APPENDIX A:
WATER QUALITY ASSESSMENT AND CALCULATIONS

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WATER QUALITY ASSESSMENT AND CALCULATIONS

METHODOLOGY

To address potential impacts on water quality at the national lakeshore from personal watercraft (PWC) use, similar methods to the 2002 Pictured Rocks National Lakeshore (national lakeshore) Personal Watercraft Environmental Assessment (EA) were used to evaluate contaminant loadings. The four segments of the lakeshore examined for PWC use were Sand Point (segment 1), Cliffs (segment 2), Beaver Basin (segment 3), and Grand Sable (segment 4) which are depicted in figure A-1. The approaches used to determine impacts to water quality are (alternatives 1 and 4) PWC use in Sand Point segment only, (alternative 2) PWC use in all four segments and, (alternative 3) prohibited PWC use in all four segments.

The overall approach to evaluate the potential impact of PWC use on the water quality of the national lakeshore was as follows:

- Determine average daily number of PWCs at each of the four segments monitored, as well as hourly usage for each PWC.
- Ascertain ecological and human health toxicity benchmarks for polycyclic aromatic hydrocarbons (PAHs) and benzene based on US Environmental Protection Agency (EPA) and Michigan Department of Environmental Quality (MDEQ) criteria.
- Estimate the loadings to the water column of PAHs (including benzo(a)pyrene, naphthalene, and 1-methylnapthalene) and benzene based on the concentrations of these contaminants in gasoline and PWC-hours.
- Determine waterbody "threshold volumes," defined as the minimum water volume needed to reduce contaminant concentrations at or below federal and state criteria or benchmark toxicity concentrations.

PWC Use

Two scenarios were modeled for daily use of PWCs – average and peak. Table A-1 presents the length of the segments and the number of PWCs modeled for average and peak days under alternatives 1, 2, and 4. PWC use is prohibited in alternative 3 and therefore not included in table A-1.

For alternatives 1 and 4, Sand Point is the only segment open for PWC use; for alternative 2, PWC use would be allowed across all four segments. Based on PWC studies, the National Park Service (NPS) estimated the current level of PWC use, as detailed in the "Assumptions Used in Determining Impacts" section of chapter 4. The NPS assigned Sand Point and Cliffs an average of 14 PWCs each per day during peak days because they have heavier visitor use. Beaver Basin and Grand Sable are expected to have lower PWC use; therefore, these segments were each assigned 7 PWCs per day. Each PWC is used for 3 hours daily.

TABLE A-1: CALCULATION OF AVERAGE AND PEAK PWC-HOURS FOR EACH SEGMENT OF PICTURED ROCKS NATIONAL LAKESHORE

Segment	Length (miles)	Alternatives 1 and 4: PWC Use from Sand Point to Miners Beach				Alternative 2: Entire Shoreline Open to PWC Use			
		Average Use		Peak Use		Average Use		Peak Use	
		# PWCs/ Day	Total PWC-hours	# PWCs/ Day	Total PWC-hours	# PWCs/ Day	Total PWC-hours	# PWCs/ Day	Total PWC-hours
1. Sand Point	9.2	4	12	14	42	4	12	14	42
2. Cliffs	6.0	0	0	0	0	4	12	14	42
3. Beaver Basin	10.2	0	0	0	0	4	12	7	21
4. Grand Sable	14.3	0	0	0	0	4	12	7	21

Pollutants Analyzed

Petroleum-related pollutants of concern related to fuel combustion include methyl tertiary butyl ether (MTBE), PAHs, benzene, toluene, ethylbenzene, xylenes and other hydrocarbons, (VanMouwerik and Hagemann 1999). Benzene, toluene, ethylbenzene, xylenes, and lower weight PAHs evaporate relatively quickly and do not stay in the water column for long periods (EPA 2013). Because of this, toluene, ethylbenzene, and xylenes were not carried forward in the analysis. Benzene was retained and fully analyzed because it is a recognized human carcinogen (EPA 2013). MTBE and higher weight PAHs may remain in the water column for longer periods, which could ultimately affect aquatic wildlife. In Michigan, the use of MTBE in gasoline was phased out in 2003 (EPA 2004); therefore, MTBE is no longer expected to be a concern in the surface waters of the national lakeshore. Following the procedure in the 2002 EA, in addition to benzene, several PAHs were analyzed for impacts on water quality: two lower-weight PAHs, naphthalene and 1-methylnaphthalene, and one higher weight PAH, benzo(a)pyrene.

Toxicity Benchmarks and Criteria

Pictured Rocks National Lakeshore does not have site-specific water quality standards; therefore, national standards were used in this analysis to evaluate the potential impacts to water quality at the national lakeshore from PWC use.

Ecotoxicological Benchmarks: EPA water quality criteria protective of aquatic life for the chemicals analyzed are not available; therefore, ecotoxicological screening benchmarks were acquired from scientific literature. Ecological screening benchmarks represent a threshold for effects to ecological receptors, which are used to determine if chemicals present in or potentially released to the environment pose an ecological threat. For this analysis, the media is the Lake Superior surface water at the national lakeshore.

The ecological toxicity values were sourced from Suter and Tsao's 1996 report. Suter and Tsao (1996) is a widely-used report for assessing chemical specific screening-level risks to aquatic organisms. This report derives toxicity benchmarks from available ecotoxicity data in the primary literature. Furthermore, data are only incorporated into the benchmarks following evaluation of quality as defined by guidelines used to develop the National Ambient Water Quality Criteria. The benchmarks were based on acute toxicity tests. The species used in the tests are invertebrates (*D. pulex*, *D. magna*, *A. aquaticus*, and *C. thummi*) and fish (*C. auratus*, *C. cognatus*, *G. aculeatus*, *P. promelas*, *O. mykiss*, *O. nerka*, *O.*

tshawytscha, *O. kisutch*, *O. gorbuscha*, *L.macrochirus*, *I. punctatus*, *P. reticulate*, *S. malma* and *T. arcticus*). The acute tests had a duration of 48 to 96 hours and used juvenile and/or adult individuals. The endpoint for the test was the median lethal/effective concentration or L/EC_{50}, resulting in death or immobilization of 50% of test population. Benchmarks were calculated by initially determining the Genus Mean Acute Value; next, the chemical specific Final Acute Value Factor is calculated. The next calculation is the Secondary Acute Value, which is required when there are few toxicity data available, as is the case for these chemicals. This is done by dividing the lowest Genus Mean Acute Value for that chemical by the Final Acute Value Factor. Next, the Secondary Acute Value needs to be extrapolated to a chronic value, as aquatic organisms are assumed to be exposed daily. The Secondary Acute–Chronic Ratio is calculated by either taking the geometric mean of the Secondary Acute Value (if there are 3 or more, which is the case with naphthalene but not with the other three chemicals) or using a default value of 17.9 from the EPA (1991). Finally, the toxicity benchmark is calculated by dividing the Secondary Acute Value by the Secondary Acute–Chronic Ratio (calculated or default 17.9).

Human Health Criteria: Human health criteria are used to determine the highest concentrations of pollutants in water that are not expected to pose significant risks to human health (EPA 2014). It is important to recognize that human health criteria are extraordinarily conservative when applied to the human exposures being addressed in this EA. Conservative benchmarks are protective and take into account possible ways a visitor could be exposed to a contaminant. This type of benchmark is appropriate because it is protective of the visitor, as it creates a worst-case scenario. Therefore, if the concentration of a chemical in the water does not exceed a very conservative and protective benchmark for any reasonable period of exposure, there is greater confidence that humans and aquatic resources are not at risk.

EPA compiles national recommended water quality criteria protective of aquatic life and human heath in surface water. These criteria are published pursuant to Section 304(a) of the Clean Water Act and provide guidance for states and tribes to use in adopting water quality standards (EPA 2015). Of the pollutants evaluated in this analysis, EPA water quality criteria are available for benzo(a)pyrene and benzene for human health. The state of Michigan also has a human health water quality criterion for benzene under MDEQ Rule 57. While the EPA criterion for benzene is more conservative, both criteria were used in the analysis for water quality.

The EPA human health Water Quality Criteria values were derived by using available toxicity data and applying exposure assumptions to calculate a chemical specific environmental concentration protective of human health. The assumptions made are a human being exposed weighs 80kg, they directly drink 2.4 L of the 'contaminated' water daily and they consume 22 g. of fish from the 'contaminated' waterbody on a daily basis.

Table A-2 presents the ecological benchmarks, human health criteria and their sources.

TABLE A-2: ECOLOGICAL AND HUMAN HEALTH TOXICITY BENCHMARKS FOR SELECTED POLLUTANTS

Pollutant	Ecological Toxicity Benchmarks			Human Health Toxicity Benchmarks		
	µg/L	mg/L	Source	µg/L	mg/L	Source
benzo(a)pyrene	0.014	1.4×10^{-5}	Suter and Tsao 1996	0.00012	1.2×10^{-7}	EPA 2015
naphthalene	12	0.012	Suter and Tsao 1996	-	-	-
1-methylnaphthalene	2.1	0.0021	Suter and Tsao 1996	-	-	-
benzene	130	0.130	Suter and Tsao 1996	12 2.1	0.012 0.0021	MDEQ 2014 EPA 2015

µg/L = microgram per liter
mg/L = milligram per liter

Daily Pollutant Loadings

The amount of each pollutant (benzene, benzo(a)pyrene, naphthalene, and 1-methylnaphthalene) that would be released to the surface water of Lake Superior during daily PWC use was estimated; this is the daily pollutant loading. The analysis used the concentrations of components in gasoline, the rate of discharge of a two-stroke carbureted engine (11.34 liters per hour), and the running time of the PWCs (based on the use assumptions outlined in table A-1) to calculate potential pollutant loading to the lake. The objective of the lake-loading analysis was to determine if the national lakeshore would receive concentrations of selected compounds from gasoline or its combustion products from PWCs that would cause pollutant levels to approach or exceed water quality standards.

The pollutant loading estimates apply only to PWC use during the two-year phase-out period of PWCs with carbureted two-stroke engines. The alternative approaches make the assumption that all PWCs at the national lakeshore will be those with carbureted two-stroke engines that discharge unburned gasoline and gasoline additives directly into the water. Post phase-out, all PWCs would have direct injection engines, which do not discharge fuel directly into the water (PWIA 2006), essentially eliminating pollutant loading to the surface water. There could be incidental releases of fuel to Lake Superior from fuel leaks or fuel spills by PWC users; however, spills and leaks are expected to be infrequent and would not create appreciable impacts on water quality.

This analysis presents total daily pollutant loadings that would be delivered to the surface water instantaneously; these loadings are assumed to dissipate via dilution and volatilization prior to the next boating day. However, in reality, pollutants are deposited throughout the day and some pollutants may persist in the water column. Of the pollutants analyzed, benzo(a)pyrene is the most likely to remain in the environment, as higher weight PAHs are more resistant to oxidation and reduction, but will be emitted in such small amounts that impacts would be undetectable (EPA 2013). Pollutant loading results are presented in tables A-3, A-4, and A-5.

Threshold Volumes

Threshold volumes are defined as the volume of water needed to dilute the calculated pollutant loads to the concentrations of water quality criteria or benchmark. The threshold volumes are calculated by dividing the estimated daily pollutant loadings by the ecological benchmark or human health criteria. An advantage of this approach is that it provides a mechanism to estimate pollution levels, even in the absence of baseline water quality data. A limitation is that the calculations yield a total daily load from PWCs that would be instantaneously delivered to the lake, and is assumed to be reduced to zero by the start of the next boating day. In reality, the pollutant load is added in conjunction with all other boating activities throughout the day, and small residual concentrations of some compounds may carry over from one day to the next.

Lake Superior is defined as a dimictic lake (Minnesota Sea Grant 2009), meaning that it mixes twice a year, in the spring and in the fall. With warmer summer temperatures, lakes can stratify into bands of warmer and cooler water. The upper layer, which goes from the surface to about 50 feet in depth, is the warmest layer and is mixed by wind action. In the summer, the upper layer does not mix with the lower, colder layer (Mazumder and Taylor 1994). The depth of Lake Superior in the 0.25-mile area from the shoreline varies but generally reaches depths less than 40 feet; therefore, the analysis for threshold volumes assumes that all water within the segments is readily mixed by wind action and is available for dilution of pollutants from all sources. Threshold volume results are presented in tables A-3, A-4, and A-5.

CALCULATIONS

Below are example loading and threshold volume calculations for a location with 4 PWCs per day that are used for 3 hours each, for a total of 12 PWC-hours per day (such as the average use in the Sand Point location under alternative 2). The daily loading amount (in milligrams) of each pollutant that is discharged to the water is determined. Next, the "threshold volume" of water needed to dilute the concentration of the pollutant to its criterion or toxicity benchmark "safe concentration" is calculated. For complete results, see tables A-3 through A-5.

