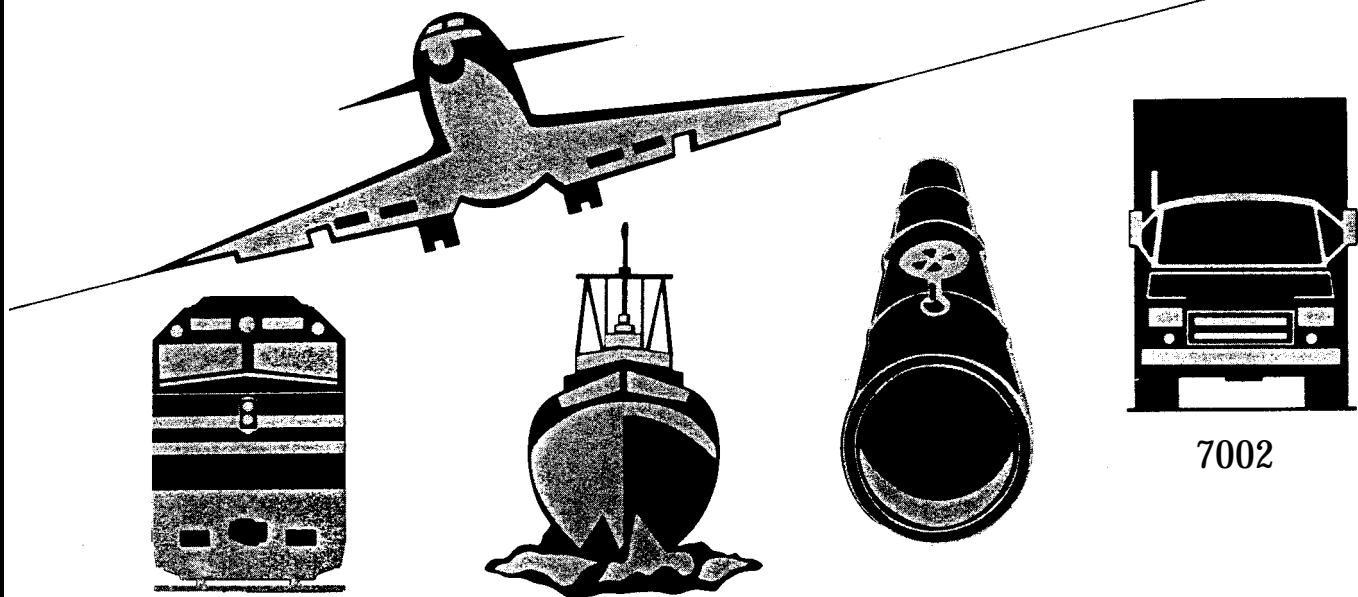


# NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

## SAFETY STUDY

### PERSONAL WATERCRAFT SAFETY



7002

**National Transportation Safety Board. 1998. Personal watercraft safety. Safety Study NTSB/SS-98/01. Washington, DC. 98 p.**

Personal watercraft (PWC) are a type of recreational boat that has become increasingly popular in recent years. Manufacturers estimate that about 200,000 PWC are sold each year and that more than 1 million are in current operation. Although the overall number of recreational boating fatalities has been declining in recent years, the number of personal watercraft-related fatalities has been increasing. PWC are the only type of recreational vessel for which the leading cause of fatalities is not drowning; in PWC fatalities, more persons die from blunt force trauma than from drowning. The National Transportation Safety Board initiated this study to more closely examine fatalities and injury in addition to accident characteristics associated with PWC accidents. The study was not designed to estimate how often PWC accidents occur, nor are the results of the study necessarily representative of all PWC accidents. The Safety Board analyzed 814 (one-third) of the 1997 reported accidents and examined all of the data for the 1996 reported accidents, which the Board believes provided a substantial number of accidents to identify the most important safety issues associated with PWC accidents. The safety issues discussed in the report include (a) protecting PWC riders from injury; (b) PWC operator experience and training; and (c) boating safety standards. The study also addressed the need for recreational boating exposure data. Safety recommendations concerning these issues were made to the manufacturers of PWC, the U.S. Coast Guard, the Coast Guard Auxiliary, the U.S. Power Squadrons, BOAT/U.S., the National Association of State Boating Law Administrators, the Personal Watercraft Industry Association, and the States and Territories.

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# Personal Watercraft Safety

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## Safety Study

NTSB/SS-98/01  
PB98-917002  
Notation 7002  
May 19, 1998



**National Transportation Safety Board**  
490 L'Enfant Plaza, S.W.  
Washington, D.C. 20594

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**Conversion Factors for  
International Standard (SI) Units**

<i>To convert from</i>	<i>to</i>	<i>multiply by</i>
mile, U.S. statute	kilometer (km)	1.609344
mile, nautical	meter (m)	1852.0
foot (ft)	meter (m)	0.3048
yard (yd)	meter (m)	0.9144
inch (in)	centimeter (cm)	2.54
cubic centimeter (cc or cm <sup>3</sup> )	cubic inch (in <sup>3</sup> )	0.06102374
pound (lb)	kilogram (kg)	0.4535924
knot (nautical mile per hour)	meter per second (m/s)	0.5144444
horsepower (550 ft · lbs/s) (hp)	watt (W)	745.6999

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## Executive Summary

Personal watercraft (PWC) are a type of recreational boat that has become increasingly popular in recent years. Manufacturers estimate that about 200,000 PWC are sold each year and that more than 1 million are in current operation. PWC now account for more than one-third of the new recreational boat sales in the United States.

Although the overall number of recreational boating fatalities has been declining in recent years, the number of personal watercraft-related fatalities has been increasing. At the time of the National Transportation Safety Board's 1993 recreational boating safety study, there were only 26 personal watercraft fatalities a year, and the Safety Board did not believe that separate consideration of PWC was warranted. However, in 1994, the number of PWC fatalities began to increase noticeably because the number of PWC in operation increased. Preliminary numbers for 1997 indicate 83 PWC fatalities. PWC are the only type of recreational vessel for which the leading cause of fatalities is not drowning; in PWC fatalities, more persons die from blunt force trauma than from drowning. The increase in fatalities and the distinctive way in which fatalities occur prompted the Safety Board to examine the nature of PWC accidents.

The Safety Board initiated the current study to more closely examine fatalities and injury in addition to accident characteristics associated with PWC accidents. The study was not designed to estimate how often PWC accidents occur. For PWC accidents that occurred between January and June 1997, the Safety Board requested that State marine accident investigators provide the Safety Board with copies of their accident reports and complete a supplemental questionnaire prepared by the Safety Board specifically for this study. The goal of the supplemental questionnaire was to obtain additional information concerning the accident characteristics and details concerning personal injury that have not previously been available from State boating accident reports. State accident reports and supplemental information were the sources of the Safety Board's accident information.

The Safety Board also reviewed State reports of PWC accidents that occurred in 1996. A total of 49 States and Territories provided either copies of their boating accident report forms, automated boating accident report database files, or summary information for 1996 and/or 1997.

Because the States voluntarily provided the Safety Board with accident reports and supplemental questionnaire information, and because of the incomplete nature of much of the information, the Safety Board does not claim that the results of the study are representative of all PWC accidents. The Safety Board analyzed 814 (one-third) of the 1997 reported accidents and examined all of the data for the 1996 reported accidents. Consequently, the Board believes that a substantial number of accidents was available to identify the most important safety issues associated with PWC accidents. Further, the Safety Board's analysis did not show any biases in the types of accidents in the half-year of

1997 accidents compared to the full year of 1996 accidents. The Safety Board's interest in truncating the 1997 data collection period to 6 months was based on a goal of providing the results of this study prior to the 1998 summer boating season.

Based on the analysis of the data reviewed, the safety issues discussed in this report include the following:

- protecting personal watercraft riders from injury,
- operator experience and training, and
- boating safety standards.

The study also addressed the need for recreational boating exposure data.

As a result of this study, recommendations were issued to the manufacturers of personal watercraft, the U.S. Coast Guard, the U.S. Coast Guard Auxiliary, the U.S. Power Squadrons, BOAT/U.S., the National Association of State Boating Law Administrators, the Personal Watercraft Industry Association, and the States and Territories. The recommendations focus on the safe operation of personal watercraft.

## Chapter 1

# Introduction

On June 29, 1997, a 25-year-old male lost control of a rented personal watercraft (PWC)<sup>1</sup> while operating at Four Bear Water Park near Shelby Township, Michigan. The vessel entered a lifeguard-supervised swimming area and struck six children, ages 5 to 12. It hit a seventh person on the beach before coming to a stop. One child sustained severe lacerations to the head, bruising of the upper torso, and remained in a coma for 3 days. Injuries to the other children included a serious laceration above the right eye; loss of two front teeth and facial bruising; lacerations to the head; bruising of the upper torso; abdominal laceration; and abrasions to the leg, arm, and chest.

The investigating officer concluded that the accident was caused by excessive speed and an inability to control the vessel. The PWC operator had never previously driven such a vessel and had been riding less than 1 hour on the day of the accident. The rental agent had provided verbal instructions but had not required the operator to demonstrate any ability to handle the 55-hp, 580-cc Bombardier Sea-Doo.<sup>2</sup> The rental agent provided verbal instruction in English on how to operate the vessel, which was translated for the Spanish-speaking operator.

A similar accident occurred on Lake Brantley in Seminole County, Florida, on April 5, 1997. A 16-year-old male PWC operator lost control of the vessel and fell off. The vessel continued to travel, hit one of a series of floating buoys that defined the Sweetwater Beach swimming area, struck two swimmers, and stopped only after striking a post at a nearby dock. The Kawasaki personal watercraft, weighing over 500 pounds, caused a scalp laceration to a 5-year-old and a closed head injury to a 7-year-old.

The Michigan accident was investigated by the Shelby Township Police Department; the Florida accident was investigated by an officer of the Florida Game and Fresh Water Fish Commission. Both accidents were documented on State boating accident report forms and

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<sup>1</sup> The Personal Watercraft Industry Association (PWIA) defines a personal watercraft as a vessel that uses an inboard motor powering a water jet pump as its primary source of power. The vessel is designed to carry from one to three persons and to be operated by a person sitting, standing, or kneeling on the vessel rather than by the conventional manner of sitting or standing inside the vessel. A State's definition of PWC may also include the length of the vessel and horsepower. (States' definitions of PWC are given in appendix A.)

<sup>2</sup> The accident information was provided by the investigating police officer based on the National Transportation Safety Board's supplemental questionnaire. (The questionnaire, which was developed by the Safety Board for use in its study on personal watercraft, is discussed in chapter 2.)



submitted to the United States Coast Guard for inclusion in the Coast Guard database.<sup>3</sup> According to the Coast Guard's most recent reporting year, 1996, there were 57 PWC-related fatalities, 1,831 persons injured, and more than 4,000 PWC involved in accidents. Table 1-1 presents a 10-year summary of recreational boating and PWC information from Coast Guard statistics, except as noted.

Although the number of recreational boating fatalities has been declining, the number of PWC-related fatalities has been increasing (table 1-1, and figures 1-1 and 1-2). The increase in PWC fatalities is proportional to the increase of PWC in operation. Coast Guard information indicates that 8,005 recreational boating accidents were reported for 1996, of which 2,868 involved PWC. Personal watercraft in use in 1996 represented 7.5 percent of the State-registered recreational boats, yet PWC accounted for 36 percent of the 1996 reported recreational boating accidents, 36 percent of the total number of vessels involved, and more than 41 percent of the persons injured in those boating accidents.

Coast Guard statistics on 1997 recreational boating accidents have not been compiled; however, preliminary information from the National Association of State Boating Law Administrators (NASBLA)<sup>4</sup> indicates there were 83 PWC fatalities in 1997 (additional data from a 1997 NASBLA survey are given in appendix B, and preliminary data by States are in appendix C).<sup>5</sup> Including NASBLA's preliminary numbers in the National Transportation Safety Board's study on personal watercraft serves two purposes. First, PWC fatalities decreased in 1996; by considering 1997 numbers, it is evident that the decrease in 1996 did not indicate a reversal in the increasing number of fatalities for 1991 through 1995. Second, the Safety Board's study collected and analyzed injury information on 27 fatalities that occurred during the first 6 months of 1997; NASBLA's preliminary numbers for 1997 indicate that the 27 fatalities analyzed are about one-third of the expected number for that year.

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<sup>3</sup> The Coast Guard's boating accident report database (BARD) contains accident information from State boating law administrators and law enforcement officers, from Coast Guard reports, and from accident reports filed by individual boat operators.

<sup>4</sup> NASBLA is a professional association consisting of State, commonwealth, and provincial officials having responsibility for administering and/or enforcing State boating laws. The Coast Guard has a Memorandum of Understanding with NASBLA, and the two organizations hold intergovernmental sessions to coordinate boating safety resources that are distributed to the States by the Coast Guard through the Aquatic Resources Trust Fund (Wallop-Breaux). Information on the 1997 fatalities came from Safety Board staff conversations with the NASBLA representatives and from the following publication: *Small Craft Advisory*. Dec. 1997/Jan. 1998. Lexington, KY: National Association of State Boating Law Administrators; 13(2): 8-13.

<sup>5</sup> The Safety Board emphasizes that the 1997 numbers are preliminary and that State counts may change as accident data for 1997 are fully assessed. NASBLA data in past years have differed somewhat from Coast Guard data. For example, NASBLA data for 1996 report 56 PWC fatalities, 1,316 injured persons, and 3,079 PWC involved in accidents, whereas Coast Guard data report 57 PWC fatalities, 1,831 persons injured, and 4,099 PWC involved in accidents.

**Table 1–1. Number of recreational boats, personal watercraft (PWC), accidents, persons injured, and fatalities, 1987 through 1996.**

Year	Number of State-registered recreational boats <sup>(a)</sup>	Number of PWC in use <sup>(b)</sup>	Number of PWC sold <sup>(c)</sup>
1987	9,963,696	92,756	29,000
1988	10,362,613	126,881	48,000
1989	10,777,370	178,510	64,000
1990	10,996,253	241,376	72,000
1991	11,068,440	305,915	68,000
1992	11,132,386	372,283	79,000
1993	11,282,736	454,545	107,000
1994	11,429,585	600,000	142,000
1995	11,735,000	760,000	200,000
1996	12,095,689	900,000	191,000

	Number of recreational boating accidents (includes accidents involving PWC) <sup>(d)</sup>	Number of persons injured in recreational boating accidents (includes PWC-related)	Number of recreational boating fatalities (includes PWC-related)
1987	6,746	3,051	1,036
1988	6,718	3,476	946
1989	6,063	3,635	896
1990	6,411	3,822	865
1991	6,573	3,967	924
1992	6,048	3,683	816
1993	6,335	3,559	800
1994	6,906	4,084	784
1995	7,863	4,064	830
1996	8,005	4,427	709

	Number of PWC involved in the recreational boating accidents	Number of persons injured in the PWC-involved accidents	Number of PWC-related fatalities
1987	376	156	5
1988	650	254	20
1989	844	402	20
1990	1,162	532	28
1991	1,513	708	26
1992	1,650	730	34
1993	2,236	915	35
1994	3,002	1,338	56
1995	3,986	1,631	68
1996	4,099	1,831	57

<sup>(a)</sup> Actual numbers may be higher because some States do not include State-registered personal watercraft in their estimates of the number of recreational boats, and some States do not identify personal watercraft in boating regulations.

<sup>(b)</sup> Estimates of the National Marine Manufacturers Association.

<sup>(c)</sup> Estimates of the Personal Watercraft Industry Association.

<sup>(d)</sup> The U.S. Coast Guard database indicates the total number of reported recreational boating accidents, but it does not indicate the number of accidents by vessel type because an accident may involve more than one vessel type. The 1996 recreational boating accidents include 2,868 accidents involving PWC and a total of 11,306 vessels.

Source: U.S. Coast Guard statistics, except where noted otherwise.

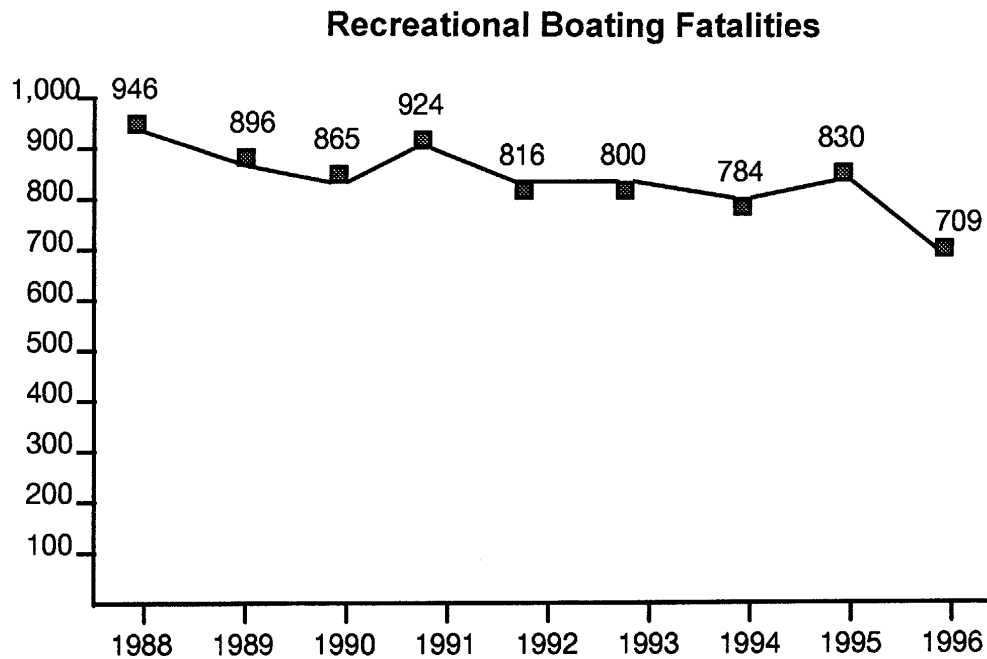


Figure 1-1. Recreational boating fatalities (including PWC-related fatalities), 1988-1996. (Source: U.S. Coast Guard. Data for 1997 are not yet available.)

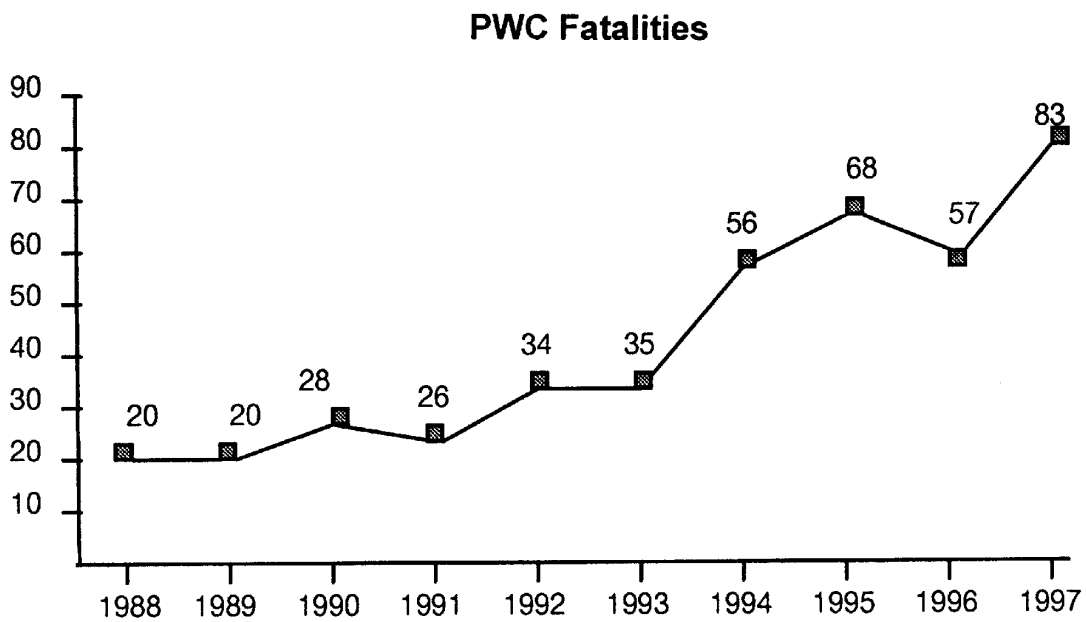


Figure 1-2. Personal watercraft fatalities, 1988-1997. (Source: Data through 1996 are from the U.S. Coast Guard, which does not yet have final data for 1997. The number of fatalities shown for 1997 is based on preliminary data from the National Association of State Boating Law Administrators.)

The number of PWC accidents involving injury varies by State. California reported 385 PWC-related accidents during the 1996 boating season, resulting in 298 injured persons, 8 fatalities, and \$508,000 in property damage. Although PWC accounted for 16 percent of the registered vessels and 14 percent of the fatalities in California, they were involved in 45 percent of all recreational boating accidents and 55 percent of the persons injured. Collisions with another vessel made up the majority of recreational boating accidents (69 percent), and of these collisions, 71 percent involved one PWC colliding with a second.<sup>6</sup> Similarly, Florida had 751,153 registered vessels in 1996, 9 percent of which were PWC, yet PWC accounted for 37 percent of the accidents (464 of 1,260), 48 percent of the persons injured (389 of 804), and 7 percent of the fatalities (4 of 59).<sup>7</sup> In Minnesota, PWC accounted for 3 percent of the number of boats (23,844 of 758,666), yet they were involved in 29 percent of the accidents (41 of 139), 45 percent of the persons reported as injured (22 of 49), and 17 percent of the fatalities (2 of 12).<sup>8</sup> The Safety Board could not determine whether PWC are over-represented when compared to other types of recreational boats or if usage type varies by type of boat because accurate data on usage and exposure time for different types of recreational boats are not available. (Exposure data are discussed further in chapter 2).

PWC injury reports taken from the National Electronic Injury Surveillance System (NEISS) of the Consumer Product Safety Commission and analyzed by the Centers for Disease Control (CDC) showed that over a 6-year period, the number of PWC in operation increased nearly three-fold (from 241,500 in 1990 to an estimated 760,000 in 1995), while the number of PWC-related injuries increased four-fold (2,860 in 1990 to an estimated 12,000 in 1995).<sup>9</sup> According to the CDC analysis, the rate of PWC-related injuries (injuries per number of PWC) requiring emergency medical treatment was 8.5 times higher than the rate of injuries from motorboats.

The Safety Board notes that many PWC accidents analyzed for this study involved injury but no reported property damage. The Board suspects that PWC-related injuries are not reported on boating accident forms but are being treated at local hospital emergency rooms (and are thereby entered in the NEISS data of the CDC).

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<sup>6</sup> State of California, Department of Boating and Waterways. 1997. California boating accident report for 1996. Sacramento, CA. 40 p.

<sup>7</sup> Personal watercraft accident summary for 1997, obtained March 18, 1998, from the Florida Web site: <http://www.dep.state.fl.us/law>.

<sup>8</sup> Data from the Minnesota personal watercraft accident summary for 1996 provided to the National Association of State Boating Law Administrators, September 8-9, 1996, Lexington, KY. Annual totals verified by Boating Law Administrator, Minnesota Department of Natural Resources.

<sup>9</sup> Branche, Christine M.; Conn, Judith M.; Annett, Joseph L. 1997. Personal watercraft-related injuries: a growing public health concern. *Journal of the American Medical Association*. 278(8): 663-665. August 27. (The CDC analysis used the Coast Guard estimate for the number of PWC in operation; the number of injuries was from CDC's analysis of 624 hospital reports taken from a national, stratified sample.)

During 1992–93, the Marine Index Bureau (MIB) Foundation conducted a study of boating accidents based on data from boating claims submitted to insurance companies.<sup>10</sup> Of the 104 identified insurers, MIB sampled data from 13 insurers that accounted for 61 percent of the total insured boating population at that time. For 1992, MIB estimated that there were 95,849 reportable accidents based on insurance data; Coast Guard data indicate 6,048 reported accidents, or 6.3 percent of the MIB estimate. Comparisons of injury were much closer: MIB estimated 4,039 persons injured; the Coast Guard reported 3,683 (91 percent of the MIB estimate). For accidents involving injury, the MIB and the Coast Guard appear to have similar data. Property damage accidents without injury may be reported to insurance companies but might not be reported on boating accident forms.

## Personal Watercraft

Personal watercraft are a type of recreational boat designed for riding entertainment (figure 1–3). Because PWC are powered by an engine and intended for the transport of person(s) on water, they fall within the Coast Guard category for motorboats. Although the Coast Guard tracks statistics on a recreational vessel type (Class A inboard motorboat) that includes personal watercraft, the Coast Guard has no official definition of personal watercraft.<sup>11</sup>

The first commercially successful personal watercraft, the Jet Ski, was introduced by Kawasaki in 1974. Models from the late 1970s and early 1980s were designed for a one-person, stand-up operation. During the mid-1980s, the sit-down style became popular, and it now accounts for 97 percent of the units sold. Most PWC sales are controlled by five companies<sup>12</sup> that actively market between 30 and 40 different models designed for one, two, or three persons. Current PWC sales run about 200,000 units per

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<sup>10</sup> The Marine Index Bureau Foundation is a nongovernmental 501(c)(3) nonprofit entity. Its work on the Recreational Boating Accident Register was funded by the Coast Guard and by the insurance industry.

<sup>11</sup> The Coast Guard boating accident statistics report for 1996 describes personal watercraft in the glossary: “Craft less than 13 feet in length designed to be operated by a person or persons sitting, standing or kneeling on the craft rather than within the confines of a hull.” (U.S. Department of Transportation, U.S. Coast Guard. 1998. Boating statistics 1996. Washington, DC. 39 p.) The Coast Guard has no regulatory definition of personal watercraft.

<sup>12</sup> The major manufacturers of personal watercraft are Kawasaki, Yamaha (WaveRunner), Polaris, Bombardier (Sea-Doo), and Arctic Cat, Inc./Tiger Shark.



Figure 1-3. A late-model personal watercraft.  
(Photo courtesy of the Personal Watercraft Industry Association.)

year, and the 1998 models range in cost from \$4,799 to \$9,399. PWC constituted more than one-third (36 percent) of all new recreational boats sold in 1997 and represent \$1.2 billion of annual sales.<sup>13</sup>

Engine power of the 33 different 1998 models of PWC ranges from 62 to 135 hp, engine displacement ranges from 639 to 1131 cc with two or three cylinders, and the vessels range from 87 to 126 inches in length.<sup>14</sup> Most models are designed to accommodate two or three riders, but results of a PWC owner survey<sup>15</sup> indicate that 68 percent of PWC riding is done alone. The typical personal watercraft sold in 1997 had a dry weight of about 450 pounds and a fuel capacity of 10 gallons.<sup>16</sup> With a single rider, PWC operating weight would be about 700 pounds.

The PWC owner survey was commissioned by the Personal Watercraft Industry Association (PWIA)<sup>17</sup> in early 1996. Owners from all 50 States who purchased their vessels between 1991 and 1995 were surveyed; a total of 11,500 surveys were mailed and 2,800 persons responded. Survey results indicated that PWC owners (a group not synonymous with PWC operators) average 41 years of age and have an average household income of \$95,400. In addition, 71 percent are married, 40 percent are college graduates, 85 percent are male, 68 percent have owned a powerboat prior to their PWC purchase, and 73 percent of the time the owner is the operator. The PWIA survey reported that the average owner uses the vessel about 7 days per month during the boating season, and on a typical riding day an average of three different people operate the vessel. In a different survey, of the readers of *Watercraft World* magazine, the average owner was found to use the vessel 36.5 days per year.<sup>18</sup>

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<sup>13</sup> Information about sales came from *BOAT/U.S. Magazine*, November 1997, page 5. The United Kingdom, as a comparison, has about 17,000 PWC.

<sup>14</sup> *Trailer Boats*. 1998. PWC buyers guide. Carson, CA: Poole Publications, Inc.: 27(3): 58-66 (p. 66).

<sup>15</sup> Bowe Marketing Research. 1996. PWIA owner usage, attitude and demographic research. Survey of PWC owners commissioned by the Personal Watercraft Industry Association (PWIA) and presented at the PWIA Board of Directors meeting July 23, 1996.

