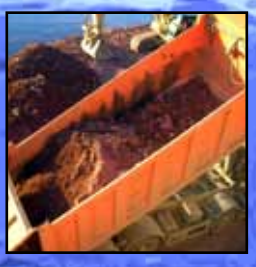
National Park Service
U.S. Department of the Interior

Natural Sounds Program

Acoustical Toolbox:
Recommendations for Reducing Noise Impacts in National Parks



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Microphone monitoring sound, Death Valley National Park.

The mission of the Natural Sounds Program is "… to protect, maintain, or restore acoustical environments throughout the National Park System. We fulfill this mission by working in partnership with parks and others to increase scientific and public understanding of the value and character of soundscapes and to eliminate or minimize noise intrusions."

Reducing Noise Impacts in National Parks

This informative toolbox is intended to help national park staff, contractors, and concessionaires reduce noise pollution and increase opportunities for visitors to hear unique natural and cultural sounds in parks. By reducing noise impacts, wildlife in ecologically sensitive areas have less chance of disturbance or displacement. Visitors also benefit because they will have better acoustic experiences and more opportunities to see and hear wildlife that may otherwise be displaced. This guide provides noise specifications for a variety of transportation sources and maintenance/construction equipment commonly used in parks.

Please use this guide to select quiet technology to meets your park's needs while also reducing impacts on park soundscapes.

What Are Acoustic Resources?

Acoustic resources include the sounds of nature such as wildlife, waterfalls, wind, and rain, as well as historic and cultural sounds in units of the National Park System. The human perception of that acoustical environment is defined as the *soundscape*.

Acoustical monitoring station in Kenai Fjords National Park

Facing page: Visitor in Great Sand Dunes National Park and Preserve, the quietest location ever measured by the Natural Sounds Program. NPS/Scott Hansen.

Recommendations for Reducing Transportation, Maintenance, and Construction Noise

Operation of maintenance equipment, tools, and construction equipment should be limited to times and locations that minimize impacts on visitors and ecologically sensitive areas. Noisy tools such as saws and leaf blowers should be operated to the extent possible in a manner that minimizes speed changes. With leaf blowers, for example, throttle/speed should be kept constant at the minimum level required to get the job done effectively. Revving or excessive throttle/speed changes of power equipment should be avoided.

In all cases, park staff should select models with the lowest sound levels and operational specifications that meet their needs. In order to help facilitate this, relevant operational specifications other than levels have been provided where possible.

The decibel (dB) is a logarithmic unit of measurement that expresses the magnitude of a physical quantity relative to a specified or implied reference level. The decibel is useful for acoustical measurements because it has the ability to conveniently represent very large or small numbers within a logarithmic scale that roughly corresponds to the human perception of sound. The A-weighted decibel (dBA) incorporates a weighting filter that reduces the contribution of low and high frequencies to produce a reading that corresponds approximately to what we hear.

Park Aircraft

- Minimize impacts on sensitive wilderness, wildlife, and/or visitors use areas.
- Make careful route choices to avoid sensitive areas.
- Combine flight missions to minimize the number of flyovers.
- Limit flights to certain seasons when impacts are less likely.
- Purchase and choose the quietest aircraft model for a given use.
- Limit throttle/thrust to reduce noise, fuel consumption, and greenhouse gas creation.

Park Vehicles

- Electric or hybrid vehicles generally should be chosen for medium- and long-distance travel.
- If possible, electric vehicles should be chosen for local, short-distance travel.
- If available, hybrid-electric vehicles should be chosen for medium- and long-distance needs.

Maintenance Equipment

• Electric motors generally create less noise than combustion engines.

Product Recommendation Key:

- Highest recommendation (lowest noise and other factors)
- Moderate recommendation (moderate noise and other factors)
- Least recommended (higher noise and other factors)

Chain Saws

In general, park staff should select models with the lowest levels (dBA) that meet their needs. In general, battery-powered models are probably best for pole saw cutting of overhead limbs, and electric models such as the Husqvarna 316 and Makita UC4000 are best for light cleanup in public areas where AC power is available. For larger trees and cleanup away from public areas, models such as the Husqvarna and Pouland 261 may be recommended. Models not shown on this list have not been measured or are not recommended in terms of noise.

Chain Saw Noise Levels
[from Noise Pollution Clearinghouse publication "Quiet Chainsaws"]

Fuel	Brand	Model	HP	Cost	Subjective cut rank	25 foot with load Lmax (dBA)	25 foot no load Lmax (dBA)	Operator with load Leq (dBA)	Operator with load Lmax (dBA)	Operator no load Leq (dBA)	Operator no load Lmax (dBA)
Electric	Makita	Battery		$198	15	61	61	79	81	79	80
Electric	Neuton	Battery		$100	14	66	67	83	84	82	83
Electric	Husqvarna	316		$229	2	71	71	90	92	92	94
Electric	Makita	UC4000		$199	1	75	77	92	95	93	95
Electric	McCulloch		1.5	$40	13	77	79	94	98	95	96
Electric	Remington		3	$85	10	78	80	98	99	97	100
Electric	Remington		1.5	$55	11	79	81	96	99	93	95
Electric	Troybuilt		3.5	$90	5	80	82	95	98	94	97
Electric	Poulan		2	$50	6	81	86	100	102	96	99
Electric	Craftsman		2.5	$50	9	81	86	101	102	97	97
Electric	Poulan		3.5	$80	4	81	87	97	100	98	101
Electric	Remington	Pole	1.25	$110	12	81	87	98	101	97	99
Electric	Craftsman	Saw	3.5	$80	8	83	86	97	99	98	101
Electric	Poulan		4	$100	3	83	87	98	101	98	102
Electric	Poulan	Pro	3	$60	7	84	86	99	101	97	100
Gas	Husqvarna					86	88	102		106	
Gas	Pouland	261				85	92	107	109	109	112
Gas	Jonserud	2775				91	98	111	114	115	117
Gas	Jonserud	Turbo 2171				NA	97	110	114	112	116

String Trimmers (Weed Eater/Wacker)
If only light-duty trimming is needed, the battery-powered BTE-1 Lawn (string) trimmer from Sunlawn is most highly recommended. It will generate fairly low noise levels. Other electric options, including corded models, will generate lower noise than gas-powered options. If gas-powered string trimmers are required, however, park staff should choose four-cycle combustion models over two-cycle engines. Four-cycle models will generally produce less noise than two-cycle trimmers. Four-cycle trimmers will also produce less noise than brush hogs and may be used to accomplish the same results in small areas.

