

# IWSF

International Water Ski Federation

## Environmental Handbook for Towed Water Sports



A Guide to Understanding and  
Addressing Environmental Issues  
A Guide to Understanding and  
Addressing Environmental Issues



The Spirit of Water Skiing



## **FOREWORD**

In 1993 a literature review on water skiing and the environment was published. It was produced as the comprehensive collection, summary and analysis of research into water skiing's interaction with the natural environment.

It was an independent assessment of the research by the UK Centre for Economic and Environmental Department (UK CEED), of Cambridge, England, and the publication was supported by the UK Sports Council.

Now, some six years on it is being taken a stage further by Green & Gold Inc. who nationally and internationally specialise in environmental matters and research in the sport, recreation and tourism industries.

This Environmental Handbook and Guide to understanding and addressing environmental issues and water skiing is produced by them under contract to the IWSF from their own studies, research and concerns for the environment. The International Water Ski Federation, (the IWSF), has been happy to co-operate and provide Green & Gold Inc. access to our environmental library.

The IWSF believes that the two publications illustrate clearly that water skiing can exist with today's, and indeed tomorrow's, environmental standards of performance.

The IWSF encourages everyone involved, manufacturers of boats and equipment, water site owners, public authorities and all those who are physically involved in water skiing and wakeboarding to read the Guide, follow it and enjoy their sport.

## **ACKNOWLEDGEMENTS**

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A special thanks goes to the Ontario Marina Operators Association for granting us permission to use sections of their "Clean Marine Practices Handbook" -- notably the sections on dock management, pollutants and the Clean Marine Policy.

Other thanks go to the many individuals, organisations and company representatives who took the time to answer e-mail, phone interviews, surveys and questions throughout the research phase of this project. In particular, the United States Environmental Protection Agency was a valuable source of research information on off-road engines and scientific studies. Thanks also to OMC (the Outboard Marine Corporation) for the latest information on cleaner engine developments.

# International Water Ski Federation

## Environmental Handbook for Towed Water Sports

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# International Water Ski Federation

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# INTRODUCTION

The International Water Ski Federation (IWSF) and its member organizations recognize the importance of taking care of the environment -- our future, as individuals and as a sport, depends on it. Water skiers have a vested interest in protecting the environment, as the ability to enjoy our sport, and good health, depends on clean, safe and non-polluted waterways.



### Why this Handbook?

The IWSF recognizes that environmental management is an important component of responsible sports management. It acknowledges that the sport of water skiing creates some environmental impacts that must be addressed. As a result, one of the IWSF's priorities for the new millennium is to embrace and implement environmentally responsible management practices. The IWSF encourages its members, the water ski community, and the boating industry as a whole to do likewise.

It is the intention of this Handbook to inspire all members of the water ski community to implement a positive, practical and proactive approach to environmental management.

### OBJECTIVES of this Handbook:

The objectives of this handbook are to:

1. ***Highlight the types of environmental impacts associated with boating and water skiing***
2. ***Offer water skiers, boaters, and club/marina operators recommended best practices and wise boating tips to reduce or prevent these impacts.***

International Water Ski Federation  
Environmental Handbook for Towed Water Sports

**WATER SKIING, BOATING  
and the ENVIRONMENT  
ISSUES and IMPACTS**



# International Water Ski Federation

## Environmental Handbook for Towed Water Sports

### **PRACTICAL STEPS to ENVIRONMENTALLY RESPONSIBLE WATER SKIING and BOATING**

#### **OVERVIEW**

Environmentally responsible water skiing and boating implies respect and care for the natural environment, both on and off the water. To become an environmentally responsible water skier and boater means first being aware of how your actions affect the environment, and second, taking steps to prevent such impacts.



In most cases a simple change of old habits is the biggest step an individual needs to take to make a difference. Here are a few examples:

- Purchase a biodegradable boat cleaner instead of one containing toxic compounds
- Switch your engine lubricant to a biodegradable brand
- Stay as far away from the shoreline as possible when water skiing

For club/marina operators there are comprehensive environmental management strategies available, if desired. One of these models is the internationally recognized ISO 14000 series of environmental management standards. Other sources include your local environmental groups or environmental consultants who specialize in Environmental Management Systems (EMS).

#### **HOW CAN I MAKE A DIFFERENCE?**

Water skiers and boaters play an important role in protecting the environment, both as members of their club/marina and as individual consumers. Simple steps can be taken now and in the future to safeguard the environment.

This section provides a range of suggested steps and best practices for each of the following areas:

**Green Rule # 1**  
**Always respect Codes of Conduct especially with regards to noise control, distance of boat and skier from shoreline, and restricted zones.**

- Green Practices – Members/guests
- Boat Maintenance
- Wise Boating
- Consumer Power
- Fueling Practices
- Dockside Practices
- Waste Prevention

## 1. CLUB/MARINA GREEN PRACTICES

### CODE of Practice:

Your club/marina may already have in place Code(s) of Conduct which specify acceptable boating behavior as well as the responsibilities that go with being a member. Some clubs/marinas may also have specific Codes of Conduct for noise control as well as a general Code of Practice to cover all other aspects.

If your club/marina has such a Code in place you should be familiar with all its restrictions and guidelines including those pertaining to the environment. If no such Code exists, or it does not address environmental issues, then the following pages provide recommended best practices that could be part of any club/marina's Codes (for an overview of Codes of Practice see Appendix C).

### GREEN Practices To Live By – Member/Guests:

The following are some of the more simple habits individuals can adopt:

- Conserve energy when and where possible:
  - > turn off lights if leaving a room
  - > use water conservatively at all times
- Minimize all wastes or garbage brought into club/marina
- Always try to Reduce, Re-Use and Recycle whenever possible (see Waste Management below)
- Seek alternative, environmentally safe cleaning products
- Minimize use of paper when possible i.e. use rags instead of paper towels, double side photocopies, canvas bags instead of paper bags etc.

### GETTING There:

- Carpool whenever possible for travel to the club/marina to conserve fuel and prevent air pollution
- Ride a bicycle or take public transportation to get to the club/marina whenever possible
- If you drive a vehicle do so with the environment in mind - make sure your car engine and tires are in proper working order, and avoid excessive trips to and from the club/marina

## **2. WISE FUELING PRACTICES**

A simple spill at a re-fueling station in itself is not a serious threat to the environment. But when added to hundreds of other spills occurring over a season the effects can be detrimental to some marine and land ecosystems. By adopting some simple and safe practices this unnecessary impact can be prevented.

### **GENERAL Fueling Tips:**

- Carry a spare fuel tank instead of jerry cans or other containers -- this allows you to exchange tanks rather than refilling the tanks while on the water and risking a spill
- Use a gasoline container that you can handle and pour easily
- Use a funnel or spout with an automatic stop device to prevent overfilling
- Fill up your tank before a trip and NOT just before mooring at the dock -- a full tank of gas can expand and overflow in the hot sun
- Check your boat for any leaks of gasoline or oil – follow club/marina Codes of Conduct, or Emergency Response Protocol, for cleaning up spills safely
- Install a fuel/air separator on tank vents where appropriate
- Transport and store gasoline out of direct sunlight in a cool dry place
- Always use caution when pumping gasoline and mixing it with oil
- Follow the manufacturers recommended engine maintenance schedule
- Be a wise shopper – make a list of alternate cleaners and products, and purchase them at the start of the boating season.

### **BEFORE Starting to Refuel a Boat:**

- Ensure that emergency absorbent materials are available including lots of rags
- Do not distract the person filling the tank
- Ensure that the boat is securely moored to the dock
- Estimate the amount of fuel to be pumped
- Locate the air vent and install a special overflow container with suction pads, if available
- Ensure that there is an absorbent donut in place around the filler on deck. Always have a rag on hand. This rag should be placed in a vented container once used.
- Ask the owner to switch off all of the boat's electrical circuits
- Ask the owner to close all ports and deck hatches
- Turn off engines
- Ensure that there is no smoking or open flames in the area of the refueling dock
- Ask the owner to ensure that no persons remain on the boat

### **WHILE Refueling:**

- Use a funnel to prevent spillage if appropriate
- Do not clip the nozzle handle open but hold it during the refueling operation
- Do not walk away from the boat
- Do not overfill. If possible, feel the air vent for increasing pressure as the level nears the top of the tank

- Advise the customer against ‘topping up’. Explain that fuel expands and that the tank may overflow if filled to the brim
- Keep an eye on the air vent. If there is a distinct increase in the airflow the tank is nearing full and fuelling should be stopped. A ‘feel’ for a full tank can be quickly developed.

#### **AFTER Refueling:**

- Remove the overflow container from the air vent and, if necessary, pour the contents back into the fuel tank
- Replace the filler cap and tighten securely
- Return the fuel nozzle to its holder, turning the nozzle upwards to avoid dripping gas between the boat and the holder
- Avoid leaving fuel lines loose on the dock
- Clean up all small spills IMMEDIATELY and place the used absorbent material in a sealed container for proper disposal
- Politely remind the owner to turn on the blower for five minutes before starting the engine

#### **FILLING Portable Fuel Tanks**

- Do not fill a portable tank while it is onboard a boat or in the back of a vehicle. Place the tank on an impermeable pad with catchment and absorbent material ready.
- Do not fill anything other than approved portable fuel tanks
- Do not fill portable fuel tanks beyond their stated capacity. Remember that fuel expands in the heat of summer.
- Ensure that the filler cap is properly secured before the tank is replaced on board.
- Observe the practices for filling inboard fuel tanks where applicable

#### **FUELING PWCs and Small Outboard Motors with Built-in Tanks:**

- Ensure the craft is tied securely before starting to refuel
- Do not fill the tank onboard a small craft that may rock around. If necessary move the craft to calmer water beside or behind the gas dock.
- If practical, before refueling, place motor/PWC ashore over an impermeable pad with catchment and absorbent material. Some club/marinas install floating drive-on PWC docks for this purpose
- Do not overfill the tank. Always leave room for the fuel to expand.
- Ensure that the filler cap is properly secured before replacing an outboard motor on the boat.
- Observe the practices for filling inboard fuel tanks where applicable.

### **3. BOAT and ENGINE MAINTENANCE**

Boat maintenance can cover a range of activities including washing, painting and mechanical repairs. These activities often require the use of chemicals, cleaners or petroleum based products which can end up released into the environment.

Whoever undertakes the work assumes the responsibility to do the job in an environmentally responsible manner. When they do not it is the environment and the club/marina that suffers in the long run.

The following practices should be made known to everyone who is working on a boat on club/marina property. All boaters, skiers and club/marina staff should not only be familiar with these clean practices but make them part of his/her wise boating habits:

Hull and engine maintenance activities most often include:

- Woodworking
- Metal working
- Surface preparation
- Engine work
- Fiberglass repair
- Washing and polishing
- Painting and coating
- Work on mechanical and hydraulic systems

The type of impacts associated with these activities include the release of:

- Metals, metal-containing compounds from paint chips direct or indirectly into the water
- Acids and alkalis directly or indirectly into the water
- Solvents direct or indirectly into the water
- Soaps, cleaners and nutrients directly into the water
- Air emissions including particulates and ozone depleting substances like hydrocarbons
- Generation of hazardous and non-hazardous wastes including used oil, coolant, gasoline and grease, dead batteries, unused cleaners and solvents, and oily rags

### **HULL Maintenance Practices:**

The following practices should be posted in an easy to read site in your club/marina's boat work area:

- Always try to keep the hull clean to reduce friction and conserve fuel
- All exterior hull work done on site by boat owners or outside contractors should have the approval of the management
- Purchase alternate cleaners and products that do not harm the environment and purchase them at the start of the boating season (see E, Tables 1,2,3)
- All hull work should be done in the designated area
- Waste should be segregated and disposed on in accordance with the waste the club/marina's waste management guidelines
- Minimize waste by opening only enough product needed to complete the task at hand.
- Always ensure that dust and particles are collected and do not blow away. To achieve this members should be encouraged to:
  - place the boat over a hard non-porous surface such as a concrete pad
  - place tarpaulins beneath the boat if working over a porous surface
  - use a vacuum regularly to collect dust and particles
  - use dustless vacuum sanders

- always wear personal protective gear
- AVOID working over water
- Use abrasive processes or heat guns to strip off old paint wherever possible
- AVOID the use of solvents for stripping paint

### **MECHANICAL Maintenance Practices:**

- Keep your engine well tuned
- Make sure the right propeller is being used
- Make sure that all mechanical work is done in designated area where spills can be contained
- Always make sure to use the proper oil mix for the motor
- DO dispose of used oils, greases and antifreeze, used oil filters, old fuel and other waste in accordance with the club/marina's waste management practices
- DO keep your engines clean to minimize chance of discharges
- Reuse and recycle all waste materials whenever possible
- DO NOT work on the gas side of air-conditioning systems unless facilities are available to contain and collect the refrigerant and a certified technician performs the work.
- Change oil before winter storage to eliminate residual acids and moisture in crankcase
- Add a fuel stabilizer to fuel tanks before onset of winter to avoid deterioration of fuel and the needless dumping of stale fuel in the spring
- Avoid ethylene glycol anti-freeze as it is highly toxic. Use a low toxic, propylene glycol-type antifreeze specially designed for marine engines.
- Make sure batteries are filled with distilled water and are fully charged. Recycle old ones.

