Report Back

On Resolve 2023 Chapter 33

Resolve, Directing the Department of Inland Fisheries and Wildlife to Study the Effects of Wake Boats on Shoreline Property and the Environment

Report to the 2nd Session of the 131st Joint Standing Committee on Inland Fisheries & Wildlife

Provided by Inland Fisheries & Wildlife

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EXECUTIVE SUMMARY

Maine's vast inland and coastal waters are one of the reasons people enjoy living in Maine and nonresidents consider our state a tourist destination. With more than 6,000 lakes and ponds, over 3,500 miles of coastline and approximately 32,000 miles of rivers, outdoor enthusiasts participate in a wide variety of water related activities such as fishing, recreational boating, water-skiing, wakeboarding, wakesurfing, birdwatching, canoeing, kayaking, standup paddle-boarding, sailing, hunting, camping, and rafting. Increased use of these aquatic resources brings competing interests and sometimes conflict between user groups. Anytime there is a discussion related to access and use of public waters, those involved should be reminded that Maine adheres to the Public Trust Doctrine. In essence this doctrine ensures that Maine waters and most submerged lands below them are publicly owned and must be available to all citizens equally for the purposes of fishing, fowling and navigation.

Participation in these popular activities on Maine's waters has increased the need for water access locations and enforcement. Public use has increased dramatically, but so have complaints related to operation of boats too close to shore, disturbing wildlife, unsafe boating behavior, environmental concerns related to large wakes and conflicts with shorefront property owners. Some of these complaints are related to wakeboarding or wakesurfing. Many bills have been introduced during recent legislative sessions aimed to correct these issues, sometimes trying to restrict horsepower on one water body or restricting certain uses on many water bodies. The Department has consistently encouraged the MDIFW Legislative Committee to look at education as the best way to address the issues but there are laws in place currently that help prevent harm from boating such as the 200-foot water safety zone and restriction of boat operation at a reasonable and prudent speed. A new law in effect January 1, 2024, requires boater education for those born after 1999 (in most circumstances) to operate a motorboat in Maine. This was one attempt this Legislature has made to increase safety and reduce conflict on Maine waters.

LD 693 - An Act to Protect Inland Water Quality, Shorelines, Wildlife and Public Safety by Prohibiting Operation of a Wake Boat to Create an Enhanced Wake Close to Shore or in Shallow Water was introduced during the First Session of the 131st (2023) Legislative Session. It sought to prohibit creating an enhanced wake with a boat that is equipped with wake-enhancing equipment within 500 feet of the shoreline or in waters less than 20 feet deep. LD 693 received over 130 pieces of testimony; the vast majority supported the bill. Only a handful of people testified against the bill, but ultimately the committee did not pass this bill.

In the same Legislative Session, *Resolve 2023 Chapter 33, titled "Resolve, Directing the Department of Inland Fisheries and Wildlife to Study the Effects of Wake Boats on Shoreline Property and the Environment"* was passed and required that the Department establish a stakeholder group to review completed studies relating to wake boats and their effects on shoreline property and the environment. The stakeholder group's focus was to be on issues relating to the types of boats used, the appropriate distance from the shoreline and depth of the body of water, enforcement mechanisms, including fines, and the definition used for "wake boat."

Wake boats are motorboats designed to increase wave height for watersports. The hull is shaped differently to help achieve larger wakes, and many have a hydrofoil device that lowers the stern when the boat is under power. Most have built-in ballast tanks that can be filled with lake water to increase the weight in the stern of the boat thereby creating larger waves. The relatively new sport of wakesurfing requires these specialized boats or boat modifications to make surfable-sized waves. Wake-

surfing involves a person trailing behind a boat on a short surfboard and surfing on the boat's wake without being attached to the boat by a rope. Wake-surfing generally occurs usually at lower speeds of 9-11 mph. It is important to note that wake-surfing is different from wakeboarding, which has been around longer and generally occurs at speeds of around 20-23 mph. In wakeboarding, the rider is continually towed by a rope, the wake is smaller than wakesurfing, and it is used by the rider to perform jumps and tricks.

The report focuses primarily on wakesurfing and not wakeboarding. There was agreement amongst the members based on literature that the wakeboarding didn't create the same environmental impacts as wakesurfing, so the group remained most focused on wakesurfing.

Summary of Proposals

After much discussion, the group came to consensus on several proposals for the Legislature to consider:

- Increase education in the form of MDIFW offering a towed water sports specific education module (similar to Oregon's);
- Require boat dealers to provide educational material to persons purchasing new boats (possibly only wake type boats);
- Increase enforcement focus from MWS on statutes already provided in law;
- Make a statutory change to rename "water safety zone" to "water protection zone" so the term brings to mind more than just safety of swimmers and boaters and instead is more indicative of protecting and preserving the water quality, shoreline, safety of people, property and the fish and wildlife that live in and around Maine waters. There were other proposals with less support that are noted below.

Conclusion

In conclusion, the studies and reports reviewed provide support for a great deal of the stakeholder group's proposals. Many of them can be incorporated into an educational approach, suggested/voluntary best operating practices, and a focused enforcement effort by Maine Warden Service. In addition, some statutory changes would be helpful to minimize detrimental impact to Maine's waters and natural resources from waves created by wakesurfing and other recreational boating activity.

BACKGROUND

LD 379 titled: An Act to Responsibly Regulate Recreational Boats on Maine Lakes was brought forth during the First Session of the 131st Joint Standing Committee on Inland Fisheries & Wildlife as a concept draft. The bill was amended and became a resolve directing Inland Fisheries and Wildlife to study the effects of wake boats and their impact on shoreline property. It also required the Commissioner to report back to the committee on Inland Fisheries and Wildlife no later than January 15, 2024.

The Department testified in support of the focus of the resolve, recognizing that interest in wakeboarding and wakesurfing in Maine is increasing and gathering information now, can help with policy making going forward.

The Department requested that the "study" be limited to gathering and consolidating/summarizing information and studies that are already available in Maine and across the United States. The Department discouraged a comprehensive new study of all aspects of this activity citing that it would be time consuming, costly, and probably not provide added value to what is already available.

Resolve 2023 Chapter 33, titled *"Resolve, Directing the Department of Inland Fisheries and Wildlife to Study the Effects of Wake Boats on Shoreline Property and the Environment"* was passed and required the Department establish a stakeholder group to review completed studies relating to wake boats and their effects on shoreline property and the environment. The stakeholder group shall pay special attention to issues relating to the types of boats used, the appropriate distance from the shoreline and depth of the body of water, enforcement mechanisms, including fines, and the definition used for "wake boat."

The stakeholder group was comprised of the following representatives: a Senator and Representative from the MDIFW Legislative Committee, a member of the MDIFW Advisory Council, a staff person from Maine Department of Environmental Protection; Maine Audubon; a member of a Lakes Environmental Association; an Association for Maine youth camps; a member representing the Maine Marine Trades Association; a member representing Maine lake associations; and a member representing the water sports industry. MDIFW hired a professional, neutral, facilitator to moderate the meetings.
During the stakeholder process 3 meetings were held on the following dates: August 31, September 29, and October 30, 2023. One meeting allowed for on-the-water demonstrations of wakesurfing. The stakeholder group was asked to offer studies related to the task and the group agreed on 7 different studies or papers to be reviewed.

Deputy Commissioner Tim Peabody chaired the meetings. He asked the stakeholder group to strive for consensus whenever possible and he explained that when the group cannot reach consensus the report back will capture individual members' opinions and concerns about proposals or topics that are discussed and document when a proposal is made by the majority or not.

Review Process for Studies on Wake Boats

The group reviewed large amounts of data from several publications and studies listed on page 34. They were asked to provide citations of data and information from this literature that they felt would support suggested proposals to the Legislative Committee. Those citations are listed beginning on page 41 with the stakeholder member's name provided and their citations following. The group agreed that there was

some variation in conclusions drawn among the reports under consideration, and that all lakes, scenarios and situations are different. Some in the group felt this meant there was inadequate information to draw conclusions while others felt that there was a growing consensus from the studies in terms of a range of depths and distances that made sense in terms of policies to reduce environmental impacts of large wakes from wakesurfing activities. They also felt that there were probably areas related to this topic that have not yet been studied. The group agreed on 7 different studies or papers to be reviewed and they have been given abbreviated names for ease of referencing and citations. They are listed as follows: **"New Hampshire Study"**, **"Michigan Study 2023"**, **"Vermont Proposed Rule"**, **"Minnesota Study", "Fay Study", "Roger Williams Univ Doc", and the "Canada Study".**

Some of the members of the stakeholder group felt that the "Minnesota Study" used boats that created larger wakes, it was inaccurate and had unsubstantiated claims relating to large wakes. Additionally, the "Fay Study" was not favored by some because it was from a computational model (not direct measured data) and sponsored by a trade association (not from a peer-reviewed journal).

Below are the topics that the group was asked to focus on (Economic Impact wasn't a focus area but was discussed):

- **Creation of Definitions for Wake Boats, Wakesurfing, Wakeboarding;**
- **Types of Boats Used and Varying Impact;**
- **Impact on Shoreline Property, Erosion;**
- **Impact on Water Quality, Fish, Wildlife and Habitat;**
- **Wave Action from Different Sources (boats & wind)**
- **Economic Impact;**
- **Optimal Distances from the Shoreline;**
- **Optimal Depths of Operation;**
- **Educational Approaches;** and
- **Enforcement**

The following section is a breakdown of the topics discussed by the group. The citations provided further in the report support proposals in each topic area.

RECOMMENDATIONS TO THE LEGISLATIVE COMMITTEE

Key Recommendations with Consensus

Though the members of the stakeholder group didn't always share the same opinion on each topic discussed, they came to a majority consensus on some proposals that will be listed first. The collective recommendations of the stakeholder group with majority support include statutory changes, policy changes and educational outreach. The following list is in order based on the group's priorities:

Increased Education

- IFW can provide a towed water sports specific education module. This can be offered on the website and could be required in statute. The module should include best practices and laws related to wake boating activity, all towed water sports, impacts to shoreline, property damage, erosion and wildlife concerns;
- Provide educational materials during motorboat registration process and from dealers to persons purchasing a wake boat. This can be voluntary or become a statutory requirement similar to educational material is provided to oversized ATVs when they are purchased from a dealer.

Increased Enforcement Focus

- Wardens will be expected to do increased headway speed enforcement details throughout the summer. These details will be focused on bodies of water that have had an increase in complaints about headway speed violations. Wardens will also be encouraged to attend lake association meetings and talk about planned details as well as recommend what witnesses can do to help address violations (i.e. videotaping or taking photos).

- This focus would be on prohibitions already in law, including:

"Title 12 Section 13068-A 7. Operating watercraft at greater than reasonable and prudent speed. *A person:*

A. May not operate a watercraft except at a reasonable and prudent speed for existing conditions; and
B. Shall regulate the speed of a watercraft so as to avoid danger, injury or unnecessary inconvenience in any manner to other watercraft and their occupants, whether anchored or under way; waterfront piers; floats or other property or shorelines, either directly or by the effect of the wash or wave created by the watercraft through its speed, or otherwise.
A person who violates this subsection commits a Class E crime."

Statutory Change to Define Wakesurfing Activity

- This definition will not include wakeboarding.
- There were 2 definitions brought forth all agreed on the Wikipedia version.
  - Wikipedia version (everyone agreed on this version)
    ""Wakesurfing" is a water sport in which a rider trails behind a boat, riding the boat's wake without being directly pulled by the boat. After getting up on the wake, typically by use of a tow rope, the wakesurfers will drop the rope, and ride the steep

face below the wave's peak in a fashion reminiscent of surfing. Wakesurfers generally use special boards, designed specifically for wakes.''

- NASBLA definition of wakesurfing: "*"Wakesurfing" the act of using a surfboard, wakeboard, or similar device while being propelled by a boat's wake or while riding on/in a boat's wake directly behind a vessel that is underway.*"

Statutory change to modify "water safety zone" Title to, "water protection zone".

The water safety zone which is defined as "the area of water within 200 feet of shoreline, whether the shoreline of the mainland or of an island". It was initially created to keep swimmers safe, but this alternate term would be more encompassing of other issues that the group has concerns over and no one in the group was opposed.

Key Recommendations with Majority Support

Statutory Change to Increase the Distance from Shore

The majority of the group supported a law change to increase the distance from shore that a person can operate any boat at greater than headway speed. The department emphasized the value of a consistent rule for all motorized boats on all water bodies in Maine, which would be simpler for both educational efforts and enforcement. All agreed to support this except for James Davenport. The distance supported was between 300-500 feet from shore.

In Support of a 300-foot headway speed only zone for all boats:

- **Colin Holme -** Executive Director of LEA
- **Al Cowperthwaite,** IFW Advisory Council Member, retired Director of North Maine Woods, maintains boat launches and is on a lake Association in Aroostook County
- **Stacey Keefer** - Executive Director Maine Marine Trades Association
- **Senator Chip Curry**
- **Ches Gundrum** - Policy Advocate at Maine Audubon

Those in support of a 500-foot setback for wake-surfing:

- **Susan Gallo** - Executive Director at Maine Lakes 500 feet
- **Colin Holme -** Executive Director of LEA

Those opposed to any setback change:

- **James Davenport** – Owner of Long Lake Marina

NOTE: The Maine Youth Camp Association takes no position on this proposed change.

Statutory Change OR Educational Approach to Suggest Minimum Depth When Wakesurfing

In support of statutory requirement:

- **Stacey Keefer** - Executive Director Maine Marine Trades Association 10 ft of depth
- **David Dickerson -** National Marine Manufacturer's Association –10 feet of depth
- **Wendy Garland** - DEP Director of Div. of Environmental Assessment – 10-20 feet of depth
- **Colin Holme -** Executive Director of LEA – 15 feet of depth

- **Susan Gallo** - Executive Director at Maine Lakes was in support of the statutory requirement for lake depth - 15 feet
- Francesca Gundrum - Policy Advocate at Maine Audubon -15 feet

In support of educational suggestion for a minimum depth of operation of 15 ft:

- **James Davenport** – Owner of Long Lake Marina
- **MWS Lt. Jason Luce** - Boating Law Administrator for State of Maine

Notable Recommendations Without Majority Support:

There were several other proposals brought forth without majority support, but the members asked that these ideas be put into the report. Several more ideas were discussed during the stakeholder meetings. These either did not have majority support or there was not adequate time to fully discuss and develop them. Members asked that three of these ideas be put into the report.