Snow Blowers
The Honda HS621A is known to be a quiet snow blower model.

Lawn Mowers
Park staff should select models with the lowest levels (dBA) that meet their needs. It is also helpful for park staff to consider whether hearing protection is recommended or needed.

Electric mowers and reel mowers such as the Brill Lexus 38 are recommended for small lawns and for noise sensitive areas. Recommended gas-powered mowers include the Ariens Model 911097, the Honda HRX21HXA, the Lawn-Boy 10684, and many Craftsman models, including 37657, 38768, 37706, 37706, 37709, and 37794. Riding lawn mowers are almost always louder than push models, but the Electric Ox is moderately quiet, followed by gas-powered models such as the Craftsman 27564 and 27570. Models not shown on this list have not been measured or are not recommended in terms of noise.

Lawn Mower Noise Levels
[from Noise Pollution Clearinghouse publication "QuietLawn05"]

Type	Brand	Model	Cost	Noise at operator's ear (dBA)	Hearing protection
Reel Mower	McLane	17" Front Throw	$200	63.2	Not Needed
Cordless Electric Reel Mower	Brill/Sun Lawn	Accu Mower 380 ASM	$350	67.6	Not Needed
Reel Mower	Brill/Sun Lawn	Luxus 38	$200	68.0	Not Needed
Reel Mower	Silent Reel		$249	74.0	Not Needed
Reel Mower	American		$130	76.0	Not Needed
Electric-Cordless	Neuton	EM 4.1	$400	77.0	Not Needed
Electric-corded	Yard Machines	13 inch	$200	79.0	Not Needed
Electric-Cordless	Black & Decker	CMM 1000	$460	79.0	Not Needed
Electric-Corded	Black & Decker	MM875	$240	80.0	Not Needed
Gas—Self Propelled	Ariens	911097	$470	81.9	Not Needed
Electric—Riding	Electric Ox		$7,500	82.0	Recommended
Gas—Self Propelled	Craftsman	37657	$280	83.3	Recommended
Gas—Push	Craftsman	38768	$220	83.4	Recommended
Gas—Self Propelled	Honda	HRX217HXA	$700	83.7	Recommended
Gas—Self Propelled	Lawn-Boy	10684	$340	83.7	Recommended
Gas—Self Propelled	Craftsman	37706	$300	83.7	Recommended
Gas—Self Propelled	Craftsman	37709	$340	84.0	Recommended
Gas—Self Propelled	Craftsman	37794	$400	84.0	Recommended
Gas—Push	Murray	225112X92A	$160	84.0	Recommended
Gas—Push	Weed Eater	961360001	$160	84.1	Recommended
Gas—Push	Lawn-Boy	10683	$320	84.3	Recommended
Gas—Self Propelled	Lawn-Boy	10695	$450	84.3	Recommended
Gas—Self Propelled	Craftsman	37910	$280	84.3	Recommended
Gas—Self Propelled	Craftsman	37784	$400	84.6	Recommended
Gas—Push	Craftsman	38885	$230	84.7	Recommended
Gas—Self Propelled	Toro	20055 Super Recycler	$520	84.7	Recommended
Gas—Self Propelled	Lawn-Boy	10685	$380	84.3	Recommended
Gas—Self Propelled	Murray	226111X92A	$220	84.9	Recommended
Gas—Self Propelled	Yard-Man	12A978Q	$400	84.9	Recommended
Gas—Push	Craftsman	38766	$140	85.0	Recommended
Gas—Self Propelled	Toro	Personal Pace Recycler 20031	$420	85.0	Recommended
Gas—Self Propelled	Toro	Personal Pace Recycler 20031	$420	85.2	Needed
Electric-Corded	Bolens	18A-V17-765	$190	85.4	Needed
Gas—Push	Craftsman	38746	$200	85.6	Needed
Gas—Self Propelled	Craftsman	37778	$330	85.6	Needed
Gas—Self Propelled	Troy-Bilt	12AV569N	$300	85.7	Needed
Gas—Self Propelled	Troy-Bilt	12AV839N	$350	85.7	Needed
Gas—Push	MTD	Pro 11A588Q795	$200	85.9	Needed
Gas—Self Propelled	Craftsman	37669	$300	86.1	Needed
Gas—Self Propelled	John Deere	JS63C	$540	86.1	Needed
Gas—Self Propelled	Husqvarna	55R21HV	$480	86.2	Needed
Gas—Push	Toro	20008	$350	86.4	Needed
Gas—Self Propelled	Craftsman	37855	$330	86.4	Needed

Lawn Mower Noise Levels (continued)
[from Noise Pollution Clearinghouse publication "QuietLawn05"]