### **BEFORE Starting:**

Make sure suitable containment is in place including absorbent material and separate containers for all fluids, rags etc.

**IF Afloat** – isolate the bilge pump from the automatic switch

Ensure that absorbent materials are in place around the work area when working on hydraulic equipment on deck.

### **WHEN Working:**

Clean all spills immediately and follow all applicable protocols for spills.

Do not wash away spills and do not mix wastes. Use a wash tank for cleaning parts.

### **AFTER Completion:**

Check for leaks

Clean work area thoroughly and deposit wastes in designated containers

### **END of Season**

- Follow the manufacturers recommended engine maintenance schedule

- Prepare boat engines properly for winter storage. Make sure that:
  - batteries are clean, do not leak, and are stored properly
  - a low-toxic propylene glycol brand of antifreeze is used
  - used antifreeze is recycled and stored properly for reuse for the next season
  - tanks are left close to full to reduce condensation and corrosion (room must be left for expansion when temperatures warm up)
  - a fuel stabilizer is added to tank before winter arrives – this prevents deterioration of fuel quality and harmful dumping of old fuel come spring
- If you purchase a new engine make sure it at least meets the US EPA's 2006 standards for hydrocarbon emissions (see Appendix B for details)
- Plan Ahead – make a list of environmentally safe cleaners and products you need to replenish or purchase, and put the list in an easy-to-find place ready for next season's preparations

### **CLEANING, Polishing, and Painting Your Boat:**

There are many ways to clean a boat without harming the environment. One of the best tools at hand is 'elbow-grease' instead of harsh detergents and cleaners. Another is to make sure to purchase products that are environmentally benign and non-toxic whenever possible (see Appendix E for alternative products).

Here are some suggested best practices for cleaning, polishing and painting:

**In some countries, or districts, there are government sponsored programs that identify environmentally-responsible products. Canada has its Ecologo program that has to date certified hundreds of products, including some specifically for the marine market, that in some way or another are more environmentally acceptable than their competitors. Check with your government environment office for a similar certification program.)**

- Use portable high-pressure power water sprayer whenever possible
- DO NOT use high-pressure washers on the slip where paint particles can be washed back into the water
- Use only pure soaps and environmentally-acceptable cleaners for hull washing
- Use cleaners and polishes that have minimal environmental impact i.e.:
  - AVOID using bleach, detergents and soaps that contain chlorine, phosphates, inorganic salts and metals
  - substitute water-based cleaners in place of those that are solvent based
  - use environmentally-safe alternatives whenever possible
- Reduce solvent use by first cleaning area with water, keep containers closed when not in use, reuse used solvents for the first rinse of the spray gun
- Reduce paint use by adjusting spray nozzle to minimize over spray, and use a gravity spray gun instead of a suction cup gun
- Change filters in the paint work shop ventilation system

**Green Rule # 2  
Always try to use alternative, non-hazardous materials whenever possible**

regularly as this reduces emissions and improves dust extraction

### **CLEAN Green Reminders:**

**BEFORE** launch, the boat should be given a thorough cleaning, in an area where run-off will not go into the waterway.

Next, a good coat of **BOAT WAX** should be applied and polished on as this will help prevent surface dirt from becoming engrained in the hull. Re-waxing periodically will keep the boat in excellent condition.

Finally, when **STORING** the boat, give it a thorough cleaning and add a final coat of wax for the season. This will protect the hull and help avoid the use of harsh chemicals come the next boating season. When covering the boat, use an all-weather tarp. They last longer and are less damaging to the environment than shrink-wrap.

### **ANTIFOULING Paints:**

Hard antifouling paints are more environmentally safe than the ablative and the non-ablative (sloughing) brands. However, all commercial anti-fouling paints are made using heavy metals (tin and copper) which are toxic to certain species above natural levels.

### **Anti-fouling Practices:**

- Instead of using an anti-fouling paint use a regular hull paint and a coat of slick non-toxic, bottom wax.
- Do not use paints containing tributyl tin (TBT) except where required and permitted for painting aluminum hulls and aluminum stern drive legs
- Always use the least toxic anti-fouling paint that is compatible with the water conditions (salt or fresh) and the required surface finish
- If anti-fouling paints are used, frequent hull scrubbing should be avoided as excessive amounts of chemicals are released
- Use water-based and high-solids paints in preference to solvent-based paints

## **4. WISE BOATING PRACTICES**

Boating smart is not only safe but it also helps the environment and all those living near the body of water. Operating a boat wisely can lead to fuel savings and in turn less air and water pollution, and it can reduce noise levels which benefits cottagers, birds and wildlife.

**Green Rule # 3**  
**Always try to avoid disturbing birds and wildlife when boating and water skiing.**

### **ECO-FRIENDLY Tips to Boat By:**

- Always try to conserve fuel
- Limit engine operation at full throttle and minimize engine accelerations
- Distribute the boat weight evenly and do not overload
- Adopt practices to keep noise levels to a minimum

- Plane quickly at take-off, then throttle back to cruising speed immediately
- Avoid boating and skiing too close to shorelines to minimize erosion and the destruction of vegetation, and to prevent the contamination of the intake valve
- Avoid, where possible, boating and skiing close to shorelines that may have nesting areas and other wildlife (check your club/marina's Code of Conduct or with operator)
- Make fewer turns so you can reduce motor load and conserve fuel
- Eliminate unnecessary idling
- Avoid shallow waters (less than 1.5 metres depth) where possible
- Clean all debris off your boat and trailer when going from one water body to another
- Always remove water from the compartment bilge and storage areas

#### **Green Rule # 4**

**To prevent shoreline erosion, loss of vegetation cover, and turbidity always try to stay as far away as possible from shorelines, shallow waters, and environmentally sensitive areas.**

## **5. WASTE MANAGEMENT**

Waste management applies to almost all activities associated with boating as most, if not all, generate waste to some degree. It is up to each and every boater and water skier to do their part to keep water skiing a clean and respected sport activity.

### **What is Waste?**

Waste consists of any unwanted products and materials, either hazardous or non-hazardous, and can be defined as:

By-products resulting from processing, manufacturing and/or consumptive activities which cannot, for whatever reason at the time, be recycled or reused and must be landfilled, incinerated or otherwise disposed.

There are basically three classes of wastes; solid, liquid and gas. Each of these can be further categorized as either non-hazardous or hazardous. Non-hazardous solid wastes typically make up the majority of the waste stream and are often the easiest to prevent or reduce.

### **Why Prevent Waste?**

Taking steps to reduce waste means:

- A reduction in the use of raw resources, like paper and fuel oil.
- Cost savings from reduced waste disposal for your club/marina
- Conservation of valuable resources like trees
- Reduced pollution levels in water and air
- Improved image of boating and water skiing to public
- Less visual pollution
- Reduced risk of injury to birds, wildlife and children

### **The 4Rs:**

The best approach to live by to prevent all types of wastes is the "4Rs":

## **Rethink**

## **Reduce**

## **Reuse**

## **Recycle**

The first R, **Rethink**, is all about doing things in a new way. It is a reminder to always think of new ways to reduce waste, to seek new, less harmful methods or products, and to continually ask ourselves how to prevent waste from being created in the first place.

The best way to avoid waste is to **Reduce** it right at the source. Here are 9 simple rules to reduce:

1. Purchase supplies in bulk
2. Purchase materials in re-usable containers
3. Encourage retailers to use minimal packaging
4. Minimize your packaging needs when planning your day on the water
5. Use reusable containers wherever possible
6. Adopt "clean" working practices at all times
7. Avoid buying or using anything described as being "disposable"
8. Use products described as "long-life" (i.e. solar powered) whenever possible
9. Seek out alternative, environmentally friendly products where possible

## **Reuse When Possible**

Products and materials can often have several uses and should be **Reused** as often as possible. This approach requires one to think of alternatives for an item such as converting old clothing into boat rags, using old food or product containers for storage bins, composting food wastes for garden fertilizer.

## **Recycle When Possible**

Find out what types of waste materials (such as plastics or newsprint) are recycled at your club/marina.

Use reusable containers to sort the waste on your boat.

Avoid contaminating the club/marina's recycling containers by carefully placing your recyclable items in the correct container.

### **TIPS to Waste-Free Boating:**

- DO NOT take packaging and other waste onboard
- DO NOT pour waste liquids into any solid waste containers
- DO NOT put waste directly into the dumpster without first checking with the club/marina operators to find out what type of waste should go where
- DO find out if club/marina operators have services to collect all liquid wastes from boats. This is important for preventing contamination of valuable recyclables.

**Green Rule # 5  
(Everything taken out  
on the boat, must come  
back on the boat)**

## HAZARDOUS Waste

All persons who use a club/marina should be aware that some materials are considered dangerous and/or hazardous. Such materials must be handled very carefully, kept segregated from other waste, and disposed of according to strict protocols usually dictated by the appropriate government or state regulations.

**Green Rule # 6**  
**Always know what products are hazardous and handle them with extreme caution at all times.**

## WHAT Qualifies as Hazardous Waste?

A hazardous waste is usually labeled as hazardous in print on the package and by universally recognized symbols, such as a skull with an 'X' or a caution sign. Hazardous wastes are often poisonous and can cause serious or fatal reactions if ingested.

Other ways to determine if a material is hazardous include:

- Examine the Material Safety Data Sheet (MSDS) supplied with the material. MSDS describe the physical and chemical nature of the substance and the methods for proper handling, storage and disposal.
- Check with the club/marina staff responsible for handling hazardous materials
- Contact the retailer or manufacturer of the product
- Contact the local government office responsible for the environment and waste management issues.

## WISE Handling Practices for Hazardous Materials:

- Confirm with club/marina operators the procedure for handling hazardous wastes i.e. location of storage containers, safe work areas for transferring liquids, lock-up areas, holding drums etc.
- Handle all hazardous waste extremely cautiously—have safety gloves, spill rags, and proper containers readily available
- Handle hazardous wastes on land and not on boat whenever possible
- Have First Aid Kit in an easy to access location
- Place materials that are contaminated with a hazardous substance in tightly closed containers of a compatible material (refer to manufacturers instructions or MSDS for guidance)
- Keep hazardous chemicals separated according to their classes
- Keep hazardous wastes in separate containers that are clearly labeled with their contents prior to being disposed of in a proper manner
- Never leave hazardous materials stored on boat – dispose of as soon as possible
- Ensure that the storage location for

**Green Rule # 7**  
**“ALL SPILLS must be cleaned up IMMEDIATELY using the proper absorbent materials contained in the Emergency Spills Kit. Used absorbent materials must be placed into a sealed container and stored for proper disposal. DO NOT place used absorbent materials in the dumpster. Treat gasoline cautiously because of fire risk**

hazardous materials is out of high traffic areas and can be secured from children and public at all times

## **6. CONSUMER POWER**

As a consumer you have the power to influence and set trends by the choices you make at the cash register. Collectively, consumers wield an even greater influence over governments and in turn manufacturers.

The recent introduction of hydrocarbon emission regulations by the United States Environmental Protection Agency acts as proof in point (see Appendix B for details). After years of lobbying by the public and environmental groups demanding better air quality, the US government took action to address the pollution issues with off-road vehicles, including recreational marine engines.