<sup>16</sup> Calculation of typical weight was determined by averaging 43 PWC from model year 1997.

<sup>17</sup> The Personal Watercraft Industry Association was formed in 1987 as an affiliate of the National Marine Manufacturers Association (NMMA). Regular membership of the PWIA is open to manufacturers of PWC who are also members of the NMMA.

<sup>18</sup> This number is not inconsistent with 7 days per month if the boating season is considered to be 5–6 months per year. The reader survey was conducted by Mediamark Research, Inc., and reported in PWIA literature.

## Operating Characteristics of Personal Watercraft

As with most types of boats, the speed and performance of PWC have increased over the years: 16 models introduced in the 1998 model year have engines with 100 hp or more.<sup>19</sup> By comparison, Kawasaki's early Jet Ski, introduced in 1974, had an output of 32 hp. Faster models can exceed 60 mph in their stock configuration, and after-market modifications, such as three-bladed impellers or flame arrestors to increase air intake, can further increase the high-end speed capability. The PWIA reports that 25 percent of all owners have made mechanical changes or modifications to their PWC; 18 percent have made engine performance modifications.<sup>20</sup>

A PWC uses a moveable nozzle connected to a jet pump, rather than a propeller, to power the vessel. This distinction affects the operating and handling characteristics of the vessel. The most notable distinction is "off-throttle steering," a trade term for the situation that exists when an operator releases the throttle and then attempts to execute a turn. The term is an oxymoron because there is little or no steering capability when the throttle is off. Turning the PWC handlebars changes the angle of water exiting the jet pump, but without power to the jet pump, there is little or no directional thrust. As stated in the owner's safety manual of one PWC manufacturer, "Remember, releasing the throttle completely eliminates the ability to steer the watercraft."<sup>21</sup> This operating characteristic is likely to be counterintuitive to novice operators, particularly in situations of potential collision. When a new rider realizes there is danger of hitting another vessel or object, the operator's typical response based on experience with other motor vehicles is to first let off the throttle and then attempt to steer away from the hazard. But closing off the throttle leaves the vessel coasting in the original direction based on the effects of momentum, and without throttle there is very limited steering control. Personal watercraft have no braking mechanism; they coast to a stop and, while coasting, there is no turning ability. Executing a controlled-speed turn is the correct response to avoid a collision, but to a new operator this may feel like speeding toward a hazard.

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<sup>19</sup> In 1996, *PWC Magazine* listed 10 models with 100 hp or more (*PWC Magazine*, January 1996: 24-27). In early 1998, *Trailer Boats* magazine listed 16 models of PWC that have 100 hp or more (*Trailer Boats*, 1998. PWC buyers guide. Carson, CA: Poole Publications, Inc.: 27(3): 58-66 (p. 66). March). A 750-cc engine has 100 hp, but unlike other motorboat engine types, the jet-pump engine horsepower at the crankshaft is not the same as the effective power of the propulsion unit. Horsepower ratings of jet-pump vessels and propeller driven boats may not be comparable.

<sup>20</sup> Bowe Marketing Research. 1996. PWIA owner usage, attitude and demographic research. Survey of PWC owners commissioned by the PWIA and presented at the PWIA Board of Directors meeting July 23, 1996.

<sup>21</sup> Polaris 1997 SLTX Owner's Safety and Maintenance Manual. Minneapolis, MN: Polaris Industries, Inc. 86 p. (p 45).



Steering difficulties were evident in many of the PWC accident reports examined for the study.<sup>22</sup> For example, a 15-year-old male was operating a PWC and his mother was a passenger. The Florida Marine Patrol accident description states, “[Operator] was attempting to make a turn south through a cut in the mangroves . . . . He was not real familiar with operating a jet ski with a passenger. When he attempted to make a left turn he let off the throttle which caused the PWC to lose steering capabilities. The forward momentum of the PWC took [operator] and passenger into the mangrove shoreline. [Operator] received a puncture wound to the left side of his neck . . . .” Another accident involving a mother and son on a Texas lake illustrates the consequences that can result from steering difficulties. The 24-year-old PWC operator attempted to spray water on his onlooking mother, lost control of the watercraft, and the vessel hit her in the back. She died the next morning. In a Minnesota accident, the investigator wrote: “He [operator] let up on the throttle, lost ability to steer, powered up again, but too late.” Examples of investigator or witness statements on boating accident reports confirm steering problems, although the statements are not recorded in any systematic manner.

Several operating characteristics distinguish PWC. It is expected that PWC operators will fall overboard as a normal part of operation. For this reason, most models have safety lanyards or “kill switches” that are connected to the operator’s wrist to ensure that the vessel stops when the operator falls off. It is also expected that PWC will roll over in the water; in effect, they capsize on a regular basis. PWC owners manuals include procedures for uprighting a capsized vessel.<sup>23</sup> According to an international group working on PWC guidelines, in traditional boats, falling overboard would be considered the first event of a boating accident, and capsizing and swamping are also considered to be boating accidents or emergency situations. But for PWC, these are expected events; consequently, PWC are designed and constructed with somewhat different objectives than traditional boats.<sup>24</sup>

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<sup>22</sup> Problems of operator control are also discussed in chapter 5.

<sup>23</sup> For example: Polaris 1997 SLTX Owner’s Safety and Maintenance Manual. Minneapolis, MN: Polaris Industries, Inc. 86 p. (p 51).

<sup>24</sup> Permanent International Association of Navigation Congresses (PIANC). [n.d.]. Guidelines for the use of certain powered craft, such as waterscooter, personal watercraft, waterbike, Jetski, Waverunner, Seadoo, on controlled waters. Report on Working Group 6, Supplemental Bulletin 86. Brussels, Belgium: General Secretariat of PIANC. 21 p.

## Purpose of the Study

The Safety Board conducted a study in 1993 on recreational boating safety.<sup>25</sup> At that time, there were only 26 PWC fatalities a year, and the Board did not believe that a separate consideration of PWC was warranted. The 1993 study evaluated Coast Guard data on boating accidents that occurred between 1986 and 1991; the Coast Guard only began tracking PWC as a separate vessel category beginning in 1988. For 1988 through 1991, PWC fatalities totaled 20, 20, 28, and 26, respectively. In 1994, however, the number of fatalities began to increase noticeably because the number of PWC in operation increased. PWC are the only type of recreational vessel for which the leading cause of fatalities is not drowning; in PWC fatalities, more persons die from blunt force trauma than from drowning. The increase in fatalities and the distinctive way in which fatalities occur prompted the Safety Board to examine the nature of PWC accidents.

The Safety Board initiated the current study to more closely examine fatalities and injury in addition to accident characteristics associated with PWC accidents. The study was not designed to estimate how often PWC accidents occur. Chapter 2 explains the methods used to conduct this safety study and summarizes the scope of information collected. Chapter 3 discusses particular recreational boating safety issues as they relate specifically to PWC, including PWC operating experience, rental operations, and State operating restrictions. Chapter 4 presents the results of the Safety Board's analysis of injuries and discusses those results within the context of available research concerning PWC. Chapter 5 discusses PWC design issues and engineering standards that affect the safety of the vessels. The Safety Board's conclusions and recommendations for improving the safety of PWC are presented at the end of the report.

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<sup>25</sup> National Transportation Safety Board. 1993. Recreational boating safety. Safety Study NTSB/SS-93/01. Washington, DC. 104 p.



## Chapter 2

# Methods and Accident Results

## Methods

The Safety Board examined 1,739 PWC accident reports for accidents that occurred during an 18-month period, January 1996 through June 1997. For accidents that occurred in 1997, the Safety Board analyzed injury information for persons involved in PWC accidents. A summary of the 1997 and 1996 data sources by State is shown in appendix D.

Coast Guard statistics on recreational boating safety are derived from State boating accident reports. It is the operator's responsibility to report an accident, but marine law enforcement officers patrol waterways, investigate accidents, and also file boating accident reports. Current regulations in Title 33 Code of Federal Regulations (33 CFR) Part 173 require the operators of recreational boats, including PWC, to file a boating accident report to State boating law officials if the vessel is involved in an accident that results in (1) loss of life, (2) personal injury requiring more than immediate first aid medical treatment, (3) complete loss of vessel or property damage exceeding \$500, or (4) the disappearance of any person on board a vessel. Operators use Coast Guard form CG-3865 to report a boating accident (appendix E).

For PWC accidents that occurred between January and June 1997,<sup>26</sup> the Safety Board requested that State marine accident investigators complete a supplemental questionnaire prepared by the Safety Board specifically for this study (appendix F). The goal of the supplemental questionnaire was to obtain additional information concerning the accident characteristics and details concerning personal injury that have not previously been available from State boating accident reports. State accident reports and supplemental information were the sources of the Safety Board's accident information.

For the January–June 1997 period, the Safety Board received boating accident reports and questionnaire responses from 37 participating States and Territories. Boating accident reports were not always accompanied by supplemental questionnaires. Also, because of concerns over personal privacy issues, five jurisdictions<sup>27</sup> did not provide the Safety Board with copies of their boating accident reports but did provide supplemental questionnaires.

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<sup>26</sup> The Safety Board is aware that January to June does not encompass the typical PWC boating season; however, this timeframe provided an adequate number of 1997 accidents for analysis.

<sup>27</sup> California, Delaware, Nevada, Washington, and the Territory of Puerto Rico.

Consequently, the boating accident reports and the supplemental questionnaires represent two different but substantially overlapping sets of data, which contain information on a total of 814 PWC accidents involving 1,218 operators.

The Safety Board also reviewed State boating accident reports of PWC accidents that occurred in 1996. A total of 49 States and Territories provided the Safety Board either copies of their boating accident report forms, automated boating accident report database (BARD) files, or summary information for 1996 and/or 1997. Several States also provided reports of their own analyses on the subject of PWC accidents. Figure 2-1 shows the participating States that provided 1996 and/or 1997 data.

Much of the boating accident information used in the Safety Board's analysis came from the same source from which the Coast Guard derives its recreational boating statistics, namely, State boating accident reports filed with the Coast Guard by State marine accident investigators. The Coast Guard's data on 1996 recreational boating accidents became available while this report was being prepared. In addition to that data, the Safety Board had access to paper copies of State boating accident reports and was able to examine the narrative descriptions of the accidents and diagrams of vessel actions. Each of the 925 PWC State boating accident reports for 1996<sup>28</sup> was reviewed to determine the number that involved steering problems or loss of control (220, or 24 percent), rental status of the PWC (192, or 21 percent), alcohol involvement (48, or 5 percent), and explosions (5).

For each person involved in a PWC accident that occurred during the January–June 1997 study period, information from the State's boating accident report and the Board's supplemental questionnaire was coded into a statistical database. For each case record, there were variables containing information about the accident, the persons involved, and their injuries.<sup>29</sup> The reporting source (investigator report or operator report reviewed by an investigator) was also coded. Investigators record accident cause on State accident reports, but the lists of causes vary among States. The Safety Board used the list of causes on the Coast Guard's boating accident form (see appendix E) as its basis for coding accident cause because this list provided a reasonable overlap for the various lists of causes used by the States. In order to distinguish “no fault” from “no cause listed,” the Safety Board also coded “no fault” as an accident cause. Accident results are discussed in the next section of this chapter. The Safety Board's analysis of these results and their relationship to PWC operating issues are presented in chapter 3.

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<sup>28</sup> The 925 PWC State boating accident reports account for about 32 percent of the 1996 recreational boating accidents that involved PWC.

<sup>29</sup> Most accident reports contained incomplete information for several variables; consequently, frequency measures for accident results indicate the responses reported for that variable in proportion to the total cases.

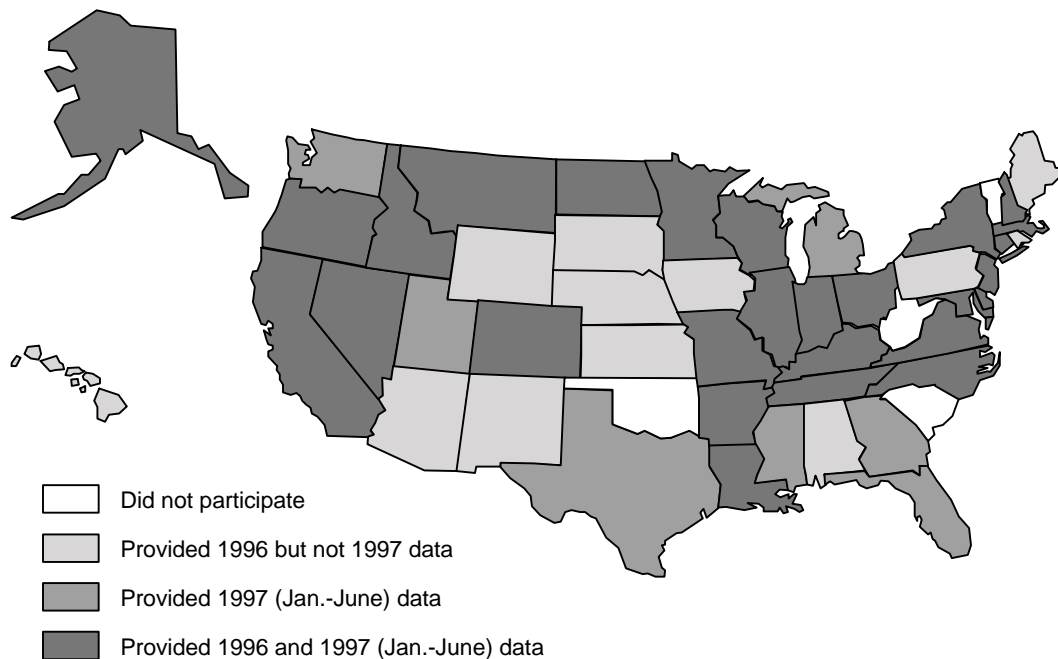


Figure 2–1. States that provided personal watercraft accident data for 1996 and/or 1997. (Guam and the U.S. Virgin Islands provided data for 1996 and 1997; Puerto Rico provided data for 1997. The District of Columbia, American Samoa, and the Northern Mariana Islands did not participate.)

The Safety Board also reviewed 176 PWC injury reports from the Consumer Product Safety Commission (CPSC) database of product-related injuries.<sup>30</sup> The injury reports originated from numerous sources: the Medical Examiners & Coroners Alert Program, Underwriters Laboratory, American Trial Lawyers Association, Consumers Union, and consumer complaints. The CPSC added a product code for PWC in 1989; 110 fatalities were recorded for 1989 through 1996.<sup>31</sup> CPSC data provided accident examples of issues identified in the Safety Board’s study, but CPSC information is illustrative in nature and is not a representative sample of accidents.

<sup>30</sup> National Injury Information Clearinghouse, July 1989 through December 1996.

<sup>31</sup> Total fatalities by year: 2 in 1989, 14 in 1990, 6 in 1991, 10 in 1992, 3 in 1993, 34 in 1994, 29 in 1995, and 12 in 1996.

Because the States voluntarily provided the Safety Board with accident reports and supplemental questionnaire information, and because of the incomplete nature of much of the information, the Safety Board does not claim that the results of the study are representative of all PWC accidents. The Safety Board analyzed 814 (one-third) of the 1997 reported accidents and examined all of the data for the 1996 reported accidents. Consequently, the Board believes that a substantial number of accidents was available to identify the most important safety issues associated with PWC accidents. A split-half comparison of 1996 data indicates that there were slightly fewer PWC involved in accidents in the first half of the year (44 percent compared to 56 percent), but that the distribution by accident type did not vary. The Safety Board's interest in truncating the 1997 data collection period to 6 months was based on a goal of providing the results of this study prior to the 1998 summer boating season.

## Accident Results

The following paragraphs summarize PWC accident data by topic. The results are based on information from the State boating accident reports for the January–June 1997 study period and the questionnaires provided to the Safety Board. The implications of these results are discussed in chapter 3.

**Type of Accident.** Type of accident was indicated for 616 of the 814 PWC accidents in the January–June period (figure 2–2). The most prevalent type of accident was vessel collision (378 of the 814 accidents, or 46 percent), followed by falls overboard (87 of the 814 accidents, or 11 percent) and collision with an object (62 of the 814 accidents, or 8 percent). Type of accident was not indicated for 198 (24 percent) of the 814 accidents.<sup>32</sup>

Vessel collision included collisions between two PWC or between a PWC and a boat. Many accident descriptions reviewed by the Safety Board were associated with PWC traveling together, despite laws in many States that prohibit operating in close proximity and despite operating instructions from PWC manufacturers that caution against such behavior. For example, a Florida investigator stated, “Operators of V1 [vessel 1] and V2 were riding their rented personal watercrafts in a parallel course . . . Operator of V1 cut in front of V2 and misjudged his clearance, running over the top of V2.” Often,

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<sup>32</sup> States and Territories that provided supplemental questionnaires without accompanying boating accident reports account for a substantial portion of missing information (182 of the 198 accidents).

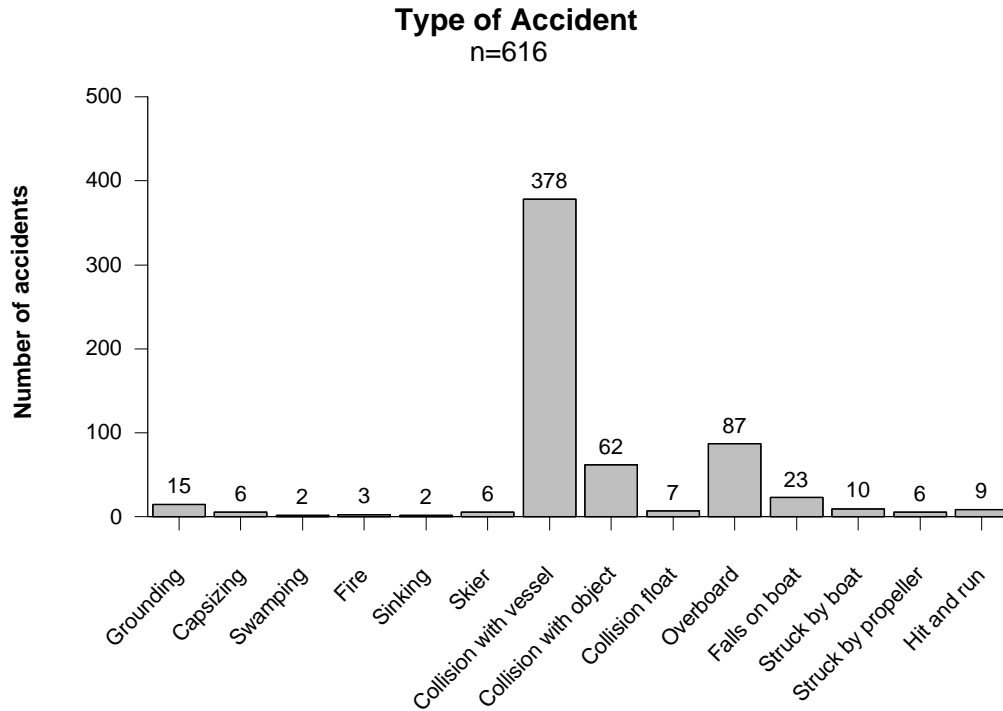


Figure 2–2. Types of personal watercraft accidents, January–June 1997. (Data were available for 616 of the 814 accidents.)

the lead PWC turns into the path of another PWC or slows to a stop and is hit by a second PWC following too closely. In another Florida accident, “V1 and V2 were traveling closely together just off the idle zone . . . V2 stated that he was traveling near V1 and apparently came around and struck V1 starboard bow.” In another case, “V1 was starting to overtake V2. V2 started to make a right turn as the operator was losing his balance. Before the operator of V2 could regain control, V1 struck V2 in the rear starboard quarter.” When PWC travel together in close proximity, the operator in the rear vessel has only a fractional second of response time to react to course changes of the lead vessel.



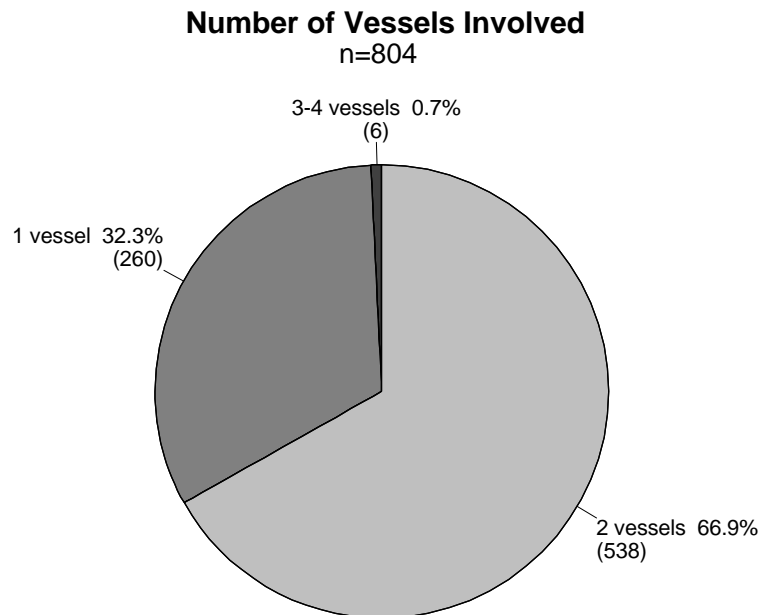


Figure 2-3. Number of vessels involved in the personal watercraft accidents, January–June 1997. (Data were available for 804 of the 814 accidents.)

**Number of Vessels Involved.** The number of vessels was reported for 804 of the 814 PWC accidents. Two vessels were involved in the majority of the accidents (figure 2-3), most of which (390 accidents) involved two PWC. Single-vessel accidents accounted for one-third of the 814 PWC accidents.

**Accident Cause.** Accident cause was attributed to 845 of the 1,218 PWC operators involved in the accidents (figure 2-4). More than one cause could be attributed to a single operator.<sup>33</sup> To code the causes for analysis, the Safety Board used the cause categories on the Coast Guard boating accident form; causes reported by the State investigators that did not fit within the Coast Guard categories were coded “other.” The Safety Board was able to determine who completed the accident report for the accidents involving 859 of the 1,218 operators; of these 859 operators, 91 percent (782) were completed by State marine accident investigators. Inattention (attributed to 307 operators),

<sup>33</sup> The accident report forms indicated 485 accidents with a single cause, 227 with two causes, 123 with three causes, 9 with four causes, and 1 with five causes.

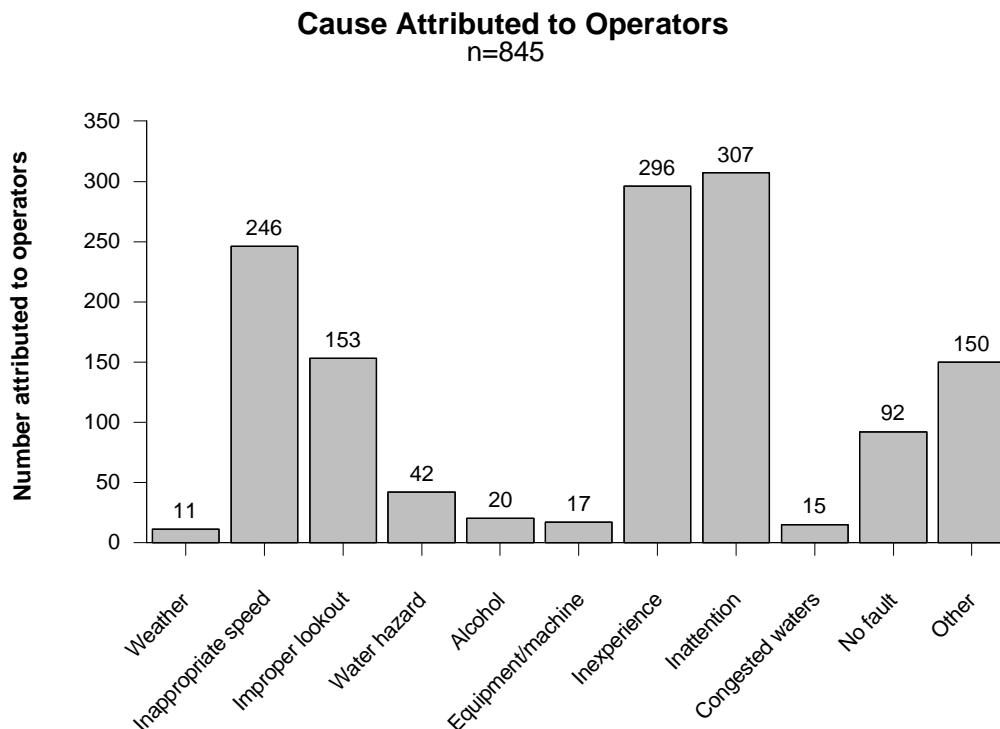


Figure 2-4. Accident causes attributed to the personal watercraft operators involved in the January–June 1997 accidents. Causes were assigned to 845 of the 1,218 operators; more than one cause could be attributed. (“Other” includes these causes: vision (7), passenger (7), improper loading (1), and causes, as described by the investigator or operator, that did not fit within the Coast Guard cause categories.)

inexperience (attributed to 296 operators), and inappropriate speed for the operating conditions (attributed to 246 operators) were the most frequently cited causes that contributed to the PWC accidents. One or more of these three causes were associated with 70 percent of the 814 accidents. A fourth cause, improper lookout (153), was associated with about one-fifth of the accidents. “Not at fault” was indicated for 92 operators. Accident cause was not indicated for any operator in 419 accidents.<sup>34</sup>

<sup>34</sup> State accident investigation forms indicate the number of vessels involved in an accident. Using this count and narrative information, the Safety Board could often determine the number of PWC involved. An operator was counted for each PWC even if there was no accident information about that vessel (for example, in hit-and-run accidents or unknown operators who left the scene). Causal information associated with these operators was unavailable. Additionally, five States provided supplemental questionnaires without accident reports (182 accidents); accident cause was not available for these cases.

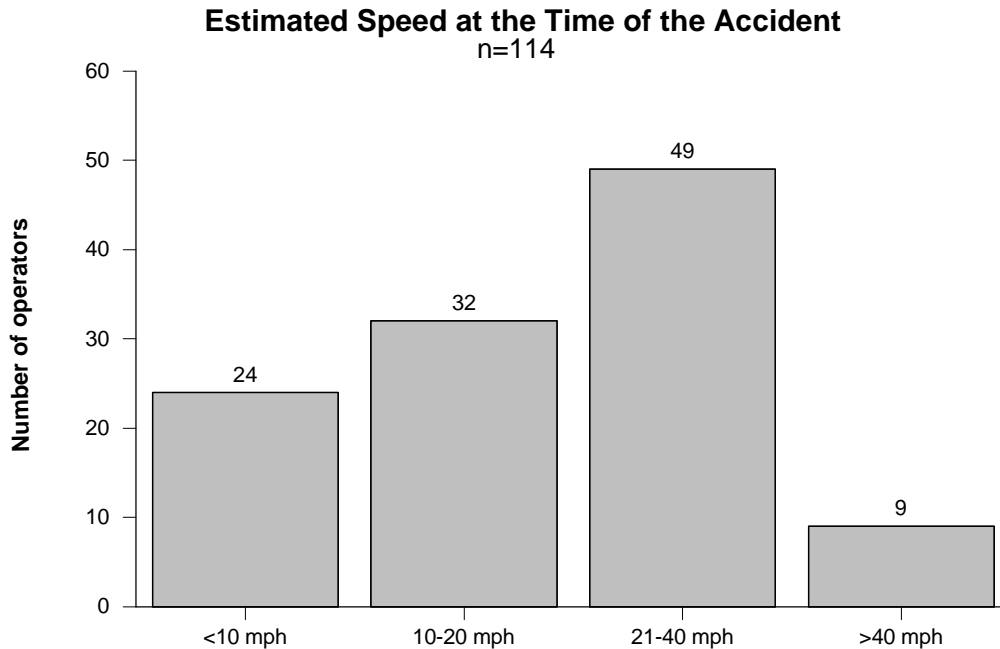


Figure 2-5. Speed attributed to the personal watercraft operator at the time of the accident. (This measure differs from speed as an accident cause. Investigator assessment of speed was assigned to the PWC operator rather than to the vessel or accident. Data were available for only 114 of the 1,218 PWC operators involved in the January-June 1997 accidents.)

