visitors as a result of increased solitude in the waters off Beaver Basin, which would be restricted from motorized use under this alternative. Consumer surplus is expected to increase for new visitors who would not have visited Pictured Rocks if there were no PWC use restrictions. Consumer surplus is expected to decrease for other motorized boaters who would have visited areas where motorized uses would be restricted.	Increases in consumer surplus similar to, but larger than, benefits realized under alternative B for other current visitors aside from motorized boat users. Consumer surplus is expected to increase for new visitors who would not have visited Pictured Rocks if there were no PWC use restrictions. This increase is expected to be larger than under alternative B. Consumer surplus is expected to decrease for other motorized boaters who would have visited areas where motorized uses would be restricted.
Producers of PWC Services (PWC rental shops, PWC sales shops, other parts of the local economy providing services to PWC users)	No change in producer surplus.	No PWC rental shops were identified in the vicinity of Pictured Rocks. Munising: Producer surplus is not expected to be affected for the one PWC dealer. Other parts of the local economy such as hotels, restaurants, and gas stations are not expected to have a decrease in producer surplus. Grand Marais: No PWC dealerships were identified. Other parts of the local economy such as hotels, restaurants, and gas stations are not expected to have a decrease in producer surplus.	No PWC rental shops were identified in the vicinity of Pictured Rocks. Munising: Producer surplus is not expected to be affected for the one PWC dealer. Other parts of the local economy such as hotels, restaurants, and gas stations are not expected to have a decrease in producer surplus. Grand Marais: No PWC dealerships were identified. Other parts of the local economy such as hotels, restaurants, and gas stations are not expected to have a decrease in producer surplus.
Local Residents (Munising and Grand Marais)	No change in welfare.	Neither community would experience a measurable change in welfare from impacts on traffic and congestion in the community as a result of PWC restrictions in Pictured Rocks.	Neither community would experience a measurable change in welfare from impacts on traffic and congestion in the community as a result of PWC restrictions in Pictured Rocks.
Producers of Services for Visitors Not Using Personal Watercraft	No change in producer surplus in either Munising or Grand Marais.	No change in producer surplus in either Munising or Grand Marais.	No change in producer surplus in either Munising or Grand Marais.
General Public	No change in welfare.	There is likely to be an increase in welfare as a result of enhanced nonuse values resulting from increased environmental quality in Pictured Rocks.	The increase in welfare is expected to be somewhat greater than under alternative B.

This analysis of benefits is qualitative since quantification was not feasible with currently available data. The primary beneficiaries under alternative B and the no-action alternative would be national lakeshore visitors who do not use personal watercraft and whose park experience is negatively affected by PWC use. Among the more popular activities and means of experiencing Pictured Rocks other than PWC use are canoeing, kayaking, fishing, boating, and hiking. In 2000 the number of recreation visits to the national lakeshore was roughly 420,000, and non-PWC users accounted for over 99% of these visits. Other beneficiaries of alternative B and the no-action alternative include those who hold positive nonuse values for the protection of the Pictured Rocks environment.

The general public, or nonusers of Pictured Rocks, could also benefit from proposed measures to restrict PWC use. For example, individuals who do not visit the national lakeshore could benefit simply from the knowledge that Pictured Rocks' natural resources are being protected.

COSTS TO PWC USERS

National lakeshore officials believe that most PWC users live or have summer residences in the local area and own their machines. Some PWC users trailer their machines to the national lakeshore and use public boat ramps to access Lake Superior. Other local areas offer an alternative to riders who might be displaced from Pictured Rocks as a result of a proposed regulation.

Two groups of PWC riders may be affected by the proposed regulations: those who currently ride in Pictured Rocks, and those who ride in other nearby areas where riders displaced from Pictured Rocks could decide to ride if the National Park Service restricted PWC use in the national lakeshore.

For PWC users who currently ride in Pictured Rocks or who want to ride here in the future, PWC use restrictions or prohibitions could result in consumer surplus losses. To the extent that individuals consider other nearby PWC areas to be substitutes for this opportunity, the loss in consumer surplus associated with restricting PWC use in the national lakeshore would be lower.

If each individual's demand curve for PWC use is or was known, then the loss of consumer surplus for all individuals could be totaled to find the consumer surplus to PWC riders from the proposed regulations. Because the demand curve reflects individual preferences for available substitute activities and the cost of these activities, measuring the lost consumer surplus from a trip in the national lakeshore takes into account substitute activities.

In this case, however, the consumer surplus associated with PWC use in Pictured Rocks is not known, nor are riders' next best alternative activities known. After conducting an extensive review of the economics literature and consulting with the authors of existing studies, experts in recreation demand analysis at universities, and experts at other consulting firms, NPS staff were unable to locate a study that estimated the consumer surplus for a PWC trip. A review of the recreation literature conducted by Rosenberger and Loomis (2000) found an average value of $31.98 (1996 dollars) per person per day for riding in motor boats (with estimates ranging from $15 to over $50). The same study reports a value of $21.78 (1996 dollars) per person per day (with estimates ranging from $11 to over $30) for off-road driving. These estimates provide a range of values for activities similar to riding personal watercraft and provide a bound on the consumer surplus loss expected from the proposed regulations.

PWC users who currently ride in nearby areas where displaced riders from Pictured Rocks might visit would lose some consumer surplus if these areas became more crowded as a result of NPS use restrictions. Although no studies were available that examined the impact of congestion on the value of a PWC trip, other recreation demand studies find that congestion lowers the value of a recreation experience.

The estimated impact of each proposed alternative on PWC users is discussed below.

Alternative A: Under alternative A there would be no change in PWC use as a result of regulation. Consumer surplus to PWC riders would remain unchanged from current conditions.

Alternative B: Alternative B would not allow PWC use in the Beaver Basin area, so those PWC users who currently ride in this area would lose consumer surplus, especially if alternate

areas were more crowded or less scenic. Nonetheless, alternative B would have no impact on total PWC visitation to Pictured Rocks, and the impacts of this alternative on consumer surplus would probably be minor.

No-Action Alternative: This alternative would result in a total ban on PWC use in Pictured Rocks, and the riders of the estimated 60 to 250 machines used in the national lakeshore each year would lose the full value of their consumer surplus for rides in Pictured Rocks.

Costs to Local Area Businesses

If PWC riding decreased as a result of the regulation, then the suppliers of PWC sales and other services might be 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. The following section describes the approach used to develop quantitative estimates of these impacts and reports the results of the cost analysis for local area businesses.