These 1998 regulations have forced manufacturers to produce more efficient marine engines (as high as 40 percent less fuel consumed), reduce hydrocarbon emissions (by as much as 90 percent), and operate with less noise.

As American manufacturers account for over 50% of all marine engines sold worldwide, significant global reductions in hydrocarbon levels can be expected.

### **POSITIVE Trends**

Today, marine engine manufacturers recognize that consumers and regulators demand cleaner and quieter engines. As a result older two-stroke engines are being gradually phased out and a much wider range of four-stroke engines being phased in. More recently, state-of-the-art cleaner direct fuel-injected (DFI) two-stroke technology has reached the marketplace in a number of models of larger engines. Not surprisingly, more consumers are choosing cleaner four-stroke engines and moving toward the newer DFI two-strokes, and an increasing number of authorities in different parts of the world are banning the older models of two-stroke engine.

There is also an increase in the use of the much cleaner burning propane gas fuel, particularly in the United Kingdom and throughout Europe, and the use of synthetic lubricants that require a lower mixing ratio.

The combined effect of these trends will mean significant reductions in hydrocarbon emissions worldwide. They also demonstrate that marine engine manufacturers are taking steps to significantly reduce emissions, and ultimately enhance the public image of water skiing and boating.

### **WHAT Can I Do?**

Today, most major engine manufacturers are already producing engines that meet or exceed the EPA emission standards. Therefore, when purchasing a new engine, make sure you choose one that meets, or preferably exceeds, the USEPA standards. Be a wise consumer and always compare manufacturers' pollution control features -- there may be significant variances in quality or grades of efficiency.

Older engines, on the other hand, can produce less emissions through a retrofit with modern pollution control devices. To significantly reduce emission levels it is essential for owners of older marine engines to service their engines regularly, use cleaner burning reformulated fuels and bio-degradable lubricants, and use the correct gasoline-to-oil ratios.

Whether you have an old, retrofitted marine engine or a brand new one you will not only incur significant fuel savings, but you will be playing an important part in pollution prevention.

### **ECO-WISE Consumer Tips:**

#### **1. Do Your Homework:**

When shopping for a new engine ask plenty of questions. Now that the move towards cleaner and quieter engines is underway, innovations will continue to be made to pollution and noise control features. Some of the best sources of information on what is new in engines include:

- local club/marina operators and staff
- marine engine dealers
- marine engine sales representatives
- local marine engine repair shop mechanics
- boating magazines and journals
- Internet web sites for boats, engines, magazines etc.

- 2. Use leaner fuel** mixtures to reduce inefficient burning. This can be done on existing engines without totally redesigning the engine.
- 3. Use simple direct fuel injection** on existing engines. This modification simply means that the fuel is injected into the cylinder after closure of the exhaust port, thereby almost eliminating unburned fuel emissions.
- 4. Purchase the most advanced two-stroke design** such as the direct fuel injection systems.
- 5. Upgrade** the advanced two-stroke design engine with a catalytic converter once this technology is readily available to consumers.
- 6. Install noise reduction** devices, such as mufflers and engine box insulation, wherever possible on old engines. Make sure the operating level falls within your club/marina's Code of Practice for Noise.

Finally, remember to always live by the **4Rs—Rethink, Reduce, Reuse, and Recycle**. Support your club/marina in the implementation of its Codes of Conduct at all times. By taking small steps and actions we can all make big differences for the betterment of the environment and the sport of water skiing.

## 1. OVERVIEW

Like most human activities, water skiing causes a certain degree of impact to the natural environment in which it takes place. Whether that impact is negative, neutral or potentially even positive is often a matter of some debate. Studies and reports rarely come to the same conclusions concerning either the degree of impact or the relative priority of any one issue as opposed to another. Several major studies undertaken in Europe and the United States conclude that in general, and relative to other boating activities, water skiing does not significantly impact the natural environment. On the other hand, various studies and one book in particular conclude that boating (more so than water skiing) does have a significant ecological impact, particularly in regards to certain environmental issues.

Rather than enter into this ongoing debate, the following pages focus instead on the most commonly cited and studied environmental impacts associated with boating and water skiing, drawn from the literature review.

The objectives of this section are to provide the reader a description of **what** impacts are associated with boating and water skiing, and secondly, **how** these impacts affect the environment as well as human, animal and plant life.

## 2. THE WATER CYCLE— HOW WATER SKIING IS GLOBALLY CONNECTED

What would water skiing be without water, moreover, without CLEAN water?

We are all globally connected through nature's ecological cycles, in particular the water cycle, also known as the hydrological cycle. Through a variety of unique natural processes all of earth's water supplies, be they from rivers, icecaps, oceans or seas, eventually evaporate into the atmosphere to become part of a continuous phenomenon called the hydrological cycle. Those raindrops that cause you to cancel a day of water skiing are actually part of a much larger and vital natural process, one that all living beings depend on for survival.

When unnatural substances, like hydrocarbon emissions from the burning of fossil fuels, enter the hydrological cycle they have a detrimental effect on earth's ecosystems, and human health. This is evident from the damage created by acid rain and greenhouse gases which are the products of human activity.

Acid rain is precipitation that contains a high level of acidic compounds such as sulfur dioxide and nitrogen oxide which come from fossil fuel emissions and some natural processes like volcanism. These compounds react in the atmosphere to produce sulfuric acid, a highly corrosive compound, and ozone, a major factor in the trapping of heat and pollutants close to ground level – the greenhouse effect. Greenhouse gases related to human activity are increasing at an unprecedented rate leading to an overall warming of the earth's surface, called the greenhouse effect or global warming. The principal gases related to human activity include:

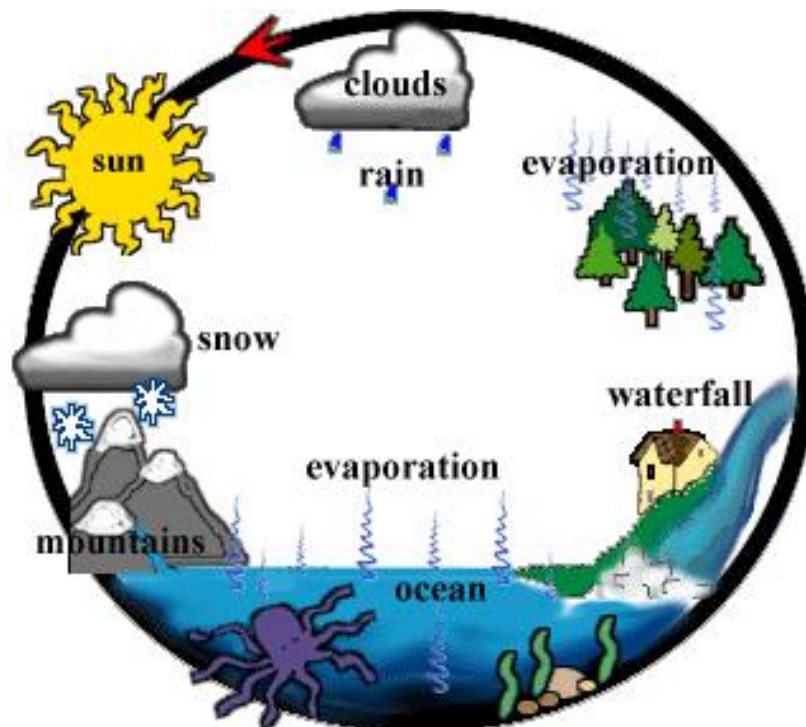
**Carbon Dioxide (CO<sub>2</sub>)** -- the major contributor to the greenhouse effect primarily from the burning of fossil fuel, coal, oil, gasoline, and natural gas

**Methane** – from natural decomposition process involving bacteria and the absence of oxygen -- considered to be about 20 times more powerful as a greenhouse gas than CO<sub>2</sub>

**Nitrous Oxide (NO<sub>x</sub>)** -- from burning of fossil fuels, nitrogen based fertilizers, and some man-made chemicals such as nitric acid

**Ozone** – main component of urban smog caused when volatile organic compounds (VOCs) and NO<sub>x</sub> react with sunlight. VOCs are released from a wide variety of chemicals and solvents

**Halocarbons** – they trap heat in the atmosphere much better than CO<sub>2</sub> – the best known of these is chlorofluorocarbons (CFC) which is known to destroy the ozone layer. The ozone layer protects us from ultraviolet rays that can cause melanoma type cancer and cataracts.



**HYDROLOGICAL CYCLE**

## **MAIN ENVIRONMENTAL IMPACTS ASSOCIATED with WATER SKIING and BOATING**

The main environmental impacts associated with boating and water skiing fall into four key categories:

- 1. Noise – engine and human noise**
- 2. Pollution – chemicals, gases, solid wastes, and biological contamination**
- 3. Geomorphology and Hydrology – shoreline and flora degradation, and turbidity**
- 4. Birds and Wildlife – disturbance and dislocation**

Some of the more common types of impacts associated with these categories include:

- Noise pollution – from boat movement on the water and the club/marina grounds
- Emission of harmful gases, gaseous products and particulates from marine engines
- Emission of hydrocarbons into water body, ground water, lake sediments and atmosphere
- Release of potentially toxic heavy metals in the water
- Increased water turbidity due to the engine, boat and even water skier
- Clogged intake valves from biological contaminants such as zebra mussels
- Creations of excess garbage on land and water
- Disturbance of birds and wildlife due to boating activity and noise

While most of the above impacts are negative, there are also some benefits of both water skiing and boating on the environment.

### **BENEFITS of Water Skiing and Boating on the Aquatic Environment**

In some instances, boating and water skiing can directly **benefit** the ecosystem by adding much needed oxygen to the water body. Studies have indicated that the action of the engine propeller, the boat hull, and the water skier cause an increase in the oxygen content in the water. This in turn can benefit the health and diversity of the animal and plant life living in that water. This oxygenation process is most advantageous in shallow waters, waters that have minimal fresh water exchange and a high incidence of algae growth.

Another benefit of water skiing and boating is the removal of carbon dioxide, and other pollutants, from the water body. This benefit is credited to marine engines with underwater exhausts. As the bubbles containing the exhaust gases are dispersed behind the boat they help to reduce noise and to transport emissions to the surface where they are evaporated. An underwater study done by Outboard Marine Corporation found that air bubbles moving through the water at high speeds can help to degrade certain pollutants.

In narrow waterways, especially canals, a low density of regular boat traffic discourages the overgrowth of potentially troublesome plant species, and helps maintain a diversity of native plant species. In addition, the restoration of disused canals and open pit mining quarries for water based recreation has benefited many types of wildlife and waterfowl.

Furthermore, in some cases the presence of water skiing has led to significant enhancements to the local ecosystems. In one region of the United Kingdom, a local water ski club, together with the region's conservation authority implemented a comprehensive remediation strategy to protect both plants and animals along a stretch of river. Some of the actions taken included the introduction of native plant species, the construction of natural berms and islands, the implementation of strict no-pass zones along certain shorelines, and the creation of a slalom course a safe distance from nesting areas. The enhancements would most likely not have taken place if the water ski club had not initiated them.

## 1. NOISE

When compared with many other types of human activities, water skiing is not particularly noisy. The typical, older two-stroke, 68 horsepower engine, operating under normal water skiing conditions produces a range between 60 to 70 dBAs<sup>1</sup>.

The following values help put this range into perspective relative to other types of common noise pollution:

- 120 dB(A) Discotheque – 1m in front of loudspeaker
- 100 “ Pneumatic drill at 5 m
- 70 “ Telephone ringing at 2m
- 40 “ Refrigerator humming at 2m

Unfortunately, in many parts of the world water skiing still has a reputation for being a noisy and dangerous sport, often more so than other watercraft activities. Recent studies on engine noise undertaken in different countries have shown that the typical water ski boat engine produces a level of noise well below the national standards for noise, and frequently below that of other watercraft.

In recent years, marine engine manufacturers have taken significant steps to reduce the level of noise created by their motors (refer to Appendix B on Marine Engines for more details). This move towards quieter technology should help to counter the image that water skiing and boating are excessively noisy.

### **BWSF's Code of Practice for Noise:**

The British Water Ski Federation has produced one of the most thorough and widely used documents on noise entitled “Code of Practice for Water Skiing & Noise” (1997).