Type	Brand	Model	Cost	Noise at operator's ear (dBA)	Hearing protection
Gas—Push	Bolens	11A-414E	$160	86.5	Needed
Gas—Self Propelled	Yard-Man	12A445E755	$260	86.9	Needed
Gas—Self Propelled	Lawn-Boy	GOLD SERIES 10655	$400	86.9	Needed
Gas—Self Propelled	Toro	Personal Pace Recycler 20041	$420	87.0	Needed
Gas—Self Propelled	John Deere	JX75	$840	87.0	Needed
Gas—Push	MTD	Pro 11A588Q	$200	87.6	Needed
Gas—Push	Bolens	11A084C163	$170	87.6	Needed
Gas—Self Propelled	Bolens	12A-264E	$230	88.0	Needed
Gas—Self Propelled	Yard-man	12A-568Q	$290	88.1	Needed
Gas—Self Propelled	Craftsman	37894	$280	88.1	Needed
Gas—Self Propelled	Yard-Man	DLX 12A567A	$300	88.3	Needed
Gas—Push	Troy-Bilt	11A-439R	$200	88.5	Needed
Gas—Self Propelled	Yard-Man	12A-556Q	$330	88.6	Needed
Gas—Self Propelled	Snapper	RP217018BV	$520	88.8	Needed
Gas—Push	Craftsman	38855	$230	89.4	Needed
Gas—Push	Bolens	11A-584E765	$170	89.4	Needed
Gas—Self Propelled	Troy-Bilt	TuffCut 230 12AF569O	$400	89.4	Needed
Gas—Push	Yard-Man	11A435D775	$190	89.4	Needed
Gas—Push	Snapper	MR216517B	$410	90.3	Needed
Gas—Self Propelled	Snapper	RP215517HC	$660	90.9	Needed
Gas—Self Propelled	Husqvarna	5521CHV	$350	90.9	Needed
Gas—Riding	John Deere	L111	$1,800	90.2	Needed
Gas—Riding	Craftsman	27564	$1,500	90.8	Needed
Gas—Riding	Craftsman	27570	$1,800	90.9	Needed
Gas—Riding	Ariens	1434 915061	$2,300	91.0	Needed
Gas—Riding	Snapper	ZT18440KH	$4,000	91.2	Needed
Gas—Riding	Craftsman	27537	$1,100	91.2	Needed
Gas—Riding	Ariens	1540 915065	$3,100	91.4	Needed
Gas—Riding	Cub Cadet	13AQ11CP	$2,000	91.6	Needed
Gas—Riding	Cub Cadet	LT1045 13AX11CH	$1,700	91.7	Needed
Gas—Riding	Husqvarna	Z4217	$2,700	92.2	Needed
Gas—Riding	Yardman	13AN791G	$1,000	92.3	Needed

Leaf Blowers

In response to an increasing number of residential complaints and noise ordinances regarding leaf blowers, manufacturers are now introducing a number of quieter leaf blower models. Recommendations follow for leaf blowers. Park staff should select models with the lowest levels (dBA) that meet their needs. Needs versus product capability may be assessed via specifications such as air velocity (mph) and air flow in cubic feet per minute (cfm). Models not shown on this list have not been measured or are not recommended in terms of noise.

Leaf Blower Noise Levels

Type	Manufacturer brand name	Model number	Rated level at 50 ft (dBA)	Distance	Operating mode	Rated air velocity	Rated air volume (in pipe/tube)
Cordless Electric	Black & Decker	NS118	Unspecified	Unspecified	Unspecified	120 mph	Unspecified
Corded Electric	Toro	Power Sweep	63.5	50 ft (15 m)	High Speed	140 mph	170 cfm
Corded Electric	Stihl	BGE 71	58	50 ft (15 m)	Low Speed	119 mph	318 cfm
			64	50 ft (15 m)	High Speed	148 mph	394 cfm
Backpack	Husqvarna	356BT	64	50 ft (15 m)	Unspecified	177 mph	473 cfm
Corded Electric	Stihl	BGE 61	64	50 ft (15 m)	Unspecified	148 mph	394 cfm
Handheld	Echo	PB-251	65	50 ft (15 m)	Unspecified	145 mph	390 cfm
Handheld	Echo	PB-255	65	50 ft (15 m)	Unspecified	145/160 mph (Round/Flared)	390/345 cfm (Round/Flared)
Backpack	Echo	PB-265L	65	50 ft (15 m)	Unspecified	135 mph	355 cfm
Backpack	Echo	PB-460LN Quiet 1	65	50 ft (15 m)	Unspecified	175 mph	380 cfm
Handheld	Stihl	BGE 66 L	65	50 ft (15 m)	Unspecified	143 mph	418 cfm
Backpack	Stihl	BR 500	65	50 ft (15 m)	Unspecified	181 mph	477 cfm
Backpack	Shindaiwa	EB8520RT	65	Unspecified	"Hush Mode" Only	Unspecified	Unspecified
Backpack			75	Unspecified	"Normal Mode"	229 mph	813 cfm
Backpack	Husqvarna	125BT	67	50 ft (15 m)	Unspecified	140 mph	311 cfm
Backpack	Husqvarna	130BT	69	50 ft (15 m)	Unspecified	145 mph	360 cfm
Handheld	Stihl	BG 55	69	50 ft (15 m)	Unspecified	140 mph	417 cfm

The most advanced quiet technology on the market today...the rake!

Portable Generators

In general, park staff should select models with the lowest levels (dBA) that meet their needs. See also the generator recommendations in the "Construction Equipment" section.