PWC Sales and Service. One firm sells and services personal watercraft in the Pictured Rocks region, and there are no rental shops. To provide a quantitative estimate of lost producer surplus resulting from the proposed regulations, estimates of PWC sales revenue were obtained from a personal interview with the business. To translate lost revenue into lost producer surplus, estimates of the loss in revenue associated with the rule and return on sale measure for the Standard Industrial Classification code were used (Dun & Bradstreet 2001). The use of this profit margin only approximates losses in producer surplus. Producer surplus captures the difference between variable costs and revenue, while return on sales contains other measures reflecting fixed costs, taxes, and/or accounting conventions rather than measures of variable profits. For this reason, the accounting profit margin data may understate producer surplus losses.

No producer surplus loss is expected under alternative A or B. Estimated annual losses in producer surplus under the no-action alternative range from a low of $1,880 to a high of $14,440.

Lodging Establishments, Restaurants, Gas Stations, and Other Businesses. PWC users in Pictured Rocks are believed to be primarily local residents on day trips. Lodging establishments, restaurants, gas stations, and other businesses that serve PWC riders are not likely to experience a reduction in business under any of the alternatives.

NATIONAL LAKESHORE MANAGEMENT AND OPERATIONS

Conflict with State and Local PWC Ordinances and Policies

Michigan has passed a Personal Watercraft Safety Act. The National Park Service has concurrent jurisdiction over the surface water within the Pictured Rocks boundary. The U.S. Coast Guard and Michigan Department of Natural Resources also patrol the Lake Superior shoreline to enforce boating regulations. The lakeshore is in the process of adopting the state PWC regulations. There are no local regulations that affect PWC operations within the lakeshore. Consistency with state and local plans must be evaluated in accordance with the National Environmental Policy Act.

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 as Currently Managed under a Special NPS Regulation

Analysis. Personal watercraft users at the lakeshore would be required to follow all applicable state regulations, as well as NPS regulations. Under this alternative NPS rangers would enforce all state regulations within the national lakeshore, and there would be no conflicts between lakeshore regulations and other regulations. Impacts for alternative A would be negligible since no conflicts with state regulations would occur.

Cumulative Impacts. Personal watercraft are prohibited from landing on Grand Island, a U.S. Forest Service managed island just west of Pictured Rocks National Lakeshore. Implementation of alternative A would not be in conflict with U.S. Forest Service policies or with state regulations. Cumulative impacts would be negligible under this alternative since management of PWC use would not be in conflict with U.S. Forest Service, state, or local regulations.

Conclusion. PWC and boating regulations within the national lakeshore 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, except use would be prohibited in the Beaver Basin segment and during the permitted use of ethnographic resources. These restrictions are within the National Park Service's right to regulate activities that can adversely affect resources within the lakeshore. 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. Personal watercraft are prohibited from landing on Grand Island, a U.S. Forest Service managed island just west of Pictured Rocks National Lakeshore. Implementation of alternative B would not be in conflict with U.S. Forest Service policies. Restrictions on personal watercraft and boats in the Beaver Basin segment would be similar to the existing management in designated primitive areas operated by the U.S. Forest Service. No conflicts with federal or state regulations or policies are anticipated from implementing the restrictions under this alternative. The restrictions would apply only within the lakeshore's jurisdictional boundary. Impacts that are 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. PWC and boating regulations within the national lakeshore would be similar to the regulations currently in place for nearby U.S. Forest Service properties. The restrictions would apply only within the lakeshore's jurisdictional boundary. Impacts related to conflicts with federal or state requirements or policies would be negligible.

Impacts of the No-Action Alternative

Analysis. The no-action alternative would ban PWC use within the lakeshore. The National Park Service has the right to regulate the types of activities that take place under its jurisdiction. Michigan

does not currently ban PWC use at any locations within Lake Superior, but it does have regulations guiding how personal watercraft 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. PWC landing is currently prohibited on Grand Island, a U.S. Forest Service managed island located just west of Pictured Rocks National Lakeshore. Other areas in the vicinity of the lakeshore are subject to state PWC regulations. Implementation of the no-action alternative would not be in conflict with U.S. Forest Service policies or with state regulations. Cumulative impacts relating to regulation conflicts are negligible.

Conclusion. Discontinuing PWC use within the lakeshore would not result in conflict with state PWC regulations or with U.S. Forest Service policies. There are no local PWC regulations. Therefore, impacts related to such conflicts (including cumulative impacts) would be negligible.

Impact to Park Operations from Increased Enforcement Needs

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 as Currently Managed under a Special NPS Regulation

Analysis. Continuing PWC use within the lakeshore would require education and enforcement by lakeshore staff. This could be completed using the existing irregular boat patrols, with the anticipation that PWC users would sometimes operate illegally within the lakeshore. To provide more control of PWC operations, daily boat patrols would be needed, requiring three additional permanent staff, the purchase of one more boat, and more funding for park operations.

Cumulative Impacts. According to lakeshore staff, existing park operations are not sufficient to adequately monitor and assist current lakeshore visitors. Motorboat users and swimmers far outnumber PWC users at Pictured Rocks National Lakeshore. Sea kayakers and canoeists are also primary user groups on the Lake Superior shoreline. Lakeshore staff would continue to provide assistance to these user groups to resolve conflicts and ensure safety. Park operations and enforcement needs for these user groups would be the same as for existing conditions, since the number of people and boats would not change under this alternative. Current staffing levels and boat patrol frequency are not adequate to enforce existing regulations. Three additional permanent staff and one additional boat 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. More staff, funding, and equipment would be needed to regulate existing PWC as well as boating use.

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

Analysis. Continuing PWC use within the lakeshore, with restrictions in the Beaver Basin segment, would require increased education and enforcement actions by lakeshore staff. Signs would be posted at the Sand Point launch to indicate PWC location restrictions. Enforcement actions would be required to prevent PWC users from entering the potential primitive area. This could be completed using the existing irregular boat patrols, with the anticipation that PWC users would sometimes operate illegally within the lakeshore. To provide more control of PWC operations, daily boat patrols would be needed, requiring three additional permanent staff, the purchase of one more boat, and more funding for park operations.

Additional boat patrols would be required during the permitted use of ethnographic resources. The need for these patrols is anticipated to be infrequent, since the use of ethnographic resources is infrequent or during a season when personal watercraft do not normally operate, such as winter, early spring or fall.

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. Three additional permanent staff and one additional boat 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, funding, and equipment would be needed to ensure full compliance with PWC and motorized use restrictions in the Beaver Basin segment and during the permitted use of ethnographic resources, as well as to regulate motorized uses in other portions of the lakeshore.

Impacts of the No-Action Alternative

Analysis. Prohibiting PWC operation within Pictured Rocks National Lakeshore would eliminate potential conflicts between PWC recreationists and other user groups, but lakeshore staff would have to increase visitor educational and enforcement programs. Signs would be posted at the Sand Point launch to indicate PWC use restrictions. Information programs would also be required at the Munising and Grand Marais launch sites. Enforcement actions to ensure that PWC use restrictions were not violated could be completed using the existing irregular boat patrols, with the anticipation that PWC users would sometimes operate illegally within the lakeshore. To ensure full compliance with the ban, daily boat patrols would be required. This could be accomplished through three additional permanent staff, one more boat, and increased funding for park operations.