Need for More Wardens

Representative Rick Mason suggested the need to provide competitive wages to address recruitment and retention of Maine Game Wardens. His point was that there are competing needs for enforcement with so many topics to enforce and such a large state to cover, there aren't enough wardens to have focused efforts on one particular issue.

In Support:

- **Stacey Keefer** - Executive Director Maine Marine Trades Association
- **Representative Rick Mason**

Statutory Prohibition of Wakesurfing on Certain Water Bodies Based on Acreage

For example, Vermont's rule limits operation of wakesports to prohibit such wakesports on lakes, ponds, and reservoirs that do not have a minimum of 50 contiguous acres that are both 500 feet from shore on all sides and a minimum of 20 feet deep.

In Support: Unknown

Statutory Definition of a Wake Boat

- **Those Supported:**
  Colin Holme - Executive Director of LEA He suggested altering the NASBLA definition to address trim plates which are designed to reduce wakes: Suggested defintion was: Wakesurf Boat: Any boat that is equipped with ballast tanks, ballast bags, compartments, containers, or similar devices or mechanical systems designed to enhance the characteristics of the boat's wake for the intention of wakesurfing. This definition may only be applicable when such devices are being utilized to alter the wake.

  Al Cowperthwaite, IFW Advisory Council Member, retired Director of North Maine Woods.

- **Those Opposed:** Newall Augur, Stacey Keefer, (concerns with challenges that aftermarket accessories can change the definition), David Dickerson said he has concerns that if one type of boat is banned it opens the door for banning of other types of boats.

Statutory Change to Establish a Home Lake Provision Law

This would that require purchase of a “home lake” sticker and require an approval process that has a map of the lake where a wake boat would primarily be kept and utilized. When the sticker is purchased the person who owns the boat would receive education on loon nesting data, recommended operational distances, and this would require an annual renewal.

- **In Support: Francesca Gundrum** - Policy Advocate at Maine Audubon
- **Opposed: Al Cowperthwaite** - IFW Advisory Council Member, retired Director of North Maine Woods, maintains boat launches and is on a lake Association in Aroostook County
- **Colin Holme -** Executive Director of LEA

Statutory Requirement for Wake Boat Owners to set depth-related alarms (preferably at 15 ft.)

This would be required while engaging in wakesurfing mode to alert operators of shallow water conditions. This would help operators avoid suspending sediment resuspension as well as other potential water quality impacts.

- **In Support:** Francesca Gundrum - Policy Advocate at Maine Audubon

Statutory Change to Create a Definition of “Island”

This was proposed since "island" is used in the definition of the "water safety zone".

- **In Support:**
  - **Stacey Keefer** - Executive Director Maine Marine Trades Association

Information/Citations to Support Stakeholder Group Proposals

Types of Boats Used in the Studies and Varying Impact

Minnesota Study:

"aftermarket products installed on non-wakesurfing boats can create wake waves similar to wakesurfing boats"

"It is important to state that this study was limited to examining only four boats. We selected watercraft that were representative of non-wakesurfing and wakesurfing boats; however, there are many other boat manufacturers and models not considered. The boat selection was based on the boats that were available to us within the short window of field work for this study."

Michigan Study:

"As larger waves strike a shoreline, they are able to dislodge and move more and larger particles (NRCS 1996, NRCS 1997, Priestas et al. 2015). Recreational boating activity can exacerbate erosion by increasing the wave energy that reaches the shoreline (Johnson 1994; Nanson et al. 1994; Bauer et al. 2002), and it follows logically that the increased wave energies produced by wake boats intensify this effect (Table 1). A recent study on 1,700-acre Whitestone Lake in Ontario (Houser et al. 2021) showed that 61–72% of total wave energy originated from powerboats."

"Wake boats create larger wakes than traditional watercraft, therefore the greater energy of waves created by wake boats operating in wakeboarding or wake-surfing mode are likely to exacerbate boat wave induced erosion."

Creation of Definitions for Wake Boats, Wakesurfing, & Wakeboarding

The group agreed that they should not attempt to define the type of boat but that they should focus on defining just the activity of wakesurfing.

There were 2 definitions that members brought forth most agreed on the Wikipedia version.

Wikipedia definition of wakesurfing: *"Wakesurfing" is a water sport in which a rider trails behind a boat, riding the boat's wake without being directly pulled by the boat. After getting up on the wake, typically by use of a tow rope, the wakesurfers will drop the rope, and ride the steep face below the wave's peak in a fashion reminiscent of surfing. Wakesurfers generally use special boards, designed specifically for wakes.*

Lt. Jason Luce and Susan Gallo supported the NASBLA definition:

NASBLA definition of wakesurfing: *"Wakesurfing" the act of using a surfboard, wakeboard, or similar device while being propelled by a boat's wake or while riding on/in a boat's wake directly behind a vessel that is underway.*

Optimal Operational Distance from the Shoreline

Michigan Study:

Table 1. Summary of wake boat effects measured or modeled at various distances from the boat's line of travel, and whether those distances were considered in determining the range of distances at which wake boat waves dissipate to energies of a typical motorboat at 100–200 feet from the sailing line or have minimal resources impacts.

Source	Distance (ft)	Data type	Considered	Notes
Water Environment Consultants (2021)	100	Field data	No	Wave energy from wake-boarding (553%) and wake-surfing (2,546%) greater than monthly maximum wind-driven wave energy.
Water Environment Consultants (2021)	100	Field data	No	Wave energy from wake-boarding (68%) and wake-surfing (581%) greater than cruising vessel wave energy.
Ray (2020)	135	Field data	No	Wake boat wave 9 inches high.
Fay et al. (2022)	200	Mathematical model	No	Claims minimal impacts at this distance.
Water Environment Consultants (2021)	225	Mathematical model	No	Wave height attenuation from wake-boarding to wake boat cruising at 100ft. Note that wave power may still be greater and that wake boat weight and hull design increase cruising wakes, thus this is an underestimate relative to typical boats.
Water Environment Consultants (2021)	300	Field data	No	Wake-boarding wave energy at 300ft similar to wake boat cruising energy at 100ft. Note that wake boat weight and hull design increase cruising wakes, thus this is an underestimate relative to typical boats.
Goudey and Girod (2015)	300	Field data	No	Measured large waves during wake-boarding (9.87in) and wake-surfing (12.92in) in deep water.
Ray (2020)	300	Field data	No	Wake boat wave 7.75 inches high.
Mercier-Blais and Prairie (2014)	328	Field data	No	Energy of wake waves decreased significantly, but not assessed relative to typical motorboat.
Macfarlane et al. (2018)	400	Field data	Yes	Maximum wave height and energy similar to reference motorboats.
Mercier-Blais and Prairie (2014)	492	Field data	Yes	Sediment resuspension observed from wake-surfing.
Water Environment Consultants (2021)	500	Field data	Yes	Wave energy from wake boating (192%) and wake-surfing (679%) greater than monthly maximum wind-driven wave energy.
Marr et al. (2022)	>575	Field data	Yes	Total wave energy similar to reference motorboat at 200ft.
Marr et al. (2022)	>600	Field data	Yes	Total wave power similar to reference motorboat at 200ft.
Mercier-Blais and Prairie (2014)	656	Field data	Yes	Sediment resuspension observed from wake-boarding.
Mercier-Blais and Prairie (2014)	675–938	Mathematical model	Yes	Estimated distances at which a wake boat waves result in equivalent sediment resuspension to normal conditions on two lakes.
Mercier-Blais and Prairie (2014)	879–1023	Mathematical model	Yes	Estimated distances at which a wake boat waves result in equivalent turbulent kinetic energy to normal conditions on two lakes.
Water Environment Consultants (2021)	950	Mathematical model	Yes	Wake-surfing wave height attenuation to typical boat at 100ft.Note that wave power is likely greater and that wake boat weight and hull design increase cruising wakes, thus is an underestimate relative to typical boats.
Mercier-Blais and Prairie (2014)	984	Mathematical model	No	Modeled complete dissipation of wake boat waves.
Ray (2020)	1000	Field data	No	Wake boat wave 4 inches high.

"showed that waves produced by a wake boat in wake-surfing and wake-boarding mode had 581% and 68% more energy, respectively, than waves produced by the same vessel operated in cruising mode at a distance of 100 feet."

"found that wake boats operating in wake-surfing mode produced the largest waves compared to other modes, with maximum wave energy approximately four times that of waves generated in wake-boarding mode."

"used statistical models to determine that the distance required for wake boat-generated waves for wakesurfing to dissipate to a level comparable to a wave height observed 100 feet from a cruising wake boat would be approximately 950 feet."

Conclusions about distance from shore: *"Boats operating in wake-surfing mode or wake-boarding mode, during which boat speed, wave shapers, and/or ballast are used to increase wave height, are recommended to operate at least 500 feet from docks or the shoreline, regardless of water depth."*

"In contrast to the studies above, Fay et. al (2022) claims that operating distances of 200 feet are sufficient to reduce wave energy and minimize erosion and resuspension. However, these conclusions are inconsistent with other studies and are built upon substantive analytical and methodological concerns. For example, Fay et al. admit that their methods for modeling waves are not appropriate beyond distances of 100 feet. Therefore, our assessment of threats to Michigan's natural resources relies more heavily on results from studies that conducted direct measurements and/or used appropriate models and methods."

Minnesota Study:

"In the first 100 ft of operational distance, there appears to be an influence of the ballast weight on the measured wake wave characteristics. At a distance of 5 ft, the initial maximum wave heights were 34 in for ballasts full and 27 in for ballasts empty. However, by 100 ft the maximum wave height of both conditions had attenuated to approximately 14 in. At operational distances greater than 100 ft, the attenuating rates were very similar and had decreased to roughly 6 in by 600 ft."

"Vermont Proposed Rule" *"This also noted that wakeboats generated comparable wave energies at distances of 100 feet or greater regardless of whether the ballast tanks were filled, but that wave shaping devices had a greater impact on wave energy.*"

"The precise distances are contingent upon lake bathymetry (depth, lakebed slope), as well as the specific boats in question. Based on the evidence reviewed, DEC believes that current evidence does not support the 1000-foot distance from shore recommended in the petition."

"Wakes are most destructive in shallow and narrow waterways because wake energy does not have the opportunity to dissipate."

"A study within the rule proposal "recommended that wakeboats only operate in wakesport mode at distances greater than 300 m (984 feet) from shore."

Optimal Depths of Operation

Michigan Study:

"wake boat propellers generated water velocities with the capacity to resuspend unconsolidated sand, silt, and smaller organic materials at a depth of 15 feet while the boat was in wake-boarding or wake-surfing modes."

"calculated that modern wake boats can cause sediment resuspension in depths over 10 meters (33 feet) deep. "

"Boats operating in wake-surfing or wake-boarding modes are recommended to operate in water at least 15 feet deep."

Minnesota Study:

"Boats of all sizes produce propeller wash and, at a certain depth the wash begins to interact with the thermocline, lake bottom, vegetation, and aquatic habitats. These complex interactions are not well-studied, and we believe this is a priority area for future research."

Vermont Proposed Rule "*Mercier-Blaies and Prarie (2014) also highlighted the role of lake bathymetry, demonstrating that lakes with steeper lakebed gradients have less wave energy attenuation as the wave approaches the shore than lakes with more gradual depth profiles"*

"According to modeling results, wakeboat slip-streams have the potential to affect bed sediments at 33 feet of depth (the slipstream, the powerful jet of water driven by the propeller towards the lakebed). Lakebed sediments at depths of up to 7 feet to 12 feet are likely to be disturbed by boat propagated waves, while wind waves are likely only to regularly disturb sediments at depths up to 5 feet."

"There are many factors that influence how a wake behaves, including the boat size, boat speed, water depth, type of lake-bottom sediments (geology), and lake size (FitzGerald et al. 2011). In field studies, boat speed, size, and water depth were the critical factors affecting resuspension with a specific lakebed"

Educational Approaches

Michigan Study:

"Education and awareness campaigns are an important component of a comprehensive approach to protecting inland lakes from damage caused by wake boats. Providing operational recommendations into educational materials on responsible wake boat operation in boating safety classes and providing informational flyers with these recommendations to new wake boat owners may improve awareness and implementation of best operation practices. Similar education campaigns have been implemented elsewhere;"

New Hampshire Study:

"Large boat wakes can be created by many different types of boats under varying circumstances and conditions. Cabin cruisers, tubing activities, plowing through channels in excess of headway speed, and heavy passenger loads all create large wakes. Boater behavior is the key factor in complaints and concerns with any type of boat, including wake boats. Efforts to educate boaters towards stronger

awareness and enforcement of the 150-foot safe passage law is a more effective way to address conflicts on waterways than singling out a particular vessel for restrictions."
"Part of the responsibility to minimize these risks lies squarely on the boat operator to understand waterbody conditions, which can and should occur through additional education. However, it also is unreasonable to expect boat operators to understand the physics of waves, wind fetch length, or the ability of a shoreline to resist erosion. For these reasons, further consideration should be given to defining the conditions that minimize the risk of lakeshore erosion and impacts to water quality and wildlife that could occur due to the increased wave height and power associated with wake boats."

Impact on Shoreline Property & Erosion

New Hampshire Study:

"The ability for these watercrafts to generate larger and more powerful waves means there is also an increased potential for shoreline erosion and impacts to water quality and wildlife. In particular, these impacts are more likely to occur if operation occurs close to shore, in shallow water, or in areas that are protected from the wind."

"Last, it is important to point out that New Hampshire has approximately 1,000 lakes and ponds. Of these 1,000 waterbodies, approximately 80% are less than 50 acres. In the study by Goudey and Girod (2015), they note that a 1-mile fetch is a common distance for wind to travel over water. They also note that a wake boat would need to pass 100' from a shoreline approximately once every nine minutes to equal the wave energy a shoreline with a 1-mile fetch is subjected to with a 10-mile per hour wind." "In other words, only New Hampshire's larger lakes have extended wind fetches with shorelines that are regularly subjected to wind-driven wave action."

"The higher waves associated with wakeboarding and wakesurfing dissipate more rapidly than those generated under the cruising condition." We can also see in this figure that the maximum wave heights associated with wakeboarding and wakesurfing dropped precipitously in the first 100' to 150' of their travel from the boat's track." "Our analysis shows that a cruising boat would need to pass 110 feet from a shoreline every 101 seconds in order to equal the energy coming from waves associated with 10 mph winds and one mile of fetch. A wakesurfing boat would only need to pass every 270 seconds to equal the same wind-wave effects."