Table 1 reveals the BWSF's standards for noise emissions for water skiing:

**Table 1**  
**British Water Ski Federation's Standards for Noise**

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<sup>1</sup> dB(A) – dB stands for decibel, which is a logarithmic scale used to measure sound. ‘A’ means it is a weighted decibel which is an internationally accepted unit for most noise measurement, and represents the sound pressure level weighted to correspond to the frequency response of the human ear.

Maximum noise emission for one recreational boat:

- 75 dB (A) for boat traveling 22 miles per hour at a minimum of 25 metres from shore

Maximum noise emission for any boat traveling outside an environmentally sensitive area:

- 55 dB(A)

Maximum noise emission for one boat for water ski racing (other conditions stated in Code):

- 98 dB(A) with boat traveling at constant maximum design engine speed, 30m from shore
- 105 dB(A) for international and World Championship IWSF sanctioned events

It is important to remember that noise is a SUBJECTIVE, and SENSITIVE issue -- what is offensive to some may not be so to others. It is wise to approach all conflicts related to noise disturbance with sensitivity. Always respect others' right to peaceful enjoyment of their property and common waterway.

A recent trend of concern is the increase in boat and jet ski stereo systems with large amplifiers. As sound travels much farther on water, skiers and boaters should make sure to keep the volume low and respect other's privacy when on the water. This additional source of noise could be a detriment to the image of boating and water skiing if allowed to get out of hand.

It is responsible boating to always abide by the club/marina's Code of Practice for Noise. If your club/marina does not have a Code, a copy of the BWSF's can be obtained and customized for your club/marina.

## **2. POLLUTION – Chemicals, Gases, Solid Waste, and Biological Contamination**

### **GASOLINE and Oil:**

Despite the best efforts of responsible boaters to prevent water contamination, gasoline and oil exhaust, namely hydrocarbons, are released every time a marine engine operates. Depending on the type of engine used, the degree of such pollution will vary.

Have you ever wondered what a few hours of boating fun and water skiing activity may be doing to the water we swim in and the air we breathe?

On an individual basis the impact of your boat and skier on local ecosystems is minimal. However, over time, and considering the combined effect of thousands of other boaters and water skiers around the world, the impact can be significant.

Consider what the typical marine engine emits from a few hours of water skiing activity.

## A Typical Two-Stroke Boat Engine and its Emissions:

The impact of a two-stroke, 68 horsepower outboard (built before 1997) mounted on a 17 to 21 foot planing runabout boat hull -- at the lower end of boats commonly used by recreational water skiers -- serves as a useful illustration.

During a three to four hour afternoon of water ski and boating activity this two-stroke engine will consume about:

***20 gallons (80 litres) of gasoline and  
3.5 pints (2 litres) of lubricating oil.***

Of this, approximately **30 percent** of the "unbent" (see Table 2) gasoline will be emitted directly into the water during operation.

Estimates for the United States alone are that 567 million to 1.6 billion litres of unburned fuel is exhausted into the environment each year by 12 million gasoline powered pleasure boats (1993 figures).

## SO, What's in Boat Engine Exhaust?

**Table 2  
Boat Engine Exhaust**

**Emissions from two- and four-stroke gasoline and diesel engines includes:**

**Hydrocarbons:** Unbent or partially burned fuel molecules that react in the atmosphere to form ground-level ozone, a major component of smog. Some hydrocarbons, such as benzene, are toxic and may cause cancer or other health problems. Another source of hydrocarbon pollution is fuel evaporation, which occurs when gasoline vapours are forced out of the fuel tank (during refueling) or when gasoline spills and evaporates.

**Particulates:** An exhaust product that comes mainly from diesel-fuelled vehicles. These microscopic airborne particles can damage the respiratory system and contribute to nuisance smoke and odour associated with diesel exhaust.

**Nitrogen Oxides:** Nitrogen and oxygen in the air, when subjected to the high temperatures and high-pressure conditions in an internal combustion engine, form nitrogen oxides. Nitrogen oxides react in the atmosphere to form ground-level ozone and contribute to acid rain.

**Carbon Monoxide:** A colourless, odourless, poisonous gas that results from incomplete fuel combustion.

**Carbon Dioxide:** CO<sub>2</sub> is the ultimate product of burning carbon-based fuel. Carbon dioxide does not impair human health, but it is a "greenhouse gas" that contributes to the potential for global warming. As engine fuel economy declines, carbon dioxide emissions increase.

## **WHAT Happens to Boat Exhaust?**

Hydrocarbons end up in the water column, in the bottom sediments, as surface film, or released into the atmosphere. Atmospheric hydrocarbons are also a prime cause of greenhouse gases and thinning of the ozone layer. Furthermore, both burnt and unburned fuel contain compounds, like polycyclic aromatic hydrocarbons, that are toxic to aquatic organisms and are linked to human illnesses like asthma, cancer, and genetic mutations.

However, there is considerable evidence to indicate that marine engine exhaust does not cause permanent damage to the aquatic environment. In particular, evidence of hydrocarbon accumulation in the sediment is inconclusive, and lead concentration is not thought to be significant. It is therefore most likely that the majority of the exhaust emissions are ending up in the atmosphere, where they are quickly dispersed. This may be good news for the local marine ecosystem but not for global air quality.

## **SOLID Wastes**

All man-made materials abandoned either on land or in the water can be considered waste, or more commonly, garbage. Not only is waste unsightly, it reduces the esthetic appeal of a club/marina and its grounds and waterways, and is a hazard to wildlife, birds and even children. Some wastes, even though they are biodegradable, will persist for many years. Those wastes that are not made of natural materials will either break down and leach minute toxic elements into the soil and groundwater or they will persist for decades and even centuries.

To sort, haul, and dispose of wastes costs the club/marina and governments considerable amounts of money that could be better spent for more productive purposes.

Fortunately, wastes are one of the impacts that club/marina operators can address through a waste prevention plan and Codes of Conduct (addressed in Part D).

Individuals also play an important role in the success of the waste prevention plan. Part C offers several suggestions on ways individual water skiers and boaters can prevent wastes, and dispose of them properly.

## **BIOLOGICAL Contamination**

Biological contamination is a term used to describe unwanted, non-native organisms, both plant and animal, that can invade aquatic ecosystems. Water skiers can unwittingly play a role in spreading these species when boats and watercraft move from one water system to another without taking proper precautions to cleanse themselves of these unwanted "hitchhikers".

The zebra mussel is one such organism that has wreaked havoc in many water systems throughout North America. The mussels attach themselves to boat hulls and propellers, intake and outtake valves, and water ballast tanks and spread rapidly once relocated to

a new body of water. The plant contaminants, such as hydrilla, hyacinth and milfoil, can spread in a similar manner as the zebra mussels.

These organisms also cause an increase in fuel consumption, a decrease in native plant diversity and survival rates, deoxygenation of the water body, loss of fish life and other aquatic species. They can also prevent the safe use of a body of water for recreational activities like water skiing or swimming as the water becomes so clogged as to be impassable. Many of these biological contaminants are difficult and costly to remove.

For additional information on the different categories of pollutants, their harmful effects, and points of control both on and off the water please refer to Appendix A.

## **GEOMORPHOLOGY and HYDROGEOLOGY**

### **SHORELINE Degradation and Turbidity:**

Shoreline erosion, degradation of shoreline flora, and turbid water (unclear or sediment-filled) are natural phenomena resulting from wind action and hydrological activities. They are also directly affected by human, water-based activities such as boating, water skiing, and docking.

Compared to all factors, such as weather and other watercrafts, recreational boating activity has been shown to contribute **minimally** to erosion and turbidity. However, some studies have shown that if water skiing and boating are practised too close to shore, and in environmentally sensitive areas, the impact from boat and skier wash can be significant.

Determining the degree of impact is complex and often involves any combination of factors from the number of boats, to the shape of the boat hull, to the speed of the boat, to the depth of the water, and the distance the boat is from shore.

When considering the causes of erosion and turbidity both natural phenomena and seasonality must be taken into account. Wind action is a major contributor to both and has a greater impact during the winter season when weather conditions can be a great deal rougher. Other factors that will influence erosion and turbidity include the form and composition of the soil, the shoreline gradient, and the degree of natural or artificial protection. The degree of damage can be severe at sites which have unstable soils, or generally weak vegetative growth.

**One benchmark used in parts of North America and Europe is that the minimum depth in which a boat and water skier should operate is 1.5 metres.**

Turbidity is caused when engine propellers and boat wash stir up bottom sediments in shallow waters and the particulates remain suspended in the water column. The degree of turbidity is directly proportional to the depth of the water, i.e. the shallower the water the greater the turbidity levels.

## **BIRDS and WILDLIFE – Disturbance and Dislocation:**

Considerable research has been undertaken in different countries to determine if and how boating and water skiing affects birds, namely waterfowl. Considerably less work has been done on the impacts on wildlife.

In general, the majority of boating and ski activity that takes place 50 metres or more from shore usually does not cause any significant impact to birds and wildlife. However, where the disturbance and dislocation is often the most serious is:

- In narrow bodies of water
- With sensitive species
- When boaters and skiers pass repeatedly too close to shorelines inhabited by birds and wildlife.
- Shorelines with poor vegetative cover

Birds, particularly waterfowl, nest close to shorelines and are especially vulnerable when molting (losing feathers). As each water body will have different characteristics related to types of species, nesting habits, and seasonal factors, it is difficult to generalize on the impacts. However, what is known is that in areas where waterfowl disturbance has been recorded, the types of impacts can include relocation of nesting site, abandonment of nest, and loss of young. There can also be long term impacts as many species of birds that normally would return year after year to the same nesting area are forced elsewhere to perhaps less desirable bodies of water.

In general, measures to protect waterfowl are also beneficial in protecting wildlife.

In summary, it can be said that all of us have a responsibility to ski and boat with care and to show respect for the environment and all the living things in it.

With that goal in mind a universal motto for the water ski community could be:

**“Water ski wisely -- leave only bubbles”**



## **WHAT'S Inside:**

The handbook is divided into the following four main parts:

**Part A – Introduction – to the IWSF handbook and its objectives**

**Part B – Water Skiing, Boating and the Environment – Issues and Impacts**

**Part C – Practical Steps to Environmentally Responsible Water Skiing and Boating**

**Part D – Recommended Environmental Practices for Club/marina Operators**

This handbook is based on an extensive literature review on the impact of water skiing (and boating) on the environment. Most of this handbook's facts and findings are based on conclusions drawn from numerous papers, reports, books, and studies, which can be found in the bibliography. The recommended best practices and practical steps were developed primarily by the IWSF, with contributions made by various individuals and respected water ski and boating organizations from around the world.

## **THE Sport of Water Skiing:**

Water skiing is a sport with many social, economic and health benefits to society. It is unique in that it is a sport where able and disabled persons, and people as young as 5 years and as old as 80 years of age can participate alongside each other. It is a sport that involves more than one person, and is a wonderful family activity that gathers members together for a day of fun at a favorite waterway.

Anyone who has put on water skis can attest to its health benefits – it is a sport that demands and develops strength, agility and endurance. The sport includes several disciplines including slalom, tricks, cable, jump, ski racing, kneeboard, wakeboard, and barefoot, with each of these practiced for either recreational or competitive enjoyment.

Economically, water skiing can be credited with generating capital and employment opportunities worldwide from both direct economic activity and spin-off products and services. The sport plays an important role in the economy, tourism, and culture of many countries around the globe.

## **WATER SKIING Into the Future**

The sport of water skiing has already begun taking action towards reducing environmental impacts, as demonstrated by the creation of this Handbook and through numerous other activities. The most significant step forward for the sport has come from the technological advancements made by the marine industry. Almost all major marine engine manufacturers are today producing engines that emit significantly less hydrocarbons and less noise, with reductions in emissions in the order of up to 80%

recorded by some two-stroke engine manufacturers. As well, there has been a shift away from the more polluting and less efficient older two-stroke engines towards both more efficient and less harmful four-stroke V-8 engines, and most recently toward cleaner more efficient two-stroke models. This trend toward cleaner, quieter, more efficient engines is sure to continue as pollution abatement technology becomes more sophisticated for the marine engine and as pressure from pollution regulators grows. (More on marine engines can be found in Appendix B.)