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 existing regulations. Three permanent staff and one additional boat would be required to meet existing and future (2012) needs. Cumulative visitor and boat activity would continue to require additional funds for park operations.

Conclusion. This alternative would have moderate adverse impacts on park operations. More staff, funding, and equipment would be needed to ensure compliance with the PWC ban and to regulate existing boating use.

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 lakeshore 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 lakeshore'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 within the 0.25-mile jurisdictional boundary 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, the small number of PWC users who could no longer ride within the national lakeshore would be adversely affected.
- Continued PWC use under alternatives A and B could result in minor impacts to potentially listed cultural resources and ethnographic sites by providing additional access and the potential for illegal collection, destruction, or disruption of activities related to ethnographic resources. PWC restrictions would be needed to prevent major impacts during the permitted ceremonial use of ethnographic sites.

LOSS IN LONG-TERM AVAILABILITY OR PRODUCTIVITY TO ACHIEVE SHORT-TERM GAIN

As noted above, some resources would be degraded to some extent through implementation of either alternative A or B. The only resource with potential long-term loss would be archeological or submerged cultural resources. This would occur through illegal collection or vandalism. The continuation of inadequate monitoring and inventorying of cultural resources, combined with long-term unlimited visitor use, could reduce the relative availability of cultural resource sites for future interpretation and development.

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 personal watercraft, to continue using the national lakeshore under alternatives A and B. The use of fossil fuels to power personal watercraft would be an irretrievable commitment of this resource; however, this use is minor.

CONSULTATION AND COORDINATION

The public scoping process for this document built on the public discussion process that occurred during the development of the *Draft General Management Plan.* This process provided the public with opportunities to give feedback about the alternative actions and impact topics. At the initial scoping meeting for this PWC project, the NPS staff at Pictured Rocks National Lakeshore decided to use newsletters and press releases to solicit public input. The staff noted that some public input on PWC use had already been obtained during the development of the *Draft General Management Plan / Wilderness Study / Environmental Impact Statement.*

A press release announced the NEPA process for personal watercraft and solicited comments on the initial scoping. As of April 2002, approximately 2,000 responses had been received by means of letter, e-mail, and phone calls. The majority of comments supported a ban on PWC use.

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 Pictured Rocks National Lakeshore. Their response of August 24, 2001, is included in appendix B. The Michigan 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. Their response of October 4, 2001, is also included in appendix B. The lakeshore has not officially corresponded with any of the local American Indian tribes.

A copy of this document will be provided to the Michigan State Historic Preservation Office for review and comment.

APPENDIX A: 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 personal watercraft 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 5 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]) (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 personal watercraft and outboards will be significantly reduced in the near future, based on regulations issued by the EPA and California Air Resources Board (see the estimated reductions on page 66).

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, ethylbenzene, 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 personal watercraft: 3 gal/hour at full throttle (California Air Resources Board 1998)
- Gasoline emission rate for two-stroke outboards: estimated at approximately the same as for personal watercraft for same or higher horsepower outboards (80–150 hp); approximately twice that of personal watercraft 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., California Air Resources Board 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 Springier, 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. 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**	US EPA 1999a
Naphthalene	62	Suter and Tsao 1996	--	--
1-methyl naphthalene	19–34*	USFWS 2000	--	--
Benzene	130	Suter and Tsao 1996	1.2**	US EPA 1999a
MTBE	57,000***	Wong et al. 2001	--****	--

* 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)

** Based on the consumption of water and fish.

***A draft water quality criteria document for MTBE for the protection of aquatic life is expected to be issued in early 2002. These criteria will be based , in part, on work performed by Mancini et al. 2002. A notice of intent was published in the *Federal Register* in October 1999 (64FR58409).

**** 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 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 personal watercraft 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 × 5760 mg/L = 2.61×10^6 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) and correcting for units (1 mg = 10^3 µg):

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 × 10^3 µg/mg / 62 µg/L = 2.71×10^7 L or 22 ac-ft

1-methyl naphthalene: 2.61×10^6 mg 1-methyl naphth. × 10^3 µg/mg / 34 µg/L = 7.77×10^7 L or 63 ac-ft

Benzene: 8.39×10^6 mg benzene × 10^3 µg/mg / 130 µg/L = 6.45×10^7 L or 52 ac-ft

MTBE: 4.99×10^7 mg MTBE × 10^3 µg/mg / 57,000 µg/L = 8.75×10^5 L or 0.71 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 [63 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 × 10^3 µg/mg / 0.0044 µg/L = 2.17×10^8 L or 176 ac-ft

Benzene: 8.39×10^6 mg benzene × 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 × 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 does not volatilize rapidly and 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.

As a result of the estimated reductions in HC emissions (from the unburned fuel) in response to EPA regulations (listed above), additional personal watercraft 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), up to 75% additional personal watercraft/ 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 A-1: Pollutant Concentrations Reported in Water

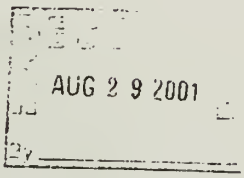
Pollutant	Source(s)	Levels Found:	
		"Lower Use" (e.g. open water, offshore locations; reduced motorized watercraft use)	"Higher Use" (e.g., nearshore, motorized watercraft activity high)
Benzene	*Lake Tahoe Motorized Watercraft Report;* several studies reported USGS Miller and Fiore U of CA	1. <0.032 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. Ortis 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 1µg/l; B(a)P – >=2.3 µg/l B. Experiment #1 – approx. 45 ng/l phototoxic PAHs; 5-70 ng/L total PAHs
MTBE	A. *Lake Tahoe Motorized Watercraft Report;* 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) 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 over period 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 B: CONSULTATION WITH U.S. FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

United States Department of the Interior

FISH AND WILDLIFE SERVICE
East Lansing Field Office (ES)
2651 Coolidge Road, Suite 101
East Lansing, Michigan 48823-6316



August 24, 2001

Lydia Nelson
URS Corporation
Thresher Square
700 Third Street South
Minneapolis, MN 55415

Re: Endangered Species List Request, Environmental Assessment, Pictured Rocks National Lakeshore, Alger County, Michigan

Dear Ms. Nelson:

Thank you for your request of August 23, 2001 for information on listed and proposed endangered and threatened species and critical habitat which may be present within the Pictured Rocks National Lakeshore. Your request and this response are made pursuant to Section 7(c) of the Endangered Species Act of 1973 (the Act), as amended, (87 Stat. 884, 16 U.S.C. 1531 *et seq.*).