Constants

Gasoline emission rate for two-stroke PWC:	11.34 L/hour
Concentration of benzo(a)pyrene in gasoline:	2.07 mg/L (Gustafson et al. 1997)
Concentration of naphthalene in gasoline:	3,695 mg/L (Gustafson et al. 1997)
Concentration of 1-methylnapthalene in gasoline:	5,760 mg/L (estimated from Gustafson et al. 1997)
Concentration of benzene in gasoline:	9,607 mg/L (Hamilton 1996)
Number of liters in 1 acre-foot:	1,233,481.87 L

Pollutant Loading Calculations to Water

PWC-hours (hr)	×	Gasoline Emission per Hour (L/hr)	×	Concentration of Pollutant in Gasoline (mg/L)	=	Pollutant Loading in Water (mg)

Benzo(a)pyrene: 12 PWC-hours × 11.34 L gasoline/hr × 2.07 mg/L = 282 mg

Naphthalene: 12 PWC-hours × 11.34 L gasoline/hr × 3,695 mg/L = 502,816 mg

1-methylnapthalene: 12 PWC-hours × 11.34 L gasoline/hr × 5,760 mg/L = 783,821 mg

Benzene: 12 PWC-hours × 11.34 L gasoline/hr × 9,607 mg/L = 1,307,321 mg

Threshold Volumes Based on Ecological Toxicity Benchmarks

Pollutant Loading in Water (mg)	/	Ecological Benchmark (mg/L)	=	Threshold Volume (L)	=	Threshold Volume (acre-feet)

Benzo(a)pyrene: 282 mg / 1.4×10^{-5} mg/L = 20,120,400 L or 16.31 acre-feet

Naphthalene: 502,816 mg / 0.012 mg/L = 41,901,300 L or 33.97 acre-feet

1-methylnapthalene: 783,821 mg / 0.0021 mg/L = 373,248,000 L or 302.60 acre-feet

Benzene: 1,307,321 mg / 0.130 mg/L = 10,056,315 L or 8.15 acre-feet

Threshold Volumes Based on Human Health Toxicity Benchmarks

Pollutant Loading in Water	/	Human Health Benchmark	=	Threshold Volume	=	Threshold Volume

(mg)	(mg/L)	(L)	(acre-feet)

Benzo(a)pyrene: 282 mg / 1.2×10^{-7} mg/L = 2,347,380,000 L or 1,903.05 acre-feet

Benzene (MDEQ): 1,307,321 mg / 0.012 mg/L = 108,943,416 L or 88.32 acre-feet

Benzene (EPA): 1,307,321 mg / 0.0021 mg/L = 622,533,809 L or 504.70 acre-feet

Tables A-3 through A-5 present the results of calculations for alternatives 1, 2, and 4 under average and peak conditions for all applicable segments. Only Sand Point calculations apply to alternatives 1 and 4, as PWCs are prohibited in the remaining three segments (table A-3). The numbers of PWCs and PWC-hours for alternative 2 are the same for Sand Point and Cliffs segments under average and peak PWC use; therefore, this scenario is combined and presented in table A-4. The same applies to Beaver Basin and Grand Sable segments; this scenario is presented in table A-5.

Volume of Water Available

Tables A-3, A-4, and A-5 also include the volume of water available within the areas where PWC use occurs (defined as the area between 200 feet of the shoreline and the edge of the national lakeshore or 0.25 mile into Lake Superior), and the threshold water volumes needed to dilute the PWC loadings to criteria or benchmark values. The volume of water in each segment was calculated by multiplying the area of the segment by the general depth.

These comparisons indicate that there is sufficient water available to dilute these loadings to safe concentrations under average use and high traffic use scenarios. Using benzo(a)pyrene at Sand Point under alternatives 1 and 4 as an example, this assessment shows that 16 acre-feet of water are required to dilute the average daily loading to the benchmark aquatic life protection concentration (0.014 µg/L), and there are 31,551 acre-feet of water within the defined mixing zone area where PWC use occurs. Similarly, for comparison to the EPA human health criterion for benzo(a)pyrene (0.00012 µg/L), 6,661 acre-feet of water are required to dilute the PWC loading to the benchmark under the peak use scenario.

In summary, there is sufficient dilution within area where PWCs are being used within each of the four park segments under each alternative. It is recognized that excursions above these benchmark values will occur for short periods (and small volumes of water) as turbulent mixing and dilution occurs within the wake of the PWC.

TABLE A-3: CALCULATIONS OF DAILY POLLUTANT LOADINGS, VOLUME OF WATER AVAILABLE, AND THRESHOLD WATER VOLUMES NEEDED (IN ACRE-FEET) TO DILUTE PWC EMISSIONS TO BENCHMARK VALUES FOR AVERAGE AND PEAK CONDITIONS FOR ALTERNATIVES 1 AND 4 – SEGMENT 1 (SAND POINT)

Pollutant	Average PWC Use			Peak PWC Use		
	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)
Volume of Water Available	**31,551 acre-feet**			**31,551 acre-feet**		
benzo(a)pyrene	282	16.31	1, 903.05	986	57.09	6,660.68
napthalene	502,816	33.97	-	1,759,855	118.89	-
1-methyl napthalene	783,821	302.60	-	2,743,373	1,059.09	-
benzene	1,307,321	8.15	88.32 (MDEQ) 504.70 (EPA)	4,575,622	28.53	309.13 (MDEQ) 1,766.44 (EPA)

TABLE A-4: CALCULATIONS OF DAILY POLLUTANT LOADINGS, VOLUME OF WATER AVAILABLE, AND THRESHOLD WATER VOLUMES NEEDED (IN ACRE-FEET) TO DILUTE PWC EMISSIONS TO BENCHMARK VALUES FOR AVERAGE AND PEAK CONDITIONS FOR ALTERNATIVE 2 – SEGMENT 1 (SAND POINT) AND SEGMENT 2 (CLIFFS)

Pollutant	Average PWC Use			Peak PWC Use		
	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)
Volume of Water Available	**31,551 acre-feet (Sand Point) 20,467 acre-feet (Cliffs)**			**31,551 acre-feet (Sand Point) 20,467 acre-feet (Cliffs)**		
benzo(a)pyrene	282	16.31	1, 903.05	986	57.09	6,660.68
napthalene	502,816	33.97	-	1,759,855	118.89	-
1-methyl napthalene	783,821	302.60	-	2,743,373	1,059.09	-
benzene	1,307,321	8.15	88.32 (MDEQ) 504.70 (EPA)	4,575,622	28.53	309.13 (MDEQ) 1,766.44 (EPA)

TABLE A-5: CALCULATIONS OF DAILY POLLUTANT LOADINGS, VOLUME OF WATER AVAILABLE, AND THRESHOLD WATER VOLUMES NEEDED (IN ACRE-FEET) TO DILUTE PWC EMISSIONS TO BENCHMARK VALUES FOR AVERAGE AND PEAK CONDITIONS FOR ALTERNATIVE 2 – SEGMENT 3 (BEAVER BASIN) AND SEGMENT 4 (GRAND SABLE)

Pollutant	Average PWC Use			Peak PWC Use		
	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)	Daily Loading to Water (mg)	Ecological Threshold Water Volume Needed (acre-feet)	Human Health Threshold Water Volume Needed (acre-feet)
Volume of Water Available	**29,716 acre-feet (Beaver Basin) 21,354 acre-feet (Grand Sable)**			**29,716 acre-feet (Beaver Basin) 21,354 acre-feet (Grand Sable)**		
benzo(a)pyrene	282	16.31	1, 903.05	493	28.55	3,330.34
napthalene	502,816	33.97	-	879,927	59.45	-
1-methyl napthalene	783,821	302.60	-	1,371,686	529.54	-
benzene	1,307,321	8.15	88.32 (MDEQ) 504.70 (EPA)	2,287,811	14.27	154.56 (MDEQ) 883.22 (EPA)

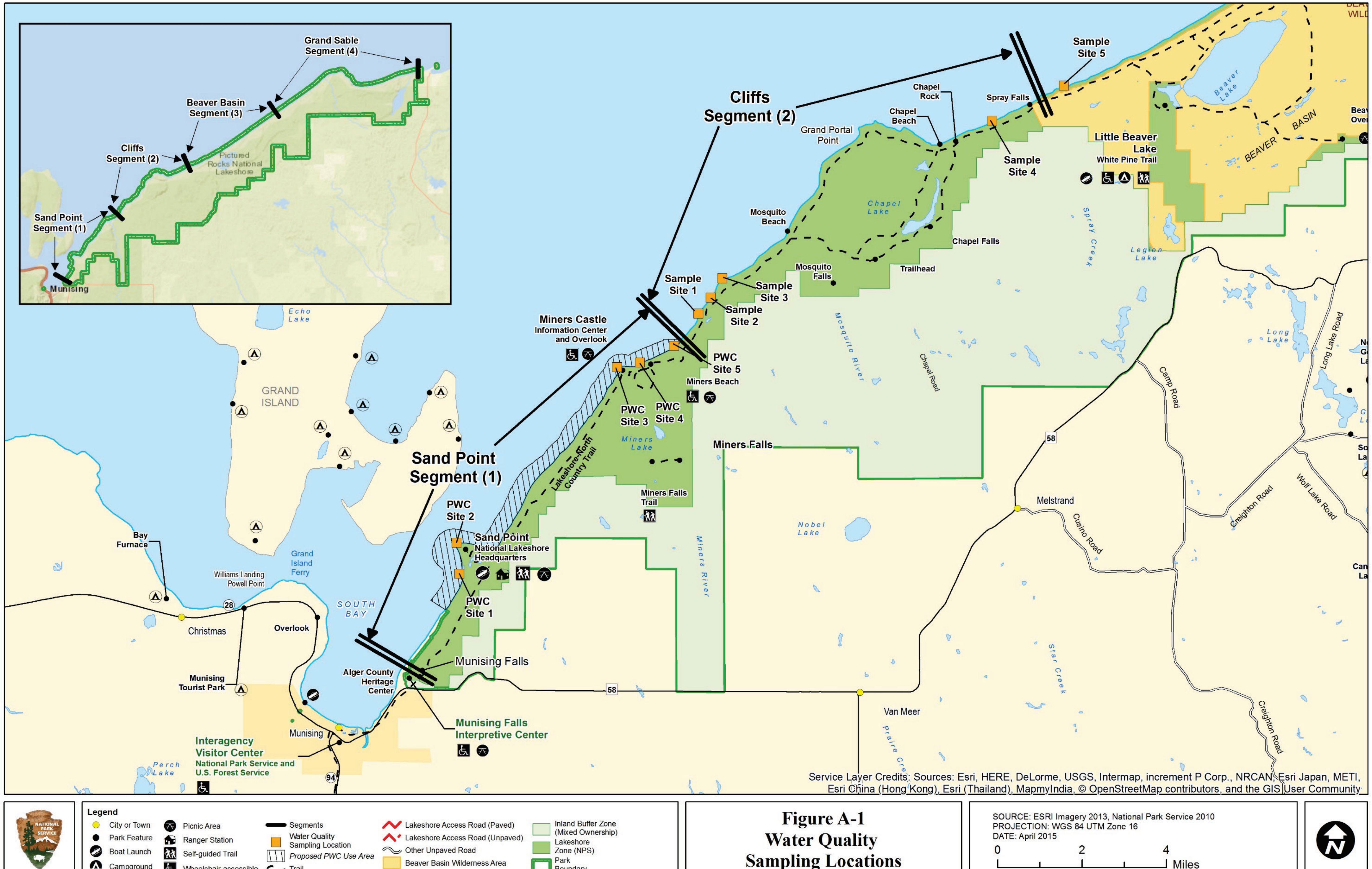

Figure A-1 Water Quality Sampling Locations

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APPENDIX B: AIR QUALITY STANDARDS AND ANALYSIS METHODOLOGY

NATIONAL AMBIENT AIR QUALITY STANDARDS AND ATTAINMENT STATUS, PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY, MARINE SPARK-IGNITION ENGINE EMISSION STANDARDS

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NATIONAL AMBIENT AIR QUALITY STANDARDS AND ATTAINMENT STATUS

The Clean Air Act (CAA) of 1970 and its subsequent amendments in 1977 and 1990 established and provided for periodic update of the National Ambient Air Quality Standards (NAAQS) to protect public health and welfare from the effects of air pollution. The NAAQS apply to six *criteria* pollutants: (1) carbon monoxide, (2) lead, (3) nitrogen dioxide, (4) ozone, (5) particle pollution, and (6) sulfur dioxide. *Primary standards* have been established to protect public health, including sensitive populations such as asthmatics, young children and the elderly. *Secondary standards* are established to protect public welfare, including protection against decreased visibility, and damage to animals, crops, vegetation and buildings. The current NAAQS are summarized in table B-1.