However, despite the anticipated benefits from technological advancements, there still remains much that can be done by administrators, club/marina operators, event organizers and individual participants to prevent impacts from ever occurring. This Handbook provides numerous tips and suggested best practices to help move our sport towards pro-active environmental management for all. Not only will such practices benefit the natural ecology, they can also result in various other social and economic benefits such as cost savings and enhanced member pride.

Furthermore, a sound environmental approach will assist water ski regulatory authorities in any country to set strategies for the sport's development based on the philosophy of "sustainable development": meeting the needs of the present in a way that does not limit the ability of future generations to meet their needs or harm the integrity of the natural environment. By taking action today, the sport of water skiing will be in a strong position down the road if and when regulatory authorities pass judgement, and set laws, based on the sport's record in environmental protection. Furthermore, an environmental management approach to our sport will help ensure that boating and water skiing are safe activities for both participants and the public. And finally, by implementing sustainable development practices we will enhance the conditions under which indigenous species of flora and fauna will flourish in countries around the world.

The following are just some of the reasons why it is in the best interest of the water ski community to embrace sound environmental management practices.

### **BENEFITS of Environmental Management:**

**Due Diligence** – this is a fundamental requirement of any legal defense against an environmental prosecution. This is especially pertinent for club/marina operators with regards to major spills of fuel and oil into the water or onto the ground. Part of due diligence is the adoption of a regularly updated emergency response plan with which all staff are familiar.

**Regulatory Requirements** – Club/marina operators must be fully aware of all applicable environmental regulations and make sure that they are being met at all times. In some jurisdictions the government's environmental regulatory body has the authority to close down a club/marina if such regulations are not being upheld.

**Reduce Operating Costs** – There are many small ways a club/marina can reduce costs and improve operating efficiencies. One of the simplest of these is waste reduction; an efficient waste reduction plan will ensure minimal waste arrives at the club/marina, which in turn results in reduced clean-up and waste haulage costs.

**Fuel Savings** – Modern two-stroke marine engines (models built after 1997) burn, and emit, significantly less fuel than their predecessors. In fact, the new engines burn up to 40 percent less fuel than the traditional two-stroke engines. This improved efficiency results in considerable fuel savings for boaters and benefits the environment by substantially reducing hydrocarbon emissions.

**Public Relations** – A clean, well-run marina will go a long way to improving public perception and the image of boating and water skiing in general. It also has the ability to improve the marketability of special events or competitions to potential sponsors.

**Property Value** – Property value relies largely on its salability. Many banks and lending institutions require environmental site assessments to be undertaken before financing. Sound environmental practices will help prevent spills of toxic substances or other types of environmental mishaps, which could reduce the value of the property.

**Legacy** – Taking steps today to protect the environment is the right thing to do for many reasons but especially because we owe it to the generations of tomorrow. Not only do we have a responsibility to clean up past damage, but also to prevent further contamination and pollution. This approach will help ensure that the sport of water skiing will exist for years and years to come. It is not unrealistic to imagine watching our grandchildren water ski behind a boat that only leaves bubbles in its wake.

This handbook is one tool which the IWSF encourages its members to use both at the national and the club/marina levels to help bring the sport of water skiing to the highest standards of environmental performance. This endeavor will not only benefit clubs/marinas and water skiers locally, but it has the potential to bring about positive change for the global environment.

The IWSF hopes that you, as a member of the international water skiing community, will find this handbook useful in identifying ways in which to improve your environmental management practices. By doing so, you and thousands of others at all levels will continue the sport's movement toward increasingly sustainable practices.

International Water Ski Federation  
Environmental Handbook for Towed Water Sports

RECOMMENDED BEST PRACTICES  
for  
CLUB/MARINA OPERATORS



## OVERVIEW

If you are a club/marina operator and are looking for practical advice on environmental management strategies, this section will help you get started.

The term 'environmental management' is used broadly to describe the process of managing an activity or program that ultimately has one or more benefits for the natural environment. This can be as simple as providing a spill prevention course for club/marina staff to implementing a comprehensive top to bottom Environmental Management System (discussed below).

Regardless of the extent of the program, the important fact is that steps are being taken today to minimize the environmental impacts of tomorrow.

## ENVIRONMENTAL MANAGEMENT GUIDELINES

### Environmental Management System (EMS):

If a comprehensive, top to bottom management approach is what your club/marina requires, then an Environmental Management System (EMS) is an excellent tool to help you achieve a high level of environmental performance.

Today, organizations of all types and sizes are implementing EMSs. There are several options as to how to implement an EMS. They range from hiring a consultant, to doing it on your own, to being part of a government or university case study program. There are also journals, publications, and public information on EMS from environmental groups and government agencies. The challenge for you, the operator, is in the practical implementation of an EMS.

An EMS guides the user through a series of logical, interconnected steps based on well thought-out goals and objectives intended to address one or more environmental issues. While there are minor variations in different EMS models, they are all very similar in the main components and overall objectives.

The following is an outline of the main components of an **EMS** model:

- **Management Support** – ensure that all key decision-makers endorse the program?
- **Statement of the Issue** – develop clear definition of the issue and its impact(s)
- **Program Leader** – point person who drives program and oversees its progress
- **Regulations** -- list all that apply to issue and incorporate into strategy
- **Goals and Performance Targets** – establish realistic goals and performance targets for each issue
- **Implementation Strategy** – develop strategies to meet performance targets within a time frame?
- **Performance Measures** – establish benchmarks by which to measure progress
- **Resource Needs** – determine resource requirements within a realistic time frame
- **Observe and Record** – monitor progress and maintain accurate records

**Remember, the greater the preparation, the more likely the program is to be a success**

- **Educate and Communicate** – *inform and educate staff, members, other stakeholders about issues, strategies, and how they can contribute to the program*
- **Review and Improve** -- *establish regular review periods and make changes as needed*
- **Fund Raising and Promotion** – *develop strategies to fund and/or promote the program if necessary.*

## **BEST PRACTICES for CLUB/MARINA OPERATORS**

Preparatory work is important as it helps prevent misunderstandings and setbacks, and lays a foundation for long-term program success. It can also have other additional benefits such as cost savings, overall improved operating efficiencies, improved public image for club/marina, and enhanced member pride.

The following headings cover the main areas of operation for club/marina operators, and include suggested best practices for preventing or minimizing environmental impacts.

### **1. CODES of PRACTICE**

One of a club/marina's best security blankets is its Codes of Practice. Codes provide members and the public a clear understanding of the club/marina's guidelines, restrictions, and rules of membership for safe, responsible boating.

#### **WHY Have Codes Of Practice?**

Codes of Practice are invaluable tools as they:

- Set the boundaries of acceptable behaviour both on and off the water
- Demonstrate the marina's commitment to the environment
- Help reduce the marina's liability and risk
- Demonstrate the marina's commitment to safety both on and off the water
- Demonstrate to the local community that the marina upholds principles of sound management and respect for the environment
- Demonstrate sensitivity and respect for neighbours and other waterway users
- Demonstrate a level of professionalism and due diligence many potential sponsors value

All Codes of Practice should be posted in the clubhouse and dock areas, and communicated regularly through the appropriate club/marina publications. As part of a Code, some clubs/marinas have developed policy statements and agreements for members to sign that demonstrate a commitment to clean and safe boating practices. A sample of such a policy and agreement can be found in Appendix E.

For a sample outline of a Code of Practice, produced by Britain's Sports Council, and a Code of Conduct for Noise, produced by the British Water Ski Federation, refer to Appendix C.

## 2. ENVIRONMENTAL REGULATIONS:

To reduce and eliminate risk and liability a club/marina must be fully aware of **all** environmental legislation and regulations related in any way to its activities, services and products. This also includes proposed or draft legislation.

Not only does this awareness help the marina address environmental liability issues, but it also provides lenders, employees, and other stakeholders evidence of sound environmental performance. Management is advised to check with local authorities and government agencies on a regular basis to make sure that they are current on proposed legislation.

**Green Rule # 8:  
Environmental regulations should be updated regularly, and where appropriate, posted for staff and members to see**

All regulations and by-laws which affect boaters, water skiers, and members should be posted, printed in marina literature, included in member contracts, and updated regularly.

## 3. ECOLOGICAL ISSUES – Addressing the Impacts:

Operators should at a minimum be aware of the types of ecological impacts associated with the club/marina's land and water-based activities. With some issues, and in certain bodies of water, these impacts may be well known and documented, while with others there may be no awareness or history of reporting.

It is to your advantage to be as knowledgeable as possible about the impacts – not only will it demonstrate a level of responsibility but you will also be prepared to respond publicly if the issue were to become controversial. It also provides you with a strong base of knowledge when the time comes to choose a strategy to minimize or prevent the impact.

It is helpful to put together a list of the most commonly known impacts and start a file on each. This is a great opportunity to seek input from other "stakeholders"/interested parties, such as members, the local cottage association, or conservation group, and invite them to be part of an environmental team.

If more information is required on an impact, the following sources may be helpful:

- Government bodies responsible for environment and land use –all recent biological and environmental reports undertaken on area
- Local library
- Local and/or national environmental groups
- Local and/or national conservation groups
- Local and/or national interest groups
- Private developers that have worked near shoreline or in general vicinity
- Universities or Colleges – potential source for biological or environmental studies

Maintaining files on each impact is beneficial because they:

- Provide management with a recorded history of the issues
- Reduce the marina's environmental risk through sound record keeping
- Involve stakeholders, and potential funding partners, in pursuit of common environmental goals
- Influence the type of remedial steps taken
- Can be used as educational material for teaching young and old boaters and skiers

**Perhaps an environmental resource library could be started at the club/marina - great for school-age water skiers and boaters**

If you are not sure where to begin, you may want to consider one or more of the following:

- Hire an environmental consultant to perform study and develop recommendations
- Undertake work on your own with professional input where necessary
- Seek assistance from affiliated organizations, such as your national water ski federation, the IWSF, or other boat or ski groups
- Partner with academic institutions to undertake study (i.e. a graduate degree project)
- Approach local government for funding or to undertake study

If your time and resources are limited, a volunteer committee could be struck to manage the program. If well organized, a volunteer program is not only cost effective but it provides people opportunities to get involved. However, as with staff, a volunteer driven program still requires guidance, direction, review and recognition on a regular basis.

#### **4. DOCK and YARD MANAGEMENT**

Dock and yard management is an important issue for a club/marina as they are two of its most visible assets. They are also the busiest, and potentially the most hazardous areas of the club/marina. Sound dock and yard management is not only important for environmental and safety reasons, but also for attracting new business.

Typically, the dock area provides the following services to the club/marina:

- Fuel dock
- Pump-out facility
- Launching and Storage
- Grounds Maintenance
- Water body usage i.e. water skiing

Each of these services has the ability to affect the environment and therefore they are addressed individually.

##### **FUEL Dock:**

One of the most common and severe risks that occur in the dock area is the spill of **hydrocarbons** (oil, gasoline, and diesel) in the water, on land, and in the atmosphere

(see Appendix A for details of impacts). Another risk in the fuel dock area is fire - a potentially devastating threat intensified by poor fueling techniques.

The following are recommended best practices for dock management:

#### **SAFE Practices for Dock Managers:**

- List proper re-fuelling practices including safety issues
- Comply with the requirements of relevant fuel handling codes and regulations
- Provide clear instructions for reporting spills
- Indicate location of absorbent materials and instructions for their use
- Make sure instructions are readily visible to boaters

#### **GENERAL Rules for Pump-Out Facilities**

The following are some basic rules for the management of pump-out facilities:

- The pump-out facility shall be available and in good operating condition at all times. If it is not, customers should be asked to inform management immediately
- Customers should be informed of what practices are and are not permitted
- Ensure that the tank is pumped out regularly – don't wait until the tank is full before calling a licensed sewage haulage contractor
- If a pump-out facility is not on site, management must indicate the nearest location
- Suction and washout hoses should be clearly marked and their storage position clearly labeled. Coil and hang the wash-water hose beside a sign which states that the water from that hose is NOT A DRINKING WATER SUPPLY
- Location of onshore toilet facilities should be clearly indicated
- Check the pipes from the dock pump-out station regularly for damage and leaks

#### **LAUNCHING and Storage:**

Some of the impacts associated with **launching** and **retrieving** boats include the release of hydrocarbons (gas, oil, and diesel) and heavy metals into the water, atmosphere and on the ground. Also, the transfer of unwanted marine organisms, or biological contaminants, can be prevented before boats are put onto the trailers.