The Service has determined that Bald Eagle, (*Haliaeetus leucocephalus*) and Pitcher's Thistle, (*Cirsium pitcheri*), both threatened species pursuant to the Act, may be present within the project area. Section 7 of the Act, requires Federal agencies, or their designees, to consider impacts to federally listed threatened and endangered species for all federally funded, constructed, permitted, or licensed projects. Federally listed species are also protected by the Michigan Department of Natural Resources through Part 365, Endangered Species Protection, of the Natural Resources and Environmental Protection Act, 1994, P. A. 451.

We suggest that a survey of the subject property be conducted to determine if the species is present. Should information indicate that the species is present within the impact area of the proposed project, a biological assessment should be prepared. The federal action agency's compliance requirements under the Act are outlined in Enclosure B.

Should the biological assessment determine that a listed species is likely to be affected (adversely or beneficially) by the project, the Federal action agency should request formal Section 7 consultation with this Service office. Even if the biological assessment shows a "no effect" situation, we would appreciate receiving a copy for our information.

Lastly, Section 7(d) of the Act underscores the requirement that the federal agency, or their designee, or the permit / license applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which in effect would deny the formulation or implementation of reasonable alternatives regarding their actions on any endangered or threatened species.

If the project is modified or new information about the project becomes available that indicates additional listed or proposed species may be present and/or effected, consultation with this Service office should be reinitiated.

We further advise that should any other species occurring in the project area become Federally listed or proposed, the Federal action agency for the work would also be required to reevaluate its responsibilities under the Act. Since threatened and endangered species data is continually updated, we suggest the lead federal agency annually request an updated Federal list of the species occurring in the project area.

We appreciate your concern for endangered species and look forward to continued coordination with your agency. Any questions can be directed to Tom Eitniear of this office at (517) 351-6283.

Sincerely,

Craig A. Czarnecki
Field Supervisor

cc: Michigan Department of Natural Resources, Wildlife Division,
Lansing, MI (Attn: Lori Sargent)

Enclosure B

FEDERAL AGENCIES' RESPONSIBILITIES UNDER SECTIONS 7(a) AND 7(c) OF THE ENDANGERED SPECIES ACT

SECTION 7(a) - Consultation/Conference

Requires:

1. Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2. Consultation with U.S. Fish & Wildlife Service (Service) when a federal action may affect a listed endangered or threatened species to ensure that any action authorized, funded, or carried out by a federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The process is initiated by the federal agency after they have determined if their action may affect (adversely or benefically) a listed species; and

3. Conference with Service when a federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or a adverse modification of proposed critical habitat.

SECTION 7(c) - Biological Assessment for Major Construction Projects [1]

Requires federal agencies or their designees to prepare a Biological Assessment (BA) for major construction projects. The purpose of the BA is to identify any proposed and/or listed species which is/are likely to be affected by a construction project. The process is initiated by a federal agency in requesting a list of proposed and listed threatened and endangered species. The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, please verify the accuracy of the list with the Service. Sec. 7(d) states agencies shall not make any irreversible or irretrievable commitment of resources during the consultation process which would result in violation of the requirements under Section 7(a)(2). Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an onsite inspection of the area to be affected by the proposal which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within the Service, state conservation departments, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures; and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. Upon completion, the report should be forwarded to: Field Supervisor, U.S. Fish & Wildlife Service, 2651 Coolidge Rd., East Lansing, MI 48823-5202.

---

[1] "Major Construction project" means any major federal action which significantly affects the quality of the human environment as referred to in NEPA (requiring an EIS) designed primarily to result in the building or erection of man-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes federal actions such as permits, grants, licenses, or other forms of federal authorization or approval which may result in construction.

STATE OF MICHIGAN
JOHN ENGLER, Governor
DEPARTMENT OF NATURAL RESOURCES
STEVENS T. MASON BUILDING, PO BOX 30028, LANSING MI 48909-7528
WEBSITE: www.michigandnr.com
K. L. COOL, Director

REPLY TO:
NATURAL HERITAGE
WILDLIFE DIVISION
PO BOX 30180
LANSING MI 48909-7680

October 4, 2001

Ms. Lydia C. Nelson
URS Corporation
Thresher Square
700 Third Street South
Minneapolis, MN 55415

Dear Ms. Nelson:

The location of the proposed policy on the use of personal watercraft was checked against known localities for rare species and unique natural features, which are recorded in a statewide database. This continuously updated database is a comprehensive source of information on Michigan's endangered, threatened and special concern species, exemplary natural communities and other unique natural features. Records in the database indicate that a qualified observer has documented the presence of special natural features at a site. The absence of records may mean that a site has not been surveyed. Records may not always be up-to-date. In some cases, the only way to obtain a definitive statement on the presence of rare species is to have a competent biologist perform a field survey. Projects that are submitted to the Department of Environmental Quality (DEQ) are routinely checked for such features regardless if they are on public or private land.

Under Act 451 of 1994, the Natural Resources and Environmental Protection Act, Part 365, Endangered Species Protection, "a person shall not take, possess, transport, ...fish, plants, and wildlife indigenous to the state and determined to be endangered or threatened," unless first receiving an Endangered Species Permit from the Department of Natural Resources, Wildlife Division. *Responsibility to protect endangered and threatened species is not limited to the list below. Other species may be present that have not been recorded in the database.*

The presence of threatened or endangered species does not preclude activities or development, but may require alterations in the project plan. Special concern species are not protected under endangered species legislation, but recommendations regarding their protection may be provided. Protection of special concern species will help prevent them from declining to the point of being listed as threatened or endangered in the future.

The following is a summary of the results for the project in:
Alger County, Pictured Rocks Nationl Lakeshore.

The following list includes special features that are known to occur on or near the site(s) and may be impacted by the project. Federally listed threatened or endangered species are marked with an asterisk (*). Please contact the U.S. Fish and Wildlife Service, 2651 Coolidge Road, East Lansing, 48823 (517-351-2555) for information on federal regulations that apply to these species.

common name	status	scientific name
Piping plover*	**state/federally endangered**	***Charadrius melodus***
Peregrine falcon	**state endangered**	***Falco peregrinus***
Bald eagle*	**state/federally threatened**	***Haliaeetus leucocephalus***

R 1026E (Rev. 09/04/2001)

There is a designated **piping plover critical habitat area** around the Grand Marais area that may be impacted by increased wave action along the shoreline. In the Great Lakes region, the piping plover prefers to nest and forage on sparse or nonvegetated sand-pebble beaches, averaging 100 feet in width. Vegetative cover is usually less than 5%. Associated bodies of water and interdunal wetlands enhance these areas by increasing food availability. Optimal foraging areas are especially crucial along Lake Superior, where shoreline and benthic invertebrate communities are known to be naturally sparse. Nests are generally placed in level areas between the water's edge and the first dune. While feeding, open shoreline is preferred to vegetated beach areas. Piping plovers begin arriving in mid- to late-April. The nesting season is under way by mid-May and lasts until mid-August. This species is declining throughout the midwest due to habitat destruction and disturbance. The nests are simple depressions in the sand and are difficult to see. People walking on the beach inadvertently destroy nests. Dogs on the beach can be especially dangerous for chicks and adults.