"Multiple simulations show great loss of wave energy at various distances from shorelines. In each case, a boat operating at 200 feet from shore and in water depths greater than 10 feet are optimal for shoreline and environmental health. In each case, the recommendation is to operate the boat 200 feet from shore and in water depths greater than 10 feet."

Michigan Study:

"Shoreline erosion can lead to degradation of fish habitat and water quality due to physical disruption of rooted plants and resuspension of sediment and nutrients and is a concern for lakefront property owners because it results in a loss of property and can damage infrastructure. Sedimentation can degrade habitat and threaten fishes"… "and the shoreline armoring that typically is installed by property owners experiencing erosion degrades fish habitat as well." "The main factors that influence shoreline erosion

are wave energy, aquatic plants, the slope of the nearshore and bank areas, and characteristics of the bank material. As larger waves strike a shoreline, they are able to dislodge and move more and larger particles"

Increased Impact on Water Quality, Fish, Wildlife and Habitat

Michigan Study:

"Sediment resuspension increases nutrients and decreases water clarity in lakes, subsequently reducing the ability of fish to find food, the depth to which aquatic plants can grow, and the dissolved oxygen content within the water column (Gardner 1981; Canfield et al. 1985; Chambers and Kaiff 1985; Barrett et al. 1992; Irvine et al. 1997; Stuart-Smith et al. 2004; Trebitz et al. 2007). Numerous studies indicate that decreases in water quality (e.g., Jacobson et al. 2008; Phelps et al. 2019) can stress or kill fishes. In addition, as sediments are resuspended and nutrients become available in the water column, excessive algae growth can occur. Boat wakes resuspend sediments, especially fine substrates such as silt or sand, in shallow waters (USACE 1994) and this resuspension increases with wave energy. Existing studies have shown that resuspended sediments caused by powerboats increase turbidity and phosphorus concentrations in rivers, lakes, and shallow experimental ponds (Yousef et al. 1980; Johnson 1994; USACE 1994; Asplund 1996, 1997; Anthony and Downing 2003). Wake boats have greater potential to exacerbate sediment resuspension through increased wave energy and propeller turbulence (Table 1). Mercier-Blais and Prairie (2014) determined sediment resuspension was significantly higher than background conditions up to 492 feet from wake boats operating in wake-surfing mode and 656 feet from wake boats operating in wake-boarding mode and was highest when wake boats were operated in wake-surfing mode at a speed of 10 mph. Mercier-Blais and Prairie's extrapolations indicate that distances of 675 and 938 feet from the line of travel are required for wake boat waves to produce sediment resuspension equivalent to normal levels on ~1,136-acre Lake Lovering and ~439,847-acre Lake Memphremagog, respectively. Previous studies of typical powerboats indicated that propellers from outboard engines create turbulence that can reach as deep as 10 feet (Gucinski 1982; Keller 2017). Field testing by Raymond and Galvez-Cloutier (2015) found that wake boat propellers generated water velocities with the capacity to resuspend unconsolidated sand, silt, and smaller organic materials at a depth of 15 feet while the boat was in wake-boarding or wake-surfing modes. Models developed by Ray (2020) calculated that modern wake boats can cause sediment resuspension in water down to 33 feet deep."

"Canada Study":

"While their impact may be negligible along shorelines subject to large wind and swell waves, wakes may represent a significant source of energy along sheltered shorelines (Gourlay 2011, Houser 2011)."
"It is important to note that this study was completed during the first summer of COVID-19, when anecdotally there appeared to be more people self-isolating at their cottages than would be expected in years without a pandemic. In addition, the relative amount of wake energy observed at the site is not necessarily representative of other areas of the lake with different fetch lengths and orientations. Boat wakes may be less important along other shorelines downwind of longer fetches, but further study is required to determine the relative importance of wind waves and boat wakes on this and other inland cottage lakes."

Increased Risk of Invasive Species Spread

Michigan Study:

"Research has shown that ballast tanks from wake boats operated on a lake with the invasive Zebra Mussel typically carried 247 Zebra Mussel veligers per sample, which was much greater than stern drive motor compartments (13 veligers per sample), outboard motor lower units (1 veliger per sample), live wells, or bilges."

"Although wake boat ballast tanks are typically emptied before trailering, they are rarely ever completely dry which increases the survival time for invasive species potentially trapped inside. Doll (2018) found that 5% of zebra mussel veligers remained alive in ballast tanks after 48 hours. Transportation of other invasive species and fish pathogens is also possible."

"The greater propeller turbulence and increased scouring caused by wake boats may result in fragmentation and proliferation of aquatic invasive plants already found in the waterbody"

"Reductions in native aquatic plants will affect fish populations. Aquatic vegetation provides rearing areas for juvenile fishes (Bryan and Scarnecchia 1992), allows for increased fish growth and total fish biomass (Radomski and Goeman 2001; Nohner et al. 2018), and reduces wave energy in the nearshore zone."

New Hampshire Study:

"It is difficult to clean and drain ballast water compartments because as they are currently designed, they do not drain completely and risk spreading AIS. Incomplete draining can lead to the harboring of viable aquatic invasive plants or animals, some of which are as small as a grain of sand and remain viable for several days. When water is pumped back into these ballast compartments from a different waterbody, and then flushed out again after use, the AIS still viable in the ballast compartments can be released into this new waterbody, thereby potentially causing a new AIS infestation."

"According to a survey of purchasers of wakeboats conducted by New Hampshire marine dealers, approximately 4% of wakeboats sold travel from lake to lake."

Within the Vermont Proposed Rule ***"****Wave energy increases exponentially with wave height, and these larger waves have substantially greater potential to cause shoreline erosion, which can result in increased phosphorus loading to lakes and damage littoral habitats for a variety of species (Asplund, 2000), including the common loon (Paugh, 2006)."*

Economic Impact

Within the Vermont Proposed Rule

"An economic analysis of the impact of this rule considered two scenarios, with and without regulation, ten years into the future. It shows that the economic benefits of regulation outweigh the costs by ten to one. The annual benefits — estimated at $93 million — include the preservation of water quality, the continuation of affordable small-scale recreational activities that form the core of Vermont's water-based recreation, and the protection of the tourist economy that depends on clean and safe lakes. The potential annual costs — about $8

million — are based on limitations that this rule would place on the growth of the wakeboat industry. Wakesurfing close to shore discourages the thousands of swimmers, paddlers, sailors, anglers, non-wakeboat water skiers and boarders, and other small-craft users who form the foundation of Vermont's lake-based economic activity. Moreover, even a few wakesurfers close to shore cause costly environmental damage, while contributing little to the state's economy."

"Additionally, larger waves have the potential to create dangerous conditions for small watercrafts or swimmers and to damage property of lakeshore residents."

Estimated Number of Tow Boats Sold in Maine

James Davenport, stakeholder member and owner of Naples Marina, provided an estimation on the number of tow boats owned/sold in Maine and how that data can be interpreted.

Maine boat dealers use what is called a "rolling market share data report" to estimate how many wake boats are owned/sold in Maine. It is used as a baseline for the state of Maine to calculate the total volume of certain manufacturers. There are a few important caveats to keep in mind when analyzing this data.

First, Maine historically only reports market share data once a year in March. That changed in 2023 so now the market share is reported through September. The fourth quarter data has not been released yet from 2023.

Second, this data only reflects purchasers whose primary residence address is in the state of Maine. There is a discounted sales tax rate for out of state residents who do their boating in the state of Maine, and because of this, dealers must use their out of state address on the purchase and sales agreement, which doesn't count in the market share analysis. This leads to the Maine boat sales market looking a bit smaller than what it actually is. Long Lake Marina has historically sold between 20-25 new and used tow boats a year, of which 80% stay in the state of Maine. There are four other competitors, and their sales are consistent with Long Lake Marina. A rough estimation on the number of tow boats sold in Maine annually is 100.

Finally, the brand list in which the data is extracted from is limited to boats that would be considered by definition wakesurf boats. There are many other manufacturers that produce boats capable of surfing, but Maine does not sort by model of boat at the time of the sale. Maine sorts by the size of the boat so there's no way to differentiate between how many total boats are sold in the state in these crossover segments that do not have surf capability versus how many boats are sold that have surf capability. An estimate of additional boats sold in Maine that have surf capability based on our other product lines sold could be an additional 50-75 units total. So a total sales estimate of both wakesurf boats and boats that have surf capability could be upwards of 150-175 boats annually.

Rolling 12 Market Share Data Report

Report: Market Share | Breakout: Make | Time Period: 12 Months Rolling | Show Top: 20 | Filters | Export Table

	2023 Sales		Growth	2022 Sales		Growth	2021 Sales		Growth		2023 MS		Growth	2022 MS		Growth	2021 MS		Growth
Total	26	↓	-16.13%	31	↓	-13.89%	36	↑	56.52%	—	100.00%	↑	0.00%	100.00%	↑	0.00%	100.00%	↑	0.00%
MasterCraft	13	↑	30.00%	10	↓	-28.57%	14	↑	75.00%	—	50.00%	↑	55.00%	32.26%	↓	-17.05%	38.89%	↑	11.81%
Nautique	5	↑	0.00%	5	↓	-16.67%	6	↑	50.00%	—	19.23%	↑	19.23%	16.13%	↓	-3.23%	16.67%	↓	-4.17%
Axis Wake Research	2	↓	-33.33%	3	↑	0.00%	3	↑	50.00%	—	7.69%	↓	-20.51%	9.68%	↑	16.13%	8.33%	↓	-4.17%
Centurion	2	↓	-50.00%	4	↑	300.00%	1		(Empty)	—	7.69%	↓	-40.38%	12.90%	↑	364.52%	2.78%		(Empty)
Heyday	1	↑	0.00%	1	↓	-66.67%	3		(Empty)	—	3.85%	↑	19.23%	3.23%	↓	-61.29%	8.33%		(Empty)
Malibu	1	↓	-80.00%	5	↑	0.00%	5	↓	-28.57%	—	3.85%	↓	-76.15%	16.13%	↑	16.13%	13.89%	↓	-54.37%
Moomba	1	↑	0.00%	1	↓	-50.00%	2		(Empty)	—	3.85%	↑	19.23%	3.23%	↓	-41.94%	5.56%		(Empty)
Supreme Boats	1	↑	0.00%	1	↓	-50.00%	2	↑	0.00%	—	3.85%	↑	19.23%	3.23%	↓	-41.94%	5.56%	↓	-36.11%
Supra	0	↓	-100.00%	1		(Empty)	0		(Empty)	—	0.00%	↓	-100.00%	3.23%		(Empty)	0.00%		(Empty)
Tige	0		(Empty)	0		(Empty)	0		(Empty)	—	0.00%		(Empty)	0.00%		(Empty)	0.00%		(Empty)

Enforcement

Vermont Proposed Rule

Vermont filing, Economic Impact Analysis Section

In 2024, Vermont will have a rule in place that will limit wakesports in the following manner:

Maps of Wake Sports Zones based on Proposed Rule Conditions | Department of Environmental Conservation (vermont.gov)

"Under the proposed Use of Public Waters Rule Amendment, as submitted to LCAR on January 4, 2024, a lake or pond is eligible for wakesports if it has a zone that meets the following criteria:

- *The lake or pond has a minimum of 50 contiguous acres that are at least 500 feet from shore on all sides.*
- *Any wakesport zones must be at least 20 feet deep, and at least 200 feet wide.*
- *Only lakes and ponds that vessels powered by internal combustion motors are allowed and may be used at speeds exceeding 5 miles per hour are eligible for wakesport zones.*

** Wakesports zones are open to all uses permitted on the subject waterbody and not exclusive to wakesports*

Based on the criteria above, 31 inland lakes and ponds in Vermont are eligible for wakesports, that are regulated under the Use of Public Waters Rules. The Use of Public Waters Rules do not apply to Lake Champlain, Wallace Pond, Lake Memphremagog, and Connecticut River Reservoirs.

Under this proposed Rule, wakesports would be prohibited on all other lakes, ponds and reservoirs under jurisdiction of Use of Public Waters Rules Rules."

"enforcement costs associated with this rule (The rule proposes to regulate "wakesports" involving a "wakeboat" on certain lakes and ponds in Vermont. The rule would prohibit such wakesports on lakes, ponds, and reservoirs that do not have a minimum of 50 contiguous acres that are both 500 feet from shore on all sides and a minimum of 20 feet deep (eligibility rule). The rule would also limit such wakesports to these defined areas that are 500 feet from shore and 20 feet deep (operating rule). Finally, the rule would require a "wakeboat" to only be used in one lake per summer unless the wakeboat is decontaminated at a certified Dept. of Environmental Conservation (DEC) service provider) (excerpt from VT filing page 4) are expected to be minimal, as enforcement will be carried out by existing staff capacity as described below:"

"Game Wardens and State Police Marine Division employees will respond to potential violations of this Administrative Procedures Economic Impact Analysis Revised January 10, 2023 page 4 rule in line with existing responsibilities to enforce other elements of the Use of Public Waters Rule and 23 V.S.A. § 3311. There may be additional calls to these law enforcement officers as the public gets used to this new rule, but DEC does not expect substantial cost associated with responding to those calls."

Increased Wave Action from Different Sources (boats & wind)

Michigan Study:

"when wake boats passed 100 feet from shore, the wave energy produced in wake-boarding and wake-surfing modes was 553% and 2,546% higher, respectively, than the monthly maximum energy from wind-driven waves. Wake-boat-induced wave energy was 192% higher for wake-boarding mode and 679% higher for wake-surfing mode, compared to wind-driven wave energy, when the wake boats passed 500 feet from shore."

"waves from a wake boat in wake-boarding and wake-surfing mode would need distances of 225 feet and 950 feet, respectively, to dissipate to the wave heights observed 100 feet from the same boat in cruising mode."

"wake boat waves required substantial distances to attenuate to reference conditions of a typical motorboat operating in planing mode at a distance of 200 feet for wave height (>500 feet), energy (>575 feet), and power (>600 feet, the maximum distance at which waves were measured in the study)."

DIRECTIVE TO INLAND FISHERIES & WILDLIFE

RESOLVE 2023 CHAPTER 33 – (LD 379) **Resolve, Directing the Department of Inland Fisheries and Wildlife to Study the Effects of Wake Boats on Shoreline Property and the Environment**
(Effective: October 25, 2023)
Department to study effects of wake boats. IFW shall establish a stakeholder group to review completed studies relating to wake boats and their effects on shoreline property and the environment. The stakeholder group shall pay special attention to issues relating to the types of boats used, the appropriate distance from the shoreline and depth of the body of water, enforcement mechanisms, including fines, and the definition used for "wake boat."
2. Stakeholder group. Resolved: That the department shall invite participation in the stakeholder group from at least the following:
1. A member of the Joint Standing Committee on IFW from the Senate;
2. A member of the Joint Standing Committee on IFW from the House of Representatives;
3. A member of the IFW Advisory Council;
4. A member representing the Department of Environmental Protection;
5. A member representing Maine Audubon;
6. A member representing the Lakes Environmental Association;
7. A member representing an association for Maine youth camps;
8. A member representing Maine Marine Trades Association;
9. A member representing Maine lake associations; and
10. A member representing the water sports industry.