**Speed.** The accident cause speed, better defined as inappropriate speed for the conditions, was attributed to 20 percent of the operators (246 of 1,218). However, the actual speed at the time of the accident was quantified for only 114 cases reported. Figure 2-5 shows the proportion of speed ranges reported: half were traveling faster than 20 mph and half were traveling 20 mph or slower.<sup>35</sup>

<sup>35</sup> Four categories of speed are included in most State boating accident reports; <10 mph, 10-20 mph, 21-40 mph, and >40 mph.

**Alcohol Involvement in PWC Accidents.** The accident investigator's narrative reports or witness statements contained information regarding alcohol involvement, if any, for 595 of the 1,218 operators. Alcohol use was cited for 59 PWC operators (5 percent of the 1,218 operators);<sup>36</sup> 5 of those accidents were fatal. Alcohol was indicated as no factor for 536 operators, and no information on alcohol involvement was given for 623 operators. The percentage of alcohol involvement in the PWC study cases is substantially lower than the percentage for recreational boating. Coast Guard data for the previous year's (1996) recreational boating fatal accidents indicated 27 percent alcohol-related.

According to NASBLA's *Reference Guide to State Boating Laws*,<sup>37</sup> all U.S. jurisdictions (that is, 50 States, 5 Territories, and the District of Columbia) have boating laws that address operating under the influence (OUI); blood alcohol content (BAC) levels are 0.08 for about one-third (17) of the jurisdictions and 0.10 for 37 jurisdictions.<sup>38</sup> One State, Iowa, has no defined BAC. The Safety Board's 1993 study of recreational boating safety indicated that 37 percent of the 451 operators in the study accidents had some level of alcohol in their system at the time of the accident.<sup>39</sup> Based on that finding, the Board called for State legislation to require drug and alcohol testing when a recreational boat operator was suspected of being impaired and to require toxicological testing of all recreational boating fatalities (Safety Recommendations M-93-2 through M-93-6). Appendix G provides the status of these recommendations.

**Age of Operator.** Age was reported for 843 of the 1,218 operators: 77 operators were under age 16, and 281 were 16 to 21 years of age (figure 2-6). More than half of the accident-involved PWC operators were younger than 30 years of age. These results strongly suggest that accident-involved PWC operators are a very different group than PWC owners (average age of 41 years, as indicated by the PWIA owner survey).

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<sup>36</sup> Six cases indicated that the operator had been charged with boating while intoxicated (BWI), 2 cases documented an accident witness report of alcohol, and blood alcohol content (BAC) testing was recorded for 15 cases.

<sup>37</sup> National Association of State Boating Law Administrators. 1997. Reference guide to State boating laws. 3d ed. Lexington, KY. 82 p., plus appendixes.

<sup>38</sup> Illinois, Louisiana, and Vermont have separate BAC levels for youths.

<sup>39</sup> National Transportation Safety Board. 1993. Recreational boating safety. Safety Study NTSB/SS-93/01. Washington, DC (p. 24). 104 p.

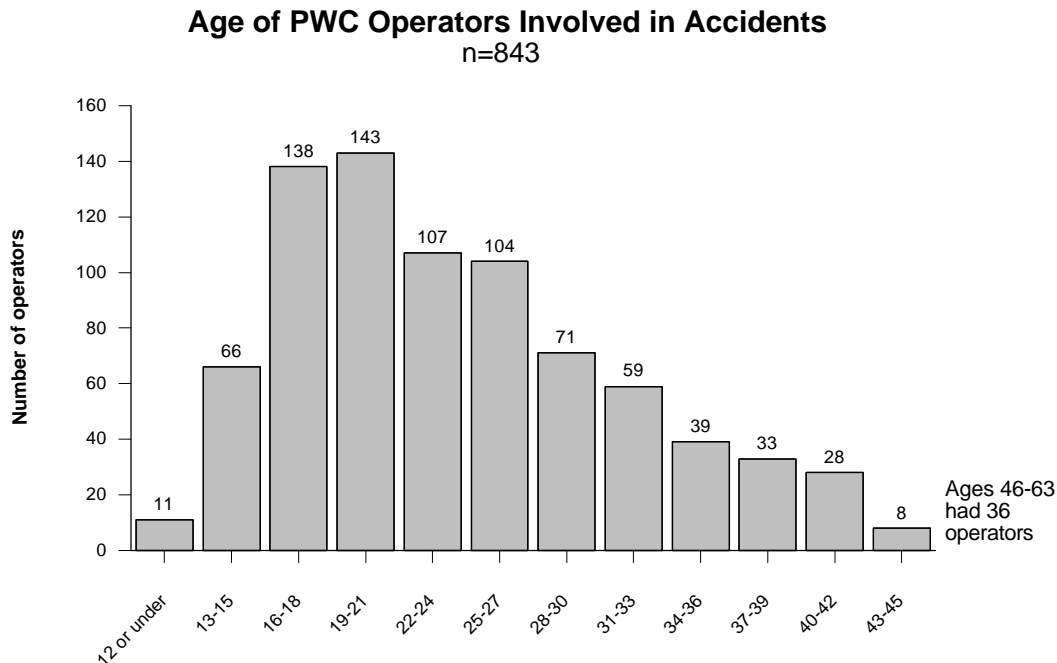


Figure 2-6. Age of the personal watercraft operators involved in the accidents that occurred January–June 1997. (Data were available for 843 of the 1,218 operators involved.)

**Operator Experience and Training.** Experience was reported for half (613) of the operators.<sup>40</sup> Nearly a third of all operators (32 percent) reported that they had operated a PWC between zero and 10 times prior to the accident: 86 never, 75 once, and 225 between 2 and 10 times. PWC operators with experience of more than 10 times accounted for 18 percent (220 of the 1,218 operators).

Operator education or training was reported by 712 PWC operators: 84 percent of those operators reported that they had no training, whereas 16 percent had received some form of boating instruction. The results concerning PWC operator training are consistent with the Safety Board's findings in its 1993 study of recreational boating: as few as 7 percent and no more than 22 percent of the persons operating a boat for the first time had taken a boating safety course.<sup>41</sup>

<sup>40</sup> The Safety Board recognizes that the data on this topic are based on self-report and may be an overestimate of the number of PWC operators with experience and training.

<sup>41</sup> National Transportation Safety Board. 1993. Recreational boating safety. Safety Study NTSB/SS-93/01. Washington, DC (p. 50). 104 p.

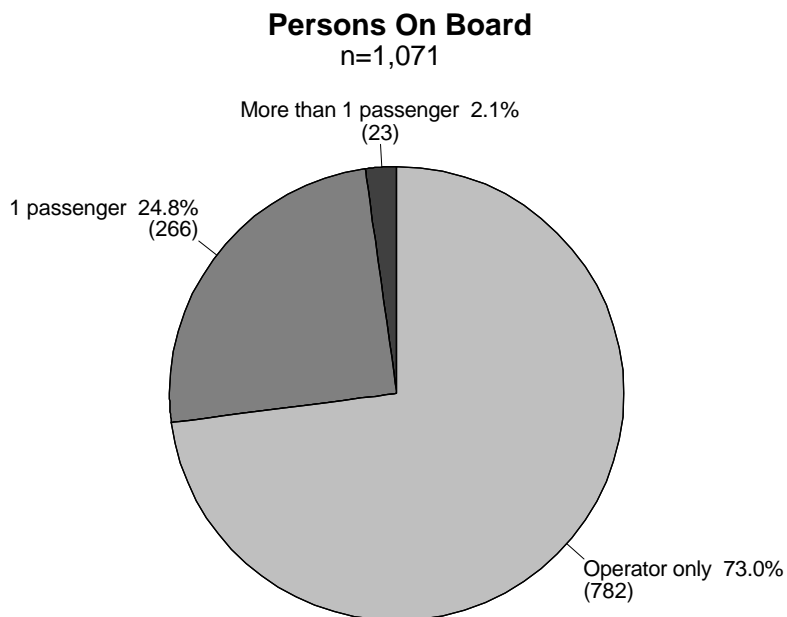


Figure 2-7. Persons on board the personal watercraft involved in the 814 accidents that occurred January–June 1997. (Data were available from 1,071 of the 1,218 PWC operators involved in the accidents.)

**Persons On Board.** Information about the number of persons on board was available from 1,071 of the 1,218 PWC operators involved in the accidents: 73 percent were riding alone, and 25 percent were carrying one passenger (figure 2-7). In 1994, PWC models for two to three riders became popular; however, only a few (2 percent) of the PWC involved in the 1997 accidents had more than two persons riding the vessel; one accident report indicated that there were three passengers in addition to the operator.

**Riding Time That Day.** Information about riding time was available for 420 PWC operators. Half of all the operators had been riding less than 1 hour before the accident (figure 2-8). Even though operators of rented PWC accounted for only 23 percent of the accident-involved PWC operators, 49 percent of the operators who had been riding less than 1 hour were riding rented PWC. Because fees for rented PWC are typically charged by the hour, riding time measures are affected by the proportion of rented vessels.

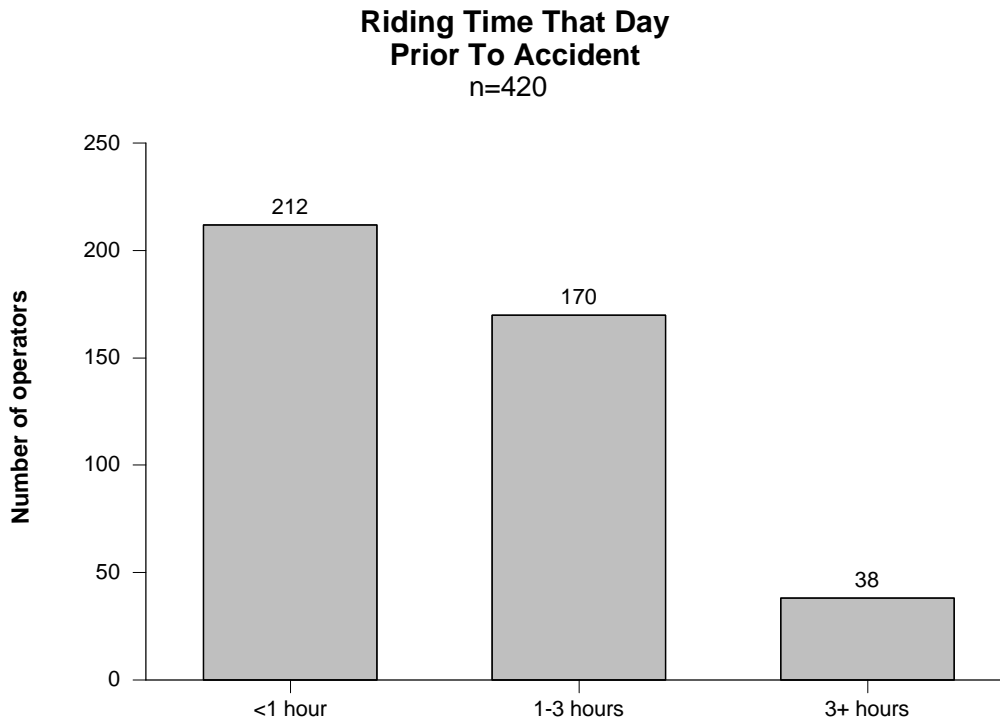


Figure 2–8. Riding time of the personal watercraft operators prior to the accident. (Data were available for 420 of the 1,218 operators involved in the accidents that occurred January–June 1997.)

Riding time is an important factor in interpreting accident and injury information. To accurately compare PWC accidents to accidents involving other types of recreational boats, it is necessary to quantify the usage time by vessel type. If PWC are used more often than other types of boats, then their exposure time for incurring an accident would be higher.

A national boating survey conducted in 1988–89 by the American Red Cross occurred at a time when PWC were just becoming popular. The survey reported 45 passenger hours per year for PWC compared to 117 passenger hours per year for all recreational boats.<sup>42</sup> Since 1989, the number of PWC has increased nearly six-fold and now account for 36 percent of new boat sales. The dramatic rise in popularity of PWC demonstrates that boating practices have changed in the intervening years since the Red Cross

<sup>42</sup> U.S. Department of Transportation, United States Coast Guard. 1991. American Red Cross national boating survey: a study of recreational boats, boaters, and accidents in the United States. Washington, DC; grant agreement 1801-82. 350 p.

survey was completed and highlights the need for a current, unbiased measure of boat usage for all recreational boat types (for example, personal watercraft, sailboat, motorboat, canoe, and rowboat).

The PWC owner survey commissioned by the PWIA documented a high usage time for PWC: an average of 7 days per month during the 1995 season.<sup>43</sup> Another source of information about usage, the National Recreational Boating Needs Assessment Survey, was prepared in response to 1997 Congressional hearings for the reauthorization of transportation trust funds.<sup>44</sup> Because the survey data were intended to be one tool to help in determining the allocation of monies derived from gasoline tax, the survey collected information only about motorboats, without an interest for other categories of recreational boats. The survey was conducted through telephone interviews to 1,000 U.S. households; the results were based on information provided by the 266 that were boating households. (By comparison, the national boating survey conducted in 1989 by the American Red Cross surveyed 5,031 households). The National Recreational Boating Needs Assessment Survey, which distinguished only two categories for motorboat usage (motorboats 18 feet or less and motorboats 19 feet or more), found that motorboats 18 feet or less were used an average of 30 days a year and 5 hours a day (150 hours per year).

Estimates of usage time specifically comparing PWC and outboard motorboats were prepared by industry in 1996 and submitted to the Environmental Protection Agency (EPA) in support of rulemaking for marine engines.<sup>45</sup> Annual time of use for PWC was 77.3 hours per year compared to 34.8 hours per year for outboard vessels; using these measures of usage time, the exposure factor for PWC was 2.22 times higher than for outboard vessels. This is a substantially different estimate than the one developed by the National Recreational Boating Needs Assessment Survey. Given the changes in boating practices since the 1989 Red Cross boating survey and the differences in estimates of PWC usage reported by industry, the Safety Board concludes that a rate of injury for PWC in relation to all recreational boat types cannot be determined because accurate information on usage by boat type is not available.

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<sup>43</sup> The survey response rate (2,800 replies from 11,500 mailed surveys) represents 26 percent of the deliverable mail-outs. The survey results did not indicate the proportion of rental agents included in the survey.

<sup>44</sup> Hagler Bailly, Inc. 1997. The national recreational boating needs assessment survey. Final report prepared for the International Association of Fish and Wildlife Agencies, Washington, DC. 36 p., plus appendixes. Project funded by the U.S. Fish and Wildlife Service, Washington, DC; Sportfish Restoration Program grant agreement 14-48-98210-97-G067.

<sup>45</sup> Submission by Mercury Marine in response to EPA request for comments concerning Rule—Air pollution control, gasoline spark-ignition marine engines. Federal Register, Vol. 61, No. 194, dated October 4, 1996, page 52088.



The Coast Guard has recognized the need for boat usage time and exposure data, and in 1997 issued a notice seeking application for grants to conduct a comprehensive national boating survey.<sup>46</sup> The Safety Board commends the Coast Guard in recognizing this need and urges completion of the survey. Once this effort is completed, there is a continuing need to accurately assess recreational boat use. The Safety Board believes, therefore, that the U.S. Coast Guard should collect recreational boating exposure data such as “operational use time” or “vessel running time” and update this information on an annual basis or conduct periodic surveys.

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<sup>46</sup> Federal Register, Vol. 62, No. 193, dated October 6, 1997, page 52175.

## Chapter 3

# PWC Operations

The Safety Board's 1993 study on recreational boating addressed several safety issues, including boater education, operator training, mandatory use of personal flotation devices (PFDs), and alcohol involvement in boating accidents. The safety issues concerning recreational boating safety, in general, are equally applicable to PWC operations. As highlighted in chapter 1 of the current study, the number of PWC in use, the number of PWC-involved accidents, and the number of PWC-related fatalities has almost doubled since the Safety Board completed the 1993 study. PWC now constitute more than one-third of new recreational boat sales, and they can no longer be considered a small subset of recreational vessels. Because of the emergence of PWC in the recreational boating arena in the last few years, the Safety Board deemed it necessary to look at particular boating safety issues as they relate specifically to PWC, including operator experience, education, and training; rental operations; State operating restrictions; and use of PFDs.

## PWC Operator Experience and Education/Training

Each year, many first-time PWC operators are exposed to the boating environment. In the Safety Board's 1997 sample of PWC accidents, nearly half (48 percent) of the operators of rented PWC had operated a PWC only once or never; 18 percent of the operators of privately owned PWC had previously operated a PWC only once or never.<sup>47</sup> This lack of experience is particularly important for PWC because the vessels have special operating characteristics, such as the loss of control during off-throttle steering and cut-off ("kill") switches activated by the use of safety lanyards to stop the vessel if the operator is ejected, that underscore the need for training.

Operating a PWC requires a high degree of vigilance. Several PWC models can exceed 60 mph, but even at a speed of 40 mph, a PWC travels about 20 yards per second. As speeds increase, the time available to react decreases. PWC are highly maneuverable vessels that can change course quickly while under power, which presents a particular problem when several PWC are traveling together.<sup>48</sup> The timeframe for perceptually

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<sup>47</sup> Issues specifically related to PWC rental operations are discussed in more detail later in this chapter.

<sup>48</sup> State boating law administrators agree that PWC operations often involve riding close to other PWC.

tracking another PWC can also be quite limited under these conditions. Operators of two PWC traveling at 40 mph on a head-on course will have a response time of 1.3 seconds to travel 50 yards. Even when the vessels are converging on a 45-degree angle, the response time is less than 2 seconds.<sup>49</sup> The response time must accommodate perceiving the other vessel, deciding which vessel is burdened to comply with rules of the road, determining the risk of collision, and executing a response to alter course. Under these conditions, inexperienced operators who are not aware of navigation rules<sup>50</sup> that dictate which vessels have the right of way and, therefore, what direction of turn can be expected for vessels on conflicting routes, are faced with split-second decisions.

California reports that operator inexperience is the leading cause of PWC-related accidents in that State (a factor in 49 percent of the PWC accidents).<sup>51</sup> The second leading cause is operator inattention (47 percent). Florida notes that nearly 50 percent of the PWC accidents in that State involve operators with less than 20 hours of experience, which is the category on the State's boating accident report form that indicates the least experience (three other categories record increasing levels of experience).<sup>52</sup>

The Safety Board's analysis of the 1997 State boating accident reports showed that 87 percent of the PWC operators had received no boating instruction.<sup>53</sup> The NTSB supplemental questionnaire submitted by the States indicated a similar proportion: 84 percent had completed no type of boating instruction.<sup>54</sup> The need for boating instruction was addressed in the Safety Board's 1993 safety study of recreational boating; 81 percent of the operators involved in fatal accidents in that study had received no boating safety instruction.<sup>55</sup> A review of 1996 Coast Guard boating statistics also illustrates that recreational boaters have a low exposure to safety education. Of the 709 recreational boating fatalities, educational experience was known for 340: 50 (15 percent) had

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<sup>49</sup> 40 mph = 19.5 yd/sec. On a direct course, each vessel traverses 25 yards; on a converging course, each vessel travels 35.35 yards before intersecting.

<sup>50</sup> PWC are subject to inland navigation rules as stated in USCG COMDTINST M16672.2B, dated August 17, 1990.

<sup>51</sup> *PWC News*. 1996. California boating accident statistics and PWC. Sacramento, CA: California Department of Waterways; p. 2.

<sup>52</sup> Shatz, David D.; Norton, Brett D. 1997. Accidents on the waterways: another focus for injury prevention. *Journal of the Florida Medical Association*. 84(7): 458-460. October.

<sup>53</sup> Training information was reported for 471 of the 1,218 PWC operators: 413 had none, and 58 had completed State courses, Coast Guard Auxiliary training, Power Squadron training, Red Cross training, or other (military) training. The duration of the reported training or quality of the course content may have varied.

<sup>54</sup> Responses to a boater education question that was included on the supplemental questionnaire were reported for 712 of the 1,218 operators; of those responding, 600 (84 percent) had no training.

<sup>55</sup> National Transportation Safety Board. 1993. Recreational boating safety. Safety Study NTSB/SS-93/01. Washington, DC. 104 p. The Safety Board's experience indicates that boating accidents involving a fatality are more likely to be reported than those involving less serious injury. Fatal accidents are also better documented. The Board used fatal accidents to illustrate the proportion of operators who had received boating education because it had greater confidence in the boating education data from that subset than from all accidents.

**Table 3–1. Boating education experience of fatally injured recreational boat**

Item	1991	1992	1993	1994	1995	1996
Number of fatally injured recreational boat operators	924	816	800	784	830	709
Number of the operators for whom boating education information was known	433	396	405	378	400	340
Number of the operators who had completed some type of boating education	72	66	86	74	46	50
Percentage of the operators who had completed some type of boating education	16.6	16.6	21.2	19.6	11.5	14.7

Source: Data reported by the States to the U.S. Coast Guard.

received operator education, and 290 (85 percent) were known not to have received operator education. Data for 1991 through 1996 reflect similar proportions regarding the fatally injured operators who had received boating safety education (table 3–1).

In 1988, no State mandated operator certification or boating safety education. By 1996, 4 States had enacted legislation for some type of certification of recreational boaters (Alabama, Connecticut, Indiana, and New Jersey),<sup>56</sup> and 20 States and Territories had mandated boater education.<sup>57</sup> Thirty-six States and Territories offer boating education in the public schools; certificates were issued to 242,665 students in 1996.<sup>58</sup> State training

<sup>56</sup> In Alabama, by April 28, 1999, all recreational boat operators age 12 or older must have a license, but there is no requirement for an operator to take a State boating safety or other recognized course. In Connecticut, all recreational boaters must now have an operator's certificate that requires boating safety training from either the State (a 10-hour course), the Coast Guard Auxiliary, the Power Squadron, or State-approved private course. In Indiana, a PWC operator must have either a valid driver's license or a picture identification card (cost \$4) indicating the holder completed an approved boating safety course. An Indiana driver's license may be obtained at age 16; the ID card is a provision for PWC operators age 15, the youngest operating age allowed by special provision. In New Jersey, PWC operators must complete the State's 8-hour course on boating safety basics, or a substantially similar course, and pass an examination before they can operate a PWC on State waters.

<sup>57</sup> NASBLA lists the District of Columbia and 17 States that require boating education for young operators: Alabama, Colorado, Connecticut, Delaware, Florida, Illinois, Indiana, Maryland, Massachusetts, Michigan, Mississippi, New Jersey, North Dakota, South Carolina, Texas, Vermont, and Wisconsin. Utah and Puerto Rico also require mandatory safety education for young operators. Connecticut, Maryland, and New Jersey require boating education for all ages. (National Association of State Boating Law Administrators. 1997. Reference guide to State boating laws. 3d ed. Lexington, KY (p. 19). 82 p., plus appendixes.)

<sup>58</sup> National Association of State Boating Law Administrators. 1997. Reference guide to State boating laws. 3d ed. Lexington, KY (p. 16). 82 p., plus appendixes.

programs have shown substantial growth in recent years, but only a small fraction of the estimated 78 million persons exposed to recreational boating on an annual basis have been trained.<sup>59</sup>

Although no State or Territory requires a special boating license to operate a PWC, 16 jurisdictions have special boating education requirements to operate a PWC.<sup>60</sup> Effective June 23, 1993, PWC operators in Connecticut were required to take a safe handling course to obtain a certificate for PWC operation; there are no exceptions. Mandatory education requirements include 10 hours of basic boating safety and an additional 2.5 hours of instruction concentrating on PWC safety. Even though there has been a substantial increase in the number of PWC operations, there have been no fatalities attributable to PWC operations in Connecticut in the past 10 years. The boating law administrator for Connecticut indicates that accidents and injuries have decreased over the last 5 years. Training is typically offered by the States' marine safety officers. Michigan's marine education program<sup>61</sup> certified 50,554 students in classroom courses in 1996.<sup>62</sup> That State also conducts a PWC education/enforcement program that began in 1995; it involves 30 marine officers assigned to PWC patrol who review regulations, discuss safety, and give equipment demonstrations. Even with a growth in PWC operations, that State has seen a decrease in both PWC accidents and fatalities; PWC accidents accounted for 45 percent of all boating accidents in 1995 and dropped to 41 percent in 1996.

On October 23, 1997, the Coast Guard issued a notice in the Federal Register requesting comments on a proposed Federal requirement for education in recreational boating. On March 20, 1998, the Coast Guard extended the comment period until May 29, 1998.<sup>63</sup> The Safety Board submitted comments supporting the need for operator education and training for recreational boaters and PWC operators, and reiterating the conclusions and recommendations of its 1993 study on recreational boating safety. The lack of education reported for the PWC operators in the current study provides further support for the need for education of recreational boat and PWC operators.

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<sup>59</sup> The U.S. Coast Guard uses 78 million as an estimate of one-quarter of the Nation's population. That proportion was taken from the 1988-89 American Red Cross survey of recreational boaters.

<sup>60</sup> The following States and Territories require PWC education: Colorado, Connecticut, Delaware, Georgia, Idaho, Kansas, Massachusetts, Minnesota, Nevada, Rhode Island, Tennessee, Texas, Utah, Wisconsin, U.S. Virgin Islands, and American Samoa. Nevada requires PWC education only of PWC operators who rent the vessel. (National Association of State Boating Law Administrators. 1997. Reference guide to State boating laws. 3d ed. Lexington, KY (p. 21). 182 p., plus appendixes.)

<sup>61</sup> Michigan's course is only 1 hour long; most States require 6 to 8 hours of classroom instruction.

<sup>62</sup> *Small Craft Advisory*. Dec. 1997/Jan. 1998. Lexington, KY: National Association of State Boating Law Administrators; 13(2): 20.

<sup>63</sup> Federal Register, Vol. 63, No. 54, dated March 20, 1998, page 13585.

**Table 3–2. Topics for a prototype personal watercraft course developed by the National Association of State Boating Law Administrators.<sup>(a)</sup>**

**Operational characteristics:**

- Jet propulsion, including off-throttle steering
- Re-boarding
- Lanyard/cut-off switch
- Fuel reserves tank
- Equipment limitations
- Maneuvering

**Preparation:**

- Pre-departure checklist—
  - Gasoline fumes
  - Safety equipment
  - Electrical systems

**Laws and regulations:**

- Equipment—
  - Noise limits
  - Equipment limitations
  - PFD wearage
  - Optional equipment: goggles, gloves, footwear, sunscreen, tow lines, high-impact PFDs
- Operator responsibilities—
  - Wake, speed, proximity to others: courtesy, requirements
  - Proximity to shoreline and shoreline facilities, limited duration
  - Proximity to wildlife, environmental effects
  - Towing water skiers: observer, vessel capacity
  - Nighttime operation (not recommended, unlawful)
  - Sudden maneuvering
  - Courtesy and common sense
- Accident prevention as it relates to PWC

<sup>(a)</sup> The NASBLA Education Committee conducts a structured review of the content of personal watercraft courses. The Coast Guard recognizes courses approved by NASBLA.

NASBLA, BOAT/U.S., the National Safe Boating Council, and the National Water Safety Congress support recreational boating education. NASBLA's Education Committee has a review process designed to standardize training information by approving boating safety curriculums. NASBLA has also developed a model PWC boating course that addresses the topics shown in table 3–2. This course outline may be used by the individual States to pattern the courses they develop, and it serves as a guide to educational organizations that work within the local communities to provide training. In addition to NASBLA's education efforts, the PWIA has also been developing model PWC education requirements. PWIA advocates mandatory education for PWC operators and has mandatory education as an element of its model legislation.<sup>64</sup>

<sup>64</sup> The PWC model legislation is discussed in more detail later in this chapter.