Peregrine falcons have been known to nest Grand Portal Point and on Grand Island and may be impacted by increased activity on the water during the nesting season. Peregrine falcons will nest on high cliffs overlooking water and other expansive openings. Artificial structures such as high rise buildings in cities will also be used. They typically migrate and return at the nesting grounds in early spring. Eggs are laid between late March and late May and young birds fledge six weeks after hatching.

Bald eagles have nested along the shoreline in question and may be impacted by increased activity on the water during the nesting season. Nest sites are usually within a ½ mile of water and at the top of tall, established trees. Bald eagles prefer forested habitats adjacent to the shorelines of lakes, large rivers, floodings, and other bodies of water where prey is available throughout the breeding season. Live trees are generally favored over dead ones. In Michigan, eagles arrive at their nesting territories between mid-February and mid-March. Nesting pairs are usually faithful to previous nesting sites. By October and November, immature bald eagles and most adults move southward, with many remaining in Michigan throughout the winter.

Based on the U.S. Fish and Wildlife Service bald eagle recovery plan for the Northern States, management guidelines for breeding areas are as follows: Eagle tolerance of human presence is highly variable, both seasonally and among different individuals or pairs of eagles. All nesting eagles are disturbed more easily at some times of the nesting season than at others. Prior to egg laying bald eagles engage in courtship activities and nest building. During this and the incubation periods they are most intolerant of external disturbances and may readily abandon the area. The most critical period is defined as one month prior to egg laying to four weeks after hatching. For Michigan this is described as January 1 to June 1 in the Lower Peninsula and from January 10 to June 10 in the Upper Peninsula.

Thank you for your advance coordination in addressing the protection of Michigan's natural resource heritage. If you have further questions, please call me at 517-373-1263.

Sincerely,

Lori G. Sargent
Endangered Species Specialist
Wildlife Division

LGS:jao
cc: Craig Czarnecki, US Fish & Wildlife Service

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.

The EPA Office of Air Quality Planning and Standards has set national ambient air quality standards for six principal pollutants, which are called "criteria" pollutants. They are listed below. Units of measure for the standards are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m^3), and micrograms per cubic meter of air ($\mu g/m^3$).

National Ambient Air Quality Standards

Pollutant	Standard Value*		Standard Type
Carbon Monoxide (CO)			
8-hour Average	9 ppm	(10 mg/m^3)	Primary
1-hour Average	35 ppm	(40 mg/m^3)	Primary
Nitrogen Dioxide (NO_2)			
Annual Arithmetic Mean	0.053 ppm	(100 $\mu g/m^3$)	Primary & Secondary
Ozone (O_3)			
1-hour Average	0.12 ppm	(235 $\mu g/m^3$)	Primary & Secondary
8-hour Average **	0.08 ppm	(157 $\mu g/m^3$)	Primary & Secondary
Lead (Pb)			
Quarterly Average	1.5 $\mu g/m^3$		Primary & Secondary
Particulate (PM_{10}) *Particles with diameters of 10 micrometers or less*			
Annual Arithmetic Mean	50 $\mu g/m^3$		Primary & Secondary
24-hour Average	150 $\mu g/m^3$		Primary & Secondary
Particulate ($PM_{2.5}$) *Particles with diameters of 2.5 micrometers or less*			
Annual Arithmetic Mean **	15 $\mu g/m^3$		Primary & Secondary
24-hour Average **	65 $\mu g/m^3$		Primary & Secondary
Sulfur Dioxide (SO_2)			
Annual Arithmetic Mean	0.03 ppm	(80 $\mu g/m^3$)	Primary
24-hour Average	0.14 ppm	(365 $\mu g/m^3$)	Primary
3-hour Average	0.50 ppm	(1300 $\mu g/m^3$)	Secondary

* Parenthetical value is an approximately equivalent concentration.

** The ozone 8-hour standard and the $PM_{2.5}$ standards are included for information only. A 1999 federal court ruling blocked implementation of these standards, which EPA proposed in 1997. EPA has asked the U.S. Supreme Court to reconsider that decision..

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 personal watercraft. 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.

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.

REFERENCES CITED

AWA	American Watercraft Association
CPFPWS	Coalition of Parents and Families for Personal Watercraft Safety
FFWCC	Florida Fish and Wildlife Conservation Commission
IWL	Izaak Walton League of America
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NTSB	National Transportation Safety Board
ODEQ	Oregon Department of Environmental Quality
PWIA	Personal Watercraft Industry Association
USGS	U.S. Geological Survey

Albers, Peter H.
2000 "Sources, Fate, and Effects of PAHs in Shallow Water Environments." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Allen, B. C., J. E. Reuther, C. R. Goldman, M. F. Fiore, and G. C. Miller
1998 "Lake Tahoe Motorized Watercraft Report — An Integration of Water Quality, Watercraft Use and Ecotoxicology Issues." Preliminary draft report prepared for the Tahoe Regional Planning Agency.

American Watercraft Association
2001 "The Advocate Action Kit: Personal Watercraft and the Environment." Burbank, CA.

Anderson, Franz E.
2000 "Effect of Wave-wash from Personal Watercraft on Salt Marshes." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Asplund, Tim
2001 "The Effects of Motorized Watercraft on Aquatic Ecosystems." Draft paper. Wisconsin Department of Natural Resources and University of Wisconsin, Madison.

Bluewater Network
2001 "Jet Skis Position Paper." Available at <1http://www.earthisland.org/bw/jetskipos.html>.

Branche, C. M., J. M. Conn, J. L. Annest
1997 "Personal Watercraft-Related Injuries: A Growing Public Health Concern." *Journal of the American Medical Association* 278(8): 663–65.

Burger, J.
1998 "Effects of Motorboats and Personal Watercraft on Flight Behavior over a Colony of Common Terns." *The Condor* 100: 528–34.

Burger, J., and J. Leonard
1999 "Conflict Resolution in Coastal Waters: the Case of Personal Watercraft." *Marine Policy* 24: 61–67.

California Air Resources Board
1998 "Proposed Regulations for Gasoline Spark-Ignition Marine Engines, Draft Proposal Summary." Mobile Resources Control Division.

1999 "Fact Sheet – New Regulations for Gasoline Engines." Available at <www.arb.ca.gov/msprog/marine/marine.htm>.

Clark, Caven P.
1993 "Archeological Survey and Site Testing at Pictured Rocks National Lakeshore, Alger County, Michigan: 1991." Technical Report No. 23. Midwest Archeological Center, National Park Service, Lincoln, NE.