The department may hold public meetings to gauge public support for any recommendations that are developed by the stakeholder group.
Report. Resolved: That the department shall report the findings and recommendations of the stakeholder group established under section 1 to the Joint Standing
Committee on IFW no later than February 1, 2024. The committee may report out a bill related to wake boats and their effects on shoreline property and the environment to the Second Regular Session of the 131st Legislature.

STAKEHOLDER MEMBERS & ORGANIZATIONS THEY REPRESENTED

1. **Senator Chip Curry**
   A member of the Joint Standing Committee on IFW from the Senate;
2. **Representative Rick Mason**
   A member of the Joint Standing Committee on IFW from the House of Representatives;
3. **Al Cowperthwaite, current IFW Advisory Council Member, retired Director of North Maine Woods, maintains boat launches and is on a lake Association in Aroostook County.**
   A member of the Inland Fisheries and Wildlife Advisory Council;
4. **Wendy Garland, DEP Director of Div. of Environmental Assessment**
   A member representing the Department of Environmental Protection;
5. **Ches Gundrum, Policy Advocate at Maine Audubon**
   A member representing Maine Audubon;
6. **Colin Holme Executive Director of LEA**
   A member representing the Lakes Environmental Association;
7. **Newall Auger, Attorney at Pierce Atwood or Fritz Seving Director of Fernwood Youth Camp**
   A member representing an association for Maine youth camps;
8. **Stacey Keefer, Executive Director Maine Marine Trades Association**
   A member representing Maine Marine Trades Association;
9. **Susan Gallo Executive Director at Maine Lakes**
   A member representing Maine lake associations;
10. **David Dickerson National Marine Manufacturer's Association**
    A member representing the water sports industry;
11. **James Davenport - Long Lake Marina**
    Added member representing water sports business owner;
12. **IFW Game Warden Lt. Jason Luce, Boating Law Administrator for State of Maine**
    Added member representing Department of Inland Fisheries & Wildlife
13. **Carole Martin,** Facilitator
14. **Tim Peabody, IFW Deputy Commissioner,** Chair
15. **Christl Theriault, IFW Assistant to the Commissioner,** Administrative Support for Stakeholder Group

SUMMARY OF FIELD DAY MEETING

On September 29th, 2023, James Davenport, owner of Long Lake Marina (a watersports business) hosted the stakeholder group at his facility in Naples, Maine. The purpose of this visit was to educate fellow stakeholders on the different types of boats on Maine's waterways, and to provide an on-water demonstration of various watersports activities. Long Lake Marina had upwards of 10 different style boats on display, each with a different type of propulsion (outboard, inboard/outboard, jet, inboard), hull design (pontoon, runabout, center console, watersports specific) and several with various wake enhancement devices. After going through the boats and the different types of boards, we split into two groups and went out on the water on a 2023 Nautique G21. A pontoon boat was set at the end of our dock to an established distance of approximately 200 feet, and half of the group remained on the pontoon boat. Conditions were flat calm, and there was no other boat traffic on the lake at the time. After both groups had an opportunity to go on the boat and see both a wakeboarding and wakesurfing presentation, we then departed the marina and continued our meeting to discuss findings. The photos beginning on page 24 capture the demonstration offered by James Davenport, owner of Long Lake Marina.

In the towboat world, technology has advanced rapidly over the past ten years. 2024 marks the ten-year anniversary of the introduction of automated surf systems on the back of this style boat, which has led to increased usability of the product and style of boat. It has also led to a rapid increase in retail costs of this product. Even so called "entry level" product in this category today begins at over $100,000 which creates a financial barrier. A significant portion of tow boat owners in the state of Maine also own waterfront property and are cognizant of the impacts of improper boat use in all cases, not just this specific style boat. As we saw during the display, the boat operated in wakesurf mode and was not unlike the normal boat traffic we would see on a busy summer afternoon. Long Lake Marina's location on the Naples Causeway is arguably one of the busiest freshwater locations in the state, and average boat traffic can cause similar types of wakes and waves.

The meeting in September allowed for an educational session on various types of wake boats and nonwake boats that can offer a similar experience, information on the current and older technology for this type of boating activity and on the water demonstrations for the group members.

DEMONSTRATION PHOTOS

2023 Nautique G21 being utilized in “wakesurf mode”. Wakesurf mode consists of full ballast, speed set for 11.6 MPH, surf system deployed. Surfer has successfully dropped the rope and is not attached to the boat.

2023 Nautique G21 bow view in wakesurfing mode.

2023 Nautique G21 in wakesurf configuration with wakesurfer rider on side closest to Long Lake Marina dock.

Close up of wakesurf wave on 2023 Nautique G21.

Rider on rear part of the surf wave.

Rider performing a carving move on the wave.

Rider preforming a carving maneuver on the wave.

Rider wakeboarding behind the 2023 Nautique G21.

Rider wakeboarding behind the Nautique G21.

Additional photo of rider wakesurfing behind the 2023 Nautique G21.

Pontoon boat used as a placeholder to set the various distances cited in the various studies.

Example of surf board and surf rope (LH) and wakeboard and wakeboard rope (RH)


255X

REPORTS READ, STUDIED & DISCUSSED BY STAKEHOLDER MEMBERS

1. **"New Hampshire Study"** Titled: New Hampshire's Final Report of the Commission to Study Wake Boats

2. **"Michigan Study 2023"** Titled: Fisheries-Report-37-Wake-Boat-Study-Official-Version-Released-on-7.28.2023.pdf (mymlsa.org)

3. **"Vermont Proposed Rule"** Titled: The Vermont Agency of Natural Resources proposed rule to regulate wake sports on Vermont lakes and ponds, public hearings occurred in August 2023.

4. **"Minnesota Study"** PDF Titled: #7 Anthony Falls Lab Study Feb 12022 Final.pdf

5. **"Fay Study"** Titled: Fay, E.M., Gunderson, A. and Anderson, A. (2022) Numerical Study of the Impact of Wakesurfing on Inland Bodies of Water. Journal of Water Resource and Protection PDF Titled: "Fay Study of Wakesurfing" from the, 2022

6. **"Roger Williams Univ Doc"** Titled: How Topography of a Shoreline Affects Waves - Roger Williams University

7. "**Canada Study**" Titled: Relative importance of recreational boat wakes on an inland lake

MAPS CREATED BY LEA

Maps showing how a 500-foot setback along with a minimum depth of 20 feet would limit acceptable areas for wakesurfing on various waterbodies in Maine.

Lake acreages on demonstration maps:

Brandy Pond: 733 acres

Hancock Pond: 858 acres

Long Lake: 4935 acres

Trickey Pond: 315 acres

Woods Pond: 461 acres

https://www.dropbox.com/scl/fo/yjd402wc8mdk28dvk6ux1/h?rlkey=h93ac4u5y47cu689sk8rfjn0a&dl=0

BrandyPondBathymetryWakeSportZone.pd

HancockPondBathymetricMapWakeSportZ

LongLakeBathymetricMapWakeZone.pdf

TrickeyPondBathymetry-wakesportzone.pd

WoodsPondBathymetricMap-WakeZone.pc

SUMMARY OF RECOMMENDATIONS FROM GROUP MEMBERS

Statement of Recommendations from MMTA & Maine Youth Camp Association

(MYCA joined in this support, including in the addendum regarding a definition of 'island')

The Maine Marine Trades Association recognizes that there is some data and there are some reports out there about wake impacts. However, we believe there is insufficient data to draw conclusions that apply to all Maine lakes and ponds, and all parts of all lakes and ponds, in a similar fashion. For example, Vermont Proposed Rule gave some economic impact data indicating that costs of environmental impacts could outweigh economic impacts by 10 to 1. However, Maine's boating industry economic impact is seven times larger and there are about 4 times more summer camps in Maine than Vermont. The Vermont economic comparison does not seem like good a comparison to Maine.

MMTA believes that it would be more important environmentally for the State to consider adding a minimum depth required for wake-producing activity rather than expanding the distance of the existing 200-foot water safety zone*. We believe it would be too confusing for enforcement to prohibit wakesurfing inside a 500-foot zone, but allow other towed sports (skiing, tubing, wakeboarding) between 500 and 200 feet. It is best to have one distance. Since all Maine's water bodies are unique, adding a minimum 10-foot depth would then potentially push the water safety zone out beyond 200 feet, but only where it is most appropriate.

MMTA prefers to see statutes that limit conditions that could be created by various types of boats and are not prohibitive based on one specific type of vessel (such as the case with PWC's).

Our last suggestion would be to rename the "Water Safety Zone" to a "Water Safety and Impact Zone" …or a "Water Protection Zone" …or something related to impacts. The zone was originally created to set up safe zones for swimmers, but a new name would help people understand there are also environmental and wildlife impacts being protected. We would then encourage the lake associations, boat dealers, and/or municipalities to post maps of their local lakes showing the shape and locations of these protected zones.

Statement of Recommendations from Long Lake Marina Owner James Davenport

As the representative for this group in the business of selling all types of boats and outdoor recreational vehicles, I came into this group with the intention of removing the stereotypes associated with "wake boats" and making this a conversation about the boating industry in the state of Maine as a whole. I believe I did my part to further educate my peers on the differences and similarities of a "wake boat" versus any of the other types of boats available for purchase. A restriction on any one specific style of boat based on the preferred use of recreation is not a viable solution to ensure everyone has access to the bodies of water in Maine that we use.

I leave this group being far more educated on some of the potential impacts of what recreational boating can do to some of the more fragile bodies of water. I believe through a combination of education, enforcement of the existing laws already on the books, and common sense, there is no reason to modify or add the existing law structure in place to put a target on the boat of any wake boat

owner. The University of Minnesota study used a previous generation bowrider as the control boat, one that is not reflective of the boats being sold in today's market. All boats used inappropriately can cause shoreline damage, not only wake boats.

In conclusion, I do not support any legislation that restricts a specific type of boat, regardless of the intended purpose of it. The arguments of preserving lakefront property values are theoretical at best, as the real-world sales data I have regarding purchasers of this style boat are the very same people purchasing lakefront property. I do believe that with existing horsepower and public access restrictions in place currently, the fragile bodies of water in the state are already protected from all boats. Should the committee decide that action does need to be taken, moving our existing 200 foot no wake zone for all boaters to a 300 foot no wake zone for all boaters and rebranding it to a lake preservation area would be the only amicable solution.

Sincerely,

James Davenport

General Manager/ Sales Long Lake Marina

Statement of recommendations from Lakes Environmental Association:

There are excellent, unbiased studies that show the environmental impact of wakesurfing. It is true that other boats or boating behaviors can also have environmental impacts, but the impact of wakesurf boats is significant because of the size and power of the waves they create and the horsepower and displacement needed to create these waves. However, most of the impact of these boats can be mitigated by using them farther from shore and in deeper water. This also reduces conflicts with other traditional users like canoers, kayakers, swimmers, and anglers.

Education has to be part of the mix, but our lakes are too valuable to simply rely on behavior modification that is voluntary. Some regulatory mechanisms need to be enacted to ensure our lakes remain pristine and usable to all people, regardless of economic status.

Our organization also understands that regulations involve enforcement, which requires staff and judgement calls. While we believe a 500-foot setback for the activity of wakesurfing will vastly reduce the impact of the sport, a single 300-foot no-wake zone for all boats would be easier to enforce and educate the public about. A 300-foot no wake zone for all boats would also address some of the issues brought up during the stakeholder meeting like tubing, larger boat and engine sizes overall, and poor boating etiquette or behavior. We feel this is an excellent compromise that the Committee should seriously consider.

Unfortunately, we were not able to come to a consensus on a minimum depth to address the resuspension of bottom sediments from wakesurfing. This is a very important issue because bottom sediments are usually laden with phosphorus and introducing them back into the water column will cause more algae blooms and reduced water clarity. While this is not a perfect solution, we hope the committee will ask the MDIFW to have a state suggested minimum depth of 15 feet for this sport. A state suggested minimum depth of 15 feet will help to educate the public on this issue and simplify messaging which currently ranges from 10 feet (water sports industry) to 20-foot minimums (lake associations and environmental organizations). Again, we feel this is a good compromise.

The transport of aquatic invasive species like zebra mussels in wakesurf boat ballasts also needs to be addressed as soon as possible. While the stakeholder group did not get to spend much time on this issue, a “home lake” sticker for wakesurf boats could solve this serious problem.

Thank you for allowing Lakes Environmental Association to serve on this stakeholder group. Maine has a long tradition of shared and equitable use of our waters, and I hope the Committee will preserve this characteristic for future generations.

Statement of recommendations from Maine Audubon:

Our mission…

Maine Audubon is a wildlife conservation non-profit – we fulfill our mission to “conserve Maine’s wildlife and wildlife habitat” by engaging people of all ages in nature through a science-based approach to education, conservation, and advocacy.

Background…

For nearly four decades, Maine Audubon has worked to assess the status and safeguard the future of Maine’s loon population. Through the Maine Loon Project we work with residents and partners statewide to promote healthy lakes, clean water, and quality habitat for loons and to understand trends in their population over time. We engage lake users in efforts to protect loons from threats like boat strikes, nest washouts from boat wakes, and nest site disturbance during the vulnerable period of egg incubation. Across Maine, there are roughly 1,500 loon conservation volunteers that dedicate time and energy to observing and protecting Common Loons. Mainers care deeply about this iconic species and are eager to support initiatives – many of which we support in this report – to help protect Common Loon habitat and health.

Because loons are heavy and their legs are located at the very back of their bodies, they move awkwardly on land. So they can easily slip on and off without being noticed, they typically build their nests within a foot of the water’s edge, which leaves nests especially vulnerable to flooding by boat wakes. As a result, big boat wakes can wash eggs out of a nest, cause eggs to become inviable, wash over young chicks, or cause adult loons to abandon the nest altogether. Every year, people in Maine report eggs off the nest and floating in the water and/or large boat wakes easily overwhelming small chicks. Additionally, loons depend on healthy fish populations to thrive and are visual predators depending on clear waters to hunt prey – degradation of water quality and fish habitat will have cascading impacts up the food chain to loons, osprey, herons, some mammal species, and other wildlife, as well as to game fish populations.