PWC manufacturers provide safety information in printed and video formats with every PWC sold, and dealers are asked to review these safety techniques with customers. The PWIA has also developed classroom material used in several State safety education courses. One manufacturer recently introduced a PWC training program that requires dealers to deliver a boating safety presentation (video and law review) to all purchasers of new PWC.<sup>65</sup> The product cannot be warranty-registered until the customer receives the information. The Safety Board commends industry efforts to provide PWC owners with point-of-purchase education and training. However, this point-of-purchase information may not reach relatives and friends of the PWC owner who may use the vessel. In its 1993 study on recreational boating, the Safety Board recommended that each State

Implement minimum recreational boating safety standards to reduce the number and severity of accidents; consider requirements such as mandatory use of personal flotation devices for children, demonstration of operator knowledge of safe boating rules and skills, and operator licensing. (M-93-1).<sup>66</sup>

Although some progress has been made in responding to the Safety Board's recommendation, as shown by the 4 States that now require boater certification and the 20 that mandate boating education, the Safety Board continues to believe that if more recreational boaters were trained, the number of persons killed and injured in recreational boating accidents, including those involving PWC, would be reduced. Therefore, the Safety Board is reiterating Safety Recommendation M-93-1 in this report. Because two-thirds of PWC owners also owned a powerboat prior to purchasing a PWC (as discussed in chapter 1), it is reasonable to believe that powerboat operators taking a recreational boating education course may someday be PWC owners or operators. To reach the maximum number of persons who may operate a privately owned PWC, recreational boating education courses should provide some level of PWC training. This is not to say that all boaters should take a PWC course, but rather that all recreational boating courses should address PWC safety issues. Therefore, the Safety Board believes that the States, NASBLA, the Coast Guard Auxiliary, the U.S. Power Squadrons, and BOAT/U.S should include information on the safe operation of PWC in all recreational boating courses.

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<sup>65</sup> Polaris Industries, Inc.

<sup>66</sup> Safety Recommendation M-93-1 has been classified "Closed—Acceptable Action" for 7 States, "Open—Acceptable Response" for 28 States, "Open—Response Received" for 4 States, "Open—Awaiting Response" for 9 States, and "Closed—Unacceptable Action" for 4 States.

## Experience of Operators Who Rented PWC

The Safety Board is concerned about persons who rent PWC. Nearly one-quarter of the PWC operators involved in the 1997 accidents analyzed by the Safety Board for this study (292 of 1,218, or 24 percent) were operating rented PWC.<sup>67</sup> Accident case analysis showed that 68 percent of the operators of rented PWC were under age 25, and 73 percent had been riding less than 1 hour at the time of the accident; 84 percent of the accidents involved collision with another vessel.

There was limited reporting of PWC renters who received safety information (110 of 292 rentals), but for those for whom the information was reported, the safety information was usually transmitted by verbal instruction (56 percent). In the Michigan accident discussed in chapter 1, the rental agent's verbal instructions were translated for the Spanish-speaking operator; the translation may have been quite effective, but the situation raises a question about whether the rental agent was sure that the operator understood the procedures necessary for safely operating the vessel. Only one out of three PWC renters included in the Safety Board's accident analysis indicated that the rental agent had required them to demonstrate PWC riding ability. To encourage all rental businesses to be responsible partners in safe boating, the PWIA provides a free education package for PWC rental businesses. The package includes a videotape, waterproof checklist, safety posters, and safety literature.

Nearly half of the rented PWC in the Safety Board's accident sample were operated by out-of-state residents (table 3-3). If the PWC was rented, 48 percent of the operators reported they were not State residents (132 of 277); for nonrented PWC, only 11 percent of the accident operators resided outside the State (80 of 757). Out-of-state operators may be less familiar with the recreational waterways in which they are operating the PWC and with the local boating regulations.

Operators of rented PWC were twice as likely as operators of personally owned PWC to have ridden the vessel less than 1 hour before the accident occurred. Table 3-4 shows that 73 percent of rental-operator accidents occurred within the first hour of operation (102 of 139) compared with 39 percent for nonrental operators (107 of 272). However, this finding may be confounded by the fact that PWC are rented by the hour and some portion of renters will rent the vessels for only an hour. As mentioned earlier in this chapter, about half of the operators of rented PWC had previously operated a PWC only once or never (table 3-5); this underscores the need for PWC education and training.

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<sup>67</sup> Boating accident report forms of all States contain a field to designate whether or not the vessel was rented. Rental information was provided for 85 percent (1,034 of the 1,218) of the PWC operators involved in the accidents that occurred during the January-June 1997 study period.



**Table 3–3. Residency of personal watercraft operators involved in the January–June 1997 study cases, by rental status of the personal watercraft.<sup>(a)</sup>**

Residency of operator	Personal watercraft not rented	Personal watercraft rented	Total
Out of State	80	132	212
In State	677	145	822
Total	757	277	1,034

<sup>(a)</sup> Information about the residency of the personal watercraft operator plus rental status of the vessel was provided by 1,034 of the 1,218 operators involved in the accidents.

**Table 3–4. Number of hours operators had ridden the personal watercraft prior to the accident, by rental status of the personal watercraft.<sup>(a)</sup>**

Riding time	Personal watercraft not rented	Personal watercraft rented	Total
Less than 1 hour	107	102	209
1–3 hours	134	32	166
More than 3 hours	31	5	36
Total	272	139	411

<sup>(a)</sup> Information about hours of operation plus rental status of the personal watercraft was provided by 411 of the 1,218 PWC operators involved in the accidents that occurred in the January–June 1997 study period.

**Table 3–5. Previous personal watercraft operating experience of the accident-involved operators, by rental status of the personal watercraft.<sup>(a)</sup>**

Number of times person had previously operated personal watercraft	Personal watercraft not rented	Personal watercraft rented	Total
Never	34	49	83
1	40	35	75
2–10	143	74	218
More than 10	198	17	214
Total	415	175	590

<sup>(a)</sup> Information about previous experience plus rental status of the personal watercraft was provided by 590 of the 1,218 PWC operators involved in the accidents that occurred in the January–June 1997 study period.

**Table 3–6. Cause of personal watercraft accidents January–June 1997, by rental status of the personal watercraft.<sup>(a)</sup>**

Cause of accident <sup>(b)</sup>	Personal watercraft not rented		Personal watercraft rented	
	Number	Percent	Number	Percent
Weather	9	1	1	0
Inappropriate speed	175	21	53	13
Improper lookout	88	11	59	14
Hazardous waters	36	4	4	1
Alcohol use	18	2	0	0
Equipment/machine	12	1	5	1
Operator inexperience	172	21	109	27
Operator inattention	181	22	105	26
Congested waters	10	1	5	1
No fault	44	5	27	7
Other	88	11	42	10
<b>Total</b>	<b>833</b>	<b>100</b>	<b>410</b>	<b>100</b>

<sup>(a)</sup> Rental information was available for 1,073 of the 1,218 PWC operators involved in the accidents that occurred during the 6-month study period.

<sup>(b)</sup> More than one cause could be attributed to the accident-involved operators.

Reported causes of the accidents involving rented PWC appeared to show a somewhat different pattern than nonrented PWC (table 3–6). Operators of rented PWC were somewhat more likely to have accidents reported as resulting from inexperience and inattention, but they were not as likely to have an accident reported as resulting from inappropriate speed.

Twenty States have taken steps to address the safety of PWC rental operations (see appendix B for details). For example, in Oregon and Florida, the minimum age (by statute) to operate a PWC is 14, but it is 16 for operators who rent PWC. In Wisconsin, the allowable operating age with training and adult supervision is 12, but 16 for those who rent a vessel. Idaho law effective July 1996 specifically requires all rental businesses and agents to educate all PWC renters concerning the safe operation of the vessel and to place a decal on the vessel that lists safe operating techniques and boating laws. The law requires the renter to take the education (PWC video and instruction provided at the point of rental) and to carry an acknowledgment-of-education form while operating the PWC. Violation is an infraction of the law. Florida requires an on-water checkride to be provided by rental agents. Nevada requires not only the renter, but each person who will operate under the rental contract, to receive instruction in the laws and safe operation of the PWC. A dozen States specify education or training requirements that rental agents must provide PWC renters.

Accident data showed that operators of rented PWC in the study sample had less PWC experience than did operators of privately owned personal watercraft. Considering the unique operating characteristics of PWC, this lack of experience creates a safety risk. Given that the percentage of PWC accidents that occur within the first hour was almost twice as high for rented PWC as for nonrented PWC (73 percent compared to 39 percent), that half of the accident-involved rental operators had limited or no experience on a PWC, and that about two-thirds of accident-involved PWC renters had not had to demonstrate their ability to operate the vessel, the Safety Board believes that States should enact or revise their recreational boating laws, as necessary, to require rental businesses to provide safety instruction training to all persons who operate rented PWC and to require the operators to demonstrate their ability to operate and control PWC. The Safety Board also believes that NASBLA, in conjunction with the Coast Guard and the PWIA, should develop a checklist for boat rental businesses to use for evaluating a person's ability to operate a PWC.

## State Operating Restrictions

**Minimum Operator Age.** The States' 1997 PWC accident cases analyzed by the Safety Board involved 77 PWC operators age 15 or under (6.3 percent of the accident-involved PWC operators). Fifty-one States and Territories have established a minimum age, by statute, for PWC operation. However, there is a wide disparity among State laws regarding the age at which a young person can operate a PWC. (The minimum age required by each State or Territory, through statute or special provision, is provided in appendix H.) In most States, provisions exist that allow operators who are younger than the minimum age by statute to operate a PWC (figure 3-1). For example, boater training or PWC certification (for PWC operating privileges at a special age) is required in 23 States and 2 Territories. Colorado law, for example, has a minimum PWC operating age of 16, but the age is lowered to 14 for holders of a PWC training certificate. Thirty States and 2 Territories have provisions for adult supervision of younger PWC operators.

Recent legislative activity by some States tends to show movement toward raising the minimum age for operating PWC. For example, California set new minimum age standards that took effect in January 1998: PWC operators must be at least 16 years old. But the new law allows persons 12 to 15 years of age to operate a PWC with adult supervision. Maryland recently set the minimum PWC operator age at 16.<sup>68</sup> In a boating

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<sup>68</sup> Maryland regulations are published in Title 8 Department of Natural Resources, Subtitle 18: Boating—Speed Limits and Operation of Vessels, Chapter 2: Personal Watercraft, Paragraph 5: Restrictions.

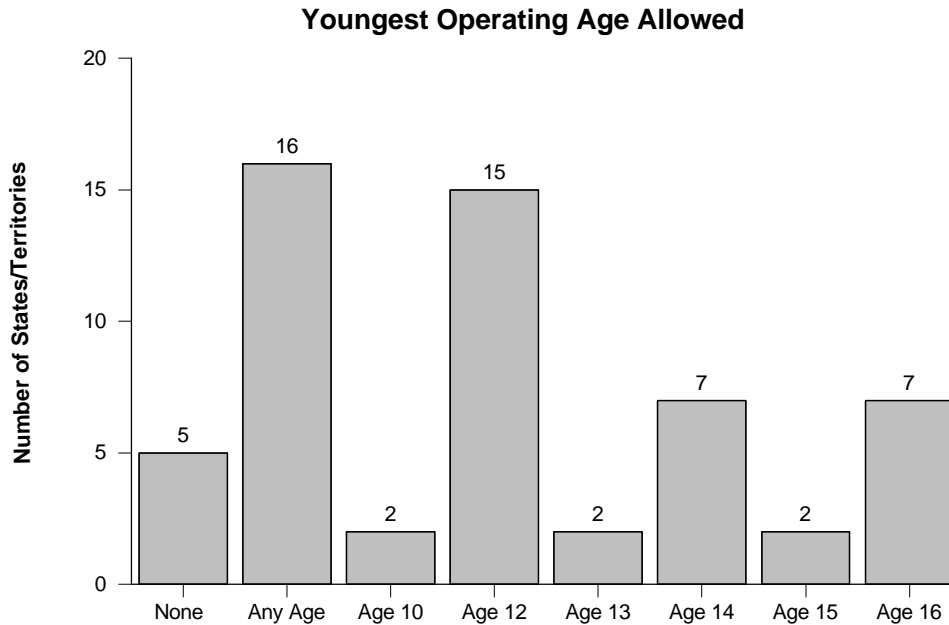


Figure 3–1. Youngest personal watercraft operating age allowed by States and U.S. Territories. (Note: This chart reflects the youngest age allowed, either by statute or, for some States, the younger age allowed by special provisions such as boater training or adult supervision. “None” accounts for States and Territories without a minimum age requirement, by statute; “Any Age” accounts for States and Territories with a minimum age requirement but allow PWC operation at any age when special provisions are met.)

survey conducted by Virginia,<sup>69</sup> where PWC operators can be as young as age 14,<sup>70</sup> 81 percent of the survey respondents believed there should be a minimum age to operate a motorboat: 33 percent believed the age should be 14, and 40 percent believed the age should be 16.

The PWIA and NASBLA have developed model acts for PWC that States may use in their legislative initiatives. The PWIA model act proposes 16 as the minimum operator age: it has advocated 16 as the minimum operator age since 1988. Twenty-one of the 56 States and Territories with statutes that specify a minimum age requirement have set 16 as the minimum age for PWC operators; 7 States and Territories have an older age requirement. The NASBLA model act also proposes age 16; however, that act includes a provision for 12- to 16-year-olds to operate a PWC if a person age 18 or older is on board the vessel. (A comparison of the PWIA and NASBLA model acts, and the complete text of both, are provided in appendix I.)

<sup>69</sup> Virginia Department of Game and Inland Fisheries. 1997. Boating education in Virginia. Richmond.

<sup>70</sup> The Commonwealth of Virginia’s General Assembly and Senate passed new PWC age requirements effective January 1, 1999: persons ages 14 and 15 may operate a PWC with training and age 16 without training. A training card must be carried by 14- and 15-year-old operators.

All but five jurisdictions have established a minimum operating age, but many States have special provisions for training, certification, or adult supervision that substantially lower the minimum age requirement. Of the 28 States and Territories with statutes that have set a minimum age of 16 years or older, all but 6 have special provisions that allow PWC operation at a younger age than set by statute. The Safety Board supports the initiatives by the PWIA and the States to establish State statutes that set 16 as the minimum operating age, and the Board acknowledges efforts to promote safety through boater education, certification, and supervision. The Safety Board is concerned, however, that special provisions are being used to lower or negate minimum operator age requirements and believes that NASBLA should examine the effects of special provisions on the operator minimum age requirement for PWC.

***Distance Restrictions.*** The Safety Board is also aware that some States have taken initiatives to impose certain operating restrictions based on distance. California reports that 25 percent of its collisions between two PWC are caused by PWC operators executing radical maneuvers including wake jumping, turning donuts, or spraying another vessel.<sup>71</sup> For example, Utah requires PWC operators to remain 150 feet from all vessels when traveling faster than no-wake speed, Maryland has a 6-knot speed limit within 100 feet of shore, and South Carolina requires no wake within 50 feet of docks or anchored boats. Fourteen States have set 100-foot restrictions for wake jumping; 3 other States have set the distance at 150 feet (appendix B contains a summary of the States' PWC operating restrictions). The Safety Board commends the States for their efforts to evaluate the need for operating restrictions and for imposing those restrictions as necessary.

## Personal Flotation Devices

The Safety Board's accident analysis showed that 97 percent of the PWC operators (971 of 999 reported) were wearing a personal flotation device (PFD). The various types of PFDs are shown in figure 3-2. Most operators (80 percent, or 425 of 534 reported) wore a type III flotation aid life jacket. Personal watercraft are the only type of recreational vessel for which the leading cause of death is not drowning; however, when drowning is involved, it is typically because the rider was not wearing a PFD. According to Coast Guard data for 1995, 38 percent of PWC fatalities were from drowning (26 of 68); 20 of the 26 persons who drowned were not wearing a PFD. In 1996, PWC fatalities from drowning decreased to 15 (of 57 PWC fatalities); however, 10 of the 15 who drowned were not wearing a PFD.

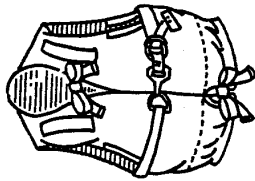
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<sup>71</sup> PWC manufacturers consider these behaviors to be inappropriate, as indicated in the PWIA model act.

**TYPE I**

**Offshore Lifejacket**

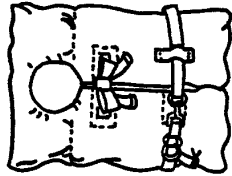
This PFD is designed for extended survival in rough, open water. It usually will turn an unconscious person face-up and has over 22 pounds of buoyancy. This is the best PFD to keep you afloat in remote regions where rescue may be slow in coming.



**TYPE II**

**Near Shore Buoyant Vest**

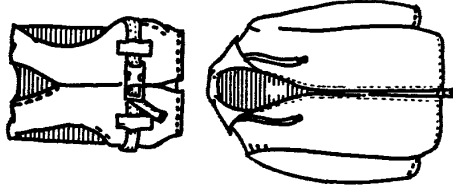
This "classic" PFD comes in several sizes for adults and children and is for calm inland water where there is chance of fast rescue. It is less bulky and less expensive than a Type I, and many will turn an unconscious person face-up in the water.



**TYPE III**

**Flotation Aid**

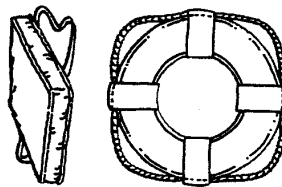
These life jackets are generally considered the most comfortable, with styles for different boating activities and sports. They are for use in calm water where there is good chance of fast rescue since they will generally not turn an unconscious person face-up. Flotation aids come in many sizes and styles.



**TYPE IV**

**Throwable Device**

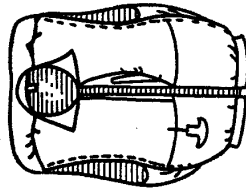
These are designed to be thrown to a person in the water. Throwable devices include boat cushions, ring buoys, and horseshoe buoys. They are not designed to be worn and must be supplemented by a wearable PFD. It is important to keep these devices immediately available for emergencies, and they should not be used for small children, non-swimmers, or unconscious people.



**TYPE V**

**Special Use Device**

Special use PFDs include work vests, deck suits, and hybrids for restricted use. Hybrid vests contain some internal buoyancy and are inflatable to provide additional flotation.



**Boating Safety is Everybody's Responsibility**

Knowing lifejacket facts is just one part of the boating safety picture. Before you go out on the water, on any kind of boat, it's important to know a few things before you start.

First of all, it's smart to take a boating course. Then, be sure you know your own capabilities as a boater, and as a swimmer. Know how to handle the craft you'll be operating. And know about the environment you'll be out in. If you are a passenger, learn safety procedures, and know what to do if an emergency arises.

When it comes to safe boating...

**It's Best to Know...Before You Go!**



**Personal Flotation Device Manufacturers Association**

200 East Randolph Dr. • Suite 5100

Chicago, IL 60601-6528

Voice: 312.946.6200

FAX: 312.946.6263

Figure 3-2. Types of personal flotation devices. (Source: The Personal Flotation Device Manufacturers Association.)

The Safety Board concludes that the high usage of personal flotation devices among PWC riders in the study sample was reflected in the low number of PWC fatalities who drowned. Because most PWC operators who drown are not wearing a PFD, PWC operators should be required to wear a personal flotation device. For 45 States and Territories, operating a PWC is a specific circumstance that requires the wearing of a PFD. Appendix J contains the requirements for PFD use by State. Two additional States (Alaska and Vermont) have PFD requirements for use on an open deck, which would include PWC. Eight jurisdictions have not defined requirements for wearing PFDs while riding a PWC. The Safety Board believes that these jurisdictions (California, Hawaii, Idaho, Mississippi, Nebraska, New Mexico, the District of Columbia, and Puerto Rico,) should enact legislation to require the use of a PFD while operating PWC.

## Chapter 4

# Injury Analysis

The Safety Board's study of PWC accidents specifically examined injury type and severity. According to Coast Guard data for 1996, drowning is the leading cause of death for all recreational boating accidents (500 of 709); however, injuries of blunt force trauma are more common to the operators and passengers of PWC. Of the 57 deaths attributed to PWC accidents in the Coast Guard 1996 data, 42 PWC operators or other boaters (74 percent) died from causes other than drowning. This distinction led the Safety Board to examine the injury characteristics of PWC accidents to see if there were special considerations for the safe use of these vessels.

## Injury Coding

For the 1997 PWC accidents resulting in injury, marine investigators indicated injury location on body diagrams on the Safety Board's supplemental questionnaire (see appendix F) and, in many cases, the investigator also provided text descriptions of the injuries. To provide some level of assessment of injury severity, Safety Board staff used this information to code each injury according to the Abbreviated Injury Scale, 1990 Revision (AIS 90).<sup>72</sup> The AIS, developed by the Association for the Advancement of Automotive Medicine, offers a standardized system for categorizing injury type and severity.<sup>73</sup> Each injury description was assigned a 6-digit numerical code in addition to an AIS severity score. A composite Injury Severity Score, ISS, was calculated for each victim based on the sum of the squares of the highest AIS severity score in each of the three most severe injuries from a defined set of six body regions.<sup>74</sup>

AIS was originally developed in the early 1970s for impact injury assessment, but subsequent revisions (1976, 1980, 1985, and 1990) have incorporated coding for brain injuries, penetrating trauma, vascular injuries, and burns. AIS 90 includes specific coding rules, which the Safety Board followed to code the injuries in the study cases, and a

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<sup>72</sup> The Safety Board staff member who coded the injury data had a nursing background, and a staff physician was available to answer questions.

<sup>73</sup> AIS 90, which was released in 1990, is the most recent coding revision. A new version, AIS 98, is expected to be released in 1998.

<sup>74</sup> Baker, S.P.; O'Neill, B.; Haddon, W.; Long, W.B. 1974. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. *Journal of Trauma*. 14: 187-196.



dictionary of over 2,000 injury descriptions. Because AIS was initially developed to assess injury to victims that were involved in emergency care (that is, its function was to project survivability), it has some limitations for postmortem assessment of injury. For the purposes of this study, fatalities were coded with a maximum severity code, ISS = 75, regardless of the AIS injuries associated with that victim. Drowning was coded as severe inhalation.

## Injured Persons

Injuries were recorded for anyone involved in a PWC accident: operators of vessels (whether they were at fault or not), passengers, boaters, swimmers, skiers, and in one case, a nonwater victim. Injury of some level was sustained in 61 percent of the study accidents (500 of 814); there were 563 injured persons in these 500 accidents. The 563 injured persons sustained a total of 835 separate injuries; some persons sustained more than one injury, and multiple injuries were coded separately (this accounts for the larger number of injuries compared to the number of injured persons). Two percent of the reported injuries (15 of 835 injuries) did not contain sufficient information to enable AIS coding. Table 4–1 summarizes the injury results by person.

Although PWC operators were the most likely persons to be killed or injured in the PWC accidents examined for the study, 37 of the persons injured or killed (7 percent) can be considered bystanders; that is, they were not operating a PWC nor were they a PWC passenger. Consumer Product Safety Commission accident reports for 1997 contain similar reports of injury and death to persons who were not the PWC operators or passengers, but were swimmers, scuba divers, and persons tubing and skiing.<sup>75</sup>

## Fatalities

Of the 563 injured persons, 27 were fatally injured. Fatalities included 24 PWC operators, one passenger, one boater, and one swimmer. The characteristics of fatal accidents differed little from those of all PWC accidents. Vessel collisions were the leading type of fatal accidents (40 percent), and when combined with collisions with objects (16 percent), collisions accounted for more than half of all fatal accidents. Overboard was indicated as the type of accident for 30 percent of the fatalities. Each fatality occurred in a separate accident.

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<sup>75</sup> In two cases, PWC struck and killed a swimmer; in two cases, PWC struck and killed a scuba diver; and in three cases, a PWC struck and killed persons who were tubing or skiing.

**Table 4–1. Number of persons injured and number of injuries sustained in personal watercraft accidents, January–June 1997, by personal watercraft accident victim.<sup>(a)</sup>**

Personal watercraft accident victim	Number of persons injured	Proportion of all accident victims (percent)	Number of injuries <sup>(b)</sup>	Proportion of all injuries (percent)
Personal watercraft operator	480	85.3	707	84.7
Passenger	44	7.8	67	8.0
Boater	18	3.2	26	3.1
Swimmer	13	2.3	22	2.6
Sailboarder	1	0.2	3	0.4
Waterskier	6	1.0	9	1.1
Nonwater	1	0.2	1	0.1
Total	563	100.0	835	100.0

<sup>(a)</sup> These data were compiled from questionnaires completed by State marine accident investigators for the National Transportation Safety Board study on personal watercraft safety. Of the 814 accidents that occurred between January and June 1997, 500 resulted in injuries.

<sup>(b)</sup> Some victims sustained multiple injuries.

Operator inexperience and inappropriate speed were the leading reported causes of the fatal PWC accidents, and they were two of the three leading reported causes of all PWC accidents. Fewer rented PWC in the Safety Board’s sample were involved in fatal accidents; rented PWC accounted for 36 percent of all accident vessels but were only 11 percent of fatal accident vessels.

## Types of Injuries

Minor injuries accounted for the majority of the injuries reported (61 percent, or 513 of the 835 separate injuries); moderate injuries accounted for 25 percent (210 of 835). For the purpose of discussion, injuries coded “moderate” under AIS could include fracture of the pelvis, dislocated knee, major skin laceration, two to three broken ribs, or retinal detachment in the eye. There were 68 serious injuries (8 percent); injuries coded severe, critical, and maximum accounted for 3.5 percent. The distribution of injury severity for the 835 reported injuries and among the accidents is shown in figures 4–1 and 4–2; figure 4–3 shows the distribution of injury by body location.

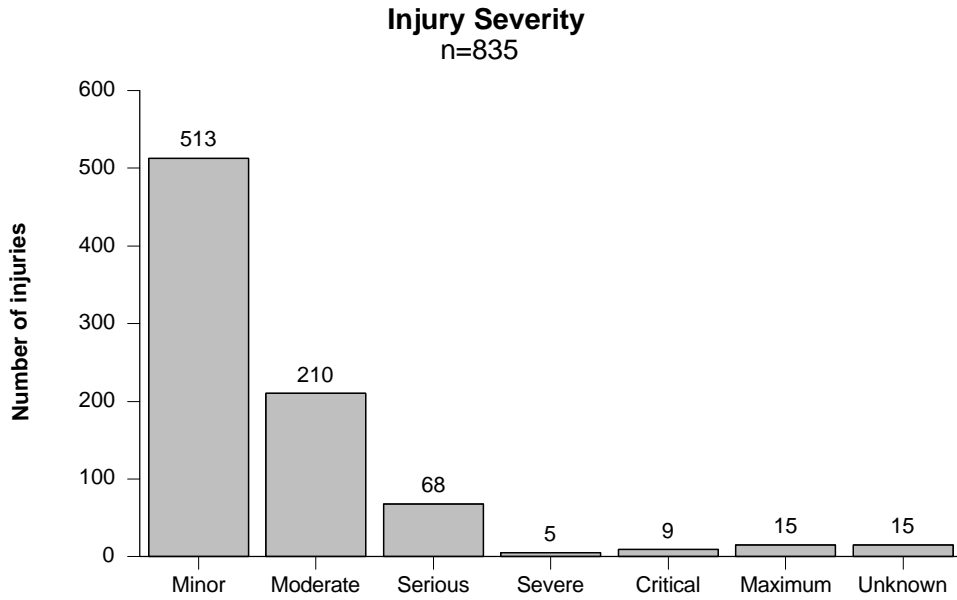


Figure 4-1. Severity of injuries sustained in the personal watercraft accidents, January–June 1997. (Data reflect 835 separate injuries that were sustained by 563 persons in the 500 accidents that resulted in injury.)