Portable Generator Noise Levels

Manufacturer brand name	Model number	Noise level at 9 ft (3 m) and rated load (dBA)	Rated load at 120V	Max load at 120V	Run time per tankful at rated load	Dry weight
Honda	EU3000isAN	58	2800W (23.3A)	3000W (25A)	7.2 hrs.	134 lbs.
Honda	EU1000iAN	59	900W (7.5A)	1000W (8.3A)	3.8 hrs.	29 lbs.
Honda	EU2000 series	59	1600W (13.3A)	2000W (16.7A)	4 hrs.	46 lbs.
Honda	EU6500isA	60	5500W (45.8A)	6500W (54.1A)	4.7 hrs.	253 lbs.
Honda	EM5000isAB	68	4500W (37.5A)	5000W (41.7A)	5.7 hrs.	217 lbs.
Honda	EB3000cKAG/N	68	2600W (21.7A)	3000W (25.0A)	6 hrs.	68.4 lbs.
Honda	EP2500X series	69	2300W (19.2A)	2500W (20.8A)	10.2 hrs.	99 lbs.
Honda	EM3800SXA	71	3300W (27.5A)	3800W (31.6A)	10.4 hrs.	192 lbs.
Honda	EB3800XA	71	3300W (27.5A)	3800W (31.6A)	10.4 hrs.	185 lbs.
Honda	EG3500XK1A	72	3000W (25.0A)	3500W (29.2A)	3.2 hrs.	118 lbs.
Honda	EM5000SXK2A	72	4500W (37.5A)	5000W (41.7A)	8.3 hrs.	223 lbs.
Honda	EB5000XK2A	72	4500W (37.5A)	5000W (41.7A)	8.3 hrs.	214 lbs.
Honda	EM6500SXK1A	75	5500W (45.8A)	6500W (54.1A)	5.3 hrs.	227 lbs.
Honda	EB6500XA	75	5500W (45.8A)	6500W (54.1A)	5.3 hrs.	220 lbs.
Honda	EG5000XK1A	76	4500W (37.5A)	5000W (41.7A)	2.4 hrs.	147 lbs.

Tools

The source of the following sound level data is the National Institute for Occupational Safety and Health (NIOSH) Power Tools Database. Updated information can be found on the following website: wwwn.cdc.gov/niosh-sound-vibration/

It is important to keep in mind that the sound power level (SWLA) is generally similar to the sound level at the operator's ear. Also, the loaded sound power level will generally be more relevant than the unloaded one, since most tools tend to spend more operational time at their loaded state than the unloaded one. Finally, if a particular operator is sensitive to hand vibration, a product with a lower vibration level can be selected to promote increased comfort during use.

Circular Saws

Park staff should select saws with the lowest loaded A-weighted sound power level (SWLA) that meet their needs.

Circular Saw Noise Levels

Manufacturer brand name	Model number	Loaded SWLA (dBA)	Unloaded SWLA (dBA)	Vibration: right hand (m/s^2)	Vibration: left hand (m/s^2)	Technical specification: saw blade diameter	Rated elec. power (Watts)	Rated speed (RPM)
Porter Cable	345	103	95	2.2	2.4	6 inch	1080	6000
Milwaukee	6370-20	102	104	8.3	6.1	8 inch metal cutting	1560	3700
Porter Cable	314	104	95	3.4	4.1	4 1/4 inch	540	4500
Makita	5277NB	105	95	2.9	3.3	7 1/4 inch	1800	4300
Makita	5057KB	105	101	3.6	3.0	7 1/4 inch	1560	5800
Hitachi	C7SB2	106	100	4.2	3.2	7 1/4 inch	1800	5800
Porter Cable	743	107	98	2.5	2.5	7 1/4 inch	1800	5800
Bosch	CS20	107	99	2.7	3.1	7 1/4 inch	1800	5600
DeWalt	DW364	108	103	1.9	2.1	7 1/4 inch	1800	5800
Ridgid	R3200	108	102	3.0	2.1	7 1/4 inch	1800	5800
DeWalt	DW378G	108	96	3.3	4.7	7 1/4 inch	1800	4600
DeWalt	DW384	109	102	5.7	4.5	8 1/4 inch	1800	5800
Milwaukee	6390-20	109	97	2.5	2.9	7 1/4 inch	1800	5800
Milwaukee	6375-20	109	102	3.2	4.4	7 1/4 inch	1800	5800
DeWalt	DW369	109	99	5.1	4.7	7 1/4 inch	1800	5800
Makita	4200NH	109	99	3.3	2.3	4 3/8 inch	1092	11000
Milwaukee	6378	110	102	3.9	4.4	8 1/4 inch	1800	4400
Makita	5007FK	110	98	2.5	3.0	7 1/4 inch	1800	5800
Porter Cable	324MAG	110	109	3.0	3.5	7 1/4 inch	1800	5800
DeWalt	DW368	110	101	4.0	3.6	7 1/4 inch	1800	5800
Skil	5400	110	105	5.0	4.8	7 1/4 inch	1440	4600
Ryobi	CSB121	110	104	6.5	5.7	7 1/4 inch	1440	4600
Milwaukee	6460	111	101	6.8	4.2	10 1/4 inch	1800	5200
Black and Decker	FS1300CS	111	103	4.1	5.1	7 1/4 inch	1560	5000
Skil	5750	111	104	3.1	4.3	7 1/4 inch	1560	4600
Makita	5008NB	112	101	2.8	3.0	8 1/4 inch	1560	5200
Skil	5600	112	104	4.0	5.6	7 1/4 inch	1560	4600
Skil	5500	113	107	3.8	4.2	7 1/4 inch	1560	4600

Impact Wrenches

Park staff should select impact wrenches with the lowest loaded A-weighted sound power level (SWLA) that meet their needs.

Impact Wrench Noise Levels

Manufacturer brand name	Model number	Loaded SWLA (dBA)	Unloaded SWLA (dBA)	Vibration: right hand (m/s^2)	Vibration: left hand (m/s^2)	Technical specification: output shaft size	Rated elec. power (Watts)	Rated speed (RPM)
DeWalt	DW290	107	91	-	-	1/2 inch	900	-

Drills

Park staff should select drills with the lowest loaded A-weighted sound power level (SWLA) that meet their needs.