From trauma caused by boat strikes, climate change impacts, habitat loss, mercury and lead poisoning, etc., loons face tremendous obstacles when it comes to hatching and raising chicks on Maine’s lakes and ponds throughout the spring and summer months. The threat of nest washouts from boat wakes –

particularly enhanced wakes produced by wake boats – is a preventable threat that we can address right now and will help mitigate the compounding impacts faced by loons.

As detailed in the above report, to protect shorelines from erosion, all boaters in Maine are required to travel at headway speeds (non-wake-producing speeds) within 200 feet of shore or islands. This law helps protect wildlife from disturbance and loon nests from boat wakes. However, to protect water quality and the fragile shoreline habitat that Common Loons depend on, it is imperative that we address the impacts of wake boats and boats with wake-enhancing equipment on shorefront property and wildlife.

Takeaways…

There are several unintended consequences of boats with enhanced wake-generating equipment operating too close to shore and in shallow water, including diminished water quality by stirring up

sediment, disruption of underwater plant habitat, erosion of shorelines, amongst others. We remain supportive of prohibiting boats purposefully generating enhanced wakes for wake sport activities within 500 feet of shore and in waters less than 20 feet deep as a sensible measure to assure that wake surfers and other wake sport enthusiasts can enjoy their activities in areas of our lakes where there are far fewer risks to lake health, shoreline erosion, wildlife habitat, and loon nesting success. After discussions that took place throughout this stakeholder group, we currently support extending the wake safety zone to 300 feet as soon as possible, as there was largely consensus for this change at this time. We also support MMTA's suggestions related to updating the name of the wake safety zone to be more inclusive to the many diverse benefits e.g., reducing environmental impacts, that the zone provides. Additionally, we reiterate our support for: a "home lake" provision rule, depth-related alarm requirements for wake boat operators, more boater education, and more support for enforcement. This combined approach is likely necessary to raise awareness of best practices among lake users and achieve behavior change from wake boat operators.

Conclusion…

Several unbiased studies demonstrate impacts of wake boats to water quality, fish, habitat, wildlife, and recreation – with the expected increase in interest in wake boats and wakesurfing in Maine, the time is now to get in front of these impacts. Additionally, more than 125 people submitted testimony in favor of LD 693 and nearly 1,000 Maine citizens signed a petition in favor of the bill, which was submitted to the IFW Committee before their April 11 Work Session. It is clear that Maine people far and wide care deeply about efforts to keep lakes clean, reduce property loss, protect wildlife, and increase safety for all who enjoy Maine's lakes and ponds.

Based on our stakeholder group's work, existing data, examples of statutory changes underway in other states, etc. we can and we must support common-sense policies to protect essential wildlife habitat, fragile shorelines, water quality, lake health, and safe recreational opportunities for everyone.

Thank you for including Maine Audubon in this essential discussion. We are grateful to DIFW and our fellow stakeholder group members for their dedication to collaboration and receptivity to policy change. We look forward to future opportunities to work together on this issue and beyond.

Statement of recommendations from Maine Lakes:

Maine Lakes fully supports boating as a valuable means of lake recreation for Maine families and visitors and a mainstay of our outdoor and sporting economy. We also recognize the need for balanced, sound policies that both protect our lakes, including shorelines, water quality, nonpoint source pollution, wildlife habitat, and the safety of all lake users, and promote sustainable, resilient economic activity. Large wakes from boats operating illegally in the Water Safety Zone or from boats beyond that zone engaged in the sport of wakesurfing can damage lake resources and property, erode shorelines, and put other users at risk. While educating boat owners is one tool to tackle the on-going problem of large wakes hitting shorelines, we believe pairing education and outreach with common-sense regulation is more effective and is absolutely essential to protect Maine's valuable lake resources.

Maine Lakes supports the creation of a wider "no wake zone" for wakesurfing (from 200 to 500 feet from shore) that would allow large wakes to dissipate before reaching the shore without significantly limiting the range and reach of this sporting activity on the vast majority of lakes in the state. This group spent a morning observing a wakesurf boat in action on Long Lake in Naples. While the wakesurfer was 400' from shore, the waves could be viewed hitting the shoreline, splashing 2-3 feet in the air, and reaching several feet up onto neighboring grassy shoreline. There is general agreement among studies reviewed

by this group that a distance of 400-600’ from shore and a water depth of 10-20’ is needed to make wakesurf wake impacts similar to impacts from more traditional motorized boats.

As an alternative to a greater distance from shore for wakesurfing activities, Maine Lakes supports the option discussed at length by this group of increasing the “no wake zone” to 300 feet for all boaters in order to simplify enforcement for IFW and to create an opportunity for the agency and partners, including lake associations, marinas, and others, to educate more boaters about wake impacts in general, ultimately reducing wake impacts and improving water safety.

We appreciate the different perspectives brought to this group by other members, especially the insight and expertise provided by James Davenport of Long Lake Marina in Naples. We are hopeful the work of this group will be useful to the IFW committee in pointing a way forward for sound policy that protects lakes while ensuring safe boating opportunities for all lake users on Maine’s clear, clean, beautiful lakes.

RELEVENT CITATIONS

PROVIDED BY SOME STAKEHOLDER MEMBERS FROM LITERATURE REVIEWS:

- **Types of Boats Used and Varying Impact;**
- **Creation of Definitions for Wake Boats, Wakesurfing, Wakeboarding;**
- **Optimal Distances from the Shoreline;**
- **Optimal Depths of Operation;**
- **Educational Approaches**;
- **Impact on Shoreline Property, Erosion;**
- **Impact on Water Quality;**
  - **Invasive Species Risk**
  - **Turbidity**
  - **Alum Treated Lakes**
- **Impact on Fish & Wildlife;**
- **Economic Impact;**
- **Enforcement; and**
- **Wave Action from Different Sources (boats & wind).**

Wendy Garland MDEP:

Impact on Water Quality; Invasive Species Risk

- **Michigan** (page 7) - *The State of Michigan's AIS Management Plan (MDEQ 2013) prioritizes the need for preventing accidental AIS introductions, which may be greatly increased by wake boats due to the presence of large ballast tanks that can be filled from or emptied directly into the water body they are operating on. For example, research has shown that ballast tanks from wake boats operated on a lake with the invasive Zebra Mussel Dreissena polymorpha typically carried 247 Zebra Mussel veligers per sample (Doll 2018), which was much greater than stern drive motor compartments (13 veligers per sample), outboard motor lower units (1 veliger per sample), live wells, or bilges. Although wake boat ballast tanks are typically emptied before trailering, they are rarely ever completely dry which increases the survival time for invasive species potentially trapped inside. Doll (2018) found that 5% of zebra mussel veligers remained alive in ballast tanks after 48 hours. Transportation of other invasive species and fish pathogens is also possible.*

- **Vermont** (pages 34-35) - *Peer-reviewed scientific research (Campbell et al 2016) has found that due to the presence of ballast systems, which are difficult or impossible for a boater to completely drain, wakeboats maintain and transport relatively large volumes of residual water (mean water volume 31.7 L) even after drain pumps run dry and that live organisms can be found in residual water for at least a week after use. Additional research has shown that ballast tanks from wakeboats operated on a lake infested with the Zebra Mussel (Dreissena polymorpha) typically carried 247 Zebra Mussel veligers per sample (Doll 2018), which was much greater than stern drive motor compartments (13 veligers per sample), outboard motor lower units (1 veliger per sample), live wells, or bilges (in other words, zebra mussels can hitch a ride in all sorts of boats, but because wakeboats generally take on the most water, they have the greatest chances to transport the greatest numbers of invaders). Although wakeboat ballast tanks are typically drained before trailering, they are rarely ever*

completely dry which increases the survival time for any invasive species trapped inside. Doll (2018) found that 5% of zebra mussel veligers remained alive in ballast tanks after 48 hours.

Citations Related to Shoreline Distance

- **Michigan (page 3-4)** – *"…Water Environmental Consultants (2021), who determined that waves from a wake boat in wake-boarding and wake-surfing mode would need distances of 225 feet and 950 feet, respectively, to dissipate to the wave heights observed 100 feet from the same boat in cruising mode. Additionally, Marr et al. (2022) found that wake boat waves required substantial distances to attenuate to reference conditions of a typical motorboat operating in planing mode at a distance of 200 feet for wave height (>500 feet), energy (>575 feet), and power (>600 feet, the maximum distance at which waves were measured in the study)."*
- **Vermont (page 28)** - *MacFarlane G. (2018). This study was performed by a professor at the University of Tasmania. Wave height and energy from several wakeboats and two benchmark boats (a ski boat and a runabout) were measured to a distance of 400 feet from shoreline. It was found that the wave energy from the wakeboats approached that of the reference condition (the reference boats at 100 feet) at around 400 feet (note that for a reference condition of 200 feet, similar to current VT guidelines, the distance would be greater and perhaps closer to 500 feet).*
- ***Vermont (pages 28-29)*** *- Marr et al. (2022). This study contained detailed measurements of wave energy from wakeboats operating along a transect out to 600 ft. from shore. This study found that distances from 425 to greater than 600 feet were needed to allow wake energy to dissipate to the levels caused by waterski boats, depending on whether the reference boats were operated in maximum wake mode (low-speed plowing mode) or under normal operating condition (planing mode). This study also noted that wakeboats generated comparable wave energies at distances of 100 feet or greater regardless of whether the ballast tanks were filled, but that wave shaping devices had a greater impact on wave energy.*
- ***Vermont (page 29)*** *- Mercier-Blais S., and Prairie H. (2014). This study measured wave energy and sediment resuspension at lake shorelines with passage of wakeboats operating in different modes (planing, wakeboarding, and wakesurfing modes). There was no comparison to non-wakeboats as a reference condition, but wave energies and sediment resuspension were significantly enhanced at all distances up to 200 m (the maximum distance measured in the study). The study recommended that wakeboats only operate in wakesport mode at distances greater than 300 m (984 feet) from shore.*
- *I did not include the Fay et al (2022) findings in my assessment due to the following citations:*
    - **Michigan (page 4)** - *In contrast to the studies above, Fay et. al (2022) claims that operating distances of 200 feet are sufficient to reduce wave energy and minimize erosion and resuspension. However, these conclusions are inconsistent with other studies and are built upon substantive analytical and methodological concerns. For example, Fay et al. admit that their methods for modeling waves are not appropriate beyond distances of 100 feet. Therefore, our assessment of threats to Michigan's natural resources relies more heavily on results from studies that conducted direct measurements and/or used appropriate models and methods.*
    - **Vermont (page 28)** - *Fay, E., Gunderson, A. and Anderson, A. (2022). This study used a computational fluid dynamics model to estimate the propagation of waves from wakeboats. This study concluded that wakeboats operating at 200 feet from shore should have minimal impacts on lake shores, but there was limited data collected, and raw data was not*

presented in a way that could be easily reviewed. There were no direct measurements of wave energy at different distances from shore, or comparisons to other watercraft. The study was sponsored by the National Marine Manufacturers Association, and the journal is not considered credible.

Citations Related to Depth

- **Michigan (page 5)** - *Field testing by Raymond and Galvez-Cloutier (2015) found that wake boat propellers generated water velocities with the capacity to resuspend unconsolidated sand, silt, and smaller organic materials at a depth of 15 feet while the boat was in wake-boarding or wake-surfing modes. Models developed by Ray (2020) calculated that modern wake boats can cause sediment resuspension in water down to 33 feet deep.*
- **Vermont (page 32)** - *Raymond and Galvez-Cloutier (2015) The effects of propeller wash appeared to have penetrated up to 16 ft (5 meters) deep for the condition associated with 10 mph and biased ballasting (i.e., wakesurfing).*
- **Vermont (page 32)** - *Beachler, M.M. and D.F. Hill. (2003) As water depths increase, the band of boat speed that induces near bed velocities greater than 25 cm/s (velocity required to disturb .3mm sand), is steadily shrinking. Beyond a depth of 2.75 meters (9.0 ft), the near bed velocity never exceeds this critical value, and therefore causes minimal potential for impact. The minimum depth is a function of boat size, power, and sediment grain size. For 50 micrometer silt, minimum depth for disturbance is 4.6 m (15.1 ft), for coarser bed material 1.0 mm, 1.8 meters (5.9 ft) depth. These are conservative estimates meant to prevent bottom stirring for all boat speeds.*
- **Vermont (page 33)** - *Ray (2020) : According to modeling results, wakeboat slip-streams have the potential to affect bed sediments at 33 feet of depth (the slipstream, the powerful jet of water driven by the propeller towards the lakebed). Lakebed sediments at depths of up to 7 feet to 12 feet are likely to be disturbed by boat propagated waves, while wind waves are likely only to regularly disturb sediments at depths up to 5 feet.*

Colin Holme – LEA

LEA submissions regarding key categories of the resolve with references to specific studies

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Color Key to submissions:

- **Black, bold bulleted item = category assigned by facilitator for stakeholder members to research**

Underlined blue = the study from which the quote was taken

"quote in blue" = a direct quote and copy from the study, paper, or submission

Blue bold within a quote = emphasis that LEA put in that pertains to the issue of interest

Green notes = LEA thoughts on an issue or clarification regarding a reference

Topics boxed in red Colin brought up and quoted during the 10/30/23 meeting

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Citations Related to Types of Boats Used

University of Minnesota, St. Anthony Falls Laboratory Study pg 19:

Table 2. Summary of the four test boats.

Manufacturer	Model	Year	Drive	Horsepower	Beam (ft)	Length (ft)	Dry Weight (lbs)	Ballast (lbs)	Hydrofoil	Wake Shaper
Larson	LXI 210	2004	Sterndrive (I/O)	260	8.3	21	2925	No	No	No
Malibu	Response LX	2004	Direct Drive (I)	310	7.5	20	2450	No	Yes	Yes -aftermarket
Malibu	Wakesetter VLX	2019	V-Drive (I)	450	8.2	21	4200	3690	Yes	Yes
Malibu	Wakesetter MXZ	2019	V-Drive (I)	450	8.5	24.5	5500	4885	Yes	Yes

Notes:
(I/O) - inboard outboard or sterndrive powertrain
(I) - inboard powertrain

Note that some models of current wakesurf boats are heavier and have more horsepower than the boats used in this study:

2023 Malibu LSV 26 (per Malibu web site): - 7,000 lbs dry weight; 6,100lbs ballast; 606HP

2023 Nautique G25 Paragon (per Nautique website): 8460 lb dry weight, 3400 lbs ballast, 630 HP

Note: During the stake holder meetings, it was noted that the Malibu Response LX used in the Minnesota study is a ski boat designed to make little wake. However, the Larson LXI is a bow rider very typical of boats seen on lakes in Maine and that was also used as a reference wake in the Minnesota study (see chart excepts on the next page).