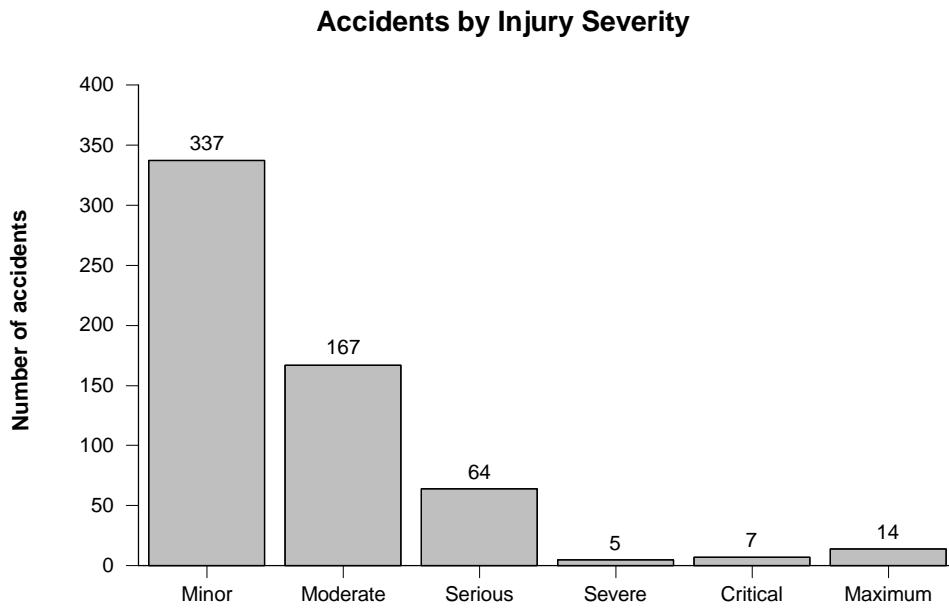


Figure 4-2. Number of personal watercraft accidents, January–June 1997, by severity of injuries.

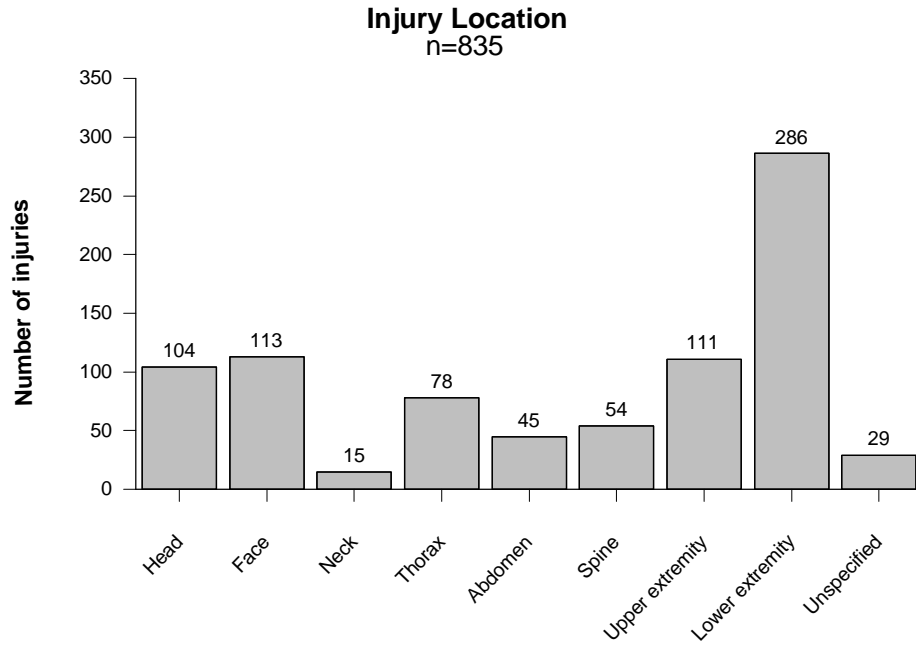


Figure 4–3. Body location of injuries sustained in the personal watercraft accidents, January–June 1997. (Data were available for 835 separate injuries that were sustained by 563 persons in the 500 accidents that resulted in injury.)

**Lower Extremity Injuries.** Collision between two PWC was the most frequent type of accident (discussed earlier in this report). When two PWC collide, the likely impact area is slightly above the waterline, where feet and legs straddle the vessel. A high proportion (one-third) of injuries in the Safety Board’s 1997 sample occurred in the lower extremities. Skeletal fractures and breaks occurred more frequently than all other types of injuries to the lower extremities; for the 286 injuries to the lower extremities, more than half (165, or 58 percent) were skeletal fractures or breaks. Combined injuries for upper and lower extremities accounted for nearly half (47.5 percent) of all injuries. However, injury to an extremity is rarely life threatening (all but one type of lower extremity injury is defined as AIS-3 or less).

For the PWC accidents involving a single vessel, there were 110 reported injuries to lower extremities. Nearly half (52) involved broken bones (the remaining were contusions, abrasions, and bleeding). This high percentage of broken legs and ankles in accidents that did not involve collision indicates that operators are being injured by their own vessel. The following case examples illustrate the events:

- In the description of one accident, the investigator stated, “Two people on board; made a right turn and flipped to the left catching the operator’s leg and breaking it.” The resulting break was to the operator’s left leg about halfway between the ankle and knee.
- The witness of another accident provided the investigator with the following statement: “[the individual] was just playing around doing figure 8 circles and was going to turn around to stay out of the no-wake zone and a wave hit the side of the Waverunner catching her off guard and threw her off the side. Her ankle got caught between the side and the seat.”
- Another accident report included the following statement: “While turning to the right to cross the wake of another vessel, at an excessive speed, the operator was thrown to the left. His foot became stuck in the foot well causing his leg to be broken.”

The Safety Board’s study did not address the mechanisms of injury; it would be difficult for any large-scale study to do that because of the isolated nature of PWC accidents. However, based on the anecdotal evidence of how injury occurred, it is suspected that some proportion of injury to lower extremities is associated with entrapment of the operator’s feet as the person is ejected from the PWC.

**Head Injuries.** Of greater concern than leg injuries are injuries to the head, neck, and face because these injuries are generally more life threatening than are injuries to the extremities. Head, neck, and facial injuries accounted for one of every four injuries reported in the PWC accidents examined for this safety study. Injuries to the head contain many examples of more severe injuries (severe = AIS 4, critical = AIS 5, maximum = AIS 6). These type of injuries would include most penetration injuries to the head, open lacerations to intracranial vessels, or skull fractures. Because of the AIS coding definitions, it would be expected that head injuries for a large number of accidents

would, on average, be more severe than leg injuries.<sup>76</sup> The Safety Board's 1997 accident sample included 12 head injuries that were categorized as severe or higher (AIS = 4, 5, or 6), 9 of which were fatal (maximum AIS = 6).

A classic response to protect against head injuries would be the use of helmets. This has been true for motorcycling, bicycling, snowboarding, skateboarding, and an array of speed-related sports. The International Jet Sport Boating Association requires PWC riders in competitive races to wear helmets.<sup>77</sup> However, there are many design questions that must be considered for recreational helmet use; for example, should the helmet be a full-face or cutaway design, what is the best material for composition, should it have a face guard, and if so, how would water spray distort vision. Research on helmet load analysis for personal watercraft<sup>78</sup> has concluded that "the likelihood of neck injury from impact with the water is significantly increased for riders with helmets even at normal riding speeds. Unless the potential for head injury due to collision is significant (like in racing), wearing a helmet is not recommended."<sup>79</sup> Further research is warranted before appropriate head gear protection can be recommended. One PWC manufacturer summarizes the helmet issue as follows:

A helmet is designed to provide some head protection. Although helmets cannot protect against all foreseeable impacts, a helmet might reduce your injuries in a collision with a boat or other obstacle. A helmet may have potential safety hazards, as well. A helmet could catch the water during a fall into the water. This is commonly called "bucketing." The resulting strain on your neck could cause choking, severe and permanent neck injuries, or death. A helmet could also increase your risk of an accident if it reduces your vision or hearing, or if it distracts you or increases your fatigue.<sup>80</sup>

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<sup>76</sup> The magnitude of AIS severity coding should not be compared for different body regions because injuries to some areas of the body are not as life threatening as to other areas; for example, injuries to the upper extremities are not as severe as injuries to the head. The AIS coding for upper extremities does not include any situation that can be coded beyond a severity level equal to 3 (minor = 1, moderate = 2, and serious = 3), whereas many head injuries are categorized higher than 3. Consequently, a comparison of average severity by body region is not valid.

<sup>77</sup> 1998 Official Competition Rule Book of the International Jet Sport Boating Association.

<sup>78</sup> Robbins, Ron; Taylor, Robert K.; Fuller, Peter M. 1997. Neck loading due to head immersion in water at high speeds. In: Proceedings, 1997 International IRCOBI conference on the biomechanics of impact; 1997 September 24-26; Hanover, Germany. [Publisher's location not indicated]: International Research Council on Biokinetics of Impacts: 455-456.

<sup>79</sup> Taylor, Robert K. 1997. Presentation at the 1997 International IRCOBI conference on the biomechanics of impact; 1997 September 24-26; Hanover, Germany.

<sup>80</sup> Yamaha Motor Corporation, U.S.A. [n.d.]. Yamaha Marine Water Vehicles, WaveRunner GP Owner's/Operator's Manual. Cypress, CA: p. 1-8.

A closer review of head injuries to separate injuries to the face and neck revealed that 113 injuries (49 percent of 232 head injuries) were facial injuries. Many accident reports contained descriptions of single-vessel accidents in which the operators hit their face on the vessel while jumping waves. Descriptive information included in the investigative reports cannot be assumed to be comprehensive (in many cases there was no indication of the mechanism of injury); consequently, the Safety Board's analyses cannot attribute cause to the facial injuries. However, descriptions such as those that follow provide examples that could be beneficial when considering future PWC design changes:

- A Missouri investigator stated that the “operator jumped the wake of a passing cruiser. When the PWC came down, the nose of the PWC went straight down into the water. Operator hit her head on the start/stop switch mounting, cutting her forehead. She was treated for lacerations and bruises at the local hospital.”
- A Virginia operator stated that “when jumping wakes, you have no control when PWC is out of water.” The operator received a laceration to the left eyebrow that required four stitches.
- An Ohio operator stated that “while wake jumping, I came down and hit my handle bars.” The operator's front tooth punctured his lower lip.

Safety Board staff visited a PWC dealer in metropolitan Washington, D.C., to examine handlebars of current models manufactured by Bombardier, Yamaha, and Kawasaki. The designs, for the most part, were composed of molded surfaces without edges; however, padding was minimal.

**Spinal Injuries.** The Safety Board's study of the 1997 PWC accidents included 19 spinal injuries that were associated with single-vessel accidents. Seven of the injuries were reported by investigators<sup>81</sup> to have involved spinal breaks. A report from the University of Florida's University Medical Center<sup>82</sup> looked at serious spinal injuries. Over a 3-year period, that medical facility treated four patients who suffered fractured vertebrae associated with wave-jumping maneuvers. Similar injuries were found in the cases analyzed by the Safety Board. For example, an Ohio accident involved an experienced PWC operator<sup>83</sup> crossing a large wake of a barge. The operator was thrown into the air and “came down on tail bone hard!” There was no property damage but the operator incurred a compression fracture to the spine.

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<sup>81</sup> For cases of serious injury, investigator reports often, but may not always, include information obtained from hospital visits.

<sup>82</sup> Solis and others. 1998. Presentation at the 1998 annual conference of the American Academy of Orthopedic Surgeons; New Orleans, LA.

<sup>83</sup> The accident description indicated that the operator had 12 years' experience on boats and PWC, with over 500 hours on the type of PWC involved in the accident.

## Protecting PWC Riders From Injury

A study by the Centers for Disease Control (CDC) used 6 years (1990 through 1995) of hospital emergency room data (collected through the National Electronic Injury Survey System) to examine PWC-related injuries.<sup>84</sup> A stratified sample of 624 injuries was used to estimate that 32,954 persons with PWC-related injuries were treated in U.S. hospitals nationwide. The distribution of injuries in the CDC study were as follows: head and neck (29.1 percent); arm (11.2 percent); upper trunk (11.7 percent); lower trunk (12.5 percent); and leg (34.4 percent). The proportions of head and leg injuries found in that study closely match those from the Safety Board's sample. The CDC study specifically identified a case of facial injury resulting from impact with the PWC handlebars.

The CDC, in its report on PWC-related injuries, offered several suggestions that might help prevent injuries to PWC users, including specific training for PWC operators and enforcement.<sup>85</sup> The Safety Board agrees with the CDC that PWC operators should receive education and training specific to PWC and, as discussed in chapter 3, is recommending that the States, NASBLA, the Coast Guard Auxiliary, the U.S. Power Squadrons, and BOAT/U.S. include PWC safety information in recreational boating courses.

The CDC found that 7 percent of PWC injuries were to persons 14 years and younger and suggested that parental or adult supervision of children using PWC would be appropriate. The Safety Board notes that several States (for example, Georgia, Minnesota, and Utah) require adult supervision; however, the Safety Board's analysis could not determine if supervision affected accident risk. Accidents in the Safety Board's study did occur to young operators who were within sight distance of adults or who had an adult passenger on board the PWC. Although it is reasonable to believe that supervision reduces risky behavior, it cannot prevent accidents; consequently, the Safety Board views designation of a minimum operator age and training requirements as better approaches.

It was the CDC's opinion that protection for the face and extremities is warranted, but it is not clear what kind of protection currently available is appropriate for use in water recreation. The CDC advises, and the Safety Board agrees, that more research is needed to determine the appropriate methods for head and extremity protection.

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<sup>84</sup> Branche, Christine M.; Conn, Judith M.; Anest, Joseph L. 1997. Personal watercraft-related injuries: a growing public health concern. *Journal of the American Medical Association*. 278(8): 663–665. August 27.

<sup>85</sup> The CDC stated that right-of-way guidelines currently in place for boat operators should be considered for extension to PWC users. A review by Safety Board staff for this study indicates that all States do require PWC to comply with the right-of-way guidelines that apply to recreational boats.



Much of the understanding of injury causation comes from highway accident investigations. When PWC are compared to those vehicles, it is clear that PWC riders do not occupy an enclosed, structurally protected driving space. The vessel is not designed to restrain riders from being ejected (as occurred in 11 percent of the Board's 1997 accident sample), nor does the vessel surround the rider to absorb the forces of impact during collision with objects or other vessels. The physical forces of the accident vessels are transferred directly to the rider upon contact.

It is evident from accident and injury data that PWC riders involved in accidents are susceptible to injury; 39.4 percent of accident-involved operators in the 1997 accidents examined by the Safety Board sustained injury. Further, PWC riders account for over 41 percent of the injured recreational boaters reported in the Coast Guard data for 1996 (1,831 of 4,427). Because 4 out of 10 accident-involved operators in the 1997 PWC accidents examined by the Safety Board were injured, the Safety Board concludes that there appears to be a high risk of injury associated with PWC operations. The Safety Board's analysis specifically identified a large number of injuries to areas of the head and lower extremities, and this finding is consistent with other research of PWC-related injury. The Safety Board believes that PWC manufacturers should evaluate PWC designs and make changes to improve operator control and to help prevent personal injuries. The manufacturers should consider items such as off-throttle steering, braking, and padded handlebars, and operator equipment such as PFDs and helmets.

## Chapter 5

# Boating Safety Standards

## Coast Guard Exemptions

Manufacturers of inboard and outboard motorboats must meet safety standards for the manufacture of boats and associated equipment (33 CFR Part 183), including requirements for certification and labeling (Part 181) and defect notification (Part 179). The standards and regulations of Part 183 specifically address capacity, loading, flotation, electrical systems, fuel systems, and ventilation. In addition to the provisions included in the regulations, many requirements are incorporated by reference.<sup>86</sup>

Federal statutes authorize the Coast Guard to issue exemptions from safety standards for manufacturers of boats to which the application of a standard is impractical or unreasonable and when the manufacturer can show that granting the exemption will not adversely affect boating safety.<sup>87</sup> Manufacturers must petition the Coast Guard for exemption from safety standards. The Coast Guard has granted exemptions to every petition received from PWC manufacturers, and for each model for which an exemption was requested.<sup>88</sup>

Personal watercraft, as a vessel design category, cannot comply with the Coast Guard standards as currently written, and thus the exemptions from the existing standards are unavoidable. The following examples are provided to explain why PWC need exemptions from the existing standards:

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<sup>86</sup> Information incorporated by reference (as listed in Paragraph 183.5) includes recommended practices developed by the Institute of Electrical and Electronics Engineers, Inc., electrical code requirements of the National Fire Protection Association, recommended practices of the Society of Automotive Engineers, Inc., and the Underwriters Laboratory, Inc.

<sup>87</sup> The Coast Guard's authorization was described in correspondence dated January 17, 1995, between U.S. Coast Guard Chief, Recreational Boating Product Assurance Branch, and the Chairman of the National Association of State Boating Law Administrators.

<sup>88</sup> The Coast Guard has issued exemptions from its standards for both inboard- and outboard-powered personal watercraft, hovercraft, airboats, raceboats, and submarines.

- The safe loading standard, as currently written, is based on the assumption that water will flow into the vessel. If there is no load area into which water will flow, it is impossible to test a vessel in accordance with the safe loading standard. Safe loading standards determine the weight limits appropriate for a particular vessel, and, by correlation, determine the person capacity.<sup>89</sup>
- In addition, if weight capacities cannot be determined in accordance with the safe loading standard, it becomes difficult to determine the required volume of flotation material for compliance with the flotation standard,<sup>90</sup> thus PWC are also exempted from the flotation standard and from requirements for labeling the capacity of the PWC.<sup>91</sup>
- Manufacturers of personal watercraft have also received exemptions from electrical and fuel systems standards and from the requirement for powered ventilation in the ventilation standard. The manufacturers' main justification for requesting these exemptions is that PWC design features minimize the possibility of arcing or sparks; specifically, fuel systems minimize the possibility of fuel vapor leakage, and the comparatively smaller size of the engine compartment compared to larger, more conventional boats limit the air supply and the PWC's ability to support combustion. Because PWC have a tendency to capsize and could take on water through their blowers, the powered ventilation standards, as currently written, cannot be applied.

## Industry Standards

Voluntary industry construction standards have been developed by the Society of Automotive Engineers (SAE) and the International Standards Organization (ISO); these standards are similar to the Coast Guard boat standards but are specific to PWC. SAE's Personal Watercraft Subcommittee of the Marine Technical Committee has developed standards to address PWC flotation (Recommendation Practice J1973), electrical systems (J2120), fuel systems (J2046), and ventilation (J2034). In its rationale for issuing these standards, the SAE recognized that PWC cannot comply with the Coast Guard regulations

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<sup>89</sup> To receive an exemption, PWC manufacturers provide the Coast Guard with test data to show adequate flotation, boat weight and passenger capacity, and the amount of flotation material installed. Based on this information, the Coast Guard determines whether each PWC model contains sufficient flotation to meet the intent of the standard.

<sup>90</sup> Basic flotation, as applied to inboard and inboard-outdrive boats, requires sufficient flotation material so that if the vessel capsizes or swamps, the boat will remain floating with some portion of its hull above the surface of the water.

<sup>91</sup> Manufacturers are considering the use of a capacity label that would indicate the rated person capacity. The proposed capacity marking label would state that the vessel complies with ISO 13590 of the International Standards Organization and that it is certified by the National Marine Manufacturers Association.

for conventional boat system designs, and it recognized the specific differences that affect PWC system requirements. For example, the SAE fuel system standard is more stringent than Coast Guard requirements; the SAE standard requires that the PWC system not leak liquid fuel into the vessel when rotated through a 180-degree roll in either direction or overturned through 90 degrees of pitch in either direction. The Safety Board recognizes that industry representatives serve on SAE committees and that all of the major PWC manufacturers voluntarily comply with the SAE standards. Industry representatives have also contributed to the development of ISO standards, which are similar to SAE standards.

In May 1997, NASBLA asked the Coast Guard to consider developing standards for PWC. Based on this request, the Coast Guard noted the similarities between SAE and ISO standards and specifically identified the differences between SAE standards and the existing safety standards as defined in Part 183. In October 1997, the Coast Guard's Boating Safety Advisory Committee requested the Coast Guard to review how manufacturers determine capacity on multiple-occupant rated PWC models—how the lack of an industry-wide standard for determining and displaying “persons capacity” impacts rider safety, including consideration of accident data. Coast Guard staff, in a meeting with Safety Board staff on April 10, 1998, indicated that there was no compelling statistical evidence that PWC problems warrant modifying existing safety standards for flotation (capacity), electrical system, fuel systems, and ventilation.

## Discussion

The Safety Board notes that the Coast Guard's four standards were developed, in part, to address the most serious safety concerns of traditional motorboats: drowning, fire, and explosion. The Safety Board's study clearly points out, however, that these are not the most prevalent safety concerns for PWC. PWC, as previously mentioned, is the only type of recreational vessel for which the leading cause of death is not drowning. Also, as pointed out earlier, in traditional boats, falling overboard and swamping would be considered emergency situations; however, for PWC, these are expected events and, consequently, PWC are designed and constructed to different design criteria than traditional boats.

The Safety Board questions the need for the Coast Guard to continue the exemption process for PWC, particularly given that industry standards exist (and in certain areas are more stringent than the Coast Guard's), that there is voluntary compliance with the standards, and that the standards appear to provide an equivalent level of safety as envisioned by the Coast Guard standards. The Safety Board concludes that the existing process of exempting PWC from standards that were defined for conventional boats is an inappropriate method for certifying the safety and seaworthiness of PWC. In the Safety Board's opinion, the exemption process does little in terms of evaluating possible safety risks that may be associated with the unique operating characteristics of PWC. The Safety Board is aware that the Coast Guard is working with the PWIA to incorporate SAE

standards by reference as an alternate method of compliance with existing Federal regulations. The fact that PWC do not “fit” existing standards for open-hull vessels does not release the Coast Guard from its responsibility to regulate the safety of these vessels, particularly since personal watercraft now represent more than one-third of the new recreational boats sold. The Safety Board believes, therefore, that the Coast Guard should eliminate the existing process of exempting PWC from standards that were defined for conventional boats and should develop, with the PWC manufacturers, comprehensive standards that are specific to the safety risks of PWC.

The Safety Board notes, however, that industry has voluntarily complied only with those standards that address the existing Coast Guard boating safety standards (flotation, capacity, electrical, fuel, and ventilation) that were established for conventional boats. The Safety Board is concerned that there are other safety issues associated with PWC that warrant attention. The need for improved steering control and prevention of “runaway” PWC once an operator is ejected serve as two prime examples of areas where improvements in design could result in a decrease in accidents.

State marine accident investigators have recognized that steering issues are associated with many PWC accidents. The Safety Board reviewed available accident reports for 1996 and 1997 and, based on narrative information contained in the accident reports, determined that more than 350 (20 percent) of the cases reviewed indicated steering or loss of control problems. Accident reports reviewed for the Safety Board’s study highlight problems of operator control during off-throttle steering situations. Some portion of operator control problems may be attributed to the operating design of personal watercraft.

The narrative report of an accident that occurred in Illinois included the following investigator comment: “She (V1) stated that as they came close, she let off the throttle and then tried to turn but couldn’t. She stated that V2 hit her in the side of the Sea-Doo causing a tremendous amount of damage....V2 advised that as she came close to V1 she turned to avoid her, but it didn’t turn because she let off of the throttle.” The report of a fatal Missouri accident included the following investigator comments: “He did not think that she knew that he was behind her. He said that it was less than a second between when she turned and when he struck her. He let go of the throttle, but it did not help.”

On September 10, 1997, NASBLA adopted a resolution (No. 97-3) petitioning the Coast Guard to evaluate off-throttle steering of jet-pump propelled craft and to develop appropriate standards. The Coast Guard issued a grant request in October 1997.<sup>92</sup> The objective of this work will be to identify the most effective of the available and emerging technologies/methodologies in the area of off-throttle steering. As part of the background information in the grant description, the Coast Guard stated: “A large percentage of accidents involving jet-pump propelled craft involve collisions with other craft or fixed objects. Because of the unique relationship between the amount of throttle and steering

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<sup>92</sup> Federal Register, Vol. 62, No. 193, dated October 6, 1997, page 52176.

response on jet-pump propelled craft, there is concern that a sudden loss of engine power—either due to part failure or operator decision—may play a significant role in these collisions.” Announcement of the grant award is anticipated in the near future. The Safety Board study data support the need for this research, and an evaluation of PWC steering design is warranted. The Safety Board is concerned that the Coast Guard has not taken a proactive role in assessing the safety risks of PWC. Therefore, the Safety Board believes that within 2 years the Coast Guard should determine, through research, the feasibility of providing PWC operators more control in an off-throttle steering situation. The Safety Board also believes that the Coast Guard should work with the PWIA to use the results of this research to develop appropriate standards for steering on jet-pump propelled vessels.

# Conclusions

1. Because 4 out of 10 accident-involved operators in the 1997 personal watercraft accidents examined by the National Transportation Safety Board were injured, there appears to be a high risk of injury associated with personal watercraft.
2. One-third of the reported injuries in the 1997 personal watercraft accidents examined by the National Transportation Safety Board occurred in the lower extremities; head, neck, and facial injuries accounted for one of every four injuries reported in the personal watercraft accidents.
3. The rate of injury for personal watercraft in relation to all recreational boat types cannot be determined because accurate information on usage by boat type is not available.
4. Analysis of 1997 boating accident report data showed that 84 percent of the personal watercraft operators in the National Transportation Safety Board's sample reported receiving no boating instruction.
5. If more recreational boaters were trained, the number of persons killed and injured in recreational boating accidents, including those involving personal watercraft, would be reduced.
6. Operators of rented personal watercraft in the National Transportation Safety Board's sample had less personal watercraft experience than did operators of privately owned personal watercraft.
7. The existing process of exempting personal watercraft from standards that were defined for conventional boats is an inappropriate method for certifying the safety and seaworthiness of personal watercraft.
8. Accident reports reviewed by the National Transportation Safety Board's study highlight problems of operator control during off-throttle steering situations. Some portion of operator control problems may be attributed to the operating design of personal watercraft.
9. The high usage of personal flotation devices among personal watercraft riders in the National Transportation Safety Board's study sample was reflected in the low number of personal watercraft fatalities who drowned. Most personal watercraft operators who drown are not wearing a personal flotation device.