Drill Noise Levels

Manufacturer brand name	Model number	Loaded SWLA (dBA	Unloaded SWLA (dBA)	Vibration: right hand (m/s^2)	Vibration: left hand (m/s^2)	Technical specification: chuck size	Rated elec. power (Watts)	Rated speed (RPM)
Milwaukee	0302-20	91	90	2.7	4.5	1/2 inch	960	850
Milwaukee	0299-20	91	91	3.0	4.3	1/2 inch	960	850
Milwaukee	0300-20	91	90	3.5	5.0	1/2 inch	960	850
Makita	6303H	91	89	4.9	5.2	1/2 inch	780	850
Hitachi	D10VH	91	90	3.8	5.6	3/8 inch	680	2500
Makita	6408	87	91	5.8	13.3	3/8 inch	588	2500
Hitachi	D13VF	92	92	2.9	3.5	1/2 inch	1020	850
Global Machinery Company	RAD45KUL	92	91	8.0	6.5	3/8 inch	630	1600
DeWalt	DW235G	93	91	3.5	6.2	1/2 inch	936	850
Black and Decker	DR211	92	93	3.2	4.6	3/8 inch	600	1350
DeWalt	DW130	94	93	2.2	1.9	1/2 inch	840	450
Black and Decker	DR501	93	94	1.8	3.8	1/2 inch	720	750
Milwaukee	0375-1	93	95	3.2	3.3	3/8 inch	420	1300
Skil	6265	94	98	3.1	5.6	3/8 inch	600	1700

Hammer Drills

Because hammer drills are significantly louder than conventional drills, they should not be used in outdoor settings or when conventional drills will work. If needed, however, park staff should select hammer drills with the lowest loaded A-weighted sound power level (SWLA) that meet their needs.

Hammer Drill Noise Levels

Manufacturer brand name	Model number	Loaded SWLA (dBA)	Unloaded SWLA (dBA)	Vibration: right hand (m/s^2)	Vibration: left hand (m/s^2)	Technical specification: chuck size	Rated elec. power (Watts)	Rated speed (RPM)
Hitachi	DH24PE	101	95	41.2	27.2	7/8 inch	620	1350
DeWalt	D25103	102	89	-	-	1 inch	900	1100
Bosch	11224VSR	102	93	-	-	7/8 inch	828	1100
DeWalt	DW505	103	91	-	-	1/2 inch	936	2700
Bosch	11236VS	104	95	-	-	1 1/8 inch	900	850
Black and Decker	FS6000HD	104	89	-	-	1/2 inch	720	2750
Black and Decker	DR601	105	94	-	-	1/2 inch	720	900
Makita	HP1501	105	92	-	-	9/16 inch	600	2800
Hitachi	FDV16VB2	106	90	-	-	1/2 inch	550	2900
Bosch	1194AVSR	106	96	-	-	1/2 inch	960	2600
Bosch	1199VSR	107	97	-	-	3/8 inch	1020	3000
Bosch	11235EVS	116	94	-	-	1 3/4 inch	1560	-

Jig Saws

Park staff should select jig saws with the lowest loaded A-weighted sound power level (SWLA) that meet their needs.

Jig Saw Noise Levels

Manufacturer brand name	Model number	Loaded SWLA (dBA)	Unloaded SWLA (dBA)	Vibration: right hand (m/s^2)	Vibration: left hand (m/s^2)	Technical specification: stroke length	Rated elec. power (Watts)	Rated speed (RPM)
Skil	4380	97	92	11.5	17.7	5/8 inch	444	3250
Milwaukee	6266-22	98	98	4.9	8.0	1 inch	744	3000
Black and Decker	JS600	99	95	17.5	23.2	3/4 inch	540	3200
Bosch	1590EVS	100	96	7.4	10.2	1 inch	768	2800
DeWalt	DW318	102	98	6.6	11.3	1 inch	540	3100

Grinders

Park staff should select grinders with the lowest loaded A-weighted sound power level (SWLA) that meet their needs.

Grinder Noise Levels

Manufacturer brand name	Model number	Loaded SWLA (dBA)	Unloaded SWLA (dBA)	Vibration: right hand (m/s^2)	Vibration: left hand (m/s^2)	Technical specification: grinder wheel size	Rated elec. power (Watts)	Rated speed (RPM)
Ryobi	AG401	95	93	2.5	7.4	4 inch	528	11000
Ryobi	AG451	97	91	5.2	11.9	4 1/2 inch	660	11000
Hitachi	G12SR2	97	94	6.7	14.4	4 1/2 inch	580	11000
Ridgid	R1000	98	96	5.6	21.7	4 1/2 inch	960	10000
Milwaukee	6148-6	99	98	6.5	10.5	4 1/2 inch	1020	10000
DeWalt	DW402	98	99	10.8	22.8	4 1/2 inch	900	10000
Bosch	1700A	99	96	4.5	11.6	4 1/2 inch	840	11000
Hitachi	G18MR	100	98	7.5	16.7	7 inch	1700	6000
McCulloch	MG832500	100	97	4.7	14.4	5 inch	900	10000
Milwaukee	6154-20	101	99	19.4	23.4	4 1/2 inch	1440	11000
Hitachi	G12SE2	101	94	5.3	10.2	4 1/2 inch	1080	10000
DeWalt	DW818	100	101	8.4	14.3	4 1/2 inch	936	11000
Bosch	1700	101	97	5.1	13.0	4 1/2 inch	840	11000
Makita	9527NB	101	97	7.1	22.5	4 1/2 inch	552	10000
DeWalt	DW400	102	98	11.0	17.3	4 1/2 inch	600	10000
Milwaukee	6156-20	103	98	14.2	21.5	5 inch	1440	11000
Porter Cable	7430	98	103	8.3	19.7	4 1/2 inch	720	10000
Bosch	1752G7	107	102	9.7	16.3	7 inch	1800	6000

Miter Saws

Park staff should select miter saws with the lowest loaded A-weighted sound power level (SWLA) that meet their needs.