TABLE B-1: NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead		primary and secondary	Rolling 3-month average	0.15 μg/m^3	Not to be exceeded
Nitrogen Dioxide		primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	Annual	53 ppb	Annual mean
Ozone		primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution	$PM_{2.5}$	primary	Annual	12 μg/m^3	Annual mean, averaged over 3 years
		secondary	Annual	15 μg/m^3	Annual mean, averaged over 3 years
		primary and secondary	24-hour	35 μg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Notes:
ppm = parts per million
μg/m^3 = micrograms per cubic meter
ppb = parts per billion
PM = particulate matter
Ozone is controlled by regulating emissions of nitrogen oxides and volatile organic compounds.

States and other local jurisdictions with responsibility for managing ambient air quality have the authority under the CAA to either adopt the NAAQS or to adopt more stringent air quality standards. The State of Michigan has adopted the federal NAAQS without change. Alger County, in the Upper Peninsula of Michigan, where Pictured Rocks National Lakeshore is located, and essentially the rest of the state, with small isolated exceptions, are designated as attainment for all of the NAAQS.

PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY

The CAA established the prevention of significant deterioration (PSD) program to protect the air in attainment areas from excessive degradation resulting from new sources of air emissions. Attainment areas may be designated as Class I, Class II, or Class III. Air quality planning areas designated as mandatory Class I under the 1977 CAA include 48 national parks larger than 6,000 acres, 87 US Forest Service wilderness areas larger than 5,000 acres, and 21 National Wildlife Refuges larger than 5,000 acres administered by the US Fish and Wildlife Service. These federally mandated Class I areas are afforded the greatest protection from air quality deterioration. There are two mandatory Class I areas in Michigan – Seney National Wildlife Refuge in Schoolcraft County, approximately 45 kilometers from Pictured Rocks National Lakeshore and Isle Royale National Park, near the northwest shore of Lake Superior, approximately 250 kilometers from the national lakeshore. Other attainment areas are currently designated as Class II, where moderate deterioration of air quality is permitted, except in specified cases. Class III areas are planning areas set aside for industrial growth. There are currently no designated Class III areas. Violations of the NAAQS are not permitted in Class I, Class II, or Class III areas. Deterioration of air quality in attainment areas is limited by controlling the consumption of "ambient air increments" or "PSD increments." Increments are fractions of the difference between the baseline concentration in an area and the NAAQS concentration, and have been established for three of the criteria pollutants: sulfur dioxide, nitrogen dioxide, and particle pollution. An increment constitutes the maximum allowable increase in pollutant concentration above baseline in the area. The increments are smallest in Class I areas, and larger in Class II and Class III areas. Pictured Rocks National Lakeshore is located in an area designated as Class II. The ambient air increments are shown in table B-2.

Emissions of criteria pollutants and the resultant increases in ambient concentration from major new and modified sources subject to PSD are not permitted to consume more than 80% of the available increment in Michigan.

TABLE B-2: AMBIENT AIR (PREVENTION SIGNIFICANT DETERIORATION) INCREMENTS

Pollutant			Class II Areas (µg/m³)
Nitrogen Dioxide		Annual arithmetic mean	25
Particle Pollution	$PM_{2.5}$	Annual arithmetic mean	4
		24-hr maximum	9
	PM_{10}	Annual arithmetic mean	17
		24-hr maximum	30
Sulfur Dioxide		Annual arithmetic mean	20
		24-hr maximum	91
		3-hr maximum	512

Abbreviations: PM = particulate matter

As a means of enabling screening assessments to determine the potential for new sources of criteria pollutants to result in ambient concentration impacts that would cause or contribute to a violation of the NAAQS or the PSD increments, US Environmental Protection Agency (EPA) established significant impact levels (SILs). SILs are numerical concentration values that represent thresholds of insignificant (*de minimis*) modeled source impacts. The Class II area SILs are shown in table B-3.

TABLE B-3: CLASS II AREA SIGNIFICANT IMPACT LEVELS

Pollutant		Averaging Period	Significant Impact Level (µg/m³)
Nitrogen Dioxide		Annual	1
Particle Pollution	$PM_{2.5}$	Annual	(0.3) [a]
		24-hour	(1.2) [a]
	PM_{10}	Annual	1
		24-hour	5
Sulfur Dioxide		Annual	1
		24-hour	5
		3-hour	25
Carbon Monoxide		8-hour	500
		1-hour	2000

Abbreviations: PM = particulate matter

Notes:

a EPA rescinded its previously promulgated $PM_{2.5}$ SILs in 2013 pursuant to a 2012 Court of Appeals vacatur and remand.

SILs are used for determining if projects subject to PSD (major stationary sources) must conduct comprehensive (multi-source) modeling before construction. If modeled impacts (ambient concentration increases) from new sources of criteria pollutants are below the SILs, the new source is considered insignificant and not to have the potential to cause or contribute to violations of the NAAQS or the PSD increments.

MARINE SPARK-IGNITION ENGINE EMISSION STANDARDS

EPA is required to evaluate air emissions from nonroad engines and vehicles to set standards to control and reduce air emissions. The most significant pollutants associated with nonroad sources are nitrogen oxides (NO_X), volatile organic compounds (VOCs), and carbon monoxide (CO), which contribute to levels of ozone and CO that exceed nonattainment levels under NAAQS in certain areas of the country (EPA 2008a, 2008b). EPA completed the Nonroad Engine and Vehicle Emission Study in 1991, and in 1994 determined that these sources contribute significantly to ozone and CO nonattainment[1]. EPA determined that gasoline marine engines are one of the largest contributors of VOC emissions from the nonroad source category (EPA 2008a).

Working cooperatively with the marine industry and personal watercraft (PWC) manufacturers, EPA finalized Emission Standards for New Gasoline Marine Engines (40 CFR § 91(104)) on October 4, 1996, which established limits and standards for new gasoline spark-ignition marine engines. For gasoline spark-ignition marine engines, the primary pollutants affected by this rule are hydrocarbons (HC), of which VOCs are a component. The rule, which took effect in 1998, affects manufacturers of new outboard engines and the type of inboard engines used in PWCs (EPA 1996). The agency adopted a

[1] As of September 27, 2010, all areas formerly designated non-attainment for CO attained the CO NAAQS and were redesignated as maintenance areas.

9-year phase-in approach to reduce emissions. By the end of the phase-in period (2006), PWC manufacturers were required to meet a combined HC and NO_X emission standard on a corporate average basis that was equivalent to a 75% reduction in HC emissions compared to unregulated levels. The corporate average standard allowed manufacturers to produce some engines that performed at levels lower than the standard and some engines that performed at levels higher than the standard, and to employ a mix of technology types, as long as the overall corporate average was at or below the standard. The emissions control technologies applied include four-stroke engines, direct injection two-stroke engines, and post-combustion catalysts.

On October 8, 2008, EPA finalized and adopted new regulations (40 CFR § 1045(a)(103)) for air quality emissions standards for nonroad spark-ignition marine engines including PWCs (EPA 2008b). EPA also adopted new standards in 2008 to control evaporative emissions for all vessels using spark-ignition marine engines, including provisions for cold weather evaporative emissions standards reflective of fuel line capabilities, and a phase-in for marine diurnal standards to enhance safety of the new regulations (EPA 2008a). EPA estimates that by 2030, these standards would result in a 60% reduction in HC and NO_X emissions from outboard and PWC engines and a 20% reduction in CO emissions from new marine spark ignition engine exhaust (EPA 2008b). These standards will also reduce evaporative emissions by about 70% (EPA 2008b). These regulations only apply to newly manufactured products starting with the 2010 model year, and are consistent with the air emissions standard requirements of the California Air Resources Board (CARB) for models produced starting in model year 2008 (EPA 2008c). EPA indicated the combined HC and NO_X and CO emissions standards can be achieved by phasing out conventional carbureted two-stroke engines and replacing them with direct injection two-stroke or four-stroke engines. This has also been the market-driven trend over the past several years and is widely used technology (EPA 2008a). All PWCs manufactured today use four-stroke direct injection engines or two-stroke direct injection technology, which reduce air emissions up to 90% from models produced in 1998 (NMMA 2013; PWIA 2006). The 2006 and 2010 EPA air quality emissions standards are outlined in tables B-4 and B-5.

TABLE B-4: MARINE SPARK-IGNITION ENGINES AND VESSELS – EXHAUST EMISSION STANDARDS

Regulation	Model Year	$HC + NO_x$[a] (g/kW-hr)		CO[b] (g/kW-hr)		Useful Life (hours/years)[c]	Warranty Period (hours/years)[c]
		P ≤ 4.3 kW	P > 4.3 kW	P ≤ 4.3 kW	P > 4.3 kW		
2006 Standards	1998	278	$(0.917 \times (151 + 557/P^{0.9} + 2.44)$	-	-	350 / 5	All Emission-related Components: 1 year[d]
	1999	253	$(0.833 \times (151 + 557/P^{0.9} + 2.89)$	-	-		
	2000	228	$(0.750 \times (151 + 557/P^{0.9}) + 3.33$	-	-		
	2001	204	$(0.667 \times (151 + 557/P^{0.9}) + 3.78$	-	-		All Emission-related Components: 1 year Specified Major Emission Control Components: 200 / 3
	2002	179	$(0.583 \times (151 + 557/P^{0.9}) + 4.22$	-	-		
	2003	155	$(0.500 \times (151 + 557/P^{0.9}) + 4.67$	-	-		
	2004	130	$(0.417 \times (151 + 557/P^{0.9}) + 5.11$	-	-		All Emission-related Components: 200 / 2 Specified Major Emission Control Components: 200 / 3
	2005	105	$(0.333 \times (151 + 557/P^{0.9}) + 5.56$	-	-		
	2006-2009	81	$(0.250 \times (151 + 557/P^{0.9}) + 6.00$	-	-		
2010 Standards	2010 +[e]	30.0	$2.1 + 0.09 \times (151 + 557/P^{0.9})$	$500 - 5.0 \times P$	300	Personal Watercraft: 350 / 5[f] Outboard: 350 / 10[f]	Personal Watercraft: 175 hours or 30 months Outboard Engines: 175 / 5

Abbreviations: HC = hydrocarbon; NO_x = nitrogen oxides; g = gram; kW = kilowatt; kW-hr = kilowatt hour; P = maximum engine power in kilowatts; CO = carbon monoxide

Notes:

- **a** The numerical emission standards for hydrocarbons (HC) must be met based on the following types of HC emissions for engines powered by the following fuels: (1) total hydrocarbon equivalent for alcohol; (2) non-methane hydrocarbon for natural gas; and (3) total hydrocarbons for other fuels.
- **b** Manufacturers may generate or use emission credits for averaging, but not for banking or trading.
- **c** Useful life and warranty period are expressed hours or years of operation (unless otherwise indicated), whichever comes first.
- **d** Also applies to model year (MY) 1997 engine families certified pursuant to 40 CFR 91.205.
- **e** Not-to-exceed emission standards specified in 40 CFR 1045.107 also apply.
- **f** A longer useful life in terms of hours must be specified for the engine family if the average service life is longer than the minimum value as described in 40 CFR 1045.103(e)(3).

TABLE B-5: MARINE SPARK-IGNITION ENGINES – EVAPORATIVE EMISSION STANDARDS

Model Year	Fuel Line Permeation ($g/m^2/day$)	Fuel Tank Permeation ($g/m^2/day$ @ 28°C)	Diurnal (g/gal/day)	Useful Life [a] (years)	Warranty Period (years)
2009	15 [b]	-	-	PWC: 5 All other vessels and portable marine fuel tanks: 10	2
2010		-	0.40 [c]		
2011+		1.5 [d, e]			

Abbreviations: $g/m^2/day$ = grams per square meter per day; g/gal/day = grams per gallon per day

Notes:

a A 2-year useful life period applies for fuel tanks or fuel caps certified to meet permeation emission standards in 2013 and earlier model years for small spark-ignition and marine spark-ignition engines.

b Applies to marine spark-ignition fuel lines, including fuel lines associated with outboard engines or portable marine fuel tanks. The emission standard for fuel lines starts for PWC, vessels, and portable marine fuel tanks manufactured on or after January 1, 2009. The emission standard for primer bulbs applies starting January 1, 2011. The emission standard for under-cowl fuel lines used with outboard engines applies over a phase-in period which is based on total length of fuel lines: 30% for 2010; 60% for 2011; 90% for 2012–2014; and 100% for 2015+. Manufacturers have the option to comply with the standard with 100% of the under-cowl lines across the full lineup of 2011 model year outboard engines. In this case, requirements would not apply to under-cowl fuel lines before the 2011 model year.

c Applies to marine spark-ignition fuel tanks, including engine-mounted fuel tanks, only. Portable marine fuel tanks must be self-sealing and remain sealed up to a positive pressure of 34.5 kilopascals (5.0 pounds per square inch gauge); however they may contain air inlets that open when there is a vacuum pressure inside the tank. In addition, detachable fuel lines that are intended for use with portable marine fuel tanks must be self-sealing (without any manual vents) when not attached to the engine or fuel tank. An alternative standard of 0.16 grams per gallon per day applies for fuel tanks installed in nontrailerable boats when measured using the corresponding fuel temperature profile in 40 CFR 1060.525. Diurnal requirements start: in the 2010 model year for PWC fuel tanks and January 1, 2010 for portable marine fuel tanks; other installed fuel tanks must meet the standards for vessels produced on or after July 31, 2011, except as allowed by 40 CFR 1045.625. See 40 CFR 1060.240(e) for the design-based option.

d Or 2.5 grams per square meter per day if testing performed at 40°C.

e Applies to marine spark-ignition fuel tanks, including engine-mounted and portable marine fuel tanks. Permeation standards start: January 1, 2011, for portable marine fuel tanks; with the 2011 model year for fuel tanks for PWC; and with the 2012 model year for other installed fuel tanks.