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# Recommendations

As a result of this safety study, the National Transportation Safety Board made the following safety recommendations:

## **To the Manufacturers of Personal Watercraft (Kawasaki, Yamaha, Polaris, Bombardier, and Arctic Cat, Inc./Tiger Shark)—**

Evaluate personal watercraft designs and make changes to improve operator control and to help prevent personal injuries. Consider items such as off-throttle steering, braking, and padded handlebars, and operator equipment such as personal flotation devices and helmets. (M-98-85)

Develop, with the U.S. Coast Guard, comprehensive standards that are specific to the safety risks of personal watercraft. (M-98-86)

## **To the U.S. Coast Guard—**

Eliminate the existing process of exempting personal watercraft from standards that were defined for conventional boats and develop, with the personal watercraft manufacturers, comprehensive standards that are specific to the safety risks of personal watercraft. (M-98-87)

Determine within 2 years, through research, the feasibility of providing personal watercraft operators more control in an off-throttle steering situation. (M-98-88)

Work with the Personal Watercraft Industry Association to use the results of off-throttle steering research described in Safety Recommendation M-98-88 to develop appropriate standards for steering on jet-pump propelled vessels. (M-98-89)

Develop, in conjunction with the National Association of State Boating Law Administrators and the Personal Watercraft Industry Association, a checklist for boat rental businesses to use for evaluating a person's ability to operate a personal watercraft. (M-98-90)

Collect recreational boating exposure data such as "operational use time" or "vessel running time" and update this information on an annual basis or conduct periodic surveys. (M-98-91)



**To the U.S. Coast Guard Auxiliary—**

Include information on the safe operation of personal watercraft in all recreational boating courses. (M-98-92)

**To the U.S. Power Squadrons—**

Include information on the safe operation of personal watercraft in all recreational boating courses. (M-98-93)

**To BOAT/U.S.—**

Include information on the safe operation of personal watercraft in all recreational boating courses. (M-98-94)

**To the National Association of State Boating Law Administrators—**

Include information on the safe operation of personal watercraft in all recreational boating courses. (M-98-95)

Develop, in conjunction with the U.S. Coast Guard and the Personal Watercraft Industry Association, a checklist for boat rental businesses to use for evaluating a person's ability to operate a personal watercraft. (M-98-96)

Examine the effects of special provisions on the operator minimum age requirement for personal watercraft. (M-98-97)

**To the Personal Watercraft Industry Association—**

Develop, in conjunction with the U.S. Coast Guard and the National Association of State Boating Law Administrators, a checklist for boat rental businesses to use for evaluating a person's ability to operate a personal watercraft. (M-98-98)

Work with the U.S. Coast Guard to use the results of off-throttle steering research described in Safety Recommendation M-98-88 to the Coast Guard to develop appropriate standards for steering on jet-pump propelled vessels. (M-98-99)

**To all States and Territories—**

Include information on the safe operation of personal watercraft in all recreational boating courses. (M-98-100)

Enact or revise your recreational boating laws, as necessary, to require rental businesses to provide safety instruction training to all persons who operate rented personal watercraft; all the operators should be required to demonstrate their ability to operate and control personal watercraft. (M-98-101)

**To California, Hawaii, Idaho, Mississippi, Nebraska, New Mexico, the District of Columbia, and Puerto Rico—**

Enact legislation to require the use of a personal flotation device while operating personal watercraft. (M-98-102)

Also as a result of this safety study, the Safety Board reiterated the following recommendation to 42 States and Territories for which the recommendation is in an “Open” status (Alaska, Arkansas, California, Connecticut, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin, the District of Columbia, Puerto Rico, and the Virgin Islands):

Implement minimum recreational boating safety standards to reduce the number and severity of accidents; consider requirements such as mandatory use of personal flotation devices for children, demonstration of operator knowledge of safety boating rules and skills, and operator licensing. (M-93-1)

## By the National Transportation Safety Board

**James E. Hall**  
Chairman

**John A. Hammerschmidt**  
Member

**Robert T. Francis II**  
Vice Chairman

**John Goglia**  
Member

**George W. Black, Jr.**  
Member

**Adopted: May 19, 1998**

# Appendix A

## State Definitions of Personal Watercraft

The definitions in this appendix are reprinted, with the permission of the National Association of State Boating Law Administrators, from the following publication:

National Association of State Boating Law Administrators. 1997. Reference guide to State boating laws. 3d ed. Lexington, KY ( p. 63-65). 82 p., plus appendixes.

### PERSONAL WATERCRAFT DEFINITION

State	Personal Watercraft Definition
Alabama	A vessel which uses an inboard motor powering a water jet pump as it's primary source of motive power and which is designed to be operated by a person sitting, standing, or kneeling on a vessel.
Alaska	Not defined.
American Samoa	Not defined.
Arizona	A watercraft that is less than 16 ft. long, powered by a water jet pump and designed to be operated by a person who sits, stands or kneels on, rather than sitting, standing, or kneeling inside the vehicle.
Arkansas	As stated in the PWIA Model Act
California	Not defined
Colorado	A motorboat that uses an inboard motor powering a water jet pump as its primary source of motive power and is designed to be operated by a person sitting, standing or kneeling on the vessel, rather than the conventional manner of sitting or standing inside the vessel. This includes "specialty prop craft" which use an outboard motor.
Connecticut	Any inboard vessel less than 16 feet in length which has an internal combustion engine powering a water jet pump as its primary source of motor propulsion and which is designed to be operated by a person sitting, standing or kneeling on the vessel rather than the conventional manner of sitting or standing inside the vessel.
Delaware	Any class A inboard powered vessel as defined by the USCG which uses either an internal combustion engine powering a water jet pump or a propeller as its primary source propulsion and which is designed to be operated by a person sitting, standing or kneeling on the vessel, or by a water skier via remote control, instead of the conventional manner of sitting or standing in the vessel.
District of Columbia	Not defined
Florida	A small class A-1 or A-2 vessel which uses an outboard motor, or an inboard motor powering a water jet pump, as its primary source of motive power and which is designed to be operated by a person sitting, standing, or kneeling on, or being towed behind the vessel, rather than in the conventional manner of sitting or standing inside the vessel.
Georgia	A Class A vessel which: (A) Has an outboard motor or which has an inboard motor which uses an internal combustion engine powering a water jet pump as its primary source of motive propulsion; (B) Is designed with the concept that the operator and passenger ride on the outside surfaces of the vessel as opposed to riding inside the vessel; and (C) Has the probability that the operator and passenger may, in the normal course of use, fall overboard.
Guam	Any motorized vessel with the capacity to carry one or more person while in operation. The term includes but is not limited to a "jet ski", hydroplane, wet bike and surf-jet
Hawaii	Any motorized vessel that falls into the category of personal watercraft, and which: (1) Is generally less than thirteen feet in length as manufactured; (2) Is generally capable of exceeding a speed of twenty miles per hour; and (3) Can be operated by a single operator, but may have the capacity to carry passengers while in operation. (4) Is designed to provide similar operating performance as a personal watercraft through a combination of small size, power plant, and hull design. The term includes, but is not limited to a jet ski, waverunner, wet bike, surf jet, miniature speed boat, hovercraft, and every description of a vessel which uses an internal combustion engine powering a water jet pump as its primary source of motive propulsion, and is designed to be operated by a person or persons sitting, standing, or kneeling on, or being towed behind the
Idaho	A small vessel which uses an outboard motor or an inboard motor powering a jet pump as it's primary source of power and is designed to be operated by a person sitting, standing or kneeling on, rather than in the conventional manner of sitting or standing inside the vessel.
Illinois	As per NASBLA Model Act
Indiana	A watercraft whose primary source of motive power is an inboard motor powering a water jet pump; and that is designed to be operated by a person who sits, stands, or kneels on the surface of the watercraft rather than sitting or standing inside the watercraft.
Iowa	No definition.
Kansas	A vessel which uses an inboard motor powering a water jet pump as its primary source of propulsion and which is designed to be operated by a person sitting, standing or kneeling on the vessel rather than the conventional manner of sitting, standing or kneeling inside the vessel.
Kentucky	Not defined
Louisiana	A vessel which uses an inboard motor powering a water jet pump as its primary source of motive power and is designed to be operated by a person sitting, standing or kneeling on the vessel rather than in the conventional manner of sitting or standing inside the vessel.
Maine	Any motorized watercraft that is less than 13 feet in hull length as manufactured, is capable of exceeding a speed of 20 miles per hour and has the capacity to carry not more than the operator and one other person while in operation. The term includes, but is not limited to, a jet ski, wet bike, surf jet, miniature speedboat and hovercraft. Personal watercraft also includes motorized watercraft whose operation is controlled by a water skier.
Maryland	A class A vessel which has an inboard motor which uses an internal combustion engine powering a water jet pump as its primary source of motive propulsion, is designed with the concept that the operators and passengers ride on the outside surfaces of the vessel as opposed to riding inside the vessel, has the probability that the operator and passengers may, in the normal course of use, fall overboard, and is designed with no open carrying area which would retain water.

**PERSONAL WATERCRAFT DEFINITION**

<b>State</b>	<b>Personal Watercraft Definition</b>
Massachusetts	A vessel propelled by a water jet pump or other machinery as its primary source of motor propulsion and which is designed to be operated by persons sitting, standing or kneeling on the vessel, rather than being operated in the conventional manner by a person sitting or standing inside the vessel.
Michigan	A vessel that uses a motor-driven propeller or an internal combustion engine powering a water jet pump as its primary source of propulsion, is designed without an open load carrying area that would retain water, and is designed to be operated by 1 or more persons positioned on, rather than within, the confines of the hull.
Minnesota	A motorboat that is powered by an inboard motor powering a water jet pump or by an outboard or propeller-driven motor is designed to be operated by a person or persons sitting, standing, or kneeling on the craft, rather than in the conventional manner of sitting or standing inside a motorboat.
Mississippi	Class A boats under 16 feet.
Missouri	A class of vessel which is less than 16 feet in length, propelled by machinery which is designed to be operated by a person sitting, standing or kneeling on the vessel rather than being operated by a person sitting or standing inside.
Montana	A vessel that uses an outboard motor or an inboard engine powering a water jet pump as its primary source of propulsion and that is designed to be operated by a person sitting, standing, or kneeling on the vessel rather than by the conventional method of sitting or standing in the vessel.
N. Mariana Islands	N/A
Nebraska	A class of inboard vessel less than sixteen feet in length which uses an internal combustion engine powering a jet pump as its primary source of motive propulsion and is designed to be operated by a person sitting, standing, or kneeling on the vessel rather than in the conventional manner of boat operation.
Nevada	A class A motorboat which is less than 13 feet in length, is designed to be operated by a person sitting, kneeling or standing on, rather than in, the motorboat, is capable of performing sharp turns or quick maneuvers and has a motor that exceeds 10 horsepower.
New Hampshire	Any motorized watercraft or private boat which is less than 13 ft in length as manufactured, is capable of exceeding a speed of 20 mph, and has the capacity to carry not more than the operator and one other person while operating.
New Jersey	Class A power vessel with jet propulsion
New Mexico	A class A motorboat designed to be operated by a person sitting, standing or kneeling on the vessel rather than the operator sitting or standing inside the vessel. Examples include jet skis, sea doos, wave runners, etc.
New York	A vessel which uses an inboard motor powering a water jet pump as its primary source of motive power and which is designed to be operated by a person sitting, standing, or kneeling on, or being towed behind the vessel rather than in the conventional manner of sitting or standing inside the vessel.
North Carolina	A small vessel which uses an outboard motor, or an inboard motor powering a water jet pump, as its primary source of motivating power and which is designed to be operated by a person sitting, standing, or kneeling on, or being towed behind the vessel, rather than in the conventional manner of sitting or standing inside the vessel.
North Dakota	A motorboat that is powered by an inboard motor powering a water jet pump or by an inboard or outboard marine engine and which is designed to be operated by a person sitting, standing, or kneeling on the craft, rather than in the conventional manner of sitting or standing inside a motorboat.
Ohio	A vessel less than 16 feet in length that is propelled by machinery and designed to be operated by an individual sitting, standing or kneeling on the vessel rather than by the individual sitting or standing inside the vessel.
Oklahoma	A vessel which uses an inboard motor powering a water jet pump as its primary source of motive power and which is designed to be operated by a person sitting, standing or kneeling on the vessel rather than the conventional manner of sitting or standing inside the vessel, or a vessel which is similar in appearance and operation to a PWC but which is powered by an outboard or propeller driven motor, or a vessel less than 16 feet in length which travels across the water above or on a cushion of air provided by engines, propellers or other means of propulsion.
Oregon	A small Class A motorboat which: (1) Uses an outboard motor or an inboard motor powering a water jet pump as its primary source of power. (2) Is designed to be operated by a person sitting, standing or kneeling on, rather than in the conventional manner of sitting or standing inside the vessel.
Pennsylvania	A boat of less than 16 feet in length which uses an internal combustion motor powering a water jet pump as its primary source of motive propulsion and is designed to be operated by a person sitting, standing or kneeling rather than in the conventional manner of boat operation.
Puerto Rico	Boats which are powered by an inboard engine and a jet pump, considered by USCG Class A inboard boat.
Rhode Island	A vessel which uses an inboard motor powering a water jet pump as its primary source of motive power and which is designed to be operated by a person sitting, standing or kneeling on the vessel rather than the conventional manner of sitting or standing inside the vessel.
South Carolina	Class A motorboat
South Dakota	Any motorboat that has an inboard or outboard motor powering a water jet pump or caged propeller as its primary source of power and is designed to be operated by a person standing on, kneeling on, sitting astride or being towed behind the watercraft.
Tennessee	Personal watercraft means a vessel propelled by machinery which is designed to be operated by a person sitting, standing or kneeling on the vessel rather than being operated by a person sitting or standing inside the vessel.
Texas	A type of motorboat which is specifically designed to be operated by a person or persons sitting, standing, or kneeling on the vessel rather than in the conventional manner of sitting or standing inside the vessel.
Utah	A motorboat that is less than 16 feet in length, propelled by a water jet pump and designed to be operated by a person sitting, standing, or kneeling on the vessel, rather than sitting or standing inside the vessel

**PERSONAL WATERCRAFT DEFINITION**

<b>State</b>	<b>Personal Watercraft Definition</b>
Vermont	A Class A vessel which uses an inboard engine powering a water jet pump as its primary source of motive power and which is designed to be operated by a person sitting, standing, or kneeling on or being towed behind the vessel rather than in the conventional manner of sitting or standing inside the vessel.
Virgin Islands	Thrillcraft: Includes personal watercrafts, specialty prop-craft which is powered by an outboard motor or propeller driven motor.
Virginia	A type of motorboat and means a Class A-1 or A-2 vessel which uses an outboard motor, or an inboard motor powering a jet pump, as its primary motive power and which is designed to be operated by a person sitting, standing or kneeling on, rather than in the conventional manner of sitting or standing inside the vessel.
Washington	A vessel of less than 16 feet that uses a motor powering a water jet pump as its primary source of motive power and that is designed to be operated by a person sitting, standing or kneeling on, or being towed behind the vessel, rather than in the conventional manner of sitting or standing inside the vessel.
West Virginia	A small Class A vessel which uses an outboard or an inboard motor powering a water jet pump as its primary source of motive power and which is designed to be operated by a person sitting, standing, or kneeling on or being towed behind the vessel rather than the conventional manner of sitting or standing inside the vessel.
Wisconsin	A motorboat that uses an inboard motor powering a water jet pump or a caged propeller as its primary source of motive power and that is designed to be operated by a person standing on, kneeling on or sitting astride the watercraft.
Wyoming	Any inboard powered vessel less than 16 feet in length which has an internal combustion engine powering a water jet pump as its primary source of motor propulsion and which is designed to be operated by a person sitting, standing or kneeling on the vessel, rather than the conventional manner of sitting or standing inside the vessel.

## Appendix B

### Summary of NASBLA 1997 Survey on PWC

The results of the 1997 PWC survey are reprinted, with the permission of the National Association of State Boating Law Administrators, from the following publication:

*Small Craft Advisory*. Dec. 1997/Jan. 1998. Lexington, KY: National Association of State Boating Law Administrators; 13(2): 8-13.

The information from States and Territories was gathered by the following organizations: the Northern Association of Boating Administrators (NABA), the Southern States Boating Law Administrators Association (SSBLAA), and the Western States Boating Administrators Association (WSBAA).



## SURVEY: PERSONAL WATERCRAFT OPERATION

State	PWC minimum operator age?	Certification required for operation? Age restrictions?	Operational restrictions?
Connecticut	12	Yes, for all operators	PFD required; sunrise to sunset operation; no water skiing behind 5 mph limit within 200' of dock, pier, float, anchored/moored boat; no wake jumping w/in 100' of vessel
Delaware	14-16 must be certified & have parent/guardian aboard; 16 must be certified to operate solo	Must have driver's license to show if renting from livery	Headway speed only near rivers, marinas; 100' distance from skiers; no wake jumping w/in 100' of vessel; no ski tows w/o observer aboard & PWC designed for 2 people
District of Columbia	16	Yes, for all operators	100 yards from shore or other vessel; no wake jumping; PFD required
Illinois	10 w/supervision; 12 w/training on all motorized watercraft	12-17	No operation sunset to sunrise; PFD wear mandatory; no wake jumping unreasonably close
Indiana	15	Driver's license; age 15 and those without driver's license must have BMV photo ID and complete boating ed. course	Persons shall not operate a PWC on public waters that endangers human life or property--includes prohibition on wake jumping, cutting between boats & persons being towed
Iowa	12 unless accompanied by an adult	No	No
Maine	12	No	Sunrise to sunset operation; mandatory PFD wear; water safety zone 200' from shore; parent/guardian responsible for minor while operating a PWC
Massachusetts	16	Safety certificates (boat & PWC) 16, 17 year olds	No nighttime operations; PFD wear required; no towing skiers; headway speed only w/in 150' of shoreline, swimmers, docks, etc.
Michigan	12 with boating certificate; 16 without	Minimum age 12; 12-15 may operate when accompanied by 16 or older; without supervision must have boating safety certificate	Must wear PFD; no operation sunset to sunrise
Minnesota	13 with operator's permit & person at least 18 in unaided visual contact; 14 with operator's permit & no adult supervision	Operator's permit required for 13-17 years unsupervised	No wake within 100' of shore, dock, swim raft; no wake jumping w/in 100'; no operation sunset to 8am; PFD required; no wildlife harassment
Nebraska	14 to operate any boat	No	Under 12 must wear PFD; BUI is .10 BAC; speed limit 5mph w/in 30 yards of any vessel, harbor, marina
New Hampshire	16	N/A	Yes
New Jersey	16	Yes; all operators	Idle speed w/in 50' of bathing beach, shoreline, swimmers; kill switch lanyard attached; 100' away for wake crossing; sunrise to sunset operation; PFD required
New York	10	All power boaters age 10-18	No night operation; 500' designated swim area; wear PFD; cut-off lanyard; no wake jumping near other vessels; no weaving through traffic
North Dakota	12-15 upon completion of Boating Basics course; under 12 must be accompanied by person at least 18	Certificates are issued with letter of completion and grade achieved	Use kill switch lanyard; observer required for skiing; slow speed w/in 100' of person, boat, shoreline
Ohio	No one under 16 except 12-15 may operate if supervised by adult 18 or over on board	No	PFD required; lanyard kill switch; sunrise to sunset operation; no wake crossing w/in 100'; no following skier within 200'
Pennsylvania	12-15 must be accompanied by adult at least 18 or alone with certificate	To operate boats 10 hp or more; under 12 must be accompanied by person at least 16; 12-15 must be accompanied by person at least 16 or have boating safety certificate	PWC operators & passengers must wear PFD; sunrise to sunset operation; lanyard attached to operator; no wake w/in 100' of shore
Rhode Island	16	Under 16: education course required	200' zone; daylight operation; PFD required; reckless operation prohibited
South Dakota	14	No	PFD required; kill switch lanyard must be attached; no wake speed w/in 150' of dock, swimmer, swim raft, non-motor boat
Vermont	16	Minimum age 12 to operate power boat; 16 to operate PWC	No night operation; PFD required
Wisconsin	12 for personal use; 16 for rental	12-15	Sunrise to sunset operation; 100' from all persons & craft, dock, rafts

## NABA PWC Survey

State	Restricted area use?	PWC accidents/fatalities in 1997	PWC percent of boating accidents/fatalities	Dealer/rental operator requirements?	Does agency utilize PWC industry loaner programs?
Connecticut	2 where PWCs are banned	6 PWC accidents; 0 fatalities	9% accidents	No, due to mandatory PWC education/certification	Yes
Delaware	No	11 accidents; 0 fatalities	33% of accidents	Livery operators must explain where PWCs can & cannot operate, provide map or chart of area, provide manual	Yes
District of Columbia	No	0	N/A	Yes	No
Illinois	No	54 accidents; 4 fatalities	35% accidents; 30% fatalities	No	Yes
Indiana	State-owned lakes less than 300 acres are restricted to boats powered by electric troll motors	29 PWC accidents; 1 fatality	28% accidents; 12% fatalities	No	No
Iowa	No	41 accidents; 0 fatalities	N/A	No	Yes
Maine	No	11 accidents; 0 fatalities	7%	Not presently	Have in past
Massachusetts	PWC prohibited on inland waters less than 75 acres	5 accidents; 1 fatality	10% accidents; 11% fatalities	Rental operators must provide or discuss the state PWC pamphlet to each customer	Yes, for education purposes
Michigan	No	221 PWC accidents; 1 PWC fatality	±5%	No	Yes, 3rd year of program
Minnesota	One lake has reduced hours of operation	56 PWC accidents; 2 fatalities	36% accidents; 9.5% fatalities	Dealers & rental agents must provide certain info to PWC buyers & renters	DNR and county sheriffs depts. both use loaner PWC
Nebraska	Yes	31 accidents; 1 fatality	85% of all accidents; 20% of all fatalities	No	Yes, 4 Kawasaki loaners
New Hampshire	Yes	8 PWC accidents; 0 fatalities	10% accidents	Yes	No
New Jersey	No PWCs in Pt. Pleasant and Cape May canals	66 accidents; 0 fatalities	27% accidents	Operator of rental PWC must be briefed by the rental agency about rules of the road, OUI rules, PWC regs and PWC handling characteristics	No
New York	Within 500' from shoreline on Lk. George use no-wake speed	6 fatalities; 17% for 1997	28.5% accidents; 27.8% vessels	Rental operator must provide demo of operation of PWC and use of safety equipment, or show video	Yes
North Dakota	All motorboats must obey No Wake zones	7 PWC accidents; 4 with injuries; 1 fatality; 44% of all accidents	14% of PWC accidents were fatalities; 43% of PWC accidents had injuries	No	Yes
Ohio	No	45 accidents; 1 fatality	30% accidents; 6.6% fatalities	No	Yes
Pennsylvania	No, except hp restrictions	120 total accidents, 18 fatalities; 31 accidents involving PWC, 0 fatalities	26% of all reported recreational boating accidents involve PWC	PWC livery operators must show video and explain rules to clients; no dealer requirements	PWC loaners are used by commission officers, not ed. specialists
Rhode Island	No	Data incomplete; 0 fatalities	Data incomplete	No	No
South Dakota	Special regulations waters—none specifically for PWCs	12 accidents; 0 fatalities	39% of total (31)	No	Yes
Vermont	Yes	0	N/A	Must meet minimum education requirements	No
Wisconsin	Local ordinances	54	26%	Yes	Yes

## SURVEY: PERSONAL WATERCRAFT OPERATION

State	PWC minimum operator age?	Certification required for operation? Age restrictions?	Operational restrictions?
Alabama	Yes	No	Yes
Arkansas	12 for all boats over 10hp	No	Mandatory PFD wear; no wake jumping close to boat
Florida	14 to operate; 16 to rent	Those born after 9/30/80 must be certified to operate any motorboat	Restrictions apply to hours of operation, wake jumping and PFD wear
Georgia	12-15 with certificate or accompanied by person 18+, or are supervised	12-15 with certificate	Yes
Kentucky	No	No	Yes
Louisiana	13	No	No operation after sunset; operators must wear PFD
Maryland	16	Those born after 7/1/72 must possess a boating safety certificate while operating a motorboat including PWC	No operation sunset to sunrise; 6-knot speed limit w/in 100' of shore, wharf, pier, people in water, other boats, etc. Mandatory PFD wear; cutoff switch required
Mississippi	16	Those born after 6/30/80 must take boating course	Certain parts of state
Missouri	14	No	No operation above idle speed w/in 50' of another vessel or person in water; no wake jumping w/in 100'; PFD wear mandated; kill switch lanyard
New Mexico	13	No	150 feet distance
North Carolina	No, except several local ordinances for young PWC riders	No	Yes
Oklahoma	Under 13 may not operate solo	None	10mph w/in 50' of other vessels when underway; mandatory PFD wear; kill switch lanyard
Puerto Rico	16	Operators born after 7/1/72 must have permit obtained only by passing NASBLA approved course	150' from other vessels; mandatory PFDs for those under 12; no wake jumping
South Carolina	No	No; if solo operator under 16, must take boater ed. course for all motorboats	No wake 50' from docks, anchored boats; no operation after sunset or before sunrise; mandatory PFD wear
Tennessee	Yes	No	Yes
Texas	13	13-17	50' from PWC, vessel, platform except at headway speed; sunrise to sunset operation only; PFD required; no wake jumping
Virgin Islands	18; 14-17 with proof of boating safety course	For persons under 18	Yes
Virginia	14	No	Hours of operation and PFD wear restrictions for PWC
West Virginia	15	No	No night operation; must wear PFD; reckless operation prohibited

## SSBLAA PWC Survey

State	Restricted area use?	PWC accidents/ fatalities in 1997	PWC percent of boating accidents/ fatalities	Dealer/rental operator requirements?	Does agency utilize PWC industry loaner programs?
Alabama	No	90 accidents; 1 fatality	40% accidents; 4% fatalities	Yes	Yes
Arkansas	Yes	35 accidents	35%	No	Yes
Florida	Local governments may regulate them	448 total accidents; 7 fatalities	38% of total to date	Yes	Yes
Georgia	N/A	52 accidents	38% accidents; 10% fatalities	Yes	N/A
Kentucky	Limit is 10hp motors on some waters	31 accidents; 4 fatalities	37% accidents; 4.75% fatalities	No	Yes
Louisiana	No	33 PWC-related accidents	26% accidents	16 or older	No
Maryland	Deep Creek Lake has hours of operation rule	52 accidents, 29 injuries, 0 fatalities	0	PWC rental operators may give written test to customers w/o safety certificate	Yes
Mississippi	On the Gulf Coast	55 accidents; 3 fatalities	45%	Some areas	Yes
Missouri	No	154 accidents; 3 fatalities	38% accidents; 15% fatalities	No	Yes
New Mexico	Several lakes	10	10%	No	No
North Carolina	Several local ordinances have restrictions	87 accidents; 3 fatalities	42% accidents; 18% fatalities	No	Yes
Oklahoma	Waters controlled by municipalities may have restrictions	54 accidents; 0 fatalities	45%	No	No
Puerto Rico	All inland lakes and some lagoons & sanctuaries cannot have PWCs	20 accidents; 0 fatalities	0	Not at time of rental	Would like to
South Carolina	No	36 accidents; 0 fatalities	29% accidents	No	Yes
Tennessee	No	58 PWC accidents; 2 fatalities	42% (of 137 total) accidents; 9% (of 21 total) fatalities	Yes	Yes
Texas	No operation on holiday weekends; operate in clockwise direction	76 accidents; 11 fatalities	38% accidents; 16% fatalities	Instruction relating to safe operation required for rental vessels and boating regs that apply to areas of operation	Yes
Virgin Islands	Restrictions apply to all territorial waters	2 accidents; 0 fatalities	±1% of accidents	No, but encouraged by DPNR	Not presently but there are plans to utilize loaners for education
Virginia	No	78 PWC accidents; 3 fatalities	36% accidents; 11% fatalities	No	Yes
West Virginia	No	None	N/A	No	Yes

## SURVEY: PERSONAL WATERCRAFT OPERATION

State	PWC minimum operator age?	Certification required for operation? Age restrictions?	Operational restrictions?
Alaska	No	No	Mandatory life jacket wear for operators and passengers 13 years or younger only
Arizona	12	No	Yes
California	16 for all vessels of 15hp or greater. Persons 12-15 may operate under direct supervision of another 18 or older	No certification for any type vessel required	Must wear kill switch lanyard; no wake jumping within 100'; no spraying of other vessels; no night operation; no reckless operation
Colorado	14 with certificate; 16 without certificate	Yes, 14-16	Yes
Guam	Under 16 must be accompanied by someone over age 18	Permits required for commercial operators. No certificate required for personal use	Yes
Hawaii	15	No	Yes
Idaho	No	Acknowledgment of instruction card required to operate rental PWC	Only those required for all vessels
Kansas	12	Yes, 12-15 mandatory education to operate alone	Yes
Montana	13-14 cannot operate alone unless certified or have 18 year old aboard 12 and under must have 18 or older aboard	Yes, certificate 13, 14 years; 15+ do not need to be certified or have 18 year old aboard	PFD required; must wear kill switch lanyard; no wake speed within 100' of dock, vessel, swimmer etc. on lake, 50' on river
Nevada	12	No	Wake jumping prohibited by requirement of flat wake within five boat lengths of another vessel
Oregon	14 to operate; 16 to rent	No	Yes, speed restrictions near shore, other vessels, swimmers, boat ramps, docks etc. Mandatory PFD wear, also
Utah	Under age 18 must have adult on board unless PWC certified	PWC ed: 12-15 certified & operate under direct adult supervision; 16-17 certified	150' from all vessels when above wakeless speed; PWC operators & riders must wear PFDs
Washington	14	No	Sunrise to sunset only; mandatory life jackets; No reckless operation
Wyoming	16	No	Yes

## WSBAA PWC Survey

State	Restricted area use?	PWC accidents/ fatalities in 1997	PWC percent of boating accidents/ fatalities	Dealer/rental operator requirements?	Does agency utilize PWC industry loaner programs?
Alaska	No	6 accidents; 1 fatality	6.6% accidents 4.7% fatalities	No	No
Arizona	No	200 PWC accidents; 2 fatalities ( <i>numbers available in February</i> )	55%	No	Yes
California	Monterrey Bay bans PWCs	354 PWC accidents; 7 fatalities (prelim.)	17.5% fatalities	No	Local agencies do; state does not provide vessels
Colorado	Some have hp restric- tions; other areas don't allow motorized vessels	37 PWC accidents	50.1% of total accidents	Cannot rent, lease or hire out a boat to someone under 16 unless the person is over 14 & has a safety certificate	Yes
Guam	Yes	0	N/A	Commercial operators must provide safety briefing	No
Hawaii	Yes	0	N/A	No	No
Idaho	Only those required for all vessels	N/A	N/A	Persons renting or leasing a PWC must take instruction; Businesses must provide instruction including PWC video & printed information	Local agencies are involved; Idaho purchased theirs
Kansas	Some county- and city-managed lakes	2 fatalities (33% of accidents)	50%	No	Yes
Montana	Horsepower restric- tions on some waters	6 accidents; 2 fatalities	.08%	No regulations, but they must provide proper equipment	Yes
Nevada	No	175 accidents YTD; 4 fatalities	66%	Yes, livery operators— not dealers	Yes
Oregon	Prohibited on most rivers	34 accidents	26%	Yes, operational safety decal; review operator rules & form verifying knowledge of rules	Yes, 6-8 county programs (out of 31) regularly participate
Utah	Not just for PWCs	N/A	N/A	Rental must provide law & rule information & required safety equipment	Yes
Washington	Yes by county ordinance	Data not complete	N/A	Not a state law; some counties	State parks don't; many county programs do
Wyoming	Yes	13 accidents	N/A	No	Yes

## Appendix C

### Preliminary Data on 1997 PWC Fatalities

**Table C-1. Number of personal watercraft fatalities, 1997.<sup>(a)</sup>**

State or Territory	Number of fatalities
Alabama	1
Alaska	1
Arkansas	0
Arizona	2
California	8
Colorado	0
Connecticut	0
Delaware	0
District of Columbia	0
Florida	8
Georgia	2
Hawaii	0
Idaho	0
Illinois	4
Indiana	1
Iowa	0
Kansas	2
Kentucky	4
Louisiana	1
Maine	0
Maryland	0
Massachusetts	1
Michigan	1
Minnesota	2
Mississippi	3
Missouri	3
Montana	2
Nebraska	1
Nevada	4
New Hampshire	0
New Jersey	0
New Mexico	0
New York	6
North Carolina	3
North Dakota	1
(continued)	

**Table C-1. Number of personal watercraft fatalities, 1997.<sup>(a)</sup>**

State or Territory	Number of fatalities
(continued)	
Ohio	1
Oklahoma	0
Oregon	0
Pennsylvania	0
Rhode Island	0
South Carolina	1
South Dakota	0
Tennessee	2
Texas	11
Utah	1
Vermont	0
Virginia	3
Washington	0
West Virginia	2
Wisconsin	1
Wyoming	0
American Samoa	—
Guam	0
Northern Mariana Islands	—
Puerto Rico	0
Virgin Islands	0
<b>Total</b>	<b>83</b>

— = Data were not provided.