Coalition of Parents and Families for Personal Watercraft Safety
2000 "Statistics." Available at <http://www.pwcwatch.org/statistics.htm>.

Continental Shelf Associates for Personal Watercraft Industry Association
1997 "Effects of Personal Watercraft Operation on Shallow-water Seagrass Communities in the Florida Keys." Jupiter, FL.

Davis, D. D.
2000 "Evaluation of Ozone Injury on Vegetation in the Seney National Wildlife Refuge, Michigan: 1999 Observations. 2000 Report." Submitted to the U.S. Fish and Wildlife Service, Air Quality Branch, Denver, CO.

Dun & Bradstreet
2001 *Industry Norms & Key Business Ratios.* Murray Hill, NJ: Dun & Bradstreet.

Earth Share of California
n.d. "The Hazards of Personal Watercraft." *Making Waves* 15, no.3. Available at <http://www.earthshareca.org/about/features/skidoos.htm>.

Florida Fish and Wildlife Conservation Commission
2000 "Buffer Zone Distances to Protect Foraging and Loafing Waterbirds from Disturbance by Personal Watercraft in Florida (Study 7520)." Prepared by J. Rodgers Jr. Bureau of Wildlife Diversity Conservation. Gainesville, FL.

Gustafson, J. B., J. G. Tell, and D. Orem
1997 "Selection of Representative TPH Fractions Based on Fate and Transport Considerations." Final draft. Vol. 3. TPH Criteria Working Group, Fate and Transport Technical Action Group. Amherst Scientific Publishing.

Hamilton, Bruce
1996 "FAQ: Automotive Gasoline." 4 parts. Available at <www.faqs.org/faqs/autos/gasoline-faq>.

Hare, C. T., and K. J. Springier
1973 "Exhaust Emissions from Uncontrolled Vehicles and Related Equipment Using Internal Combustion Engines." Final Report. Part Two: "Outboard Motors." Prepared for the U.S. Environmental Protection Agency by Southwest Research Institute, San Antonio, TX. Available at <http://www.nalms.org/bclss/impactsoutboard.htm>.

Hayes, Reagan
2002 "Can A New Breed of PWC Stem Sales Decline?" *Soundings Trade Only,* February. Soundings Publication LLC. Available at <http://www.pwia.org/articles01.htm>. Site visited June 24, 2002.

Izaak Walton League of America
1999 *Caught in the Wake. The Environmental and Human Health Impacts of Personal Watercraft,* by Laurie C. Martin. Available at <http://www.iwla.org>.

Kado, Norman Y., Robert F. Okamoto, John Karim, and Paul A. Kuzmicky
2000 "Airborne Particle Emissions from 2-Stroke and 4-Stroke Outboard Marine Engines: Polycyclic Aromatic Hydrocarbon and Bioassay Analyses." *Environ. Sci. Technol.* 34(13): 2714–20.

Kawasaki Country
2001 Personal communication with Rodney Moore (Manager) by Erica Koch (URS Corp.), September 5. On file at URS Corporation, Denver, CO.

LAW Engineering and Environmental Sciences, Inc., Arcadis JSA, and RTI
2002 "Economic Analysis of Personal Watercraft Regulations in Pictured Rocks National Lakeshore." Prepared for the National Park Service. Kennesaw, GA.

Limnetics, Inc.
1970 "A Preliminary Survey of the Environmental Quality of the Pictured Rocks National Lakeshore and Recreational Area, Alger County, Michigan." Prepared for the National Park Service. On file at Pictured Rocks National Lakeshore, Munising, MI.

Mace, B. E., R. D. Nine, N. N. Clark, T. J. Vanyo, V. T. Remcho, and R. W. Morrison
1998 "Emissions from Marine Engines with Water Contact in the Exhaust Stream." SAE Technical Paper Series. Warrendale, PA.

Mancini, E. R., A. Steen, G. A. Rausina, D. C. L. Wong, W. R. Arnold, F. E. Gostomski, T. Davies, J. R. Hockett, W. A. Stubblefield, K. R. Drottar, T. A. Spring, and P. Errico
2002 "MTBE Ambient Water Quality Criteria Development: A Public/Private Partnership." *Environmental Science and Technology* 36: 125–29.

Mestre Greve Associates
1992 *Noise Assessment for Beaver Basin Rim Road. Pictured Rocks National Lakeshore.* Prepared for the National Park Service. Newport Beach, CA.

Michigan Department of Environmental Quality
n.d. "Lake Superior Facts." Office of the Great Lakes.

1999a *Administrative Rules, Part 4. Water Quality Standards.* Lansing, MI.

1999b Air Quality Report for Michigan. Air Quality Division, Lansing, MI.

2000a "MTBE (methyl tertiary-butyl ether) Fact Sheet." Storage Tank Division. Lansing, MI.

2000b *Water Quality and Pollution Control in Michigan: 2000 Section 305(b) Report.* Lansing, MI.

Michigan State University Extension
1998 Agriculture Experiment Station Special Reports – 04089577. Lansing, MI.

National Academy of Sciences
1972 *Particulate Polycyclic Organic Matter.* Washington, DC.

National Marine Manufacturers Association
2000 *1999 U.S. Recreational Boat Registration Statistics.* Chicago, IL.

National Park Service, U. S. Department of the Interior
1968 "An Archeological Survey of the Pictured Rocks Lakeshore," by Jeffrey P. Briggs. Midwest Archeological Center, Lincoln, NE.

1981 *General Management Plan, Pictured Rocks National Lakeshore.* On file at Pictured Rocks National Lakeshore, Munising, MI.

1989 "Submerged Cultural Resources Study, Pictured Rocks National Lakeshore," by C. Patrick Labadie. Southwest Cultural Resources Center Professional Papers no. 22. Santa Fe, NM.

1990a "Archeological Investigations at Old Munising (20AR192): A Nineteenth-Century Company Town," by Jeffrey Richner. Midwest Archeological Center Occasional Studies in Anthropology no. 28. Lincoln, NE: Midwest Archeological Center, National Park Service.

1990b "Evaluative Investigations at the Au Sable Light Station, Pictured Rocks National Lakeshore, Michigan," by Bruce A. Jones. Midwest Archeological Center, Lincoln, NE.

1992 *Noise Assessment for Beaver Basin Rim Road, Pictured Rocks National Lakeshore.* Final Report. Denver Service Center.

1993a "Archeological Inventory and Evaluative Testing in Pictured Rocks National Lakeshore, Michigan, 1985–1990." Midwest Archeological Center Occasional Studies in Anthropology, no. 30. Lincoln, NE: Midwest Archeological Center.

1993c *Backcountry Management Plan, Pictured Rocks National Lakeshore.* Pictured Rocks National Lakeshore, Munising, MI.

1995a "Baseline Water Quality Data, Inventory and Analysis, Pictured Rocks National Lakeshore." Technical Report NPS/NRWRD/NRTR-95/57. Washington, DC.