Miter Saw Noise Levels

Manufacturer brand name	Model number	Loaded SWLA (dBA)	Unloaded SWLA (dBA)	Vibration: right hand (m/s^2)	Vibration: left hand (m/s^2)	Technical specification: saw blade size	Rated elec. power (Watts)	Rated speed (RPM)
Delta	MS250	103	100	-	-	10 inch	1800	5200
Hitachi	C10FCE	103	100	-	-	10 inch	1520	5000
DeWalt	DW706	104	100	-	-	12 inch	1800	4000
Global Machinery Company	MS1015AUL	110	102	-	-	10 inch	1800	5200
Tradesman	M2501W	111	101	-	-	10 inch	1800	4800
Tradesman	M3052LW	113	102	-	-	12 inch	1800	4200

Reciprocating Saws

Park staff should select reciprocating saws with the lowest loaded A-weighted sound power level (SWLA) that meet their needs.

Reciprocating Saw Noise Levels

Manufacturer brand name	Model number	Loaded SWLA (dBA)	Unloaded SWLA (dBA)	Vibration: right hand (m/s^2)	Vibration: left hand (m/s^2)	Technical specification: stroke length	Rated elec. power (Watts)	Rated speed (RPM)
DeWalt	DW309K	102	98	15.9	30.6	1 1/4 inch	1416	2900
Milwaukee	6519-22	104	99	23.7	25.6	1 1/8 inch	1200	2800
Milwaukee	6509-22	104	99	22.0	32.6	3/4 inch	1200	2800
Milwaukee	6524-21	104	96	27.2	32.7	3/4 inch	900	3000
Ryobi	RJ161V	105	105	25.9	37.3	1 3/16 inch	780	2500
Porter Cable	9741	105	101	27.3	38.7	1 1/8 inch	1080	2600
Porter Cable	9750	107	103	36.0	50.3	1 1/4 inch	1380	2900
Hitachi	CR13V	107	98	32.7	45.0	1 1/8 inch	1200	2800
DeWalt	DW308M	107	96	22.1	22.3	3/4 inch	1140	2800
Porter Cable	9747	108	100	31.5	38.2	1 1/4 inch	1380	2600
Milwaukee	6537-22	109	101	19.7	23.3	1 1/4 inch	1200	3200
Bosch	RS5	109	98	33.3	43.5	1 1/8 inch	1080	2700
Makita	JR3030T	111	96	27.8	28.4	1 3/32 inch	960	2600
Milwaukee	6521-21	112	100	8.4	14.6	1 1/4 inch	1200	3200

Orbital Sanders

Park staff should select orbital sanders with the lowest loaded A-weighted sound power level (SWLA) that meet their needs.

Orbital Sander Noise Levels

Manufacturer brand name	Model number	Loaded SWLA (dBA)	Unloaded SWLA (dBA)	Vibration: right hand (m/s^2)	Vibration: left hand (m/s^2)	Technical specification: sander size	Rated elec. power (Watts)	Rated speed (RPM)
Black and Decker	MS500K	74	74	-	-	3 5/8 x 5 1/4 inch triangle	60	11000
Black and Decker	MS550GB	74	76	-	-	3 5/8 x 5 1/4 inch triangle	60	11000
Ridgid	R2610	85	85	-	-	6 inch disk	456	10000
Black and Decker	FS350	81	86	-	-	3 1/2 by 8 1/2 inch sheet	144	10000
Ryobi	CFS1501	76	87	-	-	5 1/2 inch disk	120	12000
DeWalt	DW421	83	88	-	-	5 inch disk	240	12000
Black and Decker	FS540	87	89	-	-	4 1/2 by 5 1/2 inch sheet	216	13000
Bosch	1295DVS	86	89	-	-	5 inch disk	264	12000
DeWalt	DW411	87	91	-	-	4 1/2 by 5 1/2 inch sheet	240	13500
Ryobi	RS2418	86	91	-	-	5 inch disk	288	12500
Ridgid	R2500	87	92	-	-	4 1/2 x 5 1/2 inch sheet	288	14000
Porter Cable	340	90	92	-	-	4 1/2 x 5 1/2 inch sheet	240	14000
Ryobi	RS280VS	89	92	-	-	5 inch disk	336	12000
Porter Cable	333	88	92	-	-	5 inch disk	288	12000
Black and Decker	MS700G	84	94	-	-	4 1/4 x 6 1/2 inch triangle	168	10500
Hitachi	SV12SG	91	95	-	-	4 1/2 x 5 1/2 inch sheet	204	14000
Makita	B04552	93	97	-	-	4 1/2 x 5 1/2 inch sheet	192	14000

Power Screw Drivers

Park staff should select power screw drivers with the lowest loaded A-weighted sound power level (SWLA) that meet their needs.

Power Screw Driver Noise Levels

Manufacturer brand name	Model number	Loaded SWLA (dBA)	Unloaded SWLA (dBA)	Vibration: right hand (m/s^2)	Vibration: left hand (m/s^2)	Technical specification: tool bit size	Rated elec. power (Watts)	Rated speed (RPM)
DeWalt	DW268	91	90	4.5	11.5	1/4 inch hex drive	780	2500
DeWalt	DW257	90	91	4.4	8.6	1/4 inch hex drive	744	2500
Hitachi	W6V3	85	92	6.7	11.1	1/4 inch hex drive	768	4000
DeWalt	DW272	88	93	6.1	11.0	1/4 inch hex drive	756	4000

Construction Equipment

All of the following construction-related equipment models are recommended as products that are generally quieter than other models. When park staff and/or construction contractors have discretion in choosing construction equipment, the quietest equipment should be chosen in order to minimize noise impacts in parks. In addition, park staff may use the following list as a guideline for quieter equipment in order to evaluate contractor proposals. In general, the following product choices can be used to help to minimize noise impacts in parks.