<sup>(a)</sup> The number of fatalities shown was based on preliminary survey data gathered by the National Association of State Boating Law Administrators and then supplemented by National Transportation Safety Board staff who telephoned many States for an updated count. Because the U.S. Coast Guard has not yet compiled the number of PWC accidents in 1997 for all States, the number of fatalities shown in this table should be considered preliminary. (Results of the 1997 NASBLA survey were published in the following: *Small Craft Advisory*. Dec. 1997/Jan. 1998. Lexington, KY: National Association of State Boating Law Administrators; 13(2): 8-13.)



## Appendix D

### Summary of Data Sources Provided by the States and Territories

**Table D–1. Summary of data sources provided by the States and Territories pertaining to personal watercraft accidents.**

State or Territory	January–June 1997 <sup>(a)</sup>			1996
	Number of accident reports submitted by the State <sup>(b)</sup>	Number of injured persons for whom NTSB questionnaire was completed	Number of AIS injuries sustained by the injured persons	Number of accident reports submitted by the State <sup>(c)</sup>
Alabama	—	—	—	37
Alaska	5	5	9	1
Arkansas	18	11	13	26
Arizona	—	—	—	139
California	145	80	140	electronic
Colorado	10	7	9	36
Connecticut	5	1	1	8
Delaware	4	3	5	0
District of Columbia	—	—	—	—
Florida	256	187	265	
Georgia	30	23	29	—
Hawaii	—	—	—	2
Idaho	8	3	3	electronic
Illinois	29	19	32	43
Indiana	4	3	4	27
Iowa	—	—	—	electronic
Kansas	—	—	—	18
Kentucky	9	9	12	51
Louisiana	16	8	11	24
Maine	—	—	—	15
Maryland	15	10	16	47
Massachusetts	3	2	4	5
Michigan	1	6	13	—
Minnesota	20	15	18	43
Mississippi	12	5	5	—
Missouri	30	33	53	electronic
Montana	2	—	—	9
Nebraska	—	—	—	27
Nevada	18	9	21	electronic
New Hampshire	1	—	—	electronic

(continued)

**Table D–1. Summary of data sources provided by the States and Territories pertaining to personal watercraft accidents.**

State or Territory	January–June 1997 <sup>(a)</sup>			1996
	Number of accident reports submitted by the State <sup>(b)</sup>	Number of injured persons for whom NTSB questionnaire was completed	Number of AIS injuries sustained by the injured persons	Number of accident reports submitted by the State <sup>(c)</sup>
(continued)				
New Jersey	22	18	19	85
New Mexico	—	—	—	electronic
New York	1	1	1	electronic
North Carolina	31	17	28	126
North Dakota	1	1	1	7
Ohio	11	12	18	electronic
Oklahoma	—	—	—	—
Oregon	10	8	15	electronic
Pennsylvania	—	—	—	electronic
Rhode Island	—	—	—	4
South Carolina	—	—	—	—
South Dakota	—	—	—	9
Tennessee	22	12	20	49
Texas	6	6	6	
Utah	7	5	5	
Vermont	—	—	—	—
Virginia	28	20	30	72
Washington	8	6	6	—
West Virginia	—	—	—	—
Wisconsin	17	13	15	electronic
Wyoming	—	—	—	2
American Samoa	—	—	—	—
Guam	1	1	3	13
Northern Mariana Islands	—	—	—	—
Puerto Rico	7	4	5	
Virgin Islands	1	—	—	0
<b>Total</b>	<b>814</b>	<b>563</b>	<b>835</b>	<b>925</b>

— = Data were not provided for the National Transportation Safety Board study on personal watercraft safety.

<sup>(a)</sup> Period of data collection for the National Transportation Safety Board study.

<sup>(b)</sup> The number reported to the U.S. Coast Guard by State marine accident investigators. The accidents involved 1,218 PWC operators.

<sup>(c)</sup> The number reported to the U.S. Coast Guard by State marine accident investigators. "Electronic" denotes that only the data, but not paper copies of the State accident reports, were provided to the National Transportation Safety Board.

# Appendix E

## U.S. Coast Guard Boating Accident Report Form

DEPARTMENT OF TRANSPORTATION U.S. COAST GUARD CG-3865 (Rev. 9/95)		BOATING ACCIDENT REPORT		FORM APPROVED OMB NO. 2115-0010 EXPIRES 02/28/2000	
STATE ASSIGNED CASE NO. _____					
THE OPERATOR/OWNER OF A VESSEL USED FOR RECREATIONAL PURPOSES IS REQUIRED TO FILE A REPORT IN WRITING WHENEVER AN ACCIDENT RESULTS IN: LOSS OF LIFE OR DISAPPEARANCE FROM A VESSEL; AN INJURY WHICH REQUIRES MEDICAL TREATMENT BEYOND FIRST AID; OR PROPERTY DAMAGE IN EXCESS OF \$500 OR COMPLETE LOSS OF THE VESSEL. REPORTS IN DEATH AND INJURY CASES MUST BE SUBMITTED WITHIN 48 HOURS. REPORTS IN OTHER CASES MUST BE SUBMITTED WITHIN 10 DAYS. REPORTS MUST BE SUBMITTED TO THE REPORTING AUTHORITY IN THE STATE WHERE THE ACCIDENT OCCURRED. THIS FORM IS PROVIDED TO ASSIST THE OPERATOR IN FILING THE REQUIRED WRITTEN REPORT.					
COMPLETE ALL BLOCKS (INDICATE THOSE NOT APPLICABLE BY "NA")					
ACCIDENT DATA					
DATE OF ACCIDENT	TIME	AM PM	NAME OF BODY OF WATER	LOCATION (GIVE LOCATION PRECISELY)	
NUMBER OF VESSELS INVOLVED	NEAREST CITY OR TOWN		COUNTY	STATE	ZIP CODE
WEATHER (CHECK ALL APPLICABLE) <input type="checkbox"/> CLEAR <input type="checkbox"/> RAIN <input type="checkbox"/> CLOUDY <input type="checkbox"/> SNOW <input type="checkbox"/> FOG <input type="checkbox"/> HAZY	WATER CONDITIONS <input type="checkbox"/> CALM (WAVES LESS THAN 6") <input type="checkbox"/> CHOPPY (WAVES 6" TO 2') <input type="checkbox"/> ROUGH (WAVES 2' TO 6") <input type="checkbox"/> VERY ROUGH (GREATER THAN 6") <input type="checkbox"/> STRONG CURRENT	TEMPERATURE (ESTIMATE) AIR _____ °F WATER _____ °F	WIND <input type="checkbox"/> NONE <input type="checkbox"/> LIGHT (0-6 MPH) <input type="checkbox"/> MODERATE (7-14 MPH) <input type="checkbox"/> STRONG (15-25 MPH) <input type="checkbox"/> STORM (OVER 25 MPH)	VISIBILITY DAY NIGHT <input type="checkbox"/> GOOD <input type="checkbox"/> <input type="checkbox"/> FAIR <input type="checkbox"/> <input type="checkbox"/> POOR <input type="checkbox"/>	
NAME OF OPERATOR			OPERATOR ADDRESS		
OPERATOR TELEPHONE NUMBER ( )	DATE OF BIRTH MO DAY YR	OPERATOR'S EXPERIENCE <input type="checkbox"/> NONE <input type="checkbox"/> UNDER 100 HOURS <input type="checkbox"/> ≥ 100 HOURS	INSTRUCTION IN BOATING SAFETY <input type="checkbox"/> STATE COURSE <input type="checkbox"/> U.S. POWER SQUADRON <input type="checkbox"/> USCG AUXILIARY <input type="checkbox"/> AMERICAN RED CROSS <input type="checkbox"/> NONE		
<input type="checkbox"/> MALE <input type="checkbox"/> FEMALE					
NAME OF OWNER			OWNER ADDRESS		
OWNER TELEPHONE NUMBER ( )	NUMBER OF PEOPLE ON BOARD	NUMBER OF PEOPLE BEING TOWED	RENTED BOAT? <input type="checkbox"/> YES <input type="checkbox"/> NO		
BOAT NO. 1 (THIS VESSEL)					
BOAT REGISTRATION OR DOCUMENTATION NUMBER		STATE	HULL IDENTIFICATION NUMBER	BOAT NAME	
BOAT MANUFACTURER		LENGTH	MODEL	YEAR BUILT	
TYPE OF BOAT <input type="checkbox"/> OPEN MOTORBOAT <input type="checkbox"/> CABIN MOTORBOAT <input type="checkbox"/> AUXILIARY SAIL <input type="checkbox"/> SAIL (ONLY) <input type="checkbox"/> ROWBOAT <input type="checkbox"/> CANOE/KAYAK <input type="checkbox"/> PERSONAL WATERCRAFT <input type="checkbox"/> PONTOON BOAT <input type="checkbox"/> HOUSEBOAT <input type="checkbox"/> OTHER (SPECIFY)	HULL MATERIAL <input type="checkbox"/> WOOD <input type="checkbox"/> ALUMINUM <input type="checkbox"/> STEEL <input type="checkbox"/> FIBERGLASS <input type="checkbox"/> RUBBER/VINYL/CANVAS <input type="checkbox"/> RIGID HULL INFLATABLE <input type="checkbox"/> OTHER (SPECIFY)	ENGINE <input type="checkbox"/> OUTBOARD <input type="checkbox"/> INBOARD <input type="checkbox"/> INBOARD-STERNDRIVE (I/O) <input type="checkbox"/> AIRBOAT	PROPULSION <input type="checkbox"/> PROPELLER <input type="checkbox"/> WATER JET <input type="checkbox"/> AIR THRUST <input type="checkbox"/> MANUAL <input type="checkbox"/> SAIL	PERSONAL FLOTATION DEVICES (PFDS): WAS BOAT ADEQUATELY EQUIPPED WITH COAST GUARD APPROVED PFDS? <input type="checkbox"/> YES <input type="checkbox"/> NO WERE PFDS ACCESSIBLE? <input type="checkbox"/> YES <input type="checkbox"/> NO	
		FUEL <input type="checkbox"/> GASOLINE <input type="checkbox"/> DIESEL <input type="checkbox"/> ELECTRIC	NUMBER OF ENGINES	FIRE EXTINGUISHERS ON BOARD? <input type="checkbox"/> YES <input type="checkbox"/> NO USED? <input type="checkbox"/> YES <input type="checkbox"/> NO	
		TOTAL HORSEPOWER		WHAT CONTRIBUTED TO ACCIDENT? (CHECK ALL APPLICABLE)	
OPERATION AT TIME OF ACCIDENT (CHECK ALL APPLICABLE) <input type="checkbox"/> CRUISING <input type="checkbox"/> CHANGING DIRECTION <input type="checkbox"/> CHANGING SPEED <input type="checkbox"/> DRIFTING <input type="checkbox"/> TOWING <input type="checkbox"/> BEING TOWED <input type="checkbox"/> ROWING/PADDLING <input type="checkbox"/> SAILING <input type="checkbox"/> LAUNCHING <input type="checkbox"/> DOCKING/UNDOCKING <input type="checkbox"/> AT ANCHOR <input type="checkbox"/> TIED TO DOCK/MOORED <input type="checkbox"/> OTHER (SPECIFY)	ACTIVITY AT TIME OF ACCIDENT (CHECK ANY IF APPLICABLE) <input type="checkbox"/> FISHING <input type="checkbox"/> TOURNAMENT <input type="checkbox"/> HUNTING <input type="checkbox"/> SWIMMING/DIVING <input type="checkbox"/> MAKING REPAIRS <input type="checkbox"/> WATERSKIING/TUBING/ETC. <input type="checkbox"/> RACING <input type="checkbox"/> WHITEWATER SPORTS <input type="checkbox"/> FUELING <input type="checkbox"/> STARTING ENGINE <input type="checkbox"/> NON-RECREATIONAL <input type="checkbox"/> OTHER (SPECIFY)	TYPE OF ACCIDENT <input type="checkbox"/> GROUNDING <input type="checkbox"/> CAPSIZING <input type="checkbox"/> FLOODING/SWAMPING <input type="checkbox"/> SINKING <input type="checkbox"/> FIRE OR EXPLOSION (FUEL) <input type="checkbox"/> FIRE OR EXPLOSION (OTHER) <input type="checkbox"/> SKIER MISHAP <input type="checkbox"/> COLLISION WITH VESSEL <input type="checkbox"/> COLLISION WITH FIXED OBJECT <input type="checkbox"/> COLLISION WITH FLOATING OBJ. <input type="checkbox"/> FALLS OVERBOARD <input type="checkbox"/> FALLS IN BOAT <input type="checkbox"/> STRUCK BY BOAT <input type="checkbox"/> STRUCK BY MOTOR/PROPELLER <input type="checkbox"/> STRUCK SUBMERGED OBJECT <input type="checkbox"/> OTHER (SPECIFY)		<input type="checkbox"/> WEATHER <input type="checkbox"/> EXCESSIVE SPEED <input type="checkbox"/> IMPROPER LOOKOUT <input type="checkbox"/> RESTRICTED VISION <input type="checkbox"/> OVERLOADING <input type="checkbox"/> IMPROPER LOADING <input type="checkbox"/> HAZARDOUS WATERS <input type="checkbox"/> ALCOHOL USE <input type="checkbox"/> DRUG USE <input type="checkbox"/> HULL FAILURE <input type="checkbox"/> MACHINERY FAILURE <input type="checkbox"/> EQUIPMENT FAILURE <input type="checkbox"/> OPERATOR INEXPERIENCE <input type="checkbox"/> OPERATOR INATTENTION <input type="checkbox"/> CONGESTED WATERS <input type="checkbox"/> PASSENGER/SKIER BEHAVIOR <input type="checkbox"/> DAM/LOCK <input type="checkbox"/> OTHER (SPECIFY)	
ESTIMATED SPEED <input type="checkbox"/> 10 - 20 MPH	<input type="checkbox"/> NONE <input type="checkbox"/> 21 - 40 MPH	<input type="checkbox"/> UNDER 10 MPH <input type="checkbox"/> OVER 40 MPH	<input type="checkbox"/> HIT AND RUN		

DECEASED (IF MORE THAN 2 FATALITIES, ATTACH ADDITIONAL FORMS)			
NAME OF VICTIM		ADDRESS OF VICTIM	
DATE OF BIRTH		DEATH CAUSED BY	
<input type="checkbox"/> MALE <input type="checkbox"/> FEMALE	<input type="checkbox"/> DROWNING <input type="checkbox"/> OTHER	<input type="checkbox"/> DISAPPEARANCE	
NAME OF VICTIM		ADDRESS OF VICTIM	
DATE OF BIRTH		DEATH CAUSED BY	
<input type="checkbox"/> MALE <input type="checkbox"/> FEMALE	<input type="checkbox"/> DROWNING <input type="checkbox"/> OTHER	<input type="checkbox"/> DISAPPEARANCE	
INJURED (IF MORE THAN 2 INJURIES, ATTACH ADDITIONAL FORMS)			
NAME OF VICTIM		ADDRESS OF VICTIM	
DATE OF BIRTH		MEDICAL TREATMENT BEYOND FIRST AID? <input type="checkbox"/> YES <input type="checkbox"/> NO	
ADMITTED TO HOSPITAL?		DESCRIBE INJURY	
WAS PFD WORN? <input type="checkbox"/> YES <input type="checkbox"/> NO		PRIOR TO ACCIDENT? <input type="checkbox"/> YES <input type="checkbox"/> NO	
WAS IT INFLATABLE? <input type="checkbox"/> YES <input type="checkbox"/> NO		AS A RESULT OF ACCIDENT? <input type="checkbox"/> YES <input type="checkbox"/> NO	
NAME OF VICTIM		ADDRESS OF VICTIM	
DATE OF BIRTH		MEDICAL TREATMENT BEYOND FIRST AID? <input type="checkbox"/> YES <input type="checkbox"/> NO	
ADMITTED TO HOSPITAL?		DESCRIBE INJURY	
WAS PFD WORN? <input type="checkbox"/> YES <input type="checkbox"/> NO		PRIOR TO ACCIDENT? <input type="checkbox"/> YES <input type="checkbox"/> NO	
WAS IT INFLATABLE? <input type="checkbox"/> YES <input type="checkbox"/> NO		AS A RESULT OF ACCIDENT? <input type="checkbox"/> YES <input type="checkbox"/> NO	
OTHER PEOPLE ABOARD THIS BOAT (IF MORE THAN 2 PEOPLE, ATTACH ADDITIONAL FORMS)			
NAME		ADDRESS	
DATE OF BIRTH		WAS PFD WORN? <input type="checkbox"/> YES <input type="checkbox"/> NO	
AS A RESULT OF ACCIDENT <input type="checkbox"/> YES <input type="checkbox"/> NO		PRIOR TO ACCIDENT? <input type="checkbox"/> YES <input type="checkbox"/> NO	
NAME		ADDRESS	
DATE OF BIRTH		WAS PFD WORN? <input type="checkbox"/> YES <input type="checkbox"/> NO	
AS A RESULT OF ACCIDENT <input type="checkbox"/> YES <input type="checkbox"/> NO		PRIOR TO ACCIDENT? <input type="checkbox"/> YES <input type="checkbox"/> NO	
NAME		ADDRESS	
DATE OF BIRTH		WAS PFD WORN? <input type="checkbox"/> YES <input type="checkbox"/> NO	
AS A RESULT OF ACCIDENT <input type="checkbox"/> YES <input type="checkbox"/> NO		PRIOR TO ACCIDENT? <input type="checkbox"/> YES <input type="checkbox"/> NO	
NAME		ADDRESS	
DATE OF BIRTH		WAS PFD WORN? <input type="checkbox"/> YES <input type="checkbox"/> NO	
AS A RESULT OF ACCIDENT <input type="checkbox"/> YES <input type="checkbox"/> NO		PRIOR TO ACCIDENT? <input type="checkbox"/> YES <input type="checkbox"/> NO	
NAME		ADDRESS	
DATE OF BIRTH		WAS PFD WORN? <input type="checkbox"/> YES <input type="checkbox"/> NO	
AS A RESULT OF ACCIDENT <input type="checkbox"/> YES <input type="checkbox"/> NO		PRIOR TO ACCIDENT? <input type="checkbox"/> YES <input type="checkbox"/> NO	
BOAT NO. 2 (IF MORE THAN 2 VESSELS, ATTACH ADDITIONAL IDENTIFYING INFORMATION)			
NAME OF OPERATOR		OPERATOR ADDRESS	
OPERATOR TELEPHONE NUMBER ( )		BOAT REGISTRATION OR DOCUMENTATION NUMBER STATE	
NAME OF OWNER		OWNER ADDRESS	
OWNER TELEPHONE NUMBER ( )			
PROPERTY DAMAGE			
ESTIMATED AMOUNT: THIS BOAT AND CONTENTS: \$		OTHER BOAT(S) AND CONTENTS: \$	
DESCRIBE PROPERTY DAMAGED		OTHER PROPERTY: \$	
WITNESSES NOT ON THIS VESSEL			
NAME		ADDRESS	
NAME		ADDRESS	
NAME		ADDRESS	
NAME		ADDRESS	
PERSON COMPLETING REPORT			
NAME		ADDRESS	
SIGNATURE		QUALIFICATION <input type="checkbox"/> OPERATOR <input type="checkbox"/> OWNER <input type="checkbox"/> INVESTIGATOR <input type="checkbox"/> OTHER	
		DATE SUBMITTED	
FOR AGENCY USE ONLY			
CAUSES BASED ON (CHECK ONE): <input type="checkbox"/> THIS REPORT <input type="checkbox"/> INVESTIGATION <input type="checkbox"/> INVESTIGATION AND THIS REPORT <input type="checkbox"/> OTHER			
NAME OF REVIEWING OFFICE		DATE RECEIVED	
		RECREATIONAL <input type="checkbox"/> NON-REPORTABLE <input type="checkbox"/>	
PRIMARY CAUSE		COMMERCIAL <input type="checkbox"/>	
		SECONDARY CAUSE	

**ACCIDENT DESCRIPTION**

DESCRIBE WHAT HAPPENED (SEQUENCE OF EVENTS. INCLUDE FAILURE OF EQUIPMENT. INCLUDE A DIAGRAM IF NEEDED. CONTINUE ON ADDITIONAL SHEETS IF NECESSARY. INCLUDE ANY INFORMATION REGARDING THE INVOLVEMENT OF ALCOHOL AN/OR DRUGS IN CAUSING OR CONTRIBUTING TO THE ACCIDENT. INCLUDE ANY DESCRIPTIVE INFORMATION ABOUT THE USE OF PFD'S.)

An agency may not conduct or sponsor and a person is not required to respond to an information collection, unless it displays a currently valid OMB Control Number. The Coast Guard estimates that the average burden for this report form is 30 minutes. You may submit any comments concerning the accuracy of this burden estimate or any suggestions for reducing the burden to: Commandant (G-OPB-1), U.S. Coast Guard, Washington, DC 20593-0001 or Office of Management and Budget, Paperwork Reduction Project (2115-0010), Washington, DC 20503.

## Appendix F

### NTSB Supplemental Questionnaire

The National Transportation Safety Board developed this questionnaire specifically for this study on personal watercraft safety. For PWC accidents that occurred between January and June 1997, the Safety Board requested that State marine accident investigators complete a supplemental questionnaire.

**NTSB 1997 Personal Watercraft Accident Interview Form**

Complete one form for each personal watercraft involved in an accident






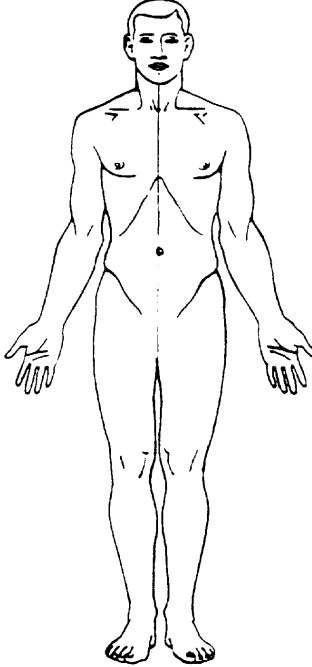
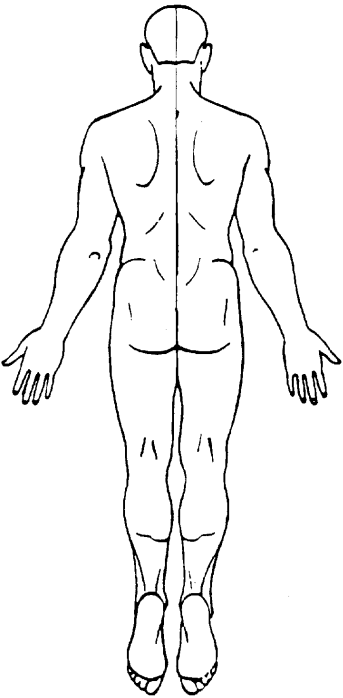
State _____	Accident Report Number _____
1. How many <u>vessels</u> involved in the accident? <input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4	2. How many <u>personal watercraft</u> (PWC) involved in the accident? <input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4
3. Operator was: male <input type="radio"/> female <input type="radio"/>	4. Was the operator cited for Boating While Intoxicated? yes <input type="radio"/> no <input type="radio"/>
5. Had operator previously been cited for Boating While Intoxicated? yes <input type="radio"/> no <input type="radio"/>	6. Number of serious boating violations previously charged to this operator: <input type="radio"/> 1 <input type="radio"/> 2 <input type="radio"/> 3 <input type="radio"/> 4+
7. Was PWC trailered to waterway? yes <input type="radio"/> no <input type="radio"/>	8. Was PWC launched from a public boat ramp? yes <input type="radio"/> no <input type="radio"/>
9. Had the PWC operator received any boating education? yes <input type="radio"/> no <input type="radio"/> If no, skip question #10	10. If boating education was yes, enter the following: Name of sponsoring organization: _____ Type or name: _____ Course length: _____ When taken (month/year) _____
11. Had operator previously driven a PWC? <input type="radio"/> never <input type="radio"/> once <input type="radio"/> 2-12 times <input type="radio"/> 12+	12. How long had operator been riding PWC that day? <input type="radio"/> less than 1 hour, <input type="radio"/> 1-3 hours, <input type="radio"/> 3+ hours
13. Was the operator wearing a personal flotation device? yes <input type="radio"/> no <input type="radio"/> type PFD? _____ (type I - extended survival,    type II - classic vest, type III - flotation jacket,    type IV - cushion or ring, type V - special)	14. How many passengers? <input type="radio"/> none, only the operator was aboard wearing PFD?    Type PFD? <input type="radio"/> one, age _____    yes <input type="radio"/> no <input type="radio"/> _____ <input type="radio"/> two, age _____    yes <input type="radio"/> no <input type="radio"/> _____ <input type="radio"/> three, age _____    yes <input type="radio"/> no <input type="radio"/> _____
15. Was the PWC rented? yes <input type="radio"/> no <input type="radio"/> If no, skip questions # 16 -21	16. Did rental agent require person renting to demonstrate hands-on ability to handle craft? yes <input type="radio"/> no <input type="radio"/>
17. Did rental agent provide safety orientation at the time of rental? yes <input type="radio"/> no <input type="radio"/> If no, skip question #18	18. How was safety information provided?    video <input type="radio"/> booklet <input type="radio"/> lecture <input type="radio"/> demonstration <input type="radio"/>
19. Did rental agent check age of person renting the PWC?    yes <input type="radio"/> no <input type="radio"/>	20. Was the operator who had the accident the person that rented the PWC?    yes <input type="radio"/> no <input type="radio"/>
21. If PWC was rented, how many watercraft does rental business operate? less than 6 craft <input type="radio"/> 6-12 craft <input type="radio"/> more than 12 craft <input type="radio"/>	22. PWC Manufacturer:    Sea-Doo <input type="radio"/> Kawasaki <input type="radio"/> Yamaha <input type="radio"/> Polaris <input type="radio"/> Tigershark <input type="radio"/> Wetjet <input type="radio"/> _____ (_____) Model Number or Code letters    seat design - none, 1, 2, 3
23. Operator was:    In-State Resident <input type="radio"/> Out-of-State Resident <input type="radio"/>	(optional) 24. Operator education level; completed: Grade School <input type="radio"/> High School <input type="radio"/> College <input type="radio"/>

For each person injured, complete the additional questions on the back of this form and indicate area of injury on the diagram. Additional copies will be needed if more than one person was injured.