1995b "Use of Personal Watercraft in Glacier National Park." Unpublished paper on file at Glacier National Park headquarters.

1998 "Proposed Rule on Personal Watercraft Use within the NPS System." Available at <http://www.nps.gov/refdesk/1pwcrule.html>.

1999 "Water Quality Concerns Related to Personal Watercraft Usage," by M. VanMouwerik and M. Hagemann. Technical paper. Water Resources Division, Fort Collins, CO.

2000 "Pictured Rocks National Lakeshore, Visitor Survey." On file at Pictured Rocks National Lakeshore, Munising, MI.

in press *Draft General Management Plan / Wilderness Study / Environmental Impact Statement.* Denver Service Center.

National Transportation Safety Board

1998 *Personal Watercraft Safety.* Safety Study NTSB/SS-98/01. Washington, D.C.

Noise Unlimited, Inc.

1996 "Boat Noise Tests Using Static and Full-Throttle Measurement Measures." Prepared for the State of New Jersey, Department of Law and Public Safety.

Norkus, George E.

1999 http://detroit.freenet.org/sigs/boating/html/data-undr2.html

O'Connor, Thomas P.

2000 "Small Boat-derived Chemical Contamination in a National Context." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Oregon Department of Environmental Quality

1999 "Carbureted 2-stroke Marine Engines: Impacts on the Environment and Voluntary Policy Options to Encourage Their Replacement." Final report. Prepared by Mindy Correll, Pollution Prevention Team. Portland, OR.

Ortis, J. T., A. C. Hatch, J. E. Weinstein, R. H. Findlay, P. J. McGinn, S. A. Diamond, R. Garrett, W. Jackson, G. A. Burton, B. Allen

1998 "Toxicity of Ambient Levels of Motorized Watercraft Emissions to Fish and Zooplankton in Lake Tahoe, California/Nevada, USA." Poster 3E-P005, presented at the 8th Annual Meeting of the European Society of Environmental Toxicology and Chemistry, April 14–18, 1998, University of Bordeaux, Bordeaux, France.

Pearce, D., and D. Moran

1994 *The Economic Value of Biodiversity.* London: Earthscan Publication.

Personal Watercraft Industry Association

n.d. "Personal Watercraft and Sound." Available at <http://www.pwia.org/Snd_PWC.htm>.

Rosenberger, Randall, and John Loomis

2000 "Using Meta-Analysis for Benefit Transfer: In-Sample Convergent Validity Tests of an Outdoor Recreation Database." *Water Resources Research* 36(4): 1097–1107.

Sea-Doo

2000 "Personal Watercraft FACTS." Available at <http://www.ozpwc.com/thefacts.html>.

2001a "Bombardier Announces Revolutionary New O.P.A.S. System." Available at <http://www.seadoo.com/usa/seadoo_today/news/010827.html>.

2001b "The New 155 hp, 1494 cc 4-TEC, Four-Stroke." Available at <http://www.seadoo.com>.

Society of Automotive Engineers
2001 "Exterior Sound Level Measurement Procedure for Pleasure Motorboats." J34. Marine Sound Level Subcommittee. Available on the Internet at <www.sae.org>.

Stevenson, J. C., and W. C. Dennison
2000 "The Potential Impacts of Recreational Boating on Submersed Aquatic Vegetation in Upper Chesapeake Bay." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Suter, G. W., and C. L. Tsao
1996 *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota*. Rev. ES/ER/TM-96/R2. Oak Ridge National Laboratory, TN.

Tahoe Regional Planning Agency
1999 *Environmental Assessment for the Prohibition of Certain Two-Stroke Powered Watercraft.*

Tjarnlund, U., G. Ericson, E. Lindersjoo, I. Petterson, and L. Balk
1995 "Investigation of the Biological Effects of 2-Cycle Outboard Engines' Exhaust on Fish." *Marine Environmental Research* 39: 313–16.

Tjarnlund, U., G. Ericson, E. Lindesjoo, I. Petterson, G. Akerman, and L. Balk
1996 "Further Studies of the Effects of Exhaust from Two-Stroke Outboard Motors on Fish." *Marine Environmental Research* 42: 267–71.

U.S. Environmental Protection Agency
1974 "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an adequate Margin of Safety." EPA 550/9-74-004. Washington, DC. Cited in Izaak Walton League of America, 1999, *Caught in the Wake. The Environmental and Human Health Impacts of Personal Watercraft,* by Laurie C. Martin.

1994 "The Effects of Marine Engine Exhaust Emissions on Water Quality: Summary of Findings of Various Research Studies." Office of Air and Radiation.

1995 "Final Water Quality Guidance for the Great Lakes System; Final Rule." *Federal Register*, 60 (Mar. 23): 15366–425.

1996a "Air Pollution Control; Gasoline Spark-Ignition Marine Engines; New Nonroad Compression-Ignition and Spark-Ignition Engines, Exemptions; Rule." *Federal Register* 61 (Oct. 4): 52087–106.

1996b "Emission Standards for New Gasoline Marine Engines." EPA 420-F-96-012. EPA Environmental Fact Sheet. Office of Mobile Sources, Ann Arbor, MI.

1996c *Regulatory Impact Analysis: Control of Air Pollution Emission Standards for New Nonroad Spark-Ignition Marine Engines.* ANR-443. Office of Air and Radiation, Office of Mobile Sources, Engine Programs and Compliance Division, Ann Arbor, MI

1997 "Control of Air Pollution; Amendment to Emission Requirements Applicable to New Gasoline Spark-Ignition Engines." *Federal Register* 62 (April 2): 15805–08.

1998 "National Recommended Water Quality Criteria." *Federal Register* 63 (Dec. 10): 68353–64.

1999a "National Recommended Water Quality Criteria — Correction." EPA822-Z-99-001. Office of Water.

1999b "Power Boating and America's Waters." Available at <http://www.epa.gov/CEIS/atlas/ohiowaters/uses/power_boating_and_america.htm>.

2000a *Lake Superior Lakewide Management Plan 2000.* Lake superior Binational Program.

2000b "Recreational Vehicles, Marine Engines." Region III, Air Protection Division. Available at <http://www.epa.gov/reg3artd/vehicletran/vehicles/recreational_vehicles.htm>.

2001 "National Primary Drinking Water Regulations: Technical Fact Sheet on Benzene." Office of Water. Available at <www.epa.gov/ogwdw000/dwh/t-voc/benzene.htm>.

United States Fish and Wildlife Service, U.S. Department of the Interior
1987 "Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review," by R. Eisler. Report 11. Laurel, MD.

U.S. Department of the Interior
n.d. *Final Environmental Impact Statement, Miccosukee 3-1 Exploratory Well, Broward County, Florida.* Washington, DC.