Backup Alarms[a]

• Preco Electronics	200 Series, 45 Series, 6000 Series	www.preco.com
• Ecco Group	Smart Alarms, 500 Series, 700 Series	www.eccolink.com
• Grote Industries	Model 73040	www.grote.com
• Brigade Electronics	BBS-TEK Series	www.bbs-tek.com

Jackhammers

• Better World	Gentle Jack	www.bwanetwork.com
• Atlas Copco	TEX PE Series	www.atlascopco.com
• Chicago Pneumatic	CP 1240-S	www.cp.com
• Makita	Makita HM1810	www.makita.com

Vacuum Excavators (Vac-Trucks)

• Guzzler	LR ACE	www.guzzler.com
• GapVax	HV Series	www.gapvax.com

Pile Drivers

• Ken-Jet	Still Worker	www.ken-jet.com
• Giken	Silent Piler	www.giken.com

Dozers

• John Deere	450H, 550H	www.deere.com
• Caterpillar	D6R III	www.cat.com

Loaders

• Volvo	L50E	www.volvo.vom
• John Deere	444J	www.deere.com
• Caterpillar	950	www.cat.com

Graders

• Caterpillar	14H, 12E, 12F, 140	www.cat.com

Scrapers

• Caterpillar	613	www.cat.com

Backhoes

• Caterpillar	420D, 416D	www.cat.com
• John Deere	410G	www.deere.com
• Case	680C	www.casece.com

Excavators

• John Deere	35D	www.deere.com
• Caterpillar	307C	www.cat.com

Tractors

• John Deere	210LE	www.deere.com
• Caterpillar	621G	www.cat.com

Hoe Rams

• Chicago Pneumatic	CP 100, CP 400	www.cp.com
• Allied	Hammer Head	www.alliedcp.com
• Allied-Rammer	City Series	www.alliedcp.com

Skid Steers

• Caterpillar	246B, 226B	www.cat.com

Dump Trucks

• John Deere	250C, 400C	www.deere.com

Rollers

• Multiquip	AR20-2	www.multiquip.com

Cranes

• Link-Belt	218-HSL	www.link-belt.com
• American	5299	www.americancrane.com
• Bucyrus Erie	30B	www.bucyrus.com

Generators

• Multiquip	GA29R, GA36HA	www.multiquip.com
• Atlas	VSS-125Dd, VSS-170Dd	www.atlascopco.com

Street Sweepers

• Elgin	GeoVac	www.elginsweeper.com
• Schwarze	A-7000	www.schwarze.com

[b] The backup alarms fall into two categories: adaptive volume warning systems and non-tonal systems. The Ecco Smart Alarm system is highly recommended for parks because it measures the ambient noise level and adjusts the alarm sound level to 5dBA above the ambient level. The Preco system uses a radar detection system to provide a higher volume warning when an object is detected. The Brigade bbs-tek alarm uses a broadband "white" noise which is less annoying than pulsed single frequency tones.

Noise-Reducing Treatments

The following materials can be used to help reduce noise that transmits from construction-related noise sources to sensitive receivers.

Noise Barriers

(can be used to create walls between noise sources and sensitive receivers)

• Carsonite	Sound Barrier	www.carsonite.com
• Sound Fighter	LSE Sound Barrier	www.soundfighter.com
• Kinetics	Noise Block	www.kineticsnoise.com

• One-inch plywood is rated at 30 STC (Sound Transmission Class, which is an integer rating of how well a building partition attenuates airborne sound).

Noise Curtains

(can be used as portable enclosures for noise sources that can't be otherwise made quieter)

• Sound Seal	BBC-13-2	www.soundseal.com
• Illbruck Acoustic	SONEX Curtain	www.illbruck-sonex.com
• McGill AirSilence	Fibersorb Curtains	www.mcgillairsilence.com

Silencers and Mufflers

• Universal Silencers	Silencers	www.universal-silencer.com
• Burgess Manning	Silencers	www.burgessmanning.com

[Source for construction equipment recommendations: Construction Noise Control Products and Vendor Guidance Sheet from the New York City (NYC) Department of Environmental Protection. Please note that the NYC document is intended to provide guidance to construction contractors with respect to finding and selecting suitable noise control products. These items are provided only as suggestions for contractors to consider and should not be construed as an official endorsement of any product and/or vendor by the City of New York.]