When an engine meets EPA requirements, the manufacturer applies the CARB sticker on the vessel, which must be affixed on PWCs 2–3 inches to the right of the assigned vessel number (CARB 2008). CARB stickers were determined in the CARB 2008 air emissions standards, which require that PWCs from 2008 and later meet the standards for HC and NO_X exhaust air emissions listed below in table B-6. EPA exhaust air emission standards for marine spark-ignition PWC model years after 2010 are consistent with CARB regulations after 2008 for HC and NO_X and for CO, while EPA air quality emissions standards for earlier models are less stringent than CARB standards (EPA 2012). EPA 2006 air quality emissions standards are consistent with the 2001 CARB standards

According to these standards, PWC also may not exceed CO exhaust emissions of 300 g/kW-hr for outboard and PWC engines greater than 40 kW and 500 – 5P (P stands for the maximum engine power in kilowatts) for PWC engines greater than 40 kW, as outlined below in table B-7 (CARB 2008).

The national lakeshore would use CARB stickers as a way to identify PWCs with air emissions that are at or under the required EPA air quality emissions standards without having to stop PWC users to look at the engine type.

TABLE B-6: CARB CORPORATE AVERAGE EMISSION STANDARDS BY IMPLEMENTATION DATE HYDROCARBONS AND NITROGEN OXIDES (G/KW-HR)

Model Year	Maximum Family Emission Limits	P_{tx}[a] < 4.3 kW[b]	P_{tx} > 4.3 kW[b]
2001–2003	N/A	81.00	$(0.25 \times (151+557/P_{tx}^{0.9})) + 6.0$
2004–2007	80	64.80	$(0.20 \times (151+557/P_{tx}^{0.9})) + 4.8$
2008 and Later[c]	44	30.00	$(0.09 \times (151+557/P_{tx}^{0.9})) + 2.1$

Source: CARB 2008

Abbreviations: kW = kilowatt

Notes:

a P_{tx} is the average power in kW of the total number of spark-ignition marine engines produced for sale in California in model year x (where X is the model year), calculated by the SAE standard J1228.

b For 2010 and subsequent model years, an engine or engine family's power category is based on maximum engine power; otherwise maximum rate power may be used.

c For 2010 and subsequent model years, standards are measured in total hydrocarbons plus oxides of nitrogen.

TABLE B-7: CARB PERSONAL WATERCRAFT CARBON MONOXIDE STANDARDS

Model Year	Power Category[a] (kW)	Carbon Monoxide Standard (g/kW-hr)
2009 and Later	kW < 40	$500 - 5 \times P$[b]
	kW > 40	300.0

Source: CARB 2008

Abbreviations: kW = kilowatt; g/kW-hr = grams per kilowatt hour

Notes:

a For 2010 and subsequent model years, an engine or engine family's power category is based on maximum engine power, otherwise maximum rated power may be used.

b P is defined as maximum rated power or maximum engine power in kW.

AIR QUALITY ANALYSIS METHODOLOGY

Pictured Rocks National Lakeshore, located in Alger County, Michigan, is in an area designated as attainment for all National Ambient Air Quality Standards (NAAQS). Hence, emissions of criteria pollutants including particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and volatile organic compounds are not as stringently regulated as in non-attainment areas. Personal watercraft (PWC) usage at the national lakeshore is fairly limited; only approximately 100 PWCs were observed in use during the 2012 summer period. With the assumption that the maximum daily usage for each was approximately 3 hours, emissions from the 2,352 annual hours of PWC operation would probably represent only a small fraction of total emissions from all mobile sources, including larger powered watercraft and light, medium, and heavy-duty vehicles operated with in the park unit. Given this relatively small contribution from PWCs to total mobile source emissions, the percentage of the operating fleet able to comply with the emission standards effective in 2010 (versus the 2006 standards), will probably not affect this significantly. Detailed analysis methodology and assumptions are described below.

AIR EMISSIONS CALCULATIONS

Air emission rates were estimated using US Environmental Protection Agency (EPA) National Mobile Inventory Model (NMIM), which incorporates the EPA NONROAD 2008a and MOBILE 6.2.03 programs. In order to quantify emissions, the NMIM model requires certain input parameters such as fuel type; temporal information; geographic region (state and county); and equipment source classification codes (SCC), equipment technology type, equipment population, and monthly activity distribution ratio. The model contains a database of emission factors which are a function of equipment SCC, equipment technology type, fuel type and metrological data of the geographical region. In any event where user-defined information is not provided for any project-specific parameter, the model will use the default value available within the software database for that parameter. The NMIM model emissions output results are provided in tons of pollutant emitted per year. Modeling inputs to the NMIM model are presented in attachment E1.

AIR DISPERSION MODELING

EPA AERSCREEN was used to quantify and assess the potential air quality impacts from PWC emissions. AERSCREEN is the EPA guideline screening-level air quality model based on AERMOD (EPA 2014). The model produces estimates of "worst-case" 1-hour concentrations for a single source that represents a conservative estimate of the maximum post-action ambient concentration at the modeled (maximum) emission rate, without the need for hourly meteorological data, and also includes conversion factors to estimate "worst-case" 3-hour, 8-hour, 24-hour and annual concentrations. AERSCREEN is intended to produce concentration estimates that are equal to or greater than the estimates produced by AERMOD, which uses a fully developed set of meteorological and terrain data.

AERSCREEN dispersion modeling was performed for carbon monoxide; no dispersion modeling was performed for other criteria pollutants because their estimated emissions were minimal, less than 5 tons/yr.

EMISSION SOURCE DESCRIPTIONS

Emissions from PWC use were modeled as multiple area sources because the model limit on the aspect ratio of the PWC use area rectangle necessitated separation into multiple rectangles. Rectangular area sources were located along shoreline of the national lakeshore. Since AERSCREEN is a single source model, it is assumed that all of emissions were evenly distributed throughout multiple rectangular area sources along the shoreline of the national lakeshore for the alternatives. Table B-8 shows inputs to the model.

TABLE B-8: AREA SOURCE PARAMETERS

Parameter	Value	Unit
Release Height	0	meter
Length	4000	meter
Width	400	meter
Orientation Angle	-48	deg

With AERSCREEN, a Gaussian model with a single source and no chemical transformations or deposition depletion modeling, concentration impacts scale in a linear fashion with the modeled emission rate. Therefore, a unit mass emission rate of 1 pound per hour was used to predict the maximum ground level concentration. The predicted ground level concentration was then used as dispersion coefficient to estimate the ambient concentration of carbon monoxide for 1-hour and 8-hour averaging periods; the EPA screening guidance (EPA 1992) recommends that the maximum 1-hour concentration be conservatively assumed to apply for averaging periods up to 24 hours.

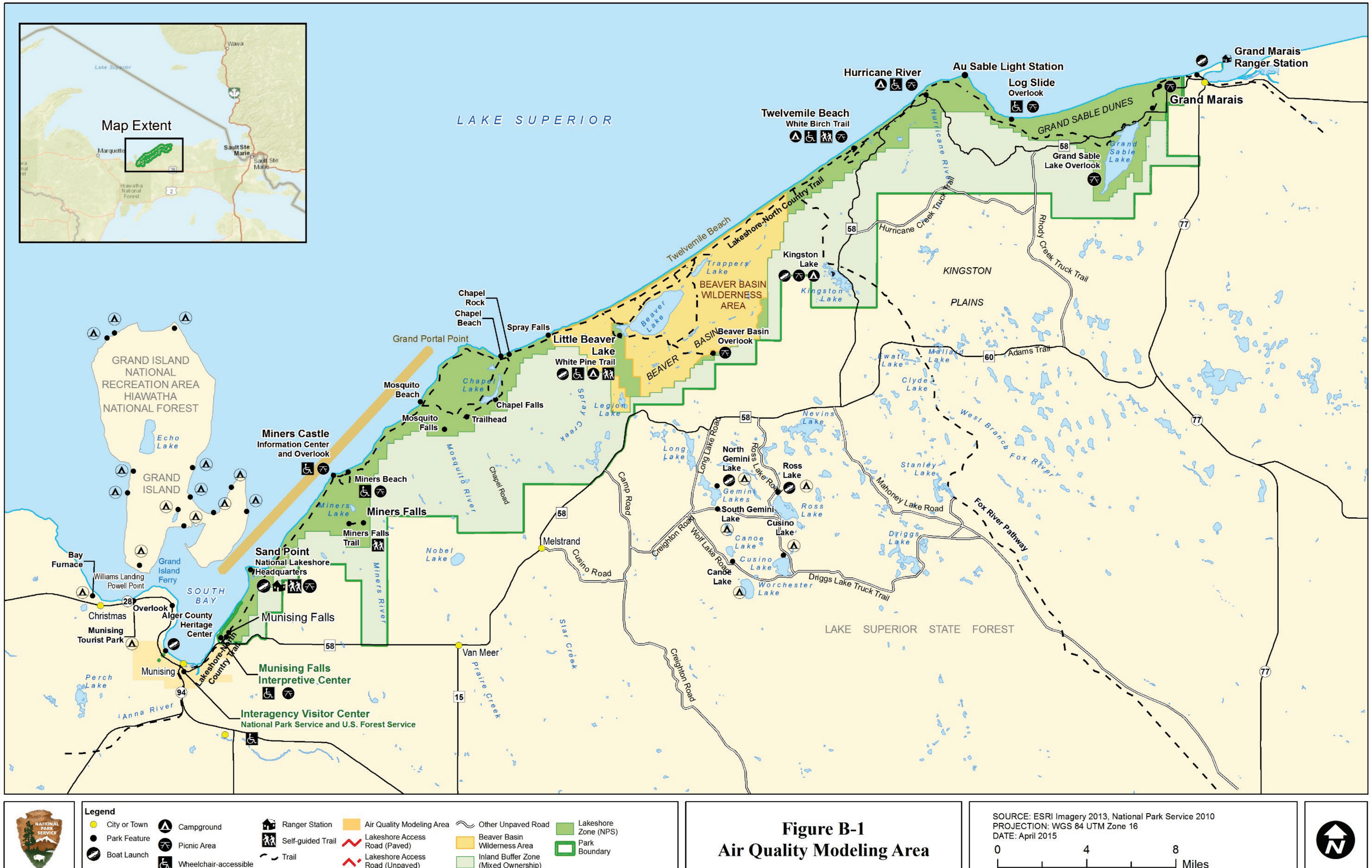

Figure B-1
Air Quality Modeling Area

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LAND USE CLASSIFICATION

The national lakeshore is categorized as rural, based on the land use procedures described in the EPA's Guideline on Air Quality Models (Revised) (EPA 1993) and the method of Auer (Auer 1978). The percentage of land falling into one of five land use types (I1, I2, C1, R2, R3) within a 3-kilometer circle around the national lakeshore was subjectively determined using US Geological Survey 7.5-minute series topographic maps. By inspection, it was determined that over 50% of the area is rural in nature. Thus, the rural option was used.

METEOROLOGICAL DATA

The MAKEMET processor in AERSCREEN generates meteorological conditions based on user-specified surface characteristics, ambient temperature extremes, minimum wind speed, and anemometer height. For this analysis, the suggested default values of MAKEMET are used for ambient extreme temperatures, the minimum wind speed of 0.5 meters per second and the anemometer height of 10 meter. AERSURFACE was used to calculate surface characteristics based on the land cover data file.

SCREENING RESULTS

The concentration output from AERSCREEN is the maximum 1-hour dispersion coefficient. This maximum dispersion coefficient is multiplied by carbon monoxide emission rate to obtain the maximum 1-hour and 8-hour carbon monoxide concentrations. Then the maximum concentrations are added to the maximum background concentration monitored at Duluth, Minnesota to compare with the respective NAAQS. Electronic copies of all AERSCREEN input and output files are provided in attachment E-2.

Table B-9 summarizes the results of the screening modeling, demonstrating compliance with NAAQS. Therefore, carbon monoxide emissions will not adversely affect public health and welfare.