### Description of Injury

Complete a separate form for each person injured

<p><b>When you arrived on scene, the victim was:</b></p> <p><input type="checkbox"/> alert</p> <p><input type="checkbox"/> confused, disoriented</p> <p><input type="checkbox"/> unresponsive</p>	<p><b>Had the victim received artificial resuscitation?</b></p> <p>yes <input type="checkbox"/> no <input type="checkbox"/></p>
<p><b>If unresponsive, was the victim breathing?</b></p> <p>yes <input type="checkbox"/> no <input type="checkbox"/></p>	<p><b>Did the victim have a pulse?</b></p> <p>yes <input type="checkbox"/> no <input type="checkbox"/></p>
<p><b>Indicate Injured Areas:</b></p> <ul style="list-style-type: none"> <li> Broken or crushed bones</li> <li> Minor bleeding</li> <li> Severe Bleeding</li> <li> Amputation</li> <li> Abrasions or Burns</li> </ul> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="text-align: center;"> <p><b>FRONT</b></p>  </div> <div style="text-align: center;"> <p><b>BACK</b></p>  </div> </div>	
<p><b>Additional Description of Injuries:</b></p>	<p><b>Was victim wearing personal flotation device?</b>    yes <input type="checkbox"/>    no <input type="checkbox"/></p> <p>type PFD? _____  <small>(type I- extended survival, type II - classic vest, type III - flotation jacket, type IV- cushion or ring, type V- special)</small></p>
<p><b>Point of contact for more information regarding medical injuries:</b></p>	

## Appendix G

### Status of Safety Recommendations M-93-2 Through M-93-6

**Safety Recommendation No.:** M-93-2  
**Date Issued:** May 25, 1993  
**Recipient:** Appropriate States  
**Status:** *Open—Await Response* (Alabama, District of Columbia, Indiana, Maryland, New York, North Carolina, Puerto Rico, Virgin Island, Virginia, and West Virginia)  
*Open—Acceptable Response* (California, Connecticut, Florida, Iowa, Kentucky, Maine, Michigan, Montana, Nebraska, New Mexico, Ohio, Oregon, Washington, Wisconsin)  
*Closed—Acceptable Action* (Alaska, Hawaii, Idaho, Kansas, Massachusetts, Mississippi, Nevada, Oklahoma, Pennsylvania)  
*Closed—Acceptable Alternate Action* (New Jersey)  
*Closed—Unacceptable Action* (Arizona, Illinois, Missouri, North Dakota, Wyoming)  
*Closed—Reconsidered* (Georgia, Tennessee)

#### Recommendation:

Enact legislation that would require a chemical test to determine the alcohol concentration of all recreational boat operators involved in a fatal boating accident.

**Safety Recommendation No.:** M-93-3  
**Date Issued:** May 25, 1993  
**Recipient:** Appropriate States  
**Status:** *Open—Await Response* (West Virginia)  
*Open—Acceptable Response* (District of Columbia, Kentucky, and New Mexico)  
*Closed—Acceptable Action* (Alabama, Hawaii, Mississippi, Missouri, Oklahoma, and South Dakota)

**Recommendation:**

Enact comprehensive legislation to address the problem of alcohol and/or drug use by recreational boat operators, including, but not limited to, a clear definition of legal impairment in terms of alcohol concentration and a provision requiring a chemical test to determine alcohol concentration if a recreational boat operator is suspected of being impaired.

**Safety Recommendation No.:** M-93-4  
**Date Issued:** May 25, 1993  
**Recipient:** State of Iowa  
**Status:** *Open—Acceptable Response*

**Recommendation:**

Enact legislation to address the problem of alcohol use by recreational boat operators by establishing a clear definition of legal impairment in terms of alcohol concentration.

**Safety Recommendation No.:** M-93-5  
**Date Issued:** May 25, 1993  
**Recipient:** Appropriate States  
**Status:** *Open—Acceptable Response* (Connecticut and Washington)  
*Closed—Unacceptable Action* (Wyoming)

**Recommendation:**

Enact legislation that would require a chemical test if a recreational boat operator is suspected of being impaired.

**Safety Recommendation No.:** M-93-6  
**Date Issued:** May 25, 1993  
**Recipient:** Appropriate States  
**Status:** *Open—Await Response* (Arizona, Massachusetts, Missouri, New Hampshire, and Oklahoma)  
*Open—Acceptable Response* (New York, Pennsylvania, and Virginia)  
*Open—Acceptable Alternate Response* (Iowa)  
*Closed—Reconsidered* (Kentucky and North Dakota)

**Recommendation:**

Enact legislation that would require toxicological testing of all recreational boating fatalities.

## Appendix H

### Minimum Age Requirements of States for PWC Operation

**Table H-1. State requirements regarding minimum age to operate personal watercraft and age-related special provisions.**

State or Territory	PWC operating age		Special provision that allows PWC operation below minimum age	
	Minimum age by Statute	Age allowed by special provision	Training or certification	Adult supervision
Alabama	12	12		
Alaska	None	None		
Arizona	12	12		
Arkansas	12	Any age		✓
California	16	12		✓
Colorado	16	14	✓	
Connecticut	12	Any age	✓	✓
Delaware	16	14		✓
District of Columbia	16	16	✓	
Florida	14	14		
Georgia	16	12	✓	✓
Hawaii	15	15		
Idaho	None	None		
Illinois	18	10	✓	✓
Indiana	16	15	✓	
Iowa	12	Any age		✓
Kansas	16	12	✓	✓
Kentucky	12	12	✓	
Louisiana	13	13		✓
Maine	12	12		
Maryland	16	16	✓	
Massachusetts	18	16	✓	
Michigan	16	12	✓	✓
Minnesota	18	13	✓	✓
Mississippi	12	12	✓	✓
Missouri	14	Any age		✓
Montana	15	Any age	✓	✓
Nebraska	14	14		
Nevada	12	12		
New Hampshire	16	16		
(continued)				

**Table H-1. State requirements regarding minimum age to operate personal watercraft and age-related special provisions.**

State or Territory	PWC operating age		Special provision that allows PWC operation below minimum age	
	Minimum age by Statute	Age allowed by special provision	Training or certification	Adult supervision
(continued)				
New Jersey	16	16	✓	
New Mexico	13	Any age		✓
New York	18	10	✓	✓
North Carolina	None	None		
North Dakota	16	Any age	✓	✓
Ohio	16	12		✓
Oklahoma	13	Any age		✓
Oregon	14	Any age		✓
Pennsylvania	16	12	✓	✓
Rhode Island	16	Any age	✓	✓
South Carolina	16	Any age	✓	✓
South Dakota	14	Any age		✓
Tennessee	12	Any age		✓
Texas	18	Any age	✓	✓
Utah	18	12	✓	✓
Vermont	16	16		
Virginia	14	14		
Washington	14	14		
West Virginia	15	12		✓
Wisconsin	16	12	✓	✓
Wyoming	16	Any age		✓
American Samoa	None	None		✓
Guam	16	Any age		
Northern Mariana Islands	None	None		
Puerto Rico	16	16	✓	
Virgin Islands	18	14	✓	✓

Source: Data from the National Association of State Boating Law Administrators.

## **Appendix I**

### **Comparison of Personal Watercraft Model Acts of the PWIA and NASBLA**

The text of the PWIA model personal watercraft operations act is provided with the permission of the Personal Watercraft Industry Association. The text of the NASBLA model act for personal watercraft is provided with the permission of the National Association of State Boating Law Administrators.

**Comparison of the PWIA and NASBLA  
Personal Watercraft Model Acts**

<b>PWIA Model Act</b>	<b>NASBLA Model Act</b>
<p><b><i>Definitions (Section 2)</i></b></p> <ul style="list-style-type: none"> <li>• Defines two classes of vessels: PWC and Specialty Prop-Craft</li> <li>• Sets no vessel length</li> <li>• PWC defined as using an inboard motor powering a water jet pump</li> <li>• Specialty Prop-Craft defined as using an outboard motor or propeller-driven motor</li> </ul> <p><b><i>Regulation of PWC (Section 4)</i></b></p> <ul style="list-style-type: none"> <li>• No person under age 16 to operate</li> <li>• Persons on board must wear PFDs including person towed by PWC; inflatable PFDs not allowed</li> <li>• Lanyard requirements same as NASBLA</li> <li>• No person shall operate between sunset and sunrise; except emergency personnel</li> </ul>	<p><b><i>Definitions (Section 1)</i></b></p> <ul style="list-style-type: none"> <li>• Defines only PWC</li> <li>• Sets vessel length at less than 16 feet</li> <li>• PWC defined as being propelled by water jet pump or other machinery</li> </ul> <p><b><i>Regulation of PWC (Section 2)</i></b></p> <ul style="list-style-type: none"> <li>• No person under age 16 to operate, except 12–16 if a person age 18 is on board</li> <li>• Persons on board must wear PFDs; inflatable PFDs not allowed; no reference to person being towed</li> <li>• Lanyard requirements same as PWIA</li> <li>• No person shall operate between sunset and sunrise</li> </ul>
<p>PWIA and NASBLA are essentially the same about operating in a reasonable and prudent manner as to:</p> <ul style="list-style-type: none"> <li>• Weaving through congested traffic.</li> <li>• Becoming airborne or completely leaving the water while crossing the wake of another vessel within 100 feet of the vessel creating the wake.</li> <li>• Operating at slow/wake speed within 100 feet of listed conditions.</li> <li>• Operating contrary to “rules of the road” (NASBLA) or navigation rules (PWIA).</li> </ul>	
<ul style="list-style-type: none"> <li>• PWIA prohibits jumping a wake when visibility is obstructed or restricted</li> </ul> <p><b><i>Required PWC Education (Section 5)</i></b></p> <ul style="list-style-type: none"> <li>• Establish at age 16</li> <li>• Non-resident section indicating non-resident responsible for education</li> <li>• Carry proof of education on board</li> </ul>	<ul style="list-style-type: none"> <li>• NASBLA does not include this specific prohibition</li> </ul> <p><b><i>Required PWC Education</i></b></p> <p>None</p>



**Comparison of the PWIA and NASBLA  
Personal Watercraft Model Acts**

PWIA Model Act	NASBLA Model Act
<p><b><i>Towing (Section 6)</i></b>                      The two sections are essentially the same, except as follows:</p> <ul style="list-style-type: none"> <li>• The observer watching the water skier must be rear-facing</li> <li>• The PWIA model act states that the number of persons operating, observing, and being towed must not exceed the manufacturer’s maximum safe load for the vessel</li> </ul>	<p><b><i>Towing (Section 5)</i></b></p>
<p><b><i>Liveries (Section 7)</i></b></p> <ul style="list-style-type: none"> <li>• Age requirement: no rental to anyone under 18</li> <li>• Liability insurance</li> <li>• Boating safety instruction in compliance with established rules and regulations</li> <li>• Provide in print: operational characteristics of PWC, boating regulations for area, and common courtesies</li> </ul>	<p><b><i>Mandatory Safety Instruction for Rental Operators (Section 4)</i></b></p> <ul style="list-style-type: none"> <li>• No requirement</li> <li>• No requirement</li> <li>• Safety instruction</li> <li>• As to operational characteristics, laws and rules, and local waterway characteristics</li> </ul>
<p><b><i>Exemptions (Section 8)</i></b>                      Both PWIA and NASBLA exempt certain activities:</p> <ul style="list-style-type: none"> <li>• Exempts age restriction and PWC education requirements for persons with Coast Guard licenses</li> </ul>	<p><b><i>Exemptions (Section 3)</i></b></p>
<p><b><i>Regulations for Specialty Prop-Craft (Section 9)</i></b></p> <ul style="list-style-type: none"> <li>• Applies Sections 4, 5, and 6 to these crafts</li> </ul>	<p><b><i>Regulations of Specialty Prop-Craft</i></b></p> <p style="text-align: center;">None</p>
<p><b><i>Uniformity of State Law and Uniformity of Law (Sections 3 and 10)</i></b></p>	<p><b><i>Uniformity of Law</i></b></p> <p style="text-align: center;">None</p>

**MODEL PERSONAL WATERCRAFT OPERATIONS ACT**

[Source: Personal Watercraft Industry Association—February 12, 1998]

Section 1. (Short Title) This act may be cited as the Personal Watercraft Operations Act.

Section 2. (Definitions) As used in this act:

(1) "Personal Watercraft" shall mean a vessel which uses an inboard motor powering a water jet pump as its primary source of motive power and which is designed to be operated by a person sitting, standing, or kneeling on the vessel, rather than the conventional manner of sitting or standing inside the vessel.

(2) Specialty Prop-Craft shall mean a vessel which is similar in appearance and operation to a personal watercraft but which is powered by an outboard motor or propeller driven motor.

Section 3. (Uniformity of State Law)

(1) If any provision of this act is in conflict with any other provision, limitation, or restriction under any law, rule, regulation, or ordinance of this state or any political subdivision, municipality, or agency, this act shall control and such law, rule, regulation, or ordinance shall be deemed superseded.

Section 4. (Regulation of Personal Watercraft)

(1) No person under the age of sixteen (16) shall operate a personal watercraft on the waters of this state.

(2) A person may not operate a personal watercraft unless each person on board or being towed behind is wearing a type I, type II, type III, or type V personal flotation device approved by the United States Coast Guard. Inflatable personal flotation devices do not meet the requirements of this section.

(3) A person operating a personal watercraft equipped by the manufacturer with a lanyard-type engine cutoff switch must attach such lanyard to his/her person, clothing, or personal flotation device as appropriate for the specific vessel.

(4) A person may not operate a personal watercraft at anytime between the hours of sunset and sunrise. However, an agent or employee of a fire rescue, emergency rescue unit, or law enforcement division is exempt from this subsection while performing his/her official duties.

(5) A personal watercraft must at all times be operated in a reasonable and prudent manner. Maneuvers which unreasonably or unnecessarily endanger life, limb, or property shall constitute reckless operation of a vessel and shall include, but not be limited to:

(a) Weaving through congested traffic;

(b) Jumping the wake of another vessel unreasonably or unnecessarily close to such other vessel or when visibility around such other vessel is obstructed or restricted;

(c) Becoming airborne or completely leaving the water while crossing the wake of another vessel within 100 feet of the vessel creating the wake;

(d) Operating at greater than slow/no-wake speed within 100 feet of an anchored or moored vessel, shoreline, dock, pier, swim float, marked swim areas, swimmers, surfers, persons engaged in angling, or any manually powered vessel;

(e) Operating contrary to navigation rules including following too closely to another vessel, including another personal watercraft. For the purpose of this subsection, "following too closely" shall be construed as proceeding in the same direction and operating at a speed in excess of 10 mph within 100 feet to the rear or 50 feet to the side of another vessel which is underway, unless said vessels are operating in a narrow channel, in which case personal watercraft may operate at the speed and flow of the other vessel traffic within the channel.

Section 5. (Required Education except as provided for in Section (7))

(1) No person born after January 1, 19\_\_, (Date to establish age at 16) shall operate on the waters of this state a personal watercraft powered by a motor of 10 Horse Power or greater (unless the operator has successfully completed either a safe boater course approved by the National Association of State Boating Law Administrators and the state, or a proficiency examination that tests the knowledge of information included in the curriculum of such a course, and has received a certificate as evidence of successful completion of the course or examination).

(2) If a non-resident of the state and operating a personal watercraft within the waters of this state, operator would be subject to the rules and regulations of subsection 5. (2) For education but may hold in his/her possession proof that he/she has completed within the state of residence, an education course or equivalency test that meets or exceeds the requirements of subsection 5. (2).

(3) Any operator, resident or non-resident, is required to have available proof of completion of such course on board the personal watercraft while operating on the waters of this state.

Section 6. (Towing Water Skiers and Towables)

(1) No person shall operate a personal watercraft towing another person on water skis or other towables unless the personal watercraft has, on board, in addition to the operator, a rear-facing observer who shall monitor the progress of the person(s) being towed.

(2) No person shall operate a personal watercraft towing another person on water skis or other towables unless the total number of persons operating, observing and being towed does not exceed the specified number of passengers as identified by the manufacturer as the maximum safe load for the vessel.

Section 7. (Regulation of Liveries)

(1) A livery may not lease, hire, or rent a personal watercraft to or for operation by any person under 18 years of age.

(2) A livery must carry liability insurance in the amount of one million dollars.

(3) Livery operators must administer boating safety instruction in compliance with department established rules and guidelines to all operators of rental vessels not having a valid safe boating certificate and valid identification.

(4) In addition, the livery must supply to the operator(s) in print, prior to rental:

(a) The operational characteristics of personal watercraft.

(b) The boating regulations peculiar to the area of rental including but not limited to no-entry zones, no-wake zones, channel routes and water hazards, and tidal flow.

(c) The common courtesies of operating a vessel on the water and the effect on wildlife, the environment, and other water users.

Section 8. (Exemptions)

(1) The provisions of section(s) (4) and (5) shall not apply to a performer engaged in a professional exhibition or a person engaging in an officially sanctioned regatta, race, marine parade, tournament, exhibition, or water safety demonstration.

(2) The provisions of section(s) (4) and (5) shall not apply to a person who holds a valid master's, mate's, or operator's license issued by the United States Coast Guard.

Section 9. (Regulation of Specialty Prop-Craft) The provisions of sections (4), (5) and (6) shall apply to specialty prop-craft.

Section 10. (Uniformity of Law) It is the policy of \_\_\_\_\_ to encourage uniform laws for all vessels. Except as provided in this chapter and other laws of the state; laws, including local laws, ordinances and regulations, that are applicable to the operation of powered vessel shall be uniformly applicable to all types of powered vessels. Local laws, ordinances and regulations shall be operative only so long and to the extent that they are identical to provisions of this chapter, amendments thereto, regulations issued thereunder or other applicable laws of the state. The provisions of this chapter and of other applicable laws of this state shall govern the operation and all other matters related to vessels, provided that nothing in this section shall be construed to prevent adoption of local laws, ordinances or regulations relating to reasonable vessel speed zones and reasonable idle speed zones or vessel exclusion zones (i.e. for swim areas) within their jurisdiction.

The state should consider an age ratchet-up approach to education so that adequate instructors, classes and materials can be made available to train users without overloading and/or taxing the system.

**NASBLA MODEL ACT FOR PERSONAL WATERCRAFT  
(Adopted 9/26/91, Amended September 1996)**

**PROPOSED Changes Underlined  
(for consideration at the 1997 annual conference)**

**General** In addition to all other boating laws and regulations in this state the following shall apply to personal watercraft:

**Section 1. (Definitions.)** As used in this chapter:

- (a) "Personal Watercraft" shall mean a vessel, less than 16 feet, propelled by a water-jet pump or other machinery as its primary source of motor propulsion which is designed to be operated by a person sitting, standing or kneeling on, rather than being operated by a person sitting or standing inside the vessel.

**Section 2. (Regulations of Personal Watercraft.)**

- (a) No person shall operate a personal watercraft unless each person aboard is wearing a type I, type II, type III or type V personal flotation device approved by the United States Coast Guard, provided no person aboard a personal watercraft shall use an inflatable personal flotation device to meet the PFD requirement of this subsection.
- (b) A person operating a personal watercraft equipped by the manufacturer with a lanyard type engine cutoff switch shall attach such lanyard to his person, clothing, or personal flotation device as appropriate for the specific vessel.
- (c) No person shall operate a personal watercraft at any time between sunset and sunrise.
- (d) No person under the age of 16 shall operate a personal watercraft on the waters of this state, except a person 12 to 16 years of age may operate a personal watercraft if a person at least 18 years of age is aboard the vessel.
- (e) Every personal watercraft shall at all times be operated in a reasonable and prudent manner. No person shall operate a personal watercraft in an unsafe manner. Unsafe personal watercraft operation shall include, but not be limited to the following:
  - i. Becoming airborne or completely leaving the water while crossing the wake of another vessel within 100 ft of the vessel creating the wake.
  - ii. Weaving through congested traffic.
  - iii. Operating at greater than slow no wake speed within 100 feet of an anchored or moored vessel, shoreline\*, dock, pier, swim float, marked swim area, swimmer(s), surfers, persons engaged in angling or any manually operated propelled vessel.

- iv. Operating contrary to the "Rules of the Road" or following too close to another vessel, including another personal watercraft. For the purposes of this section, following too close shall be construed as proceeding in the same direction and operating at a speed in excess of 10 MPH when approaching within one hundred feet to the rear or fifty feet to the side of another motor boat or sail boat which is underway unless such vessel is operating in a narrow channel, in which case a personal watercraft may operate at speed and flow of other vessel traffic.
- (f) No person who owns a personal watercraft or who has charge over or control of a personal watercraft shall authorize or knowingly permit the personal watercraft to be operated in violation of this act.

**Section 3. (Exemptions.)**

- (a) The provisions of Section 2 shall not apply to a person participating in an officially sanctioned regatta, race, marine parade, tournament, or exhibition.

**Section 4. (Mandatory Safety Instruction by Rental Operators.)**

- (a) No person shall rent a personal watercraft to another person without first providing safety instruction to that person. Such instruction shall include, but not be limited to: (1) operational characteristics of personal watercraft; (2) laws and regulations, boating rules of the road, personal responsibility; and (3) local characteristics of the waterway to be used.

**Section 5. (Towing Water Skiers.)**

- (a) No person shall operate a personal watercraft towing another person on waterskis or other device(s), unless the personal watercraft has, on board, in addition to the operator, an observer who shall monitor the progress of the person(s) being towed.
- (b) No person shall operate a personal watercraft towing another person on waterskis or other device(s), unless there is adequate seating space available on the craft for the operator, the observer, and each person being towed.

\* Special consideration should be given to operation on rivers and other narrow bodies of water, particularly when the personal watercraft is operating in strong current requiring speed greater than slow/no wake speed to maintain steerage and make headway.

## Appendix J

### State Requirements for Wearing Personal Flotation Devices

Source of the requirements:

National Safe Boating Council; U.S. Coast Guard. 1997. Boat smart from the start: wear your life jacket. Public safety message of the 1998 National Safe Boating Campaign; (p. 20–21) 28 p. Produced under a grant from the Aquatic Resources (Wallop/Breaux) Trust Fund and administered by the U.S. Coast Guard.

The requirements of Alaska and Vermont specify the use of a personal flotation device on an open deck, which would include personal watercraft. The Arkansas boating law administrator has indicated to Safety Board staff that the State amended its PFD requirements to include personal watercraft; the amended requirement is not reflected in the listing that follows.

State	Mandate Wearing PFDs at Some Level	Circumstances and Age Requirements
Alabama	Yes	Within 800 ft below dams. PWC operators and water skiers. Children under 8 years of age
Alaska	Yes	Under 13 while water skiing or on open deck
American Samoa	Yes	All on board while boat is underway. PWC and water skiers
Arizona	Yes	Children 12 and under when vessel is underway. PWC and water skiers
Arkansas	Yes	Ages 12 and under; except within enclosed area while not under way
California	Yes	Under 7 years of age on vessels more than 26 feet, unless in an enclosed cabin.
Colorado	Yes	PWC operators and passengers. Water skiers and persons on aquaplanes, surfboards and similar devices when towed behind a boat must wear some type of flotation like a wetsuit or belt (need not be USCG approved). All persons aboard outfitter's vessels must wear a type V device.
Connecticut	Yes	Under 12; Between Oct. 1 and May 30th all people in canoes, PWC riders and skiers.
Delaware	Yes	All PWC riders and children under 12
District of Columbia	Yes	When the operator of a vessel is under 18 years old, all others under 18 must wear PFD's.
Florida	Yes	Children under 6 on vessels 26 feet while underway, all PWC operators and water skiers
Georgia	Yes	PWC and water skiers; in designated "hazardous area." Children below age 10 in moving vessel, except when enclosed in cabin
Guam	Yes	PWC and water skiers
Hawaii	No	None
Idaho	No	None
Illinois	Yes	PWC (current). Children under 13
Indiana	Yes	PWC
Iowa	Yes	PWC and water skiers or others being towed
Kansas	Yes	PWC; children 12 and under
Kentucky	Yes	PWC
Louisiana	Yes	Children under 12 on vessels less than 26 feet. PWC
Maine	Yes	Children 10 years old and under. PWC and water skiers
Maryland	Yes	PWC and water skiers
Massachusetts	Yes	Persons being towed, PWC, canoeists/kayakers (mid-September - mid-May). Children 12 years of age
Michigan	Yes	PWC and water skiers. Children under 6
Minnesota	Yes	PWC

\*PWC (Personal watercraft) means both operator and passengers. Water skiers may have different definitions in each state. Contact that state for the proper explanation.



State	Mandate Wearing PFDs at Some Level	Circumstances and Age Requirements
Mississippi	Yes	12 yrs or younger in boats under 26 ft and when boats are underway
Missouri	Yes	PWC; Children under age 7
Montana	Yes	Children under 12 when vessel is in motion. PWC and water skiers
N. Mariana Islands	Yes	PWC and water skiers
Nebraska	Yes	Children under 12. Water skiers
Nevada	Yes	PWC and water skiers
New Hampshire	Yes	Children 5 years or under; PWC operators and persons being towed.
New Jersey	Yes	PWC
New Mexico	Yes	Water skiers
New York	Yes	Children under 12 years of age on a boat less than 65 feet unless inside an enclosed cabin. PWC and water skiers
North Carolina	Yes	PWC and water skiers
North Dakota	Yes	Everyone 10 years or younger, on boats less than 27 ft while in operation. PWC and water skiers. Persons under 16 while board sailing
Ohio	Yes	Children less than 10 on boats less than 18 ft. PWC and water skiers
Oklahoma	Yes	Children under 13 when vessel is underway. PWC and water skiers
Oregon	Yes	PWC
Pennsylvania	Yes	PWC, water skiers, sailboards, children 12 years of age and under.
Puerto Rico	Yes	Children under 12
Rhode Island	Yes	PWC; Children under 10 on class A vessels underway
South Carolina	Yes	PWC; Children under 12 on class A
South Dakota	Yes	PWC
Tennessee	Yes	Below dams in the areas marked; PWC; Children 12 and under
Texas	Yes	Children 13 and under; PWC
Utah	Yes	PWC, water skiers and sailboarders; Children 12 or less except when in a closed cabin area on boats 19 feet or more; all boaters on river must wear PFD except at designated flat water areas.
Vermont	Yes	Children under age 12 while under way & on an open deck
Virgin Islands	Yes	PWC and water skiers
Virginia	Yes	PWC; Children 14 and under
Washington	Yes	PWC and water skiers
West Virginia	Yes	PWC; Everyone on white water
Wisconsin	Yes	PWC
Wyoming	Yes	PWC and water skiers

This is not a legal document. For a complete list of the PFD wearing requirements in your state, contact your state boating law administrator's office.