Road Design

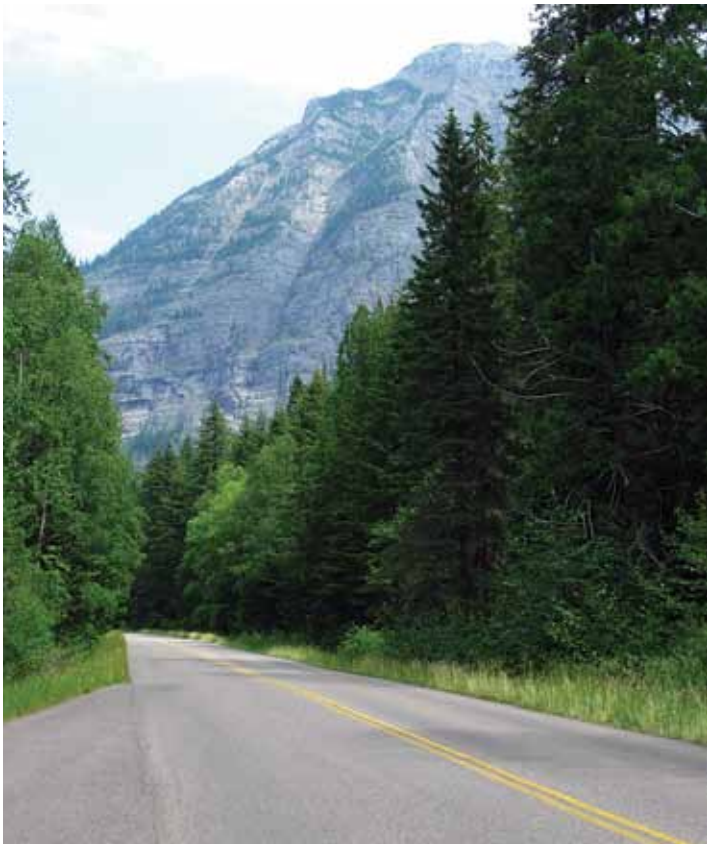
Quiet road materials should be selected by park staff for all new road construction and resurfacing. Quiet road materials will not only reduce traffic noise impacts on park areas but will also provide a smoother, quieter ride that will help vehicle occupants better attend to the sights and sounds of the park. If asphalt is chosen, a porous hot mix asphalt surface is preferred. An Open-Graded Friction Course (OGFC) mix is generally the quietest asphalt surface, while a Stone Matrix Asphalt (SMA) is the next quietest choice. When OGFC is modified with an asphalt binder, there can be additional benefits in lowered noise, reduced maintenance costs, and increased lifespan. Use of rubber binders in road materials is also good for the environment because it provides a recycling use for discarded tires. Two-layer porous asphalt (TLPA), where a fine-graded top layer is placed on top of a coarse layer, is an experimental road surface that has been tested in Europe. Some tests indicate that TLPA may not be as durable as OGFC or SMA; however, it may offer another option for reduced noise.

If concrete is chosen by park staff, surface treatments can significantly reduce noise. A new uncured concrete surface can be modified to reduce noise via the astro-turf drag method, which creates a random grooved texture in the direction of travel. Diamond grinding can correct for surface variations and significantly reduce noise for existing concrete roads. A typical diamond grinding results in parallel 1/8" by 1/8" longitudinal grooves, spaced 1/8" apart and aligned in the direction of travel.

When road sealing is required to prolong the life of pavement, a thin rubberized asphalt chip seal should be considered by park staff as an alternative to conventional "tar and chip" treatments, which often result in an unacceptably noisy road surface. A rubberized asphalt chip seal consists of a mixture of rubberized asphalt and gravel; it has been shown to produce a number of advantages:

- It does not reflect cracks from the existing pavement.
- It is more durable and skid-resistant than conventional asphalt.
- It reduces traffic noise and provides a smooth, quiet ride.

The condition of existing road surfaces should also be considered in terms of noise impacts on parks. As road surfaces deteriorate, noise impacts can increase dramatically. As a rule of thumb, when road surfaces become cracked, spalled, or otherwise worn, resurfacing or sealing (asphalt) and diamond grinding (concrete) should be considered to extend the life of the road and reduce undesirable noise impacts on parks.



Acoustical road traffic study site in Glacier National Park

More information on quiet road surfaces can be found at the following website: www.quietroads.com.

Where speed controls are required, noise should be considered. For example, rumble strips should be avoided, since they can generate unnecessary noise at greater distance than other speed control devices. Speed bumps, especially elongated ones, would be preferable to rumble strips.

Noise impacts on trails, wilderness, and other sensitive areas should also be considered during new road design and location phases.

In-Park Lodging, Visitor Center, and Administrative Buildings

To minimize expected noise impacts inside buildings from outdoor noise sources and outside buildings from indoor noise sources, high-quality acoustical windows should be chosen. The following is a short list of recommended vendors for acoustical windows:

Acoustical Windows

• Harvey Industries	Acoustical Windows	www.harveyind.com
• Peerless Products	Acoustical Windows	www.peerlessproducts.com
• Acoustic Standards	Quiet Window	www.acousticstandards.com
• Soundproof Windows	Soundproof Windows	www.soundproofwindows.com

[Source for construction equipment recommendations: Construction Noise Control Products and Vendor Guidance Sheet from the NYC Department of Environmental Protection]

HVAC

Building HVAC systems should be designed for low noise impacts, both inside and outside. Where possible, noise from exterior fans, heat exchangers, and chillers should be considered. If HVAC system design is required for a noise-sensitive large building such as a visitor center or lodge, an acoustical consultant with HVAC noise experience should be hired to help ensure that acoustical considerations are adequately considered.

PTAC

If in-wall package terminal air conditioners (PTAC) are required, the quietest possible model should be selected. In general, Amana PTAC units are widely chosen for quiet operation.

Central A/C

For park residential installations, the Lennox XC15 is one of the quietest central air conditioner units and best choices; its selection will significantly reduce outdoor noise impacts. The Lennox XC21 is one of the next quietest options, with a potentially higher efficiency rating.

Window A/C

If a window air conditioner is required, an energy-efficient, quiet model should be selected by park staff. The Kenmore 76081 is a quiet, 7,800 BTU model that can be used in rooms up to 400 sq ft. The Friedrich FAC107P1A and Haier ESA3105 are 10,000 BTU models which may be considered for larger rooms (500 sq ft). A quiet, low-profile unit for small rooms (200 sq ft) is the 6,000 BTU LG LP6000ER. Other quiet, small-room models include the GE ASM06LK, the LG GL6000ER, the Friedrich X-Star, the Sharp AF-S60MX, and the GE ASM05LK.

Two smaller quiet air conditioners are quieter than one larger one.

Dishwashers

Other appliances such as dishwashers should be selected with consideration of noise impacts in order to reduce indoor noise impacts and reduce the need for occupants to increase voice levels. If noise levels are available, models with the lowest numbers should be selected. In lieu of published noise levels, Bosch and Asko dishwashers are generally very quiet. While not as quiet as the Bosch and Asko choices, KitchenAid and LG do make some fairly quiet models.

Facing page: New River Gorge National River. NPS/Gary Hartley.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
U.S. Department of the Interior

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