TABLE B-9: AERSCREEN MODELING RESULTS AND NAAQS COMPARISON

	Emission Rate (lb/hr)	Averaging Period	Maximum Modeled Concentration (ppm)	Maximum Background Concentration (ppm)	Total Concentration (ppm)	NAAQS (ppm)
2015/2016	113.8	1-hour	2.51	8.7	11.21	35
	42.7	8-hour	0.94	3	3.94	9
2017	105.2	1-hour	1.97	8.7	10.67	35
	39.4	8-hour	0.74	3	3.74	9

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2008c EPA Finalizes Emission Standards for New Nonroad Spark-Ignition Engines, Equipment, and Vessels. September. EPA420-F-08-013. Available [online]: http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P10017GK.txt. Accessed June 3, 2013.

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ATTACHMENT B-1: NMIM MODEL INPUT DATA

PWC Year 2000 Model

SCC, HPMAX, Model Year, Tech Type, Population, Hours/Year

Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

2282005015, 175, 2000, All, 14, 168

0, 0, 0, 0, 0, 0.333, 0.333, 0.333, 0, 0, 0, 0

PWC Year 2014 Model

SCC, HPMAX, ModelYear, TechType, Population, Hours/Year

Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

2282005015, 175, 2014, All, 14, 168

0, 0, 0, 0, 0, 0, 0.5, 0.5, 0, 0, 0, 0

ATTACHMENT B-2: AERSCREEN MODELING FILE

```
AERSCREEN 11126 / AERMOD 1206                     06/04/14
                                  13:41:40

TITLE: SCENARIO 4

------------------------------------------------------------------------------
****************************** AREA PARAMETERS ****************************
 -----------------------------------------------------------------------------
-
SOURCE EMISSION RATE:      0.1260 g/s        1.000 lb/hr

AREA EMISSION RATE:      0.787E-07 g/(s-m2)    0.625E-06 lb/(hr-m2)
AREA HEIGHT:            0.00 meters        0.00 feet
AREA SOURCE LONG SIDE:     4000.00 meters      13123.36 feet
AREA SOURCE SHORT SIDE:     400.00 meters      1312.34 feet
INITIAL VERTICAL DIMENSION:    0.00 meters        0.00 feet
RURAL OR URBAN:          RURAL

INITIAL PROBE DISTANCE =     10000. meters       32808. feet

------------------------------------------------------------------------------
*********************** BUILDING DOWNWASH PARAMETERS **********************
------------------------------------------------------------------------------
               BUILDING DOWNWASH NOT USED FOR NON-POINT SOURCES

------------------------------------------------------------------------------
************************** FLOW SECTOR ANALYSIS ***************************
             25 meter receptor spacing: 1. meters - 5000. meters
           50 meter receptor spacing: 5050. meters - 10000. meters
------------------------------------------------------------------------------
  MAXIMUM IMPACT RECEPTOR

  Zo    SURFACE  1-HR CONC RADIAL DIST  TEMPORAL
  SECTOR  ROUGHNESS (ug/m3)  (deg)  (m)  PERIOD
  ------------------------------------------------------
    1    1.127   38.51    0 2000.0   ANN
    2*    0.498   63.01    0 2000.0   ANN
 * = worst case diagonal

------------------------------------------------------------------------------
********************** MAKEMET METEOROLOGY PARAMETERS *********************
------------------------------------------------------------------------------
MIN/MAX TEMPERATURE:  250.0 / 310.0 (K)

MINIMUM WIND SPEED:    0.5 m/s

ANEMOMETER HEIGHT:   10.000 meters

SURFACE CHARACTERISTICS INPUT: C:\Lakes\AERMOD
View\piro_AERSURF1\AERSURFACE.OUT

DOMINANT SECTOR:      2 (225 45)

ALBEDO:         0.12
```

```
BOWEN RATIO:        0.21
ROUGHNESS LENGTH:     0.498 (meters)

    METEOROLOGY CONDITIONS USED TO PREDICT OVERALL MAXIMUM IMPACT
    -------------------------------------------------------------

 YR MO DY JDY HR
 -- -- -- --- --
 10 01 01  1 01

   H0   U*   W* DT/DZ ZICNV ZIMCH M-O LEN  Z0 BOWEN ALBEDO REF WS
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 -0.78 0.033 -9.000 0.020 -999.  14.   3.6 0.498  0.21  0.12  0.50

   HT REF TA   HT
 - - - - - - - - - - -
  10.0  250.0  2.0


    METEOROLOGY CONDITIONS USED TO PREDICT AMBIENT BOUNDARY IMPACT
    --------------------------------------------------------------

 YR MO DY JDY HR
 -- -- -- --- --
 10 01 01  1 01

   H0   U*   W* DT/DZ ZICNV ZIMCH M-O LEN  Z0 BOWEN ALBEDO REF WS
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 -0.78 0.033 -9.000 0.020 -999.  14.   3.6 0.498  0.21  0.12  0.50

   HT REF TA   HT
 - - - - - - - - - - -
  10.0  250.0  2.0
```

```
--------------------------------------------------------------------------------
*********************** AERSCREEN AUTOMATED DISTANCES **********************
          OVERALL MAXIMUM CONCENTRATIONS BY DISTANCE
--------------------------------------------------------------------------------
```

MAXIMUM DIST (m)	1-HR CONC (ug/m3)	MAXIMUM DIST (m)	1-HR CONC (ug/m3)
1.00	50.63	3775.00	21.31
25.00	50.84	3800.00	21.16
50.00	51.05	3825.00	21.01
75.00	51.25	3850.00	20.86
100.00	51.46	3875.00	20.72
125.00	51.66	3900.00	20.57
150.00	51.87	3925.00	20.43
175.00	52.07	3950.00	20.29
200.00	52.26	3975.00	20.15
225.00	52.46	4000.00	20.02
250.00	52.66	4025.00	19.88
275.00	52.85	4050.00	19.75
300.00	53.04	4075.00	19.62
325.00	53.23	4100.00	19.48
350.00	53.42	4125.00	19.35
375.00	53.61	4150.00	19.22
400.00	53.79	4175.00	19.09
425.00	53.97	4200.00	18.97
450.00	54.15	4225.00	18.84
475.00	54.33	4250.00	18.72
500.00	54.51	4275.00	18.60
525.00	54.69	4300.00	18.48
550.00	54.87	4325.00	18.37
575.00	55.04	4350.00	18.25
600.00	55.21	4375.00	18.13
625.00	55.38	4400.00	18.01
650.00	55.55	4425.00	17.90
675.00	55.72	4450.00	17.79
700.00	55.89	4475.00	17.68
725.00	56.05	4500.00	17.57
750.00	56.22	4525.00	17.46
775.00	56.38	4550.00	17.35
800.00	56.54	4575.00	17.25
825.00	56.70	4600.00	17.14
850.00	56.86	4625.00	17.04
875.00	57.02	4650.00	16.93
900.00	57.18	4675.00	16.83
925.00	57.33	4700.00	16.73
950.00	57.49	4725.00	16.63
975.00	57.64	4750.00	16.53
1000.00	57.79	4775.00	16.43
1025.00	57.94	4800.00	16.33
1050.00	58.09	4825.00	16.24
1075.00	58.24	4850.00	16.14
1100.00	58.39	4875.00	16.05
1125.00	58.53	4900.00	15.96
1150.00	58.68	4925.00	15.86
1175.00	58.82	4950.00	15.77
1200.00	58.96	4975.00	15.68

1225.00	59.10	5000.00	15.59
1250.00	59.24	5050.00	15.41
1275.00	59.38	5100.00	15.23
1300.00	59.52	5150.00	15.06
1325.00	59.66	5200.00	14.90
1350.00	59.79	5250.00	14.73
1375.00	59.93	5300.00	14.57
1400.00	60.06	5350.00	14.42
1425.00	60.20	5400.00	14.26
1450.00	60.33	5450.00	14.11
1475.00	60.46	5500.00	13.96
1500.00	60.59	5550.00	13.81
1525.00	60.72	5600.00	13.67
1550.00	60.85	5650.00	13.52
1575.00	60.97	5700.00	13.38
1600.00	61.10	5750.00	13.25
1625.00	61.23	5800.00	13.11
1650.00	61.35	5850.00	12.98
1675.00	61.48	5900.00	12.85
1700.00	61.60	5950.00	12.72
1725.00	61.72	6000.00	12.59
1750.00	61.85	6050.00	12.46
1775.00	61.96	6100.00	12.34
1800.00	62.08	6150.00	12.22
1825.00	62.20	6200.00	12.11
1850.00	62.32	6250.00	11.99
1875.00	62.44	6300.00	11.88
1900.00	62.55	6350.00	11.77
1925.00	62.67	6400.00	11.66
1950.00	62.78	6450.00	11.55
1975.00	62.90	6500.00	11.44
2000.00	63.01	6550.00	11.33
2025.00	52.98	6600.00	11.23
2050.00	49.80	6650.00	11.13
2075.00	47.61	6700.00	11.03
2100.00	45.95	6750.00	10.93
2125.00	44.54	6800.00	10.83
2150.00	43.32	6850.00	10.73
2175.00	41.97	6900.00	10.64
2200.00	41.09	6950.00	10.55
2225.00	40.27	7000.00	10.46
2250.00	39.51	7050.00	10.37
2275.00	38.79	7100.00	10.28
2300.00	38.12	7150.00	10.19
2325.00	37.48	7200.00	10.10
2350.00	36.88	7250.00	10.01
2375.00	36.31	7300.00	9.928
2400.00	35.76	7350.00	9.845
2425.00	35.25	7400.00	9.763
2450.00	34.75	7450.00	9.682
2475.00	34.27	7500.00	9.603
2500.00	33.81	7550.00	9.524
2525.00	33.37	7600.00	9.448
2550.00	32.95	7650.00	9.372
2575.00	32.54	7700.00	9.297
2600.00	32.14	7750.00	9.224
2625.00	31.75	7800.00	9.152