Citations Related to Shoreline Distance

- University of Minnesota, St. Anthony Falls Laboratory Study pg 85:

  "based on both the actual data points and best-fit power law regressions, that operational distances greater than **500 ft are needed to attenuate the wake wave characteristics of the wakesurf boats** to the selected reference condition levels, which were roughly 6 in, 1,000J/m-s and 35 J/m-s for maximum wave height, total wave energy, and maximum wave power, respectively."

  University of Minnesota, St. Anthony Falls Laboratory Study pg 88 and 89:

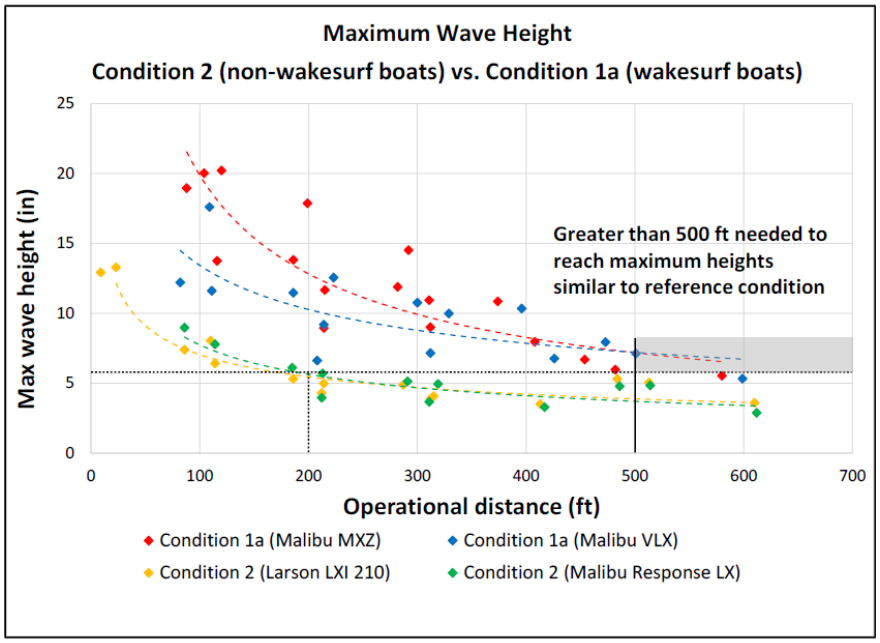

Figure 45. Illustration of a potential method for estimating the operational distance needed to reduce the maximum wave height of the wakesurf boat to reference levels associated with Condition 2 (planing) of the non-wakesurf boats (black horizontal dashed line).

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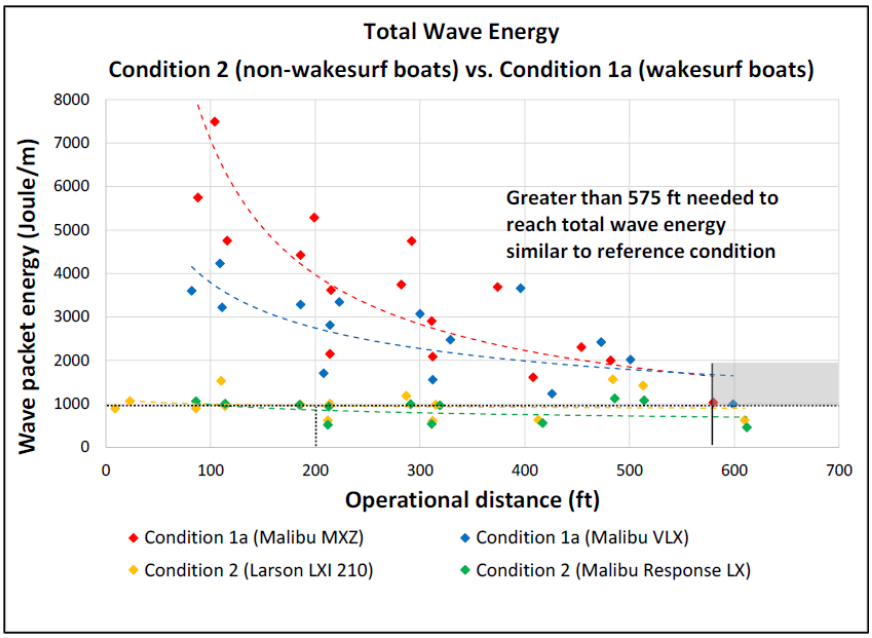

Figure 46. Illustration of a potential method for estimating the operational distance needed to reduce the total wave energy of the wakesurf boat to reference levels associated with Condition 2 (planing) of the non-wakesurf boats (black horizontal dashed line).

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Michigan Department of Natural Resources Literature Review pg 2:

"Boats operating in wake-surfing mode or wake-boarding mode, during which boat speed, wave shapers, and/or ballast are used to increase wave height, are **recommended to operate at least 500 feet from docks or the shoreline, regardless of water depth**."

"The large waves generated by wake boats take between **400–1,023 feet to dissipate to heights and wave energies observed 100–200 feet away from typical boats operating at cruising speed."**

Michigan Department of Natural Resources Literature Review pg 4:

Comments regarding the Numerical Study on the Impacts of Wake Surfing on Inland Bodies of Water conclusions regarding distance: "In contrast to the studies above, Fay et. al (2022) claims that operating distances of 200 feet are sufficient to reduce wave energy and minimize erosion and resuspension. However, these conclusions are inconsistent with other studies and are built upon substantive analytical and methodological concerns. For example, Fay et al. admit that their methods for modeling waves are not appropriate beyond distances of 100 feet."

Numerical Study on the Impacts of Wake Surfing on Inland Bodies of Water pg 258

"The resolution near the boat is good but deteriorates at more than three boat lengths away from the boat making it impossible to plot the expected wave height more than 100 feet from the track of the boat."

Citations Related to Depth

Michigan Department of Natural Resources Literature Review pg 2:

"Boats operating in wake-surfing or wake-boarding modes are recommended to **operate in water at least 15 feet deep.**"

Michigan Department of Natural Resources Literature Review pg 5:

"Field testing by Raymond and Galvez-Cloutier (2015) found that wake boat propellers generated water velocities with the capacity to resuspend unconsolidated sand, silt, and smaller organic materials at a depth of **15 feet** while the boat was in wake-boarding or wake-surfing modes. Models developed by Ray (2020) calculated that modern wake boats can cause sediment resuspension in water down to **33 feet deep**."

Terra Vigilis Environmental Services Group, Water Quality and Wave Impact Study, pg 25
Not included in our reading but an excellent study

"Wakeboard boats in surf mode operating 200 feet from shore within depths of 15 to 25 feet of water were associated with a 25% increase in total phosphorus concentrations in the water column after periods of less than 30 minutes."

- **Citations Related to Educational Approaches**;

Michigan Department of Natural Resources Literature Review pg 9:
"Education and awareness campaigns are an important component of a comprehensive approach to protecting inland lakes from damage caused by wake boats. Providing operational recommendations into educational materials on responsible wake boat operation in **boating safety classes**, and providing **informational flyers** with these recommendations to new wake boat owners may improve awareness and implementation of best operation practices. Similar education campaigns have been implemented elsewhere; for example, the State of Oregon requires boaters to complete an educational program to wakeboard and wakesurf on certain sections of the Willamette River."

NH Commission Report pg 8:

"Part of the responsibility to minimize these risks lies squarely on the boat operator to understand waterbody conditions, which can and should occur through additional education. However, it also is **unreasonable to expect boat operators to understand the physics of waves, wind fetch length, or the ability of a shoreline to resist erosion**. For these reasons, further consideration should be given to defining the conditions that minimize the risk of lakeshore erosion and impacts to water quality and wildlife that could occur due to the increased wave height and power associated with wake boats."

- **Citations Related to Erosion:**
Michigan Department of Natural Resources Literature Review pg 4:

"As larger waves strike a shoreline, they are able to dislodge and move more and larger particles (NRCS 1996, NRCS 1997, Priestas et al. 2015). Recreational boating activity can exacerbate erosion by increasing the wave energy that reaches the shoreline (Johnson 1994; Nanson et al. 1994; Bauer et al. 2002), and it follows logically that the increased wave energies produced by wake boats intensify this effect (Table 1). A recent study on 1,700-acre Whitestone Lake in Ontario (Houser et al. 2021) showed that 61–72% of total wave energy originated from powerboats."

"Wake boats create larger wakes than traditional watercraft, therefore the greater energy of waves created by wake boats operating in wake-boarding or wake-surfing mode are likely to exacerbate boat wave induced erosion."

Vermont filing, Scientific Information Statement Section pg 2

"Wave energy increases exponentially with wave height, and these larger waves have substantially greater potential to cause shoreline erosion, which can result in increased phosphorus loading to lakes and damage littoral habitats for a variety of species (Asplund, 2000), including the common loon (Paugh, 2006)."

- **Citations Relate to Property Damage:**
  Vermont filing, Economic Impact Analysis Section pg 3

  "Lakefront property and lake town tax bases would remain steady, thus avoiding the **$11.5 million potential annual decrease in property values caused by wakesurfing, and the concomitant $180,000 loss of annual property tax revenue to lake towns**."

  Vermont filing, Economic Impact Analysis Section pg 5

  "If the rule is not adopted, the Agency (*the Vermont Agency of Natural Resources*) estimates eventual annual costs to Vermont citizens, businesses, and the state government to amount to **$97.8 million, while the benefits to wakeboat dealers and state sales tax would total $7.9 million.** The annual costs to Vermont citizens, businesses, and the state government if the rule is not adopted are derived as follows: $3.2 million in environmental damage, $3.9 million in damage to small craft owners and businesses that operate or sell small crafts, reductions in small-craft related tourism revenue and related tax revenue of $79 million, and reductions in lakefront property value of $11.7 million."

  Vermont filing, Scientific Information Statement Section pg 2

  "Additionally, larger waves have the potential to create dangerous conditions for small watercrafts or swimmers and to damage property of lakeshore residents."

  LEA note: Property damage and safety of swimmers, other boaters, and people on floating docks are the most common concerns cited by landowners who contact LEA regarding wakesurf boats.

- **Citations Related to Water Quality:**
  Vermont filing, Economic Impact Analysis Section pg 4

  "Failure to adopt the rule will lead to a degradation of lake water quality and safety that will suppress this economic growth and require substantial expense to repair."

NH Commission Report pg 8:

"The ability for these watercrafts to generate larger and more powerful waves means **there is also an increased potential for shoreline erosion and impacts to water quality and wildlife**. In particular, these impacts are more likely to occur if operation occurs close to shore, in shallow water, or in areas that are protected from the wind."

- **Citations Related to Fish and Wildlife:**
  Michigan Department of Natural Resources Literature Review pg 7:

  (regarding aquatic plants)
  "Asplund and Cook (1997) documented 20% reductions in aquatic plant coverage due to the physical disturbance caused by recreational boating in Wisconsin, which has similar 100-foot regulations to Michigan. They also found that excluding powerboats from experimental plots dramatically increased aquatic plant biomass, coverage, and shoot height compared to areas with boats. Results indicated that powerboats affected plant growth through scouring of the sediments and direct cutting as opposed to increased turbidity, and it was unclear if the amount of plant material lost would have larger-scale or long-term impacts on the ecosystem (Asplund 2000). Murphy and Eaton (1983) documented an inverse relationship between recreational boating traffic and both submersed and emergent aquatic plant abundance in canals in British Columbia. Since wake boats produce greater wave energy, propeller turbulence, and sediment resuspension compared to the powerboats observed in these studies, it follows that wake boats could significantly disrupt native aquatic vegetation in inland lakes."

  (Aquatic plant reduction relationship to fish health)
  "Reductions in native aquatic plants will affect fish populations. Aquatic vegetation provides rearing areas for juvenile fishes (Bryan and Scarnecchia 1992), allows for increased fish growth and total fish biomass (Radomski and Goeman 2001; Nohner et al. 2018), and reduces wave energy in the nearshore zone."

  (regarding aquatic invasive species)
  "research has shown that **ballast tanks from wake boats** operated on a lake with the invasive Zebra Mussel *Dreissena polymorpha* typically **carried 247 Zebra Mussel veligers** per sample (Doll 2018), which was much greater than stern drive motor compartments (13 veligers per sample), outboard motor lower units (1 veliger per sample), live wells, or bilges. Although wake boat ballast tanks are typically emptied before trailering, they are rarely ever completely dry which increases the survival time for invasive species potentially trapped inside. Doll (2018) found that **5% of zebra mussel veligers remained alive in ballast tanks after 48 hours**. Transportation of other invasive species and fish pathogens is also possible."

  NH Commission Report pg 5:

  (regarding invasive species)
  "It is difficult to clean and drain ballast water compartments because as they are currently designed, **they do not drain completely and risk spreading AIS**. Incomplete draining can lead to

the harboring of viable aquatic invasive plants or animals, some of which are as small as a grain of sand and remain viable for several days. When water is pumped back into these ballast compartments from a different waterbody, and then flushed out again after use, the **AIS still viable in the ballast compartments can be released into this new waterbody,** thereby potentially causing a new AIS infestation.

- **Citations Related to a Wake Boat Definition:**
  NASBLA "Wake Boat Definition = (also known as wakesurf boat, ballasted boat) is defined as any boat that is equipped with ballast tanks, ballast bags, compartments, containers, or similar devices or mechanical systems designed to alter or enhance the characteristics of the boat's wake. This definition may only be applicable when such devices are being utilized to alter the wake."

  PROPOSED VERMONT USE OF PUBLIC WATERS RULES
  https://dec.vermont.gov/sites/dec/files/wsm/lakes/docs/Use_of_Public_Waters_Rules_2023_Amendment%20clean.pdf

  "SECTION 5: DEFINITIONS
  5.16 "Wakeboat" means a motorboat that has one or more ballast tanks, ballast bags or other similar
  devices used to enhance or increase the size of the motorboat's wake.
  5.17 "Wakesports" means:
  A. to operate a wakeboat with ballast tanks, bags, or similar devices engaged to enhance the boat's wake or with someone riding the wake directly behind the boat; or
  B. to use a surfboard, wakeboard, hydrofoil, or similar device to ride on or in the wake directly behind a wakeboat with or without a rope."