The following are some best practice tips for safe launching and retrieving:

- Keep fuel, oil, grease and heavy metals out of the water
- Help members reduce their launching time whenever possible. Explain that oil, grease and other contaminants may drip from the hull into the water
- Remove boats from the ramp as quickly as possible to minimize oil and grease spills
- Avoid leaving the travel hoist parked over the haul-out dock when not in use to minimize the chance of hydraulic oil and grease dripping into the water. The hoist must be well maintained to prevent leaks.

- Boats should be removed from the haul-out slip area to a designated wash area before hulls are power washed. Only light hosing or hand washing should be done in the ramp and haul-out areas
- Encourage members to keep trailers well maintained and free of excessive oil and grease
- Encourage members to use vegetable-based greases for trailer wheel bearings

Similarly, **storage** of boats and liquids can also lead to release of hydrocarbons and heavy metals due to leaks. And, the storing of boats can be done without the creation of unnecessary solid wastes.

The following are some best practice tips for boat storage:

- Ensure stern drive units and outboard engines are not leaking
- Place drip trays under grease-filled stern tubes
- Place drip trays under stern drives and outboards
- Add inhibitors to the gas tank before long term storage to stabilize the fuel
- Ensure that fuel tank suction line valves are closed where appropriate
- Encourage boat owners to use tarpaulins or invest in a canvas boat cover that can be reused over and over
- If possible, restrict the use of shrink-wrap in the absence of a recycling contract with the supplier as part of the standard service
- If shrink-wrap is being used, be sure to tape over all fuel vents before igniting heat gun

**As an added incentive members could be offered free storage of tarpaulins as part of their storage of cradles contract**

For the storage of **liquids** make sure to:

- Check the condition of fuel lines to the gas dock
- Check the condition of above ground tanks and secondary containment walls for damage and/or corrosion
- Check that the drain valves to the secondary containment are kept closed
- Verify that the fuel pumped at the gas dock corresponds to changes in tank levels. This should be done on a daily basis during the season and once a month out of season. When dipping, look for water in the tank as well as checking the fuel level
- Always have someone standing by when fuel tanks are being refilled

## 5. GROUNDS MAINTENANCE

The grounds of a club/marina include everything from roads, parking, and outdoor storage to drainage, grass, buildings and utilities.

The following are some suggested best practices for grounds maintenance:

- Allow the grounds to grow as naturally as possible and explain this to the members
- Avoid or at least minimize the use of toxic herbicides and pesticides for weed and insect control – use biological means of control whenever possible
- Do not cut grass more often than necessary and leave all grass at least 5cm long

- Cut grass only where necessary for recreational purposes
- Do not water more often than absolutely necessary
- Maintain a natural buffer area wherever possible between marina and the shoreline. This will help to restrict storm-water runoff and will improve visual impact of club/marina
- Keep storm-water gullies clear of debris and grass well groomed
- Encourage members to enjoy the wildlife that will be attracted
- Ask members to avoid throwing food and fish scraps that may attract unwanted wildlife pests. Also, discarded fish parts can lead to a reduction in the oxygen content of the water and foul smells
- Provide members a fish cleaning station with a closed lid container for fish scraps.
- Ensure that fish cleaning station has running water and filtered drain that leads into sewer drain—do not allow fishy water to drain into water body
- Provide members with baggies for cleaning up after pets and encourage them to take pets far from recreational and work areas
- Collect and properly dispose of garbage regularly
- Maintain granular surfaces to maximize storm water absorption and minimize runoff
- Use only vegetable-based liquids (such as black liquor from the pulp and paper industry) or calcium for dust suppression.
- Use only environmentally acceptable cleaners and disinfectants for buildings and washrooms – avoid flushing any chemicals as they may be toxic to the bacteria that keep a septic system functional.
- Avoid using any air conditioning units that produce chlorofluorocarbons (CFCs)
- Do not let refrigerant gases be released during maintenance of air conditioning units
- Maintain all machinery in good working condition and repair all leaks immediately
- Provide drip trays or other containment wherever leaks occur in machinery
- Use vegetable-based greases where possible

**Check with local gardening shops or agricultural departments of universities or governments for alternative methods of weed and pest control**

## 6. WATER BODY USAGE

We all have a responsibility to keep the water body in as natural, and clean a state as possible. While the majority of the evidence finds that boating and water skiing has a minimal impact on aquatic ecosystems, there are also studies that find that boating activity can have a significant impact on certain aquatic environments.

The following are suggested best practice tips to prevent damage to the water body:

- Do not allow members to operate boats, or water ski at high speeds in shallow waters (a minimum level in some areas is 1.5 metres) – not only does it cause turbidity and destroy fish habitats, but it is very dangerous where there are swimmers in the water
- Put in place no-pass zones to prevent shoreline erosion from wash especially if shorelines do not have natural or artificial reinforcement or protection barriers. It can also damage boats moored on outer docks of some club/marinas

- Put in place controls to prevent excessive noise (as in Code of Conduct for Noise)
- Inform customers that they are responsible for their own waste management and request that they use the club/marina facilities and containers for appropriate wastes
- Introduce a Safety Education Program for water skiers and boaters
- Create an Awards Program to recognize members for excellence in boat and ski safety and environmental responsibility.

To control **aquatic plant growth** around dock and the shoreline certain precautions can be taken including:

- Obtain appropriate permits for weed removal from government, if necessary.
- Keep plant removal to a minimum—in some areas the removal of a small amount can have a detrimental effect on a marine environment
- Be aware of periods when fish spawn in order to protect spawning habitats
- Avoid use of herbicides and pesticides – some jurisdictions ban such chemicals
- Use mechanical methods, such as boat-mounted cutters, to cut back excess plant growth where possible and practical. The plant debris should then be collected and composted at a suitable composting site away from recreational areas.
- Dredging should be avoided as much as possible – it destroys habitats and breeding areas for fish, amphibians and other organisms. It can also disturb harmful contaminants that may have settled in the sediments and affect water quality
- All dredged material must be disposed of on land and suitably contained to prevent it from washing back into the water

**Green Rule # 9**  
**Always strive to keep the water body in a clean, natural state and prevent damage to shorelines and all types of natural habitats**

**Weeds that have been removed can be composted, used as mulch or given away to local gardeners for fertilizer**

## 7. WASTE MANAGEMENT

Implementing a waste prevention program is usually simple and, if done correctly, cost effective. The 4R philosophy should be promoted and members encouraged to reduce wastes in every way possible.

A waste prevention program can provide the following benefits:

- Reduction in use of raw materials
- Cost savings from reduced waste disposal fees
- Conservation of valuable resources
- Reduced pollution and enhanced visual impact
- Improved public image and employee pride
- Compliance with regulations and reduced liability

### The Waste Audit

One of the best steps to take before implementing a waste management program is to conduct a waste audit at your club/marina. This is a simple procedure that will tell you

what categories of waste are being generated and in what volumes. The findings become the benchmarks upon which realistic waste reduction targets can be set and measured against.

For an outline of a waste audit please refer to Appendix D.

### **WASTE Collection -- Non- Hazardous:**

Once management has determined what the waste categories will be, separate containers for garbage, recyclable materials, and reusable items should be set up side by side, at convenient locations around the marina.

Members and other club users should be encouraged to participate in the recycling program. This requires plenty of easy to read informative signs and containers placed in convenient locations. This program also demands that the containers be emptied on a regular and/or as needed basis.

### **WASTE Management Practices for Operators:**

- Ensure that containers have lids that are in place
- Ensure that containers for recyclables are clearly labeled
- Ensure that containers are emptied into the dumpster regularly
- Keep collection areas neat and tidy
- Ensure that lids on dumpsters are kept closed
- Ensure that dumpsters drains are kept closed
- Call the waste hauler for pick-up before the container is completely full
- Always set a good example by picking up waste and keeping the marina premises tidy.

### **MEMBERS and Customers:**

- Members should be discouraged from taking packaging and other waste onboard.
- Members should be offered onboard containers for their recyclables
- Do not allow members to pour waste liquids into any solid waste containers
- Do not allow members to put waste directly into the dumpster. Management should know and control what goes into the dumpster.
- Management can offer a service to collect all liquid wastes from the boats. This will prevent contamination of valuable recyclables and of dumpster

### **WHAT Qualifies as Hazardous Waste?**

A hazardous waste can be either liquid or solid and is usually labeled as hazardous in print, by universally recognized symbols. The other ways to properly identify a hazardous waste include:

- Examine the Material Safety Data Sheet (MSDS) supplied with the material. MSDS describe the physical and chemical nature of the substance and the methods for proper handling, storage and disposal.
- Contact the manufacturer of the product
- Contact the local government office responsible for the environment and waste management
- Obtain a copy of a registration guidance manual for generators of liquid industrial waste and hazardous waste usually available from government offices.

#### **SAFE Hazardous Waste Handling Practices:**

- Register as a generator of hazardous waste (depending on local government regulations)
- Ensure that the hazardous wastes are collected regularly by a registered hauler
- Ensure that each shipment is properly manifested.

#### **WISE Storage Practices for Hazardous Materials:**

- Place materials that are contaminated with a hazardous substance in tightly closed containers of a compatible material (refer to MSDS for guidance)
- Keep hazardous chemicals separated according to their classes
- Keep hazardous wastes in separate containers that are clearly labeled with their contents prior to being disposed of in a proper manner
- Minimize the amount of materials stored on site
- Ensure that the storage location for hazardous materials is out of high traffic areas and can be secured from public at all times

The contracted waste hauler should be asked to assist in the preparation of both the waste generator registration report and the manifests. This co-operation will be of benefit to both parties in ensuring that the documentation correctly identifies the waste to be transported.

#### **WASTE Collection – Hazardous Waste:**

All persons who use a marina should be aware that some materials are considered to be hazardous wastes and are regulated accordingly. Such materials must be segregated and collected separately.

Management would also be wise to check periodically with local environmental organizations for suggestions on alternative products, and where applicable, with government departments that have a labeling program for environmentally approved products or services.

## **9. ENERGY CONSERVATION**

One of the best ways to determine if a club/marina could be more energy efficient is to undertake an energy audit. The audit should be carried out by someone with an

understanding of the various energy systems of the club/marina, or by an energy consultant. In many countries there are private companies who will undertake an audit, retrofit a facility, and arrange for financing based on the savings accrued over time from the retrofit.

To find such an energy consultant check with your local government agency, hydroelectric commission, or energy association. A search of the internet may also prove worthwhile.

### **ENERGY Efficiency Practices:**

Management should have a good understanding of what operations consume energy, how much energy is used, and at what times during a 24-hour period. An energy audit is the best way to reveal this, while simple things, like monthly hydroelectric bills, can help pinpoint general energy consumption practices.

The following are some energy saving tips for a club/marina and its facilities:

#### **DOCK Area:**

- Provide a metered electrical supply to individual docks to encourage energy savings
- Provide customers with magnetic identity cards to use the toilet facilities where possible
- Turn off unnecessary lights--operate area lighting on automatic timers or motion sensors

#### **OFFICE:**

- Turn off unnecessary lights--operate area lighting on automatic timers or motion sensors
- Use only enough wattage per bulb as necessary
- Turn off all computers and other office machines when not in use
- Use high quality, energy efficient lighting throughout offices – compact fluorescent bulbs use 70% to 80% less energy than regular light bulbs
- Plant deciduous shade trees near windows to reduce demand for air conditioning in summer, and heat in the winter months by allowing sun through windows
- Attach awnings outside and curtains (or blinds) inside to reduce demand for air conditioning and heat in summer and winter months
- Use fans instead of air conditioning if possible – fans use less energy and do not contain the ozone depleting coolants that many air conditioners require (like chlorofluorocarbons)

#### **YARDS and Grounds:**

- Where possible, use hand operated equipment over power tools or vehicles
- Let grass areas grow longer and cut less frequently to reduce use of electric mowers

## 10. OTHER KEY SUCCESS FACTORS

### **EDUCATION and Communication Programs:**

Effective education and communication strategies can be critical to the success of an environmental program. They inform members and in turn encourage them to participate. They can also ensure a minimum level of compliance by all, and make the enforcement of Codes of Conduct by management and staff much easier.