2650.00	31.38	7850.00	9.081
2675.00	31.02	7900.00	9.011
2700.00	30.67	7950.00	8.940
2725.00	30.33	8000.00	8.870
2750.00	30.00	8050.00	8.802
2775.00	29.68	8100.00	8.734
2800.00	29.36	8150.00	8.667
2825.00	29.06	8200.00	8.600
2850.00	28.76	8250.00	8.535
2875.00	28.47	8300.00	8.470
2900.00	28.19	8350.00	8.406
2925.00	27.91	8400.00	8.343
2950.00	27.64	8450.00	8.281
2975.00	27.38	8500.00	8.220
3000.00	27.14	8550.00	8.160
3025.00	26.91	8600.00	8.101
3050.00	26.68	8650.00	8.042
3075.00	26.45	8700.00	7.984
3100.00	26.23	8750.00	7.927
3125.00	26.01	8800.00	7.871
3150.00	25.79	8850.00	7.816
3175.00	25.58	8900.00	7.761
3200.00	25.38	8950.00	7.707
3225.00	25.17	9000.00	7.654
3250.00	24.97	9050.00	7.600
3275.00	24.77	9100.00	7.547
3300.00	24.57	9150.00	7.494
3325.00	24.38	9200.00	7.442
3350.00	24.19	9250.00	7.391
3375.00	24.00	9300.00	7.341
3400.00	23.81	9350.00	7.291
3425.00	23.63	9400.00	7.242
3450.00	23.45	9450.00	7.193
3475.00	23.28	9500.00	7.145
3500.00	23.10	9550.00	7.098
3525.00	22.93	9600.00	7.051
3550.00	22.75	9650.00	7.005
3575.00	22.58	9700.00	6.959
3600.00	22.42	9750.00	6.914
3625.00	22.25	9800.00	6.870
3650.00	22.09	9850.00	6.826
3675.00	21.93	9900.00	6.783
3700.00	21.77	9950.00	6.740
3725.00	21.61	10000.00	6.697
3750.00	21.46		

```
-----------------------------------------------------------------------------
********************* AERSCREEN MAXIMUM IMPACT SUMMARY ******************
-----------------------------------------------------------------------------
3-hour, 8-hour, and 24-hour scaled
concentrations are equal to the 1-hour concentration as referenced in
SCREENING PROCEDURES FOR ESTIMATING THE AIR QUALITY
IMPACT OF STATIONARY SOURCES, REVISED (Section 4.5.4)
Report number EPA-454/R-92-019
http://www.epa.gov/scram001/guidance_permit.htm
under Screening Guidance

           MAXIMUM   SCALED   SCALED   SCALED   SCALED
            1-HOUR   3-HOUR   8-HOUR   24-HOUR   ANNUAL
  CALCULATION     CONC    CONC    CONC    CONC    CONC
  PROCEDURE     (ug/m3)   (ug/m3)   (ug/m3)   (ug/m3)   (ug/m3)
 ---------------  ---------- ---------- ---------- ---------- ----------
FLAT TERRAIN    63.01    63.01    63.01    63.01     N/A

DISTANCE FROM SOURCE    2000.00 meters

IMPACT AT THE
AMBIENT BOUNDARY  50.63    50.63    50.63    50.63     N/A

DISTANCE FROM SOURCE     1.00 meters
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APPENDIX C: SPECIAL-STATUS SPECIES FOUND IN ALGER COUNTY, MICHIGAN

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SPECIAL-STATUS SPECIES FOUND IN ALGER COUNTY, MICHIGAN

TABLE C-1: LIST OF SPECIAL-STATUS ANIMALS IN ALGER COUNTY, MICHIGAN

Scientific Name	Common Name	State Status	Federal Status
Mussels			
Ligumia nasuta	Eastern pondmussel	E	
Fish			
Acipenser fulvescens	Lake sturgeon	T	
Coregonus artedi	Lake herring or Cisco	T	
Coregonus kiyi	Kiyi	SC	
Coregonus zenithicus	Shortjaw cisco	T	
Cottus ricei	Spoonhead sculpin	SC	
Insects			
Erora laeta	Early hairstreak	SC	
Lycaeides idas nabokovi	Northern blue	T	
Nicrophorus americanus	American burying beetle	X	LE
Phyciodes batesii	Tawny crescent	SC	
Trimerotropis huroniana	Lake Huron locust	T	
Birds			
Accipiter gentilis	Northern goshawk	SC	
Ammodramus savannarum	Grasshopper sparrow	SC	
Botaurus lentiginosus	American bittern	SC	
Buteo lineatus	Red-shouldered hawk	T	
Charadrius melodus	Piping plover	E	LE
Coturnicops noveboracensis	Yellow rail	T	
Dendroica cerulea	Cerulean warbler	T	
Falco columbarius	Merlin	T	
Falco peregrinus	Peregrine falcon	E	
Gavia immer	Common loon	T	
Haliaeetus leucocephalus	Bald eagle	SC	
Pandion haliaetus	Osprey	SC	
Picoides arcticus	Black-backed woodpecker	SC	
Spiza americana	Dickcissel	SC	
Tympanuchus phasianellus	Sharp-tailed grouse	SC	

State Status: E = endangered; T = threatened; SC = special concern; X = presumed extirpated
Federal Status: LE = listed endangered; LT = listed threatened

TABLE C-2: LIST OF SPECIAL-STATUS PLANTS IN ALGER COUNTY, MICHIGAN

Scientific Name	Common Name	State Status	Federal Status
Ferns and Fern Allies			
Botrychium acuminatum	Moonwort	E	
Botrychium campestre	Prairie Moonwort or Dunewort	T	
Botrychium hesperium	Western moonwort	T	
Botrychium mormo	Goblin moonwort	T	
Botrychium spathulatum	Spatulate moonwort	T	
Huperzia selago	Fir clubmoss	SC	
Flowering Plants			
Astragalus canadensis	Canadian milk vetch	T	
Callitriche hermaphroditica	Autumnal water-starwort	SC	
Calypso bulbosa	Calypso or fairy-slipper	T	
Cirsium pitcheri	Pitcher's thistle	T	LT
Crataegus douglasii	Douglas's hawthorn	SC	
Cypripedium arietinum	Ram's head lady's-slipper	SC	
Elymus glaucus	Blue wild-rye	SC	
Empetrum nigrum	Black crowberry	T	
Gnaphalium sylvaticum	Woodland everlasting	T	
Leymus mollis	American dune wild-rye	SC	
Listera auriculata	Auricled twayblade	SC	
Littorella uniflora	American shore-grass	SC	
Luzula parviflora	Small-flowered wood rush	T	
Myriophyllum alterniflorum	Alternate-leaved water-milfoil	SC	
Myriophyllum farwellii	Farwell's water milfoil	T	
Oryzopsis canadensis	Canada rice grass	T	
Pinguicula vulgaris	Butterwort	SC	
Potamogeton confervoides	Alga pondweed	SC	
Senecio indecorus	Northern ragwort	T	
Stellaria longipes	Stitchwort	SC	
Tanacetum huronense	Lake Huron tansy	T	
Trisetum spicatum	Downy oat-grass	SC	
Vaccinium cespitosum	Dwarf bilberry	T	

State Status: E = endangered; T = threatened; SC = special concern
Federal Status: LT = listed threatened

APPENDIX D: PWC DATA COLLECTED FROM MARCH TO OCTOBER OF 2012 BY THE CAPTAINS OF THE PICTURED ROCKS CRUISES

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PWC DATA COLLECTED FROM MARCH TO OCTOBER OF 2012 BY THE CAPTAINS OF THE PICTURED ROCKS CRUISES

TABLE D-1: PWC DATA COLLECTED BY THE CAPTAINS OF THE PICTURED ROCKS CRUISES, 2012

Date	Time	Daily Max Temp (˚F)	Location of PWC	PWC #	PWC Description	Comments
6/28/2012	13:45	80	200 yards off East end of Miners Beach	1	Blue/Yellow	2 people on board
6/29/2012	15:20	77	Sand Point	2		
6/29/2012	19:41	77	Sand Point	1		
7/2/2012	13:25	77	Chapel	2		
7/2/2012	13:58	77	20 yard off Rainbow Cave	1	Orange	2 people on board, heading SW
7/2/2012	14:25	77	50 yards SW of Indianhead	2	White/Blue	2 people/1 person heading SW
7/2/2012	18:50	77	100 yards off Bridanveil	2	Yellow	4 people heading SW
7/2/2012	20:55	77	Miners Beach East	2	White	4 people
7/3/2012	13:45	88	20 yards off Bridal Falls heading E	2	both Yellow/White	3 people on one, 2 on other
7/3/2012	20:48	88	50 yards off the Grand Portal	2	Yellow/White	2 single seat machines
7/5/2012	11:54	74	Miners Beach	2		Two 2-seaters riding along beach
7/5/2012	13:30	74	50 feet off Rainbow Cave (W of Miners Beach)	1	White/Yellow	3 Passengers (2 adults, 1 child)
7/5/2012	13:40	74	900 feet off Mosquito Harr. (W of Miners Beach)	2	Yellow	1 passenger each
7/5/2012	14:15	74	20 yards off of Indian Drums	1	Yellow/White	3 people on board, towing raft with 3 people
7/5/2012	14:55	74	30 yards off of Bridalveil	1	Yellow	2 people on board
7/5/2012	17:15	74	500 feet off Sand Point	1	White/Green	2 passengers
7/5/2012	19:12	74	150 feet off Miners Castle	2	1-White/Aqua with Pink Stripe 2-White/Teal	1 passenger each
7/6/2012	17:35	90	30 yards off shore just SE of Miners Castle	2	1-Red/White 2-Green/White	1 person on one, 2 people on other
7/11/2012	11:51	73	200 feet off Bridal Veil	1	Blue/White with black hull	2 passengers
7/13/2012	14:03	87	500 feet off Rainbow Cave	2	Gold/White	5 passengers heading SW
7/15/2012	17:22	88	100 feet off Chapel Rock	3	Red/Blue and White/Green	1 passenger each
7/15/2012	17:46	88	Bridalveil Falls	2	1-Red/White 2-Black	
7/15/2012	17:48	88	Paint Coves	1	Green/White	

Date	Time	Daily Max Temp (˚F)	Location of PWC	PWC #	PWC Description	Comments
7/16/2012	19:00	75	Indian Drums/Chapel Rock/Spray Falls	1	Blue/White	1 passenger
7/20/2012	11:54	73	East End Miners Beach	1	Black/White	1 passenger
7/20/2012	13:30	73	50 feet off bow at Stony Point	1	Yellow/White	1 passenger
7/20/2012	14:28	73	Chapel Beach	5	4-Stand ups 1-sit down	5 passengers, 1 stand up was probably same one from July 20 at 11:54
7/22/2012	12:47	79	1,000 feet from Bridalveil	1	Teal/Indigo	2 passengers
7/22/2012	13:20	79	800 feet of Battleship Rock	2	Forest Green	1 passenger each
7/24/2012	15:45	86	200 yards off between Coves and Mosquito	3		2 people on each heading NE
7/29/2012	13:55	72	Miners Castle	1	Obsidian	2 passengers (adult/child)
7/29/2012	16:17	72	Sand Point Beach	1	Fusia/Ebony	1 passenger (adult)
8/1/2012	17:37	67	200 yards off Miners Castle Heasing SW	2		2 people on each, one pulling a tube
8/2/2012	15:32	84	Between Miners and Sand Point	1	Black/Yellow	2 passengers
8/4/2012	15:34	72	Between Miners and Sand Point	4	3-Green/White 1-Chrome/White	6 passengers (4 women, 2 men)
8/6/2012	14:32	69	Rainbow Cave	2	1-Red 1-Black	1 passenger each (1 man, 1 woman)
8/6/2012	15:10	69	30 yards off Battleship Heading NE	2		1 person on each
8/12/2012	14:50	69	Bridal Veil	2	Dark Violet/Piano Key Black	1 passenger each (1 man, 1 woman)
8/12/2012	15:45	69	Bridalveil	1	Yellow/White	2 people
8/13/2012	12:45	72	Miners Beach	1		
8/13/2012	14:45	72	Bridal Veil	2	1-Golden Rod 1-Blanco	2 passengers each
8/13/2012	15:15	72	20 yards off Chapel Beach	2	White	2 persons on each
8/15/2012	10:55	72	400 feet off Mosquito	2	Red	1 passenger and 2 passengers
8/15/2012	14:41	72	100 feet off Mosquito	2	Green/White	1 passenger each
8/15/2012	15:10	72	Between Chapel Beach and Battleship pt. heading West	2	Both White/Green	1 person each
9/1/2012	9:38	74	Miners Castle	1	White/Green	1 passenger
9/3/2012	17:20	76	Spray Falls	2	1-Green 2-Black	with powerboat

Source: NOAA National Climatic Data Center http://www.ncdc.noaa.gov/; NPS PR Cruises 2012 PWC Count

APPENDIX E:
ACOUSTIC ENVIRONMENT AND SOUNDSCAPES

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ACOUSTIC ENVIRONMENT AND SOUNDSCAPES

SOUND ATTENUATION MODELING

Sound attenuation modeling was conducted to determine the level of noise produced by PWCs and how that noise affects the soundscape at the national lakeshore under the action alternatives. The modeling was completed for shoreline visitors in seven locations throughout the national lakeshore and in one location for a kayaker on the water, as described in the "Soundscapes and Acoustic Environment" section of chapter 4. When reviewing the modeling results, it became apparent that though the conditions of the location of the visitor changed (distance from shoreline, habitat, elevation above the PWC), the noise experienced by the visitors differed by only 1.6 to 1.8 dBA. To simplify the analysis, the average noise levels experienced are presented in chapter 4 for comparison to the baseline sound levels recorded during the 2012 acoustical monitoring survey at the national lakeshore (NPS 2013f). This appendix presents the full results of the sound attenuation modeling for each visitor location – Sand Point, Miners Beach (visitor on shore and kayaker), the North Country National Scenic Trail at Grand Portal, Chapel Beach, the North Country National Scenic Trail at Spray Falls, Twelvemile Beach at Beaver Creek (within the Beaver Basin Wilderness Area), and the North Country National Scenic Trail north of Hurricane River.

Table E-1 presents the location of the PWC, the location of the visitor, the type of terrain or habitat in which the visitor is located, the type of visitor experience that could be interrupted by PWC noise, the type of PWC behavior that would be expected, the total distance between the PWC and the visitor, and the elevation of the visitor above the PWC. Tables E-2 through E-13 present the modeling results for alternatives 1 and 2 for carbureted two-stroke PWC engines and direct injection two-stroke and four-stroke PWC engines for peak noise levels, average noise levels, and noise levels while transiting and during play behavior. Figure E-1 presents the sound attenuation modeling locations.

Model Limitations

As discussed in the "Acoustic Environment and Soundscapes" sections of chapters 3 and 4, there are many factors that influence how sound travels. The sound attenuation modeling accounts for several of these factors, but the model has some limitations. The model integrates into the results the effects of the following:

- divergence, or spreading loss – as sound leaves the source, it radiates out and the sound level is reduced as it gets further away from the source
- ground absorption – sound levels are reduced from reflection off the ground surface; the amount of loss is dependent on the surface (e.g., solid ground, open water)
- atmospheric absorption – factors such as temperature, relative humidity, and precipitation can absorb sound, thus reducing sound levels

The sound attenuation model does not consider several pertinent environmental factors, including the following:

- terrain shielding – the model does not incorporate the effects of obstacles on sound travel, which results in inflated sound level estimates
- vegetation – the model does not incorporate the absorption effects of vegetation, which results in inflated sound level estimates

- refractive effects of atmospheric profiles – the model assumes that sounds are traveling downwind in weather conditions favorable to long-range travel and does not account for inversion conditions over water surfaces, which results in lower sound level estimates

Although the sound attenuation model does not include all factors that affect how sound would be experienced by a visitor, the model does assume certain conditions that are representative of park conditions.

TABLE E-1: SOUND MODELING RECEIVER LOCATIONS

PWC Location	Affected Visitor Location	Type of Terrain	Affected Visitor Experience	Primary PWC Use	Distance of Visitor from PWC (feet)	Elevation of Visitor above PWC (feet)
200 feet from the shoreline at the Sand Point picnic area	Sand Point picnic area	Beach	Overlook	Play	313	3
200 feet from the shoreline at the Miners Beach steps	Miners Beach steps	Beach	Overlook	Play	303	10
200 feet from the shoreline at the Miners Beach steps	Kayak on water, 50 feet from shore	Water	Kayaking	Play	150	0
200 feet from the shoreline at the Grand Portal	Grand Portal	Cliffs	Short hike	Transit	363	197
200 feet from the shoreline at the Chapel Beach Trail steps	Chapel Beach Trail steps	Beach	Short hike	Play	303	4
200 feet from the shoreline at the North Country Trail at Spray Falls	North Country Trail at Spray Falls	Cliffs	Short hike	Play	343	60
200 feet from the shoreline at the Twelvemile Beach at Beaver Creek	Twelvemile Beach at Beaver Creek	Beach	Short hike	Transit	301	1
200 feet from the shoreline at the North Country Trail North of Hurricane River	North Country Trail	Beach	Short hike	Play	320	18

ALTERNATIVE 1, DURING THE PHASE-OUT PERIOD

TABLE E-2: PEAK AND AVERAGE NOISE LEVELS FROM A CARBURETED TWO-STROKE PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Distance of Receiver from PWC (ft)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
200 feet from Sand Point picnic area	313	60.9	50.7
200 feet from Miners Beach steps (beach)	303	61.7	51.2
200 feet from Miners Beach steps (kayak)	150	72.8	59.3

PWC type = Sea-Doo GTS; Number of PWCs = 1; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-3: DAILY NOISE LEVELS FROM CARBURETED TWO-STROKE PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs
200 feet from Sand Point picnic area	30.6	36.6	39.6
200 feet from Miners Beach steps (beach)	31.2	37.2	40.2
200 feet from Miners Beach steps (kayak)	39.3	45.3	48.3

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-4: DAILY NOISE LEVELS FROM CARBURETED TWO-STROKE PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes
200 feet from Sand Point picnic area	60.5	63.5	65.3
200 feet from Miners Beach steps (beach)	61.1	64.1	65.9
200 feet from Miners Beach steps (kayak)	68.9	71.9	73.7

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours; Box size = 150 feet

ALTERNATIVE 1, POST PHASE-OUT PERIOD

TABLE E-5: PEAK AND AVERAGE NOISE LEVELS FROM A DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Distance of Receiver from PWC (ft)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
200 feet from Sand Point picnic area	313	55.2	44.9
200 feet from Miners Beach steps (beach)	303	55.9	45.4
200 feet from Miners Beach steps (kayak)	150	67.1	53.6

PWC type = Sea-Doo GTS QT; Number of PWCs = 1; Speed = 50 mph

TABLE E-6: DAILY NOISE LEVELS FROM DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs
200 feet from Sand Point picnic area	24.9	30.9	33.9
200 feet from Miners Beach steps (beach)	25.4	31.4	34.4
200 feet from Miners Beach steps (kayak)	33.6	39.6	42.6

PWC type = Sea-Doo GTS QT; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-7: DAILY NOISE LEVELS FROM DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 1

Location of PWC	Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes
200 feet from Sand Point picnic area	54.8	57.8	59.6
200 feet from Miners Beach steps (beach)	55.3	58.3	60.1
200 feet from Miners Beach steps (kayak)	63.2	66.2	68.0

PWC type = Sea-Doo GTS QT; Speed = 50 mph; Duration of visitor's stay = 4 hours; Box size = 150 feet

ALTERNATIVE 2, DURING THE PHASE-OUT PERIOD

TABLE E-8: PEAK AND AVERAGE NOISE LEVELS FROM A CARBURETED TWO-STROKE PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Distance of Receiver from PWC (ft)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
200 feet from Sand Point picnic area	313	60.9	50.7
200 feet from Miners Beach steps (beach)	303	61.7	51.2
200 feet from Miners Beach steps (kayak)	150	72.8	59.3
200 feet from Grand Portal	363	60.6	50.9
200 feet from Chapel Beach Trail steps	303	61.1	50.6
200 feet from North Country Trail at Spray Falls	343	62.2	52.3
200 feet from Twelvemile Beach at Beaver Creek	301	61.0	50.5
200 feet from North Country Trail North of Hurricane River	320	61.4	51.2

PWC type = Sea-Doo GTS; Number of PWCs = 1; Speed = 50 mph

TABLE E-9: DAILY NOISE LEVELS FROM CARBURETED TWO-STROKE PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs
200 feet from Sand Point picnic area	30.6	36.6	39.6
200 feet from Miners Beach steps (beach)	31.2	37.2	40.2
200 feet from Miners Beach steps (kayak)	39.3	45.3	48.3
200 feet from Grand Portal	30.9	36.9	39.9
200 feet from Chapel Beach Trail steps	30.6	36.6	39.6
200 feet from North Country Trail at Spray Falls	32.3	38.3	41.3
200 feet from Twelvemile Beach at Beaver Creek	30.5	36.5	39.5
200 feet from North Country Trail North of Hurricane River	31.2	37.2	40.2

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor’s stay = 4 hours

TABLE E-10: DAILY NOISE LEVELS FROM CARBURETED TWO-STROKE PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes
200 feet from Sand Point picnic area	60.5	63.5	65.3
200 feet from Miners Beach steps (beach)	61.1	64.1	65.9
200 feet from Miners Beach steps (kayak)	68.9	71.9	73.7
200 feet from Grand Portal	60.9	63.9	65.6
200 feet from Chapel Beach Trail steps	60.5	63.5	65.3
200 feet from North Country Trail at Spray Falls	62.2	65.2	67
200 feet from Twelvemile Beach at Beaver Creek	60.4	63.4	65.2
200 feet from North Country Trail North of Hurricane River	61.1	64.1	65.9

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor’s stay = 4 hours; Box size = 150 feet

ALTERNATIVE 2, POST PHASE-OUT PERIOD

TABLE E-11: PEAK AND AVERAGE NOISE LEVELS FROM A DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Distance of Receiver from PWC (ft)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
200 feet from Sand Point picnic area	313	55.2	44.9
200 feet from Miners Beach steps (beach)	303	55.9	45.4
200 feet from Miners Beach steps (kayak)	150	67.1	53.6
200 feet from Grand Portal	363	54.8	45.1
200 feet from Chapel Beach Trail steps	303	55.4	44.9
200 feet from North Country Trail at Spray Falls	343	56.4	46.5
200 feet from Twelvemile Beach at Beaver Creek	301	55.3	44.8
200 feet from North Country Trail North of Hurricane River	320	55.7	45.5

PWC type = Sea-Doo GTS QT; Number of PWCs = 1; Speed = 50 mph

TABLE E-12: DAILY NOISE LEVELS FROM DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs
200 feet from Sand Point picnic area	24.9	30.9	33.9
200 feet from Miners Beach steps (beach)	5.4	31.4	34.4
200 feet from Miners Beach steps (kayak)	33.6	39.6	42.6
200 feet from Grand Portal	25.1	31.1	34.1
200 feet from Chapel Beach Trail steps	24.9	30.9	33.9
200 feet from North Country Trail at Spray Falls	26.5	32.5	35.5
200 feet from Twelvemile Beach at Beaver Creek	24.8	30.8	33.8
200 feet from North Country Trail North of Hurricane River	25.5	31.5	34.5

PWC type = Sea-Doo GTS QT; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-13: DAILY NOISE LEVELS FROM DIRECT INJECTION TWO-STROKE OR FOUR-STROKE PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 2

Location of PWC	Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes
200 feet from Sand Point picnic area	54.8	57.8	59.6
200 feet from Miners Beach steps (beach)	55.3	58.3	60.1
200 feet from Miners Beach steps (kayak)	63.2	66.2	68.0
200 feet from Grand Portal	55.1	58.1	59.9
200 feet from Chapel Beach Trail steps	54.8	57.8	59.6
200 feet from North Country Trail at Spray Falls	56.4	59.4	61.2
200 feet from Twelvemile Beach at Beaver Creek	54.7	57.7	59.5
200 feet from North Country Trail North of Hurricane River	55.4	58.4	60.2

PWC type = Sea-Doo GTS QT; Speed = 50 mph; Duration of visitor's stay = 4 hours; Box size = 150 feet

ALTERNATIVE 4, NO PHASE-OUT

These calculations are the same as those presented for alternative 1, during the phase-out.

TABLE E-14: PEAK AND AVERAGE NOISE LEVELS FROM A CARBURETED TWO-STROKE PWCS BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 4

Location of PWC	Distance of Receiver from PWC (ft)	Peak Noise Levels (dBA)	Average Noise Levels (dBA)
200 feet from Sand Point picnic area	313	60.9	50.7
200 feet from Miners Beach steps (beach)	303	61.7	51.2
200 feet from Miners Beach steps (kayak)	150	72.8	59.3

PWC type = Sea-Doo GTS; Number of PWCs = 1; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-15: DAILY NOISE LEVELS FROM CARBURETED TWO-STROKE PWCS DURING TRANSIT BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 4

Location of PWC	Noise Levels (dBA)		
	1 PWC	4 PWCs	8 PWCs
200 feet from Sand Point picnic area	30.6	36.6	39.6
200 feet from Miners Beach steps (beach)	31.2	37.2	40.2
200 feet from Miners Beach steps (kayak)	39.3	45.3	48.3

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours

TABLE E-16: DAILY NOISE LEVELS FROM CARBURETED TWO-STROKE PWCS DURING CIRCLING PLAY BEHAVIOR BASED ON SOUND ATTENUATION MODELING FOR ALTERNATIVE 4

Location of PWC	Noise Levels (dBA)		
	30 minutes	60 minutes	90 minutes
200 feet from Sand Point picnic area	60.5	63.5	65.3
200 feet from Miners Beach steps (beach)	61.1	64.1	65.9
200 feet from Miners Beach steps (kayak)	68.9	71.9	73.7

PWC type = Sea-Doo GTS; Speed = 50 mph; Duration of visitor's stay = 4 hours; Box size = 150 feet

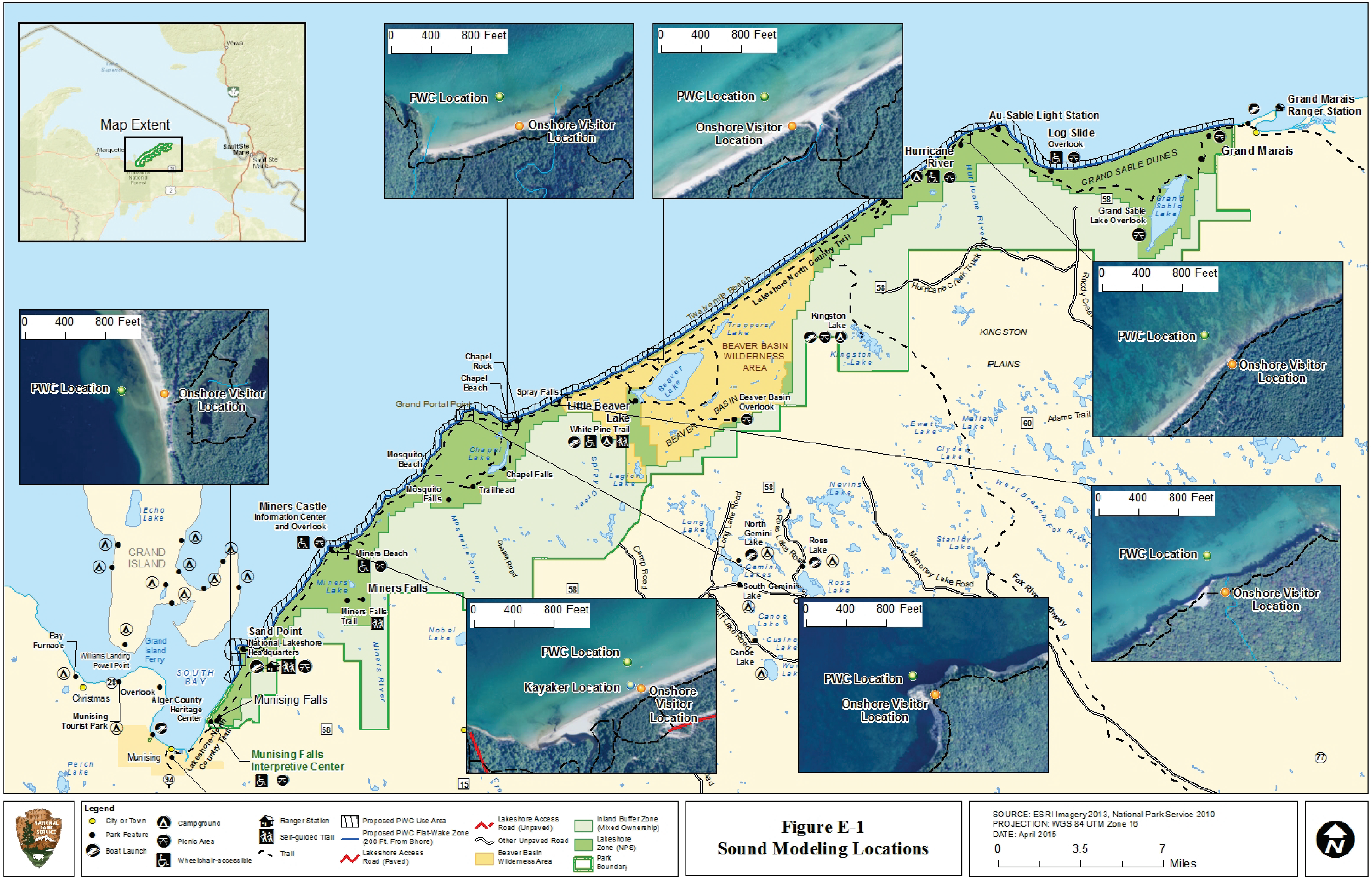

Figure E-1
Sound Modeling Locations

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APPENDIX F:
NPS RESPONSES TO PUBLIC COMMENTS

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PIRO PWC EA: PUBLIC COMMENT RESPONSES

Concern Statement 1: The EA does not analyze a true no-action, or status quo, alternative. The EA dismisses an alternative that would continue current management of PWCs, and although alternative 1 retains the same PWC use area that is currently allowed at the national lakeshore, the phase-out of carbureted two-stroke PWCs would preclude most PWCs from being used at the national lakeshore after two years.

> **Response:** As explained on page 26 of the Revised EA, the NPS selected the "no PWC use" alternative (alternative 3) as the no-action alternative due to the 2010 court ruling on the original EA from 2002. The no-action alternative in the 2002 EA was the "no PWC use" alternative. To address the direction from the court, which was to correct the deficiencies of the 2002 PWC management EA, the NPS wanted to provide a comparable analysis using the same no-action alternative and similar action alternatives. However, the Revised EA includes a new "alternative 4," which is now the NPS preferred alternative. It is based on the preferred alternative (alternative 1) from the 2017 EA without the requirement for the phase out of carbureted 2-stroke PWC engines. It is essentially the "status quo" alternative.

Concern Statement 2: The EA addressed the impacts to park resources based on the current level of PWC use, which is low. However, this trend could change based on factors such as the expansion of the Munising Marina. The EA does not indicate what the NPS would do if PWC use substantially increased at Pictured Rocks and resulted in unacceptable environmental impacts. The Revised EA should indicate how monitoring of park resources will occur and what actions the NPS would take in the event that resource impacts approach an unacceptable level.

> **Response:** As documented in the Revised EA, resource impacts from PWC use are very slight due to the very low level of PWC use at the national lakeshore. Recent PWC counts at the park do not indicate that PWC use has increased since the original PWC use regulation was implemented in 2005, even though overall park visitation has increased since then. PWC use will likely remain low at the national lakeshore due to the remoteness of the park and distance from large population centers, cold water temperature, cool ambient air temperature, sudden changes in weather conditions, and heavy winds and wave action on Lake Superior. The NPS believes these factors will limit PWC use regardless of such factors as expansions of nearby marinas. This was the rationale for analyzing impacts at the current level of PWC use. To ensure that impacts were not underestimated, the NPS analyzed impacts using the older, more polluting PWCs even though there are likely newer, cleaner PWCs in use at the park.