  LEA suggestions:
  Based on what the committee was shown, LEA suggests altering the NASBLA definition to address trim plates which are designed to reduce wakes:

  Wakesurf Boat: Any boat that is equipped with ballast tanks, ballast bags, compartments, containers, or similar devices or mechanical systems designed to enhance the characteristics of the boat's wake for the intention of wakesurfing. This definition may only be applicable when such devices are being utilized to alter the wake.

  Difference from NASBLA definition: (removed the term "alter" and added for the "intention of wakesurfing"

  Based on the definition suggested above, we also need to define "wakesurfing". Suggested LEA definition:

"Wakesurfing: Slow speed boating (generally 9-12 mph) which creates a large enough wake for an individual to surf behind using the wave's slope as propulsion for the rider thus eliminating the need for a tow rope after the rider is lifted out of the water and pulled into the wave."

- **Citations Related to Enforcement:**
  Vermont filing, Economic Impact Analysis Section pg 3

  "enforcement costs associated with this rule (*The rule proposes to regulate "wakesports" involving a "wakeboat" on certain lakes and ponds in Vermont. The rule would prohibit such wakesports on lakes, ponds, and reservoirs that do not have a minimum of 50 contiguous acres that are both 500 feet from shore on all sides and a minimum of 20 feet deep (eligibility rule). The rule would also limit such wakesports to these defined areas that are 500 feet from shore and 20 feet deep (operating rule). Finally, the rule would require a "wakeboat" to only be used in one lake per summer unless the wakeboat is decontaminated at a certified Dept. of Environmental Conservation (DEC) service provider)* (excerpt from VT filing page 4) are expected to be minimal, as enforcement will be carried out by existing staff capacity as described below:"

  "Game Wardens and State Police Marine Division employees will respond to potential violations of this Administrative Procedures Economic Impact Analysis Revised January 10, 2023 page 4 rule in line with existing responsibilities to enforce other elements of the Use of Public Waters Rule and 23 V.S.A. § 3311. **There may be additional calls to these law enforcement officers as the public gets used to this new rule, but DEC does not expect substantial cost associated with responding to those calls**."

- **Citations Related to Wind Wave Action:**
  Michigan Department of Natural Resources Literature Review pg 4:

  "wave energy produced in wake-boarding and wake-surfing modes was 553% and 2,546% higher, respectively, than the monthly maximum energy from wind-driven waves. Wake-boat-induced wave energy was 192% higher for wake-boarding mode and 679% higher for wake-surfing mode, compared to wind-driven wave energy, when the wake boats passed 500 feet from shore."

  Vermont filing, Scientific Information Statement Section pg 9

  "Ray (2020) : According to modeling results, wakeboat slip-streams have the potential to affect bed sediments at 33 feet of depth (the slipstream, the powerful jet of water driven by the propeller towards the lakebed). Lakebed sediments at depths of up to 7 feet to 12 feet are likely to be disturbed by boat propagated waves, while wind waves are likely only to regularly disturb sediments at depths up to 5 feet."

Stacey Keefer Maine Marine Trades Association:

Citations Related to Types of Boats Used

1. Minnesota study, page 11 of the pdf
   [Referencing the Malibu Response] "aftermarket products installed on non-wakesurfing boats can create wake waves similar to wakesurfing boats"
2. Minnesota study, page 33 of the pdf
   "It is important to state that this study was limited to examining only four boats. We selected watercraft that were representative of non-wakesurfing and wakesurfing boats; however, there are many other boat manufacturers and models not considered. The boat selection was based on the boats that were available to us within the short window of field work for this study."

Citations Related to Distances from Shoreline:

1. Minnesota study, page 81 of the pdf
   "In the first 100 ft of operational distance, there appears to be an influence of the ballast weight on the measured wake wave characteristics. At a distance of 5 ft, the initial maximum wave heights were 34 in for ballasts full and 27 in for ballasts empty. However, by 100 ft the maximum wave height of both conditions had attenuated to approximately 14 in. At operational distances greater than 100 ft, the attenuating rates were very similar and had decreased to roughly 6 in by 600 ft."
2. Vermont report, page 29
   [referencing the Marr et al 2022 study]
   "This study also noted that wakeboats generated comparable wave energies at distances of 100 feet or greater regardless of whether the ballast tanks were filled, but that wave shaping devices had a greater impact on wave energy."
3. Vermont report, page 30
   "The precise distances are contingent upon lake bathymetry (depth, lakebed slope), as well as the specific boats in question. Based on the evidence reviewed, DEC believes that current evidence does not support the 1000-foot distance from shore recommended in the petition."
4. Vermont report, page 31 of the pdf
   "Wakes are most destructive in shallow and narrow waterways because wake energy does not have the opportunity to dissipate."

Citations Related to Depth:

1. Minnesota study, page 112 of the pdf
   "Boats of all sizes produce propeller wash and, at a certain depth the wash begins to interact with the thermocline, lake bottom, vegetation, and aquatic habitats. These complex interactions are not well-studied, and we believe this is a priority area for future research."
2. Vermont report, page 27 of the pdf
   "Mercier-Blaies and Prarie (2014) also highlighted the role of lake bathymetry, demonstrating that lakes with steeper lakebed gradients have less wave energy attenuation as the wave approaches the shore than lakes with more gradual depth profiles"

3. Vermont report, page 31 of the pdf

"There are many factors that influence how a wake behaves, including the boat size, boat speed, water depth, type of lake-bottom sediments (geology), and lake size (FitzGerald et al. 2011). In field studies, boat speed, size, and water depth were the critical factors affecting resuspension with a specific lakebed"

Citations Related to Educational Approaches:

1. New Hampshire report, page 20
   "Large boat wakes can be created by many different types of boats under varying circumstances and conditions. Cabin cruisers, tubing activities, plowing through channels in excess of headway speed, and heavy passenger loads all create large wakes. Boater behavior is the key factor in complaints and concerns with any type of boat, including wake boats. Efforts to educate boaters towards stronger awareness and enforcement of the 150-foot safe passage law is a more effective way to address conflicts on waterways than singling out a particular vessel for restrictions."

Citations Related to Erosion and Wave/Wind Action:

1. Canada study, page 2
   "While their impact may be negligible along shorelines subject to large wind and swell waves, wakes may represent a significant source of energy along sheltered shorelines (Gourlay 2011, Houser 2011)."
2. Canada study, page 5-6
   "It is important to note that this study was completed during the first summer of COVID-19, when anecdotally there appeared to be more people self-isolating at their cottages than would be expected in years without a pandemic. In addition, the relative amount of wake energy observed at the site is not necessarily representative of other areas of the lake with different fetch lengths and orientations. Boat wakes may be less important along other shorelines downwind of longer fetches, but further study is required to determine the relative importance of wind waves and boat wakes on this and other inland cottage lakes."
3. NH report, page 8 of the pdf
   "Last, it is important to point out that New Hampshire has approximately 1,000 lakes and ponds. Of these 1,000 waterbodies, approximately 80% are less than 50 acres. In the study by Goudey and Girod (2015), they note that a 1-mile fetch is a common distance for wind to travel over water. They also note that a wake boat would need to pass 100' from a shoreline approximately once every nine minutes to equal the wave energy a shoreline with a 1-mile fetch is subjected to with a 10-mile per hour wind. Given the small size (<50 acres) of most of New Hampshire's lakes and ponds, a minority have open water areas more than 1-mile in length. This is not to say that natural wind-driven wave action is not important in structuring the shorelines, rather it is meant as a point of emphasis that there are many water bodies and shorelines that are protected from the erosive forces of the wind-driven waves. To put this in perspective, in order for a 50-acre lake to have a 1-mile fetch it would only be about 400' wide on average. In other words, only New Hampshire's larger lakes have extended wind fetches with shorelines that are regularly subjected to wind-driven wave action."

Citations Related to Economic Impact:

*Left off of the list was **Economic Impact** and we ran short on time, so it was not brought up in the meeting on October 30. MMTA was planning to note that the Vermont Report gave some economic impact data indicating that costs of environmental impacts could outweigh economic impacts by 10 to 1. However, Maine's boating industry economic impact is seven times larger and there are about 4 times more summer camps in Maine than Vermont. The Vermont economic comparison does not seem like an apples-to-apples comparison.

Statement of Recommendations from MMTA

The Maine Marine Trades Association recognizes that there is some data and there are some reports out there about wake impacts. However, we believe there is insufficient data to draw conclusions that apply to all Maine lakes and ponds, and all parts of all lakes and ponds, in a similar fashion. MMTA believes that it would be more important environmentally for the State to consider adding a minimum depth required for wake-producing activity rather than expanding the distance of the existing 200-foot water safety zone*. We believe it would be too confusing for enforcement to prohibit wakesurfing inside a 500-foot zone, but allow other towed sports (skiing, tubing, wakeboarding) between 500 and 200 feet. It is best to have one distance. Since all Maine's water bodies are unique, adding a minimum 10-foot depth would then potentially push the water safety zone out beyond 200 feet, but only where it is most appropriate.

MMTA prefers to see statutes that limit conditions that could be created by various types of boats and are not prohibitive based on one specific type of vessel (such as the case with PWC's).

Our last suggestion would be to rename the "Water Safety Zone" to a "Water Safety and Impact Zone" …or a "Water Protection Zone" …or something related to impacts. The zone was originally created to set up safe zones for swimmers, but a new name would help people understand there are also environmental and wildlife impacts being protected. We would then encourage the lake associations, boat dealers, and/or municipalities to post maps of their local lakes showing the shape and locations of these protected zones.

*reference Vermont report, page 31 of the pdf

"Wakes are most destructive in shallow and narrow waterways because wake energy does not have the opportunity to dissipate."

Susan Gallo Representing Maine Lakes

Wakeboat Issue Areas and Relevant Citations from the Literature

Submitted to the Wakeboat Stakeholder Group

Maine Lakes, October 2023

Citations Related to Wave/Wind Action

The waves created for the sport of wakesurfing are larger and contain greater wave energy than those created for other watersports, such as water skiing, tubing, and wakeboarding.

- MacFarlane (2018) found that wave energy from ballasted wake-surfing craft was 5–17 times higher than a benchmark speedboat (cited in MI DNR 2023, p 3)
- Marr et al. (2022) found that waves produced by wake boats were 2–3 times higher, had 3–9 times more energy, and were 6–12 times more powerful than a typical motorboat. (Cited in MI DNR 2023, p. 3).
- Mercier-Blais and Prairie (2014) compared wave energies produced by a wake boat operated in wake-surfing (10 mph, one ballast tank filled), wake-boarding (20 mph, both ballast tanks filled), and cruising (30 mph, empty ballast tanks) modes and discovered wave energies were significantly different between operating modes at a distance of 328 feet. The waves created in wake-surfing mode were on average 1.7 times higher than those created in cruising mode. (Cited in MI DNR 2023, p. 3)
- Water Environmental Consultants (2021) showed that waves produced by a wake boat in wake-surfing and wake-boarding mode had 581% and 68% more energy, respectively, than waves produced by the same vessel operated in cruising mode at a distance of 100 feet. (Cited in MI DNR 2023, p. 3)
- Both Goudey and Girod (2015) and Ruprecht et al. (2015) found that wake boats operating in wake-surfing mode produced the largest waves compared to other modes, with maximum wave energy approximately four times that of waves generated in wake-boarding mode. (Cited in MI DNR 2023, p. 3)
- Water Environmental Consultants (2021) compared wave energy from wake boats to the monthly maximum wave energy from wind for two locations in Lake Rabun, Georgia; when wake boats passed 100 feet from shore, the wave energy produced in wake-boarding and wake-surfing modes was 553% and 2,546% higher, respectively, than the monthly maximum energy from wind- driven waves. Wake-boat-induced wave energy was 192% higher for wake-boarding mode and 679% higher for wake-surfing mode, compared to wind-driven wave energy, when the wake boats passed 500 feet from shore. (Cited in MI DNR 2023, p. 4)
- It is important to note that studies will inevitably lag behind in measuring current wakeboat size and potential. For example, the Marr et al. 2022 study used a Malibu XHZ boat (2019, 5,500 lbs. Dry weight, 4,885 lbs. Ballast, 450 HP engine). In comparison, a 2023 Malibu LSV 26 is 7,000 lbs. Dry weight, 6,100 lbs. Ballast, 606 HP engine.

Citations Related to Distance from Shore:

The larger wakes produced by boats engaged in the sport of wake-surfing need substantial distance to dissipate to the size and energy of waves generated from other recreational activities when they reach shore.

- Mercier-Blais and Prairie (2014) used statistical models to determine that the distance required for wake boat-generated waves for wakesurfing to dissipate to a level comparable to a wave height observed 100 feet from a cruising wake boat would be approximately 950 feet. (Cited in MI DNR 2023, p. 3)

- Water Environmental Consultants (2021) determined that waves from a wake boat in wake-boarding and wake-surfing mode would need distances of 225 feet and 950 feet, respectively, to dissipate to the wave heights observed 100 feet from the same boat in cruising mode. (Cited in MI DNR 2023, p. 3)

- Marr et al. (2022) found that wake boat waves required substantial distances to attenuate to reference conditions of a typical motorboat operating in planing mode at a distance of 200 feet for wave height (>500 feet), energy (>575 feet), and power (>600 feet, the maximum distance at which waves were measured in the study). (Cited in MI DNR 2023, p. 3)

- Marr et al. (2022), pp. ix to x – **"…**we show that when operating under typical wakesurfing conditions, wakesurf boats required distances greater than 500 ft to attenuate wake wave characteristics (height, energy, and power) to levels equivalent to non-wakesurf boats operating under typical planing conditions."

- Marr et al. (2022), p. 85 – "…operational distances greater than 500 ft are needed to attenuate the wake wave characteristics of the wakesurf boats to the selected reference condition levels, which were roughly 6 in, 1,000 J/m, and 35 J/m-s for maximum wave height, total wave energy, and maximum wave power, respectively." Note: The study applied the Minnesota recommendation of 200 ft as the reference operational distance.

- Fay et al. (2022) claims that operating distances of 200 feet are sufficient to reduce wave energy and minimize shoreline erosion and sediment resuspension. However, the models presented in this study do not address either erosion or sediment resuspension. Their conclusions are inconsistent with other studies. The authors themselves admit that their methods for modeling waves are not appropriate beyond distances of 100 feet (page 258, re:CFD models: "The resolution near the boat is good but deteriorates at more than three boat lengths away from the boat making it impossible to plot the expected wave height more than 100 feet from the track of the boat." For more on a critique of this study, see pages 4-5.