Water skiers and boaters need to know what the environmental issues are, and how their activities contribute to the impacts. And importantly, they need to be informed in a constructive way as to what steps they can take to prevent further impacts.

A **Communications Committee** made up of volunteer members is one way to develop a communications strategy. This committee would be responsible for making sure that the correct messages are getting out and in a timely manner.

Some of the information vehicles at their disposal may include:

- Provide regular updates to members through club/marina newsletter
- Ensure a staff member is on the Committee to ensure all staff are informed
- Create an environmental section on club/marina notice board
- Use posters and flyers
- Make announcements over public service system
- Place inserts into regular club/marina mail outs
- Use member internet e-mailings and a club/marina web site
- Annual reports

The Communications Committee can oversee a staff awareness program and make sure that required protocols, like Emergency Spill Plans, First Aid, or Hazardous Waste Management Procedures are updated, well communicated, and visible to all affected.

Management and its Committee members may also want an **external communication plan** to inform sponsors, the boating/water ski public, and other stakeholders about the environmental programs. A separate mailing may be the way to communicate with some of these audiences, or any of the above listed vehicles could also be used.

### **MONITOR and Review:**

In order to assess a club/marina's environmental performance, regular record keeping should be maintained. This will provide results, allow managers to spot weak areas, and provide the benchmark for setting new goals.

Furthermore, a regular review period of all environmental programs is wise as it will help club/marina operators measure performance, control spending, and ensure that performance targets are being met.

### **RECOGNITION and Awards:**

Last, but certainly not least, is a reminder to recognize all those who contribute to the environmental management program. Some organizations create awards to recognize

staff and volunteers who made a valuable contribution to an environmental goal. Some possible awards include:

- Best Boat Driver
- Lowest Marine Engine Emission
- Quietest Marine Engine
- Green Volunteer Award

An environmental management program is an excellent way for a club/marina to introduce a range of stakeholders to the world of water skiing and boating and strengthen bonds within the community. Their assistance can sometimes make an environmental program truly successful. Expressing gratitude to these persons is not only the right thing to do, but good public relations for the club/marina and the sport of water skiing.

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### APPENDICES

**Appendix A - Types of Pollutants and their Impacts**

[Appendix B - Marine Engines and Fuels](#)

[Appendix C - Codes of Practice](#)

[Appendix D - Waste Management Program](#)

[Appendix E - A Sample "Clean Boating Policy"](#)

[Appendix F - References and Resources](#)

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#### APPENDIX A

#### TYPES OF POLLUTANTS AND THEIR IMPACTS

##### Hydrocarbons -- Gasoline and Oil Emissions

**What are Hydrocarbons?** Hydrocarbons are products derived from crude oil and include gasoline, diesel fuel and most oils and greases.

**Why are they harmful?** They are toxic to humans and some species. Being less dense than water, they float on the surface and smother marine larvae that need to breathe at the surface. This loss can impact the water body's food chain of species. In their gaseous state, they contribute to ground level ozone that is a major component of smog. Smog, or air pollution, is known to cause asthma and cancer in humans.

**Points of Control:** Boat engine operation (through Codes of Practice), Gas docks, pumping bilges, machinery service, engine tuning, and transfer of fuel tanks.

##### Air Emissions

**What are they?** There are five main classes of atmospheric pollutants, namely particulates, ground level ozone, carbon monoxide, hydrocarbons, nitrogen oxides and sulfur oxides. They originate from three processes: combustion, vapourization and mechanical abrasion and wear.

**Why are they harmful?** As contaminants in the atmosphere these air emissions are highly toxic to plants and animals; consequently, they directly disrupt the ecosystem. These contaminants cause local problems, including summer smog. They are also responsible for acid rain, global warming, ozone depletion and the 'green-house' effect.

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**Points of control:** The operation of engines and furnaces, fuel filling and storage, mechanical service and maintenance work, engine tuning, and use of some aerosol products.

### **Bacteria and Viruses**

**What are they?** Microbial organisms contained in human and animal sewage.

**Why are they harmful?** They include bacteria and viruses that are directly harmful to human health. Illnesses resulting from ingestion of polluted water include diarrhea, dysentery, hepatitis and salmonella.

**Points of control:** Pump-out station, black water holding tanks and overboard discharges (especially the “Y” valve release system); septic systems, grounds maintenance.

### **Sediments**

**What are they?** Suspended particulate matter from bottom of water body that causes water turbidity. Particulate matter washed off the land into the water column.

**Why are they harmful?** They contain organic material that uses up the water’s dissolved oxygen in their decomposition process. An increase in the turbidity of the water reduces the amount of light getting into the water column and in turn reduces the growth of submerged aquatic vegetation. They also cause an increase in phosphorous concentrations that can lead to increase in algae, chlorophyll concentrations, and gross oxygen production.

**Points of control:** Boat engine operation (especially in waters less than 2 metres); stormwater management system; dock and shore area where boats and other vehicles may be washed; garage and repair shop areas.

### **Metals including Anti-fouling Paints**

**What are they?** Metals and metal-containing compounds have many marine applications including use as fuel additives (lead), paint pigments (arsenic), wood preservatives (arsenic), corrosion protection (zinc), anti-fouling (tin and copper), construction materials (iron, aluminum and chrome).

**Anti-fouling paints** – these are used widely by all boaters as they protect the hull and improve fuel efficiency. They are made using metals which can be carcinogenic and toxic to both marine and land animals, and humans. Tributyltin (TBT) was the major biocide used before being banned in the late eighties in most developed countries because of its toxicity, specifically to shellfish.

**Why are they harmful?** Above certain concentrations metals are toxic to humans and aquatic organisms. They are bio-accumulative and may eventually reach concentrations in the food chain where they are toxic to larger species, like humans.

New anti-fouling paints are being made using copper. Copper ingestion above natural levels can prove toxic to certain marine organisms.

**Points of control:** Boat engine operation, fuel dock, engine and hull maintenance area, retail store, water and wash areas.

### **Solvents**

**What are they?** Chemicals used as cleaners, degreasers, thinners for paints and lacquers, including substances such as trichloroethylene and methylene chloride.

**Why are they harmful?** Many are known carcinogens. Being relatively stable, they are insoluble in water and tend to accumulate in the ecosystem.

**Points of control:** Machinery and hull maintenance areas, retail store

### **Antifreeze**

**What is it?** Ethylene glycol or propylene glycol used in engine cooling systems to prevent freezing during winter storage

**Why is it harmful?** Both types can be harmful to humans and aquatic organisms.

**Points of control:** Machinery service, boat storage areas, and retail store.

### **Acids and Alkalis**

**What are they?** Acids are used as the electrolyte in batteries and occasionally as straight cleaners. Both strong acids and alkalis are often the main constituents of cleaning compounds and detergents.

**Why are they harmful?** They are toxic if ingested. Acids in particular will dissolve other contaminants such as heavy metals, resulting in indirect toxicity to humans and aquatic organisms.

**Points of control:** Machinery and hull maintenance areas, dock area, and retail store.

### **Surfactants**

**What are they?** Chemicals added to detergents to reduce surface tension.

**Why are they harmful?** Some, such as alkyl benzene sulfonate (ABS), are chronically toxic to aquatic organisms. Surfactants can form a film on the surface of water and reduce oxygen transfer at the air/water interface.

**Points of control:** Any process that generates grey water

### **Nutrients**

**What are they?** Chemical elements, primarily nitrogen and phosphorous, that are essential for aquatic plants and algae to grow and reproduce. They are found in many soaps and detergents and are the main working ingredients of fertilizers.

**Why are they harmful?** In excessive concentrations they may stimulate nuisance growths of some plants and algae. Excessive growth and decay of plants lowers dissolved oxygen concentrations and reduces water clarity.

**Points of control:** All processes that generate grey water containing soaps and detergents; ground maintenance (especially fertilizers).

### **Solid Wastes**

**What are they?** All man-made solid debris that finds its way into the natural environment.

**Why are they harmful?** Plastics, in particular, remain intact for decades. They attract wildlife that then tries to eat them or gets caught in them. Nylon fishing line and the plastic ring holders for beverage six-packs are especially dangerous to birds and water fowl. All debris is visually unacceptable. Concentrations of food waste can affect dissolved oxygen levels as they decompose in the water.

**Points of control:** The marina's waste management system, boaters (Code of Practice), dock area, and retail store.

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## **APPENDIX B**

### **MARINE ENGINES**

Recreational marine engines, either gasoline or diesel burning, generate pollution from the combustion of fuel which creates exhaust. In the early 1990s it was estimated that between 567 million to 1.6 billion litres of unburned fuel was emitted into the environment each year by 12 million gas powered pleasure boats, in the United States alone (Mele, 1993). By factoring in an estimate for the impact from all recreational boats operating in countries around the world, over several decades, it quickly becomes apparent why the boating industry must, and is, taking action to significantly reduce hydrocarbon emissions.

The following section provides an overview of:

- The different types of marine engines used for water skiing and how they impact the environment.
- The various types of fuels used in boating
- The most recent technological advancements in marine engines
- The United States Environmental Protection Agency's (and California's) recent regulations for marine engines

### **TYPES OF MARINE ENGINES SUITABLE FOR WATER SKIING**

The engines used for water skiing are either inboard or outboard, with the former most likely a four-stroke gasoline or diesel engine. Boat engines used for water ski racing are often turbo or supercharged. Outboard engines are attached to the stern of the boat and are invariably two-stroke, operating on a gasoline/oil mix. Historically, the typical two-stroke engine tended to be noisier and emit considerably higher levels of hydrocarbons, than the four-stroke engines.

#### **Two-Stroke and Four-Stroke Marine Engines**

Older two-stroke outboard engines have the reputation of being one of the most polluting of recreational engines because of an inefficient 'scavenging' process. What this means is that incoming fuel to the piston's combustion chamber 'scavenges' or pushes the burned exhaust gases out of the cylinder causing compression, ignition and energy. Through this scavenging process between 20 and 50 percent of the unburned fuel is emitted into the water through the exhaust system.

The four-stroke engine is considerably cleaner as there is no mixing of gas and oil and it typically gets about twice the mileage of the common older model two-stroke engine. A four-stroke fires its spark plug to make power every *other* time the piston has climbed to the top of the cylinder verses the two-stroke engine firing every time. The other major difference

between these two engines is that the lubricating oil for the two-stroke engine is mixed with the fuel and is emitted on each stroke whereas the oil for the four-stroke sits in the crankcase or sump. Only if the piston rings that seal the gap between the piston and the cylinder wall become badly worn does this heavy fluid find its way into the cylinder head.

The two-stroke engines built after 1997 are not at question, rather the biggest polluters are the older two-strokes, many of which have a typical life span of 20 years or more. Unless these older engines are mechanically retrofitted, they will continue to emit excessively high levels of hydrocarbons into the water and atmosphere.

## **FUELS – OLD AND NEW**

### **Gasoline**

Gasoline, as a fuel, has been in use since around 1910 and its early forms were relatively simple and burned clean. The gasoline used today is a complex blend that varies from producer to producer, from grade to grade, and even by location and season.

Emissions from gasoline contain zinc, platinum, rhodium, cadmium, and iron plus six fundamental hydrocarbons, eleven basic polycyclic hydrocarbons, cyanides, ammonia, nitrous oxides, hydrogen sulfide, sulfur dioxide, ten individual aldehydes and ketones, phenols, amines, nitrosamines, and myriads variants

This fuel is so widely used because it is inexpensive to produce and contains 50 times more energy by weight than lead-acid batteries. The advent of a range of sophisticated engine refinements have resulted in emission levels dropping to single-digit percentages as compared to the double-digit levels of only twenty years ago.

The new 'reformulated' gasolines are the result of certain compounds being removed and others added to produce a fuel that is intended to be higher in octane, keep engines cleaner, and produce less emissions. However, engine manufacturers and boaters have complained that this reformulated gasoline clogs and damages outboard motors due to high carbon deposits.

Check with your supplier, and or mechanic, to make sure that you are using the best form of gasoline for your marine engine.