>
> However, the NPS realizes that visitation numbers and use patterns can fluctuate over time which could result in changes to the number of PWCs that operate in the park in the future. Therefore, the preferred alternative in the Revised EA includes a provision for the park to conduct a PWC count to determine the level of PWC use in the future. In five years (or sooner if necessary), the park would undertake a PWC count similar to the one that was conducted during this EA process. If the results of the PWC count indicate that PWC use at the park has substantially increased from current levels, the NPS would determine if additional compliance actions are necessary, and if so, complete that additional compliance.

Concern Statement 3: The EA should analyze an alternative that includes all portions of the shoreline except for the Beaver Basin Wilderness Area.

> **Response:** Although there was not a specific stand-alone alternative that included PWC use along the entire shoreline except for Beaver Basin, the EA analyzed the impacts of PWC use along the entire shoreline of Pictured Rocks and included alternatives where PWC use was not allowed adjacent to the Beaver Basin Wilderness. The environmental impacts of allowing use in all portions of the shoreline except for Beaver Basin fall within the range of impacts of the alternatives that the NPS analyzed. Based on the analysis in the EA, the NPS does not believe that it would be appropriate to allow PWC use along the eastern portion of the National Lakeshore. As described in Chapter 4 of the EA, allowing PWC use east of Beaver Basin would result in increased impacts to wildlife, threatened and endangered species, visitor experience, the acoustic environment, and visitor safety.

Concern Statement 4: Due to the proximity of US Forest Service (USFS) campsites to the PWC use area under alternative 1, particularly those on Grand Island in Hiawatha National Forest, the NPS should consider additional outreach to these users via signage and online notices. The NPS should also provide outreach to national lakeshore visitors that use more remote areas to make them aware of PWC use.

> **Response:** As stated on page 24 of the Revised EA, the action alternatives include an improved education and outreach program. This program will include providing information to park visitors in person, as well as through the website, publications, and brochures. The NPS will reach out to USFS to determine if there is a need to provide additional information to campers on Grand Island.

Concern Statement 5: The EA does not analyze a full range of alternatives. Alternative 3 would completely ban PWC use. Under alternatives 1 and 2, the phase-out of carbureted two-stroke PWCs would eliminate nearly all PWCs in currently in use at the national lakeshore, thus resulting in a near ban of PWCs. The EA should analyze another action alternative that does not include the phase-out of carbureted two-stroke PWCs.

> **Response:** While the NPS believes that the 2017 EA did analyze a full range of reasonable alternatives, the Revised EA includes a new alternative 4, which is essentially alternative 1 from the 2017 EA without the phase-out of carbureted two-stroke PWCs. Alternative 4 represents the NPS preferred alternative in the Revised EA.

Concern Statement 6: The phase-out of carbureted two-stroke PWCs under alternatives 1 and 2 over a two-year period is too abrupt, as it would cause adverse impacts on PWC users that do not own PWCs with direct injection engines. A longer phase-out period, such as the 10-year period adopted at Lake Mead, would allow PWC users to continue recreating at the national lakeshore.

> **Response:** The NPS reviewed this comment and discussed extending the two-year phase-out period due to the potential for impact to owners of older PWCs. After a thorough review of the environmental analysis of the preferred alternative in the 2017 EA, the NPS decided that the requirement for PWCs to meet the 2010 EPA emissions standards was not necessary, due to the

low level of PWC use at the park and the limited area in which PWCs would be allowed to operate. Therefore, the NPS added a new alternative in the Revised EA which eliminates the phase-out of carbureted two-stroke PWCs but still allows PWC use in areas of the park where PWCs are currently authorized to operate. This alternative (alternative 4) is the NPS preferred alternative in the Revised EA.

Concern Statement 7: The EA does not demonstrate the need for the phase-out of carbureted two-stroke PWCs under alternatives 1 and 2. The analysis states that the use of carbureted two-stroke PWC engines produces very low adverse impacts on natural, cultural, and human resources at the national lakeshore. Although a movement towards only allowing direct injection PWC engines would reduce these impacts slightly, the EA does not support the phase-out.

Response: After much deliberation and additional investigation, the NPS agrees that the extremely minimal level of expected impact to resources from PWC use disclosed in the EA does not warrant a requirement that all PWCs used in the park meet the 2010 EPA emissions standards. Therefore, the requirement for a phase-out of older 2-stroke PWCs was not included in the NPS preferred alternative in the Revised EA for the following reasons:

- Air and water quality at the park are both very good, even with the presence of older PWCs in park waters. As described in the EA, impacts to water quality and air quality from current PWC use are minimal and do not rise to a detectable level. Therefore, implementing additional restrictions would not result in measurable benefits to air or water quality.

- The low level of PWC use and limited area of operation under the preferred alternative would keep impacts to the park's acoustic environment to a minimum, even if the 2010 EPA standards are not implemented. PWCs would not be allowed adjacent to park wilderness in the preferred alternative.

- Newer PWCs have replaced older ones in the PWC fleet since this NEPA process was started, and will continue to do so as time passes. Since 2011, all PWCs manufactured have direct injection engines, which do not deposit fuel directly into the water and produce much lower levels of airborne pollutants. Also, the newer PWCs are quieter due to the 4-stroke engine and improved hull design.

- As described in the response to Concern Statement 2, the preferred alternative in the Revised EA contains a provision for the NPS to conduct a PWC count in five years to determine the level of PWC use and if further compliance actions are necessary.

Concern Statement 8: The EA dismisses socioeconomics from full analysis. This dismissal focuses on the lack of concessionaires in the park and rental facilities in gateway communities. The EA should analyze the socioeconomic impact of the phase-out of carbureted two-stroke PWCs under alternatives 1 and 2 on PWC owners. The impact of the phase-out is analyzed under Visitor Use and Experience, but this analysis does not cover the cost of replacing a PWC with a newer model. The cost of a new PWC could eliminate this recreation activity for some visitors that currently use PWCs at the national lakeshore.

Response: Socioeconomic issues were dismissed from detailed analysis based on guidance in the 2015 NPS NEPA Handbook. The Handbook states that issues should be fully analyzed if the impacts are of critical importance, detailed analysis is necessary to decide between alternatives, the impacts are a big point of contention among the public or agencies, or there are potentially significant impacts to resources. The dismissal of socioeconomics on pages 17 and 18 of the Revised EA explains that the management of PWC use at the national lakeshore would not have an impact on gateway communities, as there are no local businesses that rent PWCs. For these reasons, socioeconomics is not considered a key element in determining the proper management of PWC use at the national lakeshore.

When considering the economic impacts of PWC management on visitors to the national lakeshore, the NPS must consider all visitors. PWC users represent a very small portion of national lakeshore visitors; therefore, the effects of phasing out carbureted two-stroke PWCs would adversely affect only a small number of national lakeshore visitors. However, because, as the commenter states, the phase-out could adversely affect PWC users and preclude them from recreating in the park, the Visitor Use and Experience sections have been updated to address this issue. Also, the preferred alternative in the Revised EA would not require a phase out of two-stroke PWCs, so there would be no adverse impact to owners of older PWCs who want to recreate at the national lakeshore under the preferred alternative.

Concern Statement 9: PWCs and other motorized watercraft should be managed similarly at the national lakeshore. All internal combustion engines generate noise and pollution, operate at high speeds, cause wake, and can transport invasive species; therefore, all motorized watercraft should be given the same access and operate under the same restrictions.

Response: While it is true that all internal combustion engines can cause impacts to the resources at Pictured Rocks, due to their design and maneuverability, PWCs can cause greater levels of impact to the acoustic environment, wilderness, and wildlife. The scope of the EA is confined to PWCs, which have a specific regulatory definition and require a special regulation in order to be allowed in national park units. As described in the EA, PWCs are often operated in "play behavior" which can include rapid speed and directional changes and circling in a limited geographic area. It is these characteristics of PWC use that warrant different management for PWCs when compared to other motorized vessels and are the reason behind not allowing unlimited PWC access under the NPS preferred alternative.

Furthermore, the state of Michigan also has regulations specific to the operation of PWCs that do not apply to other watercraft. The 200-foot flat wake zone, operator safety requirements, speed limits, and age restrictions in the EA's action alternatives are consistent with the existing state regulations on PWC use along the Lake Superior shoreline. While the NPS could develop more stringent regulations for PWCs at Pictured Rocks, Michigan's PWC safety and flat-wake restrictions were considered to be appropriate for use in the park and were therefore incorporated into the action alternatives.

Concern Statement 10: Despite the challenges of decreased funding and increased visitation, the NPS must continue to monitor and manage conflicts between user groups at the national lakeshore. To ensure that the safety of visitors is adequately protected, the NPS should closely monitor instances of visitor conflicts particularly at Sand Point and Miners Beach where recreational use is concentrated.

Response: As stated on page 75 of the Revised EA, there is little evidence of visitor conflicts and safety concerns, and to date, no documented accidents have occurred at the national lakeshore from PWC operation. If PWC use were to substantially increase in the future or if park staff observe a meaningful increase in conflicts between PWC users and other visitors, the superintendent has the ability to restrict or terminate access to areas of allowed PWC use. This provision is included in the action alternatives and is stated on page 19 of the Revised EA. Furthermore, as part of the preferred alternative in the Revised EA, the NPS would commit to completing additional compliance, as necessary, if PWC use were to substantially increase.

Concern Statement 11: Use of PWCs at the national lakeshore will increase the likelihood of transporting non-native aquatic species into the waters of the park.

Response: PWCs represent a very small part of the vessels that operate in park waters. Furthermore, state regulations require that all vessels and trailers be free of all aquatic organisms prior to transporting over land. Therefore, the continued use of PWCs is not expected to measurably increase the likelihood of non-native aquatic species in the park.

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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

March 2019

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