University of Arizona
1999 *Traditional Ojibway Resources in the Western Great Lakes.* Bureau of Applied Research in Anthropology, University of Arizona, Tucson.

Verschuren, K.
1983 *Handbook of Environmental Data on Organic Chemicals.* 2nd ed. New York: Van Nostrand Reinhold Company.

Vlasich, Brian
1998 "Personal Watercraft: Environmental Effects of a 'Thrill-Craft.'" Claremont Environmental Policy Briefs, Student Edition. Roberts Environmental Center, Claremont McKenna College, Claremont, CA.

Wark, Kenneth, and Cecil F. Warner
1981 *Air Pollution: Its Origin and Control.* 2nd ed. New York: Harper and Row, Publishers.

White, J. J., J. N. Carroll
1998 "Emissions from Snowmobile Engines Using Bio-Based Fuels and Lubricants." Final Report. Prepared for Montana Department of Environmental Quality, Helena, MT.

Winger, Parley V.
2000 "Toxicological Assessment of Aquatic Ecosystems." In *Impacts of Motorized Boats on Shallow Water Systems,* Science Workshop Abstracts, November 7–8, 2000, Douglass College Center, Rutgers, the State University of New Jersey. Rutgers, NJ.

Wong, D. C. L., W. R. Arnold, G. A. Rausina, E. R. Mancini, and A. E. Steen
2001 "Development of a Freshwater Aquatic Toxicity Database for Ambient Water Quality Criteria for Methyl Tertiary-Butyl Ether." *Environmental Toxicology and Chemistry* 20 (5): 1125–32.

Yamaha Motor
2001 "World's First 4-Stroke Personal Watercraft." Available at <http://www.yamaha-motor.com/new/07-19_01_wc_press.html>.

Yaws, C. L., Pan Xiang, and Lin Xiaoyin
1993 "Water Solubility Data for 151 Hydrocarbons. *Chemical Engineering,* 100 (n..2): 108–11.

LIST OF PREPARERS

National Park Service

Pictured Rocks National Lakeshore

Karen Gustin, Superintendent. B. S., Outdoor Recreation.

Larry Hach, Chief of Visitor Services and Land Management. B. S., Outdoor Recreation Resources.

Jerry Belant, Supervisory Biologist. Ph.D. candidate, Wildlife and Biology; M. S. Wildlife Biology; B.S. Wildlife Management, Biology.

Gregg Bruff, Chief of Interpretation and Cultural Resources. B. S., Wildlife Biology.

Air Resources Division, Washington Office

Tamara Blett, Ecologist. M. S., Forest Ecology. Assisted in developing air quality methodology. Experience: 15 years air resource management experience with the National Park Service and USDA Forest Service.

John D. Ray, Program Manager for the Gaseous Pollutant Monitoring Program. Ph.D., Chemistry. Assisted in developing air quality methodology. Atmospheric chemist. Experience: 9 years with National Park Service.

Aaron Worstell, Environmental Engineer. B.S., Chemical Engineering. Assisted in developing air quality methodology. Experience: 9 years experience in air quality (5 federal, 4 state).

Environmental Quality Division, Washington Office

Sarah Bransom, Compliance Program Coordinator. MRP (Master's Degree, Environmental Planning). Managed all PWC environmental assessments for the National Park Service. Experience: 24 years NEPA compliance (federal service).

Madoline Elizabeth Scott Wallace, Environmental Protection Specialist. B. S., Journalism; J. D., Law. Personal watercraft project co-lead. Experience: 1 year National Park Service.

Intermountain Region Support Office

Rick Ernenwein, Overflights and Noise Program Coordinator. B. S., Renewable Natural Resources. Assisted in developing soundscape methodology. Experience: 15 years with NPS noise and NEPA issues; 23 years federal service.

Water Resource Division, Washington Office

Gary Rosenlieb, Hydrologist, Water Quality Program Coordinator. M. S., Water Resources Management. Assisted in developing water quality methodology. Experience: 23 years federal service, with primary experience in water quality management and environmental impact analysis for water resources issues.

Mark VanMouwerik, Contaminants Specialist / CSU Research Associate. M. S., Environmental Health. Worked with fate and effects on contaminants in the environment. Experience: 5 years with National Park Service.

Consultants

URS Corporation

Gen Bolling, Natural Resource Technician. B. S., Horticulture. Responsible for natural resource analysis. Experience: 3 years plus in natural resource review.

Thomas G. Campbell, Consultant and Leader, Risk Assessment Team. M. S., Marine Biology. Refined approach to evaluating surface water quality impacts. Experience: Over 25 years experience in aquatic and marine ecology, water quality, toxicology, and ecological risk assessment.

John Crawford, P. E., Senior Transportation Engineer. B. S., Civil Engineering. Responsible for air and noise analysis. Experience: 10 years plus in air and noise evaluation.

Jessica T. Lau, Senior Environmental Scientist. B. A., Botany; B. S. Geology; M. A., Natural Science. Responsible for air quality analysis and technical review. Experience: Over 14 years in air quality, including various NEPA projects

Tatiana Nawrocki, Water Resource Specialist. , Ph. D. Responsible for water quality evaluation. Experience: 20 years plus in GIS evaluations and water resource studies.

Lydia Nelson, P.S.S., Natural Resource Specialist. B. S., Biology; B. S., Soil Science. Responsible for document coordination, technical review of natural resource analysis, and coordination with NPS staff. Experience: 15 years plus in natural resource evaluation, NEPA review, technical writing, and document coordination.

Rusty Schmidt, Natural Resource Specialist. B. S., Biology; B. S., Art and Chemistry. Responsible for natural resource analysis. Experience: 10 years plus in natural resource evaluation, restoration.

Greg Sorensen, Technical Writer/Editor. B. A., International Affairs. Responsible for editing document. Experience: 27 years.

Patti Steinholtz, Editor/Graphic Illustrator. B. A., Communications and English. Responsible for editing text and preparing maps. Experience: 9 years.

Nancy VanDyke, Senior Consultant and Leader, Regulatory Team. B. A., Biology and Geography; M. S., Environmental Sciences. Responsible for technical review of document, water quality methodology. Experience: Over 22 years in environmental planning, assessment, and compliance.

EDAW, Inc.

Karen Z. Lusby, Associate Environmental Planner. B. S., Outdoor Recreation and Park Administration; M. S., Forest Economics. Responsible for initial development of impact methodologies. Experience: Over 16 years in NEPA environmental compliance and documentation, biological assessments, wetland statements of finding, NPS NEPA compliance documents.

Michael A. Morelli, Associate Landscape Architect/Environmental Planner. Bachelor's degree, Environmental Design; Master of Landscape Architecture. Responsible for initial scoping meetings and alternatives development. Experience: Over 24 years in NEPA environmental compliance and documentation, recreational planning, landscape architecture, facilities planning, NPS NEPA compliance, project management.