- Conclusions about distance from MI DNR 2023 (page 2): ""Boats operating in wake-surfing mode or wake-boarding mode, during which boat speed, wave shapers, and/or ballast are used to increase wave height, are recommended to operate at least 500 feet from docks or the shoreline, regardless of water depth."

Boats engaged in wakesurfing activities near shore and in shallow water pose a risk to water quality and wildlife habitat due to the resuspension of sediments and nutrients from the lake bottom.

- As larger waves strike a shoreline, they are able to dislodge and move more and larger particles (NRCS 1996, NRCS 1997, Priestas et al. 2015). (Cited in MI DNR 2023)
- Sedimentation can degrade habitat and threaten fishes (Muncy 1979; Dombeck et al. 1984, Ventling-Schwank and Livingstone 1994)
- Mercier-Blais and Prairie (2014) determined sediment resuspension was significantly higher than background conditions up to 492 feet from wake boats operating in wake-surfing mode and 656 feet from wake boats operating in wake-boarding mode and was highest when wake boats were operated in wake-surfing mode at a speed of 10 mph. Mercier-Blais and Prairie's extrapolations indicate that distances of 675 and 938 feet from the line of travel are required for wake boat waves to produce sediment resuspension equivalent to normal levels on ~1,136-acre Lake Lovering and ~439,847-acre Lake Memphremagog, respectively. (Cited in MI DNR 2023, p. 5)
- Field testing by Raymond and Galvez-Cloutier (2015) found that wake boat propellers generated water velocities with the capacity to resuspend unconsolidated sand, silt, and smaller organic materials at a depth of 15 feet while the boat was in wake-boarding or wake-surfing modes. (Cited in MI DNR 2023, p. 5)
- Models developed by Ray (2020) calculated that modern wake boats can cause sediment resuspension in depths over 10 meters (33 feet) deep. (Cited in MI DNR 2023, p. 5)
- Conclusions about distance from MI DNR 2023 (page 2): Boats operating in wake-surfing or wake-boarding modes are recommended to operate in water at least 15 feet deep.

<u>Citations Related to Invasives</u>

The process of taking in and expelling water into ballast tanks of wakesurfing boats poses risks to the spread of aquatic invasive species.

- Research has shown that ballast tanks from wake boats operated on a lake with the invasive Zebra Mussel *Dreissena polymorpha* typically carried 247 Zebra Mussel veligers per sample (Doll 2018), which was much greater than stern drive motor compartments (13 veligers per sample), outboard motor lower units (1 veliger per sample), live wells, or bilges. (Cited in MI DNR 2023, p. 7)
- Although wake boat ballast tanks are typically emptied before trailering, they are rarely ever completely dry which increases the survival time for invasive species potentially trapped inside. Doll (2018) found that 5% of zebra mussel veligers remained alive in ballasttanks after 48 hours. Transportation of other invasive species and fish pathogens is also possible. (Cited in MI DNR 2023, p. 7)

- The greater propeller turbulence and increased scouring caused by wake boats may result in fragmentation and proliferation of aquatic invasive plants already found in the waterbody (Keller 2017). (Cited in MI DNR 2023, p. 7)

<u>Citations Related to Shoreline Distance, Water-Quality, Wildlife Habitat and Erosion</u>

Wind-generated waves and other boats disobeying headway speed rules can also contribute to the issues discussed above for water quality, wildlife habitat and erosion.

- LRM article about wind vs. human caused wakes. Areas with consistent high winds will naturally have armored shores.
- Maine DEP actively discourages armored shores, which is much more common in other states, for very good scientific reasons (protecting littoral habitat, managing wave energy, etc.)
- Yves Prairie, frequency of large wind events is small, especially on smaller lakes
- We cannot control mother nature, but we can reduce the additive human-caused risks.
- Compliance with 200 foot no wake zone will work for boating activities that produce "regular waves" but do not work for wake boats (see first and second bullet points).
- Compliance with existing laws would work but are unenforceable. They put an unreasonable burden of proof on lake users to document the harm caused by one specific wake, when in many instances it could be cumulative impacts over a season or multiple seasons that creates the harm.

The economic benefits to retailers must be balanced with the economic costs of maintaining water quality and combating invasive species.

- Numerous studies, including a recent study at the University of Maine, have shown a direct relationship between water quality and property values (see list of references in VT Petition, 2022, p. 9). For example, Voigt et al. (2015) found that on Lake Champlain for every meter of reduced water clarity, property values fell 3% for year-round lakeside residences and 37% for seasonal dwellings. Similar findings have been found in Maine (Holly et al. 1996, Daignault, pers. comm.) Note that more information from the UMaine study will be available this fall.
- The Vermont Agency of Natural Resources conducted an economic impact analysis that found the following (VT ANR report, 2023, cover sheet, summarized and quoted below from p. 6; more details on pages 2-7 of the main body of the document):

> "An economic analysis of the impact of this rule considered two scenarios, with and without regulation, ten years into the future. It shows that the economic benefits of regulation outweigh the costs by ten to one. The annual benefits — estimated at $93 million — include the preservation of water quality, the continuation of affordable small-scale recreational activities that form the core of Vermont's water-based recreation, and the protection of the tourist economy that depends on clean and safe lakes. The potential annual costs — about $8 million — are based on limitations that this rule would place on the growth of the wakeboat industry. Wakesurfing close to shore discourages the thousands of swimmers, paddlers, sailors, anglers, non-wakeboat water skiers and boarders, and other small-craft users who form the foundation

of Vermont's lake-based economic activity. Moreover, even a few wakesurfers close to shore cause costly environmental damage, while contributing little to the state's economy.

- Environmental and structural damage costs from wakesurfing would be avoided. This would save the State and lake associations $3.2 million annually in environmental damage repair. (VT ANR report, p. 2)
- Lakefront property and lake town tax bases would remain steady, thus avoiding the $11.5 million potential annual decrease in property values caused by wakesurfing, and the concomitant $180,000 loss of annual property tax revenue to lake towns. VT ANR report, p. 3).
- A UMaine study recently surveyed a random selection of Maine residents about their use of Maine's lakes. The number one reason for choosing to visit/recreate on a lake is good water quality (Daignault, pers comm.)
- That same study found that over 52% of survey respondents replied that excessive wakes from wakes from recreational boaters were having a moderate, strong, or extreme impact on Maine's lake water quality. (Daignault, pers. comm.)
- As an additional note, the job of monitoring water quality, conducting watershed surveys, creating access to funding and motivation for shoreline improvements, fund-raising for alum treatments, inspecting boats for invasive species, and managing invasive species infestation is supported by DEP but the burden falls largely onto the shoulders of local lake association volunteers and regional watershed groups. If existing enforceable laws are not in place to curb wakeboats/wakesurfers risk contributions to these problems, the burden of protecting and improving lake health to these nonprofits (as well as DEP) will continue to grow.

A reference provided for review by this task force (EM Fay et al., 2022) makes numerous inaccurate and unsubstantiated claims about the impact of large wakes on water quality and shoreline integrity.

- The journal publishing this article - The Journal of Water Resources and Protection - has been deemed a predatory journal, which is an exploitative academic publishing model that involves charging publication fees to authors without checking articles for quality and legitimacy, and without providing editorial and publishing services that legitimate academic journals provide (https://predatoryreports.org/home).

- A clue to the questionable nature of this publisher is provided by the publication timeline. The article was submitted to the publisher on February 29, 2022, accepted for publication on March 20, 2022 and published on March 23, 2022. For anyone who has pursued publication of scientific research in legitimate scientific journals, this timeline of less than a month from submission to publication is virtually unheard of. Adequate peer-review during this stream-lined process is highly unlikely.

- The MI DNR literature review specifically calls out this study: "In contrast to [other] studies…Fay et. al (2022) claims that operating distances of 200 feet are sufficient to reduce wave energy and minimize erosion and resuspension. However, these conclusions are inconsistent with other studies and are built upon substantive analytical and methodological concerns. For example, Fay et al. admit that their methods for modeling waves are not appropriate beyond distances of 100 feet. Therefore, our assessment of threats to Michigan's natural resources relies more heavily on results from studies that conducted direct measurements and/or used appropriate models and methods. From those studies, we

found that wake boat waves require at least 400–1,023 feet to dissipate to energies of a typical motorboat at 100–200 feet from the sailing line or have minimal resource impacts.

- The study inaccurately cites other studies, claiming to corroborate findings that a distance of 200' from shore is adequate to allow waves to dissipate to the point where they have little or no impact. Neither Goudey and Girod (2015) or Galmore (2008), two frequently cited studies to support this paper's conclusion, come to that conclusion.

- From Matt Goodrich, Water Environmental Consultants: "The model is not calibrated or validated. Typically models are directly compared to measured data and error statistics are calculated to give the investigator an idea of model accuracy and uncertainty. That was not done in this case, and as a result one can't have any confidence that the model is suitable for evaluating the problem."

- From Yves Prairie, University of Quebec in Vermont: "The authors write: …the key to reducing the impact of wakesurfing is to operate the boat far enough offshore to allow the wake near the boat to dissipate into its component parts where the individual wave heights of the group are reduced to a height less than 28 cm (11 inches). The field test data found 200 feet to be adequate to reduce the wave heights to under 28 cm (11 inches). In comparison to wind generated waves, the wave height of 28 cm is common in a modest wind event on lakes with a fetch of a half mile (0.8 km) at a wind speed of 20 mph (9.0 m/s)." This is misleading. In their critique, Prairie writes, the authors "used this [wind speed] threshold of 9m/s stating that this is a common thing. **This is completely false.** A wind of 9m/s is exceedingly rare. A wind greater or equal to 9 m/s only occurs about 0.025% of the time at the most. For the vast majority of lakes (say 90%), winds greater than 9m/s are extremely rare

- A full critique of the Fay et al. 2022 study can be found here: https://dec.vermont.gov/sites/dec/files/wsm/lakes/docs/Critiques%20of%20NMMA%20CFD%20Study%2020220419.pdf

At the last meeting, a member of the group claimed that the Minnesota study had not had a true peer review. Susan Gallo shared a response from the primary author, Jeff Marr, who responded to an email she sent asking him about the peer review process:

> The research review was refereed by a local consulting engineer who holds his PhD in civil (hydraulic) engineering and is a licensed professional engineer. Dr. Mohseni is a highly respected member of the engineering community and oversaw a robust review of the report. He identified two reviewers willing to review the 100+ page report. To be absolutely clear, no one on our research team had/has any relationship, friendship or collaboration with the two reviewers and this is true even today. The reviewers were selected by the referee purely because they were subject matter experts and were willing to donate the time to review this important research. Both reviewers provided thorough critical review totaling over 200 comments, critiques, and corrections of the draft report. Once receiving these comments, our team carefully revised the report over several months, addressing each of the comments, and ultimately producing the final version published in February 2022. We also provided the referee with a summary of each reviewer comment and how it was addressed in the revised version and these were further

shared with the reviewers themselves. The referee and reviewers concurred we had addressed review comments and gave approval for us to publish the report.

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Helpful citation summary found in MI DNR study:

Table 1. Summary of wake boat effects measured or modeled at various distances from the boat's line of travel, and whether those distances were considered in determining the range of distances at which wake boat waves dissipate to energies of a typical motorboat at 100–200 feet from the sailing line or have minimal resources impacts.

Source	Distance (ft)	Data type	Considered	Notes
Water Environment Consultants (2021)	100	Field data	No	Wave energy from wake-boarding (553%) and wake-surfing (2,546%) greater than monthly maximum wind-driven wave energy.
Water Environment Consultants (2021)	100	Field data	No	Wave energy from wake-boarding (68%) and wake-surfing (581%) greater than cruising vessel wave energy.
Ray (2020)	135	Field data	No	Wake boat wave 9 inches high.
Fay et al. (2022)	200	Mathematical model	No	Claims minimal impacts at this distance.
Water Environment Consultants (2021)	225	Mathematical model	No	Wave height attenuation from wake-boarding to wake boat cruising at 100ft. Note that wave power may still be greater and that wake boat weight and hull design increase cruising wakes, thus this is an underestimate relative to typical boats.
Water Environment Consultants (2021)	300	Field data	No	Wake-boarding wave energy at 300ft similar to wake boat cruising energy at 100ft. Note that wake boat weight and hull design increase cruising wakes, thus this is an underestimate relative to typical boats.
Goudey and Girod (2015)	300	Field data	No	Measured large waves during wake-boarding (9.87in) and wake-surfing (12.92in) in deep water.
Ray (2020)	300	Field data	No	Wake boat wave 7.75 inches high.
Mercier-Blais and Prairie (2014)	328	Field data	No	Energy of wake waves decreased significantly, but not assessed relative to typical motorboat.
Macfarlane et al. (2018)	400	Field data	Yes	Maximum wave height and energy similar to reference motorboats.
Mercier-Blais and Prairie (2014)	492	Field data	Yes	Sediment resuspension observed from wake-surfing.
Water Environment Consultants (2021)	500	Field data	Yes	Wave energy from wake boating (192%) and wake-surfing (679%) greater than monthly maximum wind-driven wave energy.
Marr et al. (2022)	>575	Field data	Yes	Total wave energy similar to reference motorboat at 200ft.
Marr et al. (2022)	>600	Field data	Yes	Total wave power similar to reference motorboat at 200ft.
Mercier-Blais and Prairie (2014)	656	Field data	Yes	Sediment resuspension observed from wake-boarding.
Mercier-Blais and Prairie (2014)	675–938	Mathematical model	Yes	Estimated distances at which a wake boat waves result in equivalent sediment resuspension to normal conditions on two lakes.
Mercier-Blais and Prairie (2014)	879–1023	Mathematical model	Yes	Estimated distances at which a wake boat waves result in equivalent turbulent kinetic energy to normal conditions on two lakes.
Water Environment Consultants (2021)	950	Mathematical model	Yes	Wake-surfing wave height attenuation to typical boat at 100ft.Note that wave power is likely greater and that wake boat weight and hull design increase cruising wakes, thus is an underestimate relative to typical boats.
Mercier-Blais and Prairie (2014)	984	Mathematical model	No	Modeled complete dissipation of wake boat waves.
Ray (2020)	1000	Field data	No	Wake boat wave 4 inches high.

MEETING MINUTES

8-31-23 Wake Boat Stakeholder Meeting Minutes

9-29-23 Wake Boat Stakeholder Meeting Minutes

10-30-23 Wake Boat Stakeholder Meeting Minutes