**Emissions from gasoline contain zinc, platinum, rhodium, cadmium, and iron plus six fundamental hydrocarbons, eleven basic polycyclic hydrocarbons, cyanides, ammonia, nitrous oxides, hydrogen sulfide, sulfur dioxide, ten individual aldehydes and ketones, phenols, amines, nitrosamines, and myriads variants**

### **Ethanol and Methanol**

Over the years, millions of dollars have been spent on research into alternative fuels, namely ethanol and methane. Emission tests support the claim that alcohols burn cleaner, reduce hydrocarbon emissions by half in uncatalyzed engines, and less so in a variety of catalyzed engines. Ethanol is made from corn, wheat, rice, oats, rye, beets, sugarcane and other common crops. Methanol is made primarily from coal, natural gas, and a variety of woods and wood by-products or effluent. While both have higher octane ratings than gasoline, they are less energy-dense than gasoline: a gallon of ethanol contains only as much energy as two-

thirds of a gallon of gasoline. Most alcohol fuels are being used as additives in around 10 percent solution with gasoline, sold as super unleaded. These biomass fuels emit fewer greenhouse gases but generate large quantities of formaldehyde (Mele, p 99)

## **Diesel**

Diesel fuel is a better source of energy than gasoline. In fact, it produces more foot-pounds of torque per gallon and per mile/km than gasoline, and at a lower cost. It operates with an oxygen surplus (a lean exhaust condition) and produces much less carbon dioxide emissions.

The problem with diesel fuel is primarily its emission of sulfates due to its high sulfur content, as well as the emission of particulates, unburned hydrocarbons, polycyclic aromatics, aldehydes, and a high degree of nitrogen oxides. These compounds are associated with smog and its many negative effects on the environment and human health. However the new, reformulated diesel fuels have a reduced sulfur and aromatics content, and contain cetane-enhancing additives (a hydrocarbon of the methane family that assists ignition).

## **Natural Gas**

This naturally occurring petroleum product is found in abundance worldwide. It is a very pure fuel, requiring almost nothing in the way of refinement. The emissions from the combustion of natural gas are much lower than gasoline, diesel fuel, and even the alcohol fuels. There are no particulates, and almost no engine residue deposits. It is also one of the least expensive fuels on the market.

The downside for boaters is that to retrofit an existing fuel system to natural gas is not practical as it requires large storage space for the holding tanks. Also, its availability is limited in certain countries and regions as distribution networks are not well established.

## **Alternatives**

There are other types of fuels being proposed for boating, but none are yet widely available or affordable. Some of these include fuel hydrogen, solar, and electric powered. You can check with your local marine dealer, or engine manufacturer, to find out if such soft energy options will be available in the near future. It is not unrealistic to imagine boaters one day using zero emission fuel systems, or a combination of very low emission systems such as ethanol fuel and electric motors.

## **US EPA HYDROCARBON EMISSION CONTROL REGULATIONS**

In 1998 the United States Environmental Protection Agency introduced regulations to reduce hydrocarbon emissions from marine engines by 70 to 80 percent over a phase in period ending in 2006. In the state of California even more stringent regulations have been introduced called California Air Resources Board (CARB). CARB requires all gasoline engine manufacturers to meet the USEPA 2006 standards by 2002 and continue the gradual reduction of exhaust emissions through 2008. This long-term target will mean an additional 2/3 reduction in hydrocarbon emissions of engines that meet the USEPA 2006 standard.

To satisfy these standards, marine engine manufacturers are producing new engines that meet, and often exceed these regulatory standards for outboards, personal watercraft, and jetboats. And because American manufactured motors account for over fifty percent of worldwide sales of marine engines, these regulations will translate into significant reduction in global hydrocarbon emissions.

## **MODERN ENGINES – NEW TECHNOLOGIES IN POLLUTION CONTROL**

To meet the USEPA regulatory requirements engine manufacturers have been relying on three basic technologies; direct injection for two-stroke engines, catalytic converters, and high performance four-stroke technology for outboard motors.

**Direct fuel injection (DFI)**, two-stroke technology is designed to significantly reduce HC emissions from engines used in outboard boats and personal watercraft . This process injects the fuel charge directly into the cylinder above the piston, after the exhaust port is closed. Since the exhaust port is closed at time of injection, unburned fuel cannot escape through the exhaust port, as it used to in earlier two-stroke models. The outcome of this new technology is an engine that produces 80 percent less hydrocarbon emissions and consumes between 35 to 45 percent less fuel.

Direct-injection technology is currently available from a variety of manufacturers of outboards and range in power from 90 to 225 horsepower. Some of the most recent PWCs go as high as 135 horsepower.

**Catalytic converters** present a greater challenge despite their proven success in automotive applications. The two main challenges to the engineers involve temperature control. Many marine engines require water to help cool the engine and quiet the exhaust. If the water used is saltwater, as is often the case, it will corrode engine parts and reduce the longevity of the catalyst. The second challenge is that marine engines often operate at higher temperatures for extended periods of time. This type of operation can lead to significant loss of conversion efficiency of the catalyst over time. Engines equipped with catalysts and closed-loop, electronic-fuel-injection systems, like automotive engines, often can achieve more than 90 percent HC conversion efficiency. However, these engines do not operate at higher temperatures for extended periods, which keeps the catalyst from reaching the high temperatures that can result in deactivation of the catalyst.

For marine applications, catalyst conversion efficiency may be restricted to lower conversion efficiency levels (below 80 percent) due to these temperature concerns. The outboard engine manufacturers are working hard to address these challenges and predictions are that a catalytic conversion system for the marine industry will be perfected by the millennium. One PWC manufacturer has introduced a 1999 model that is equipped with a catalyst.

**Four-stroke engine designs** have traditionally made up a smaller percent of the engines used to pull water skiers because they have generally been more expensive, not as quick at the start, and are usually heavier motors. However, in recent years manufacturers have made some significant changes to make the four-stroke engines lighter, quicker to start, and

smoother to operate. They have also been able to build engines that exceed 100 horsepower due to the lighter components.

Just about every marine engine manufacturer offers a range of four-stroke power options for nearly any marine application.

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## **APPENDIX C**

### **CODES OF PRACTICE**

Codes of Practice, namely ones for Conduct and Noise, help ensure that club members are more environmentally responsible and practice safe boating. It also may reduce management liability should a case arise involving negligent behavior on the part of a club member.

Some Codes include separate sections for each major area of concern such as safety regulations, boating, and water skiing. However it is divided, the Code should be targeted to the marina operators, the water ski boat driver, and the water skier.

Every member should be given a copy of the Code and asked to read it in its entirety.

The following are examples of the type of ingredients found in a Code of Conduct and a Code of Practice for Water skiing and Noise:

#### **Table of Contents of a Code of Conduct for Water Skiers and Boat Drivers**

##### **All boat drivers and water skiers agree to:**

- Comply with all the club's By-Laws at all times
- Respect speed limits on the water at all times
- Take care not to disturb wildlife and waterfowl, particularly during nesting and moulting and in sensitive areas
- Use unleaded fuel or propane gas instead of leaded fuel
- Do not idle engines unnecessarily
- Drive the motorboat in a manner which produces least fuel emissions
- Reduce wash as much as possible
- Stay out of shallow water and well away from shorelines

- Meet requirements for boat registration and display certificate on boat
- Meet requirements for certificate of insurance and display certificate on boat
- Respect club policy on noise emissions and display noise emission certificate on boat
- Respect club requirements for driver license including annual testing and carrying the license on their person at all times when driving a motorboat
- Follow accepted standards of boating etiquette including acting with due consideration for swimmers, fishermen and all other water or shore side users
- Abide by By-Law # which specifies the distance from shore water skiing is permitted
- Abide by By-Law # which specifies the hours of operation permitted for water skiing and power-boating
- Respect all restrictions placed on sensitive areas and areas that are seasonally constrained.
- Only refuel or use the bilge pump far from any sensitive wildlife areas.
- Follow club policy and state law that no person shall drive a vessel, observe in a vessel or water ski behind a vessel whilst under the influence of alcohol.
- Follow the club Safety Code and carry a copy of this Code at all times in boat

## **BWSF'S Code of Practice for Water Skiing and Noise**

### **Table of Contents**

The following table of contents indicates the elements of the British Water Ski Federation's Code of Practice for Water Skiing and Noise (1997).

Introduction  
 Aims of the Code  
 Guidance for Avoiding Significant Impact of Water Skiing Noise  
 Existing Facility  
 New Facility  
 Noise Limits  
 Method of Rating Water Ski Noise  
 Control and Monitoring  
 Water Ski Racing

#### **Appendices:**

Pass-by Test – Recreational, Tournament & Barefoot Skiing

Pass-by Test- Water Ski Racing

Summary of Criteria

Typical Activities at British Water Ski Clubs

Characteristics Usage of Water Ski Tow Boats

Possible Boat Concentrations for Water Skiing

Guidance on Method of Calculation of Water Ski Noise

Glossary of Acoustical Terms

The BWSF's Code of Practice for Noise states that "the following factors should be considered where water skiing takes place or is proposed to take place:"

Regard should be had to the following factors:

- Noise output of boat
- Course layout
- Hours of Operation
- Number of boats in use at any one time
- Screening
- Public address systems
- Cars and car parking

To obtain a copy of the BWSF's Code of Practice for Noise contact:

The British Water Ski Federation  
390 City Road  
London  
EC1V 2QA  
BRITAIN

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## APPENDIX D

### WASTE MANAGEMENT PROGRAM

#### The Waste Audit:

A first step of a waste management plan is to conduct a waste audit to determine what items are going into the waste stream at the marina. While a waste audit is not critical to a sound waste management program it is a very good barometer for determining its success, particularly over the long term.

Waste audits are simple and usually not unreasonable in cost. They often pay for themselves over a short time due to accrued savings from reduced waste haulage costs.

The following are the steps involved in a standard solid waste audit:

1. Review and inventory all marina operations and activities
2. Identify waste categories (i.e. plastics, cardboard, newsprint, aluminum, glass, yard waste etc.)
3. Plan audit (when, where, tools needed, waste collection, how much, number of audits etc)
4. Conduct audit
5. Prepare waste audit report

Typically, a club/marina will examine the types of wastes and how much of each type is being generated over a given time period, usually not less than one week's operation.

At the end of each day during that period, the waste materials are separated into preset categories such as glass, plastic, paper and hazardous waste.

After all categories have been weighed and weights recorded management will have a fairly accurate picture of what wastes are being generated.

All audit findings are projected over time (usually a year) making it all the more important that the waste audit reflect normal operating practices. If special events are scheduled, then projections for these events can be made and added as separate line items in the report.

Waste auditing can be a messy business and it may be best to let a professional consulting company perform the audit. The findings will play an important role in the waste reduction targets you set for your club/marina.

Another place to look for support is your local government office that deals with waste issues. Often, these departments have advisors and useful guide documents to take you through an audit and help you set up a waste diversion program.

Based on the audit findings, management can then develop a comprehensive 4Rs waste management strategy and set objectives figuring in how many categories of items can be diverted from landfill or incineration, recycled, reused or avoided altogether.

Performance indicators, like waste diversion goals, can then be set.

Your next step is to contract with a local waste hauler for removal of recyclables and other wastes. By shopping around you may find one more reasonable in price than another.

### **Waste Diversion Program:**

Once you have decided what materials you intend to divert from the waste stream through a recycling or reuse program, and have contracted with your local waste hauler, you are ready to set up your containers.

### **What you will Need:**

- Waste containers for recyclables, reusable items, and other garbage wastes—all with strong, secure lids.

Colour code and label systems for the different material containers to prevent contamination (i.e. recyclables being placed in garbage containers)

- Well thought out placement for each of the containers
- Very easy to read signage indicating what item goes where
- Storage space for each category of wastes
- Regular emptying of containers
- Response system to questions about waste program from staff and customers
- Staff trained to look for contamination problems with recyclables and encouraged to come up with solutions to problems
- Another waste audit to measure effectiveness of program
- Improvements made where necessary keeping principles of 4Rs in mind

### **Communication and Education:**

Key components of a successful waste diversion program are communication and education. All staff, members, and guests coming on to the property should be aware that such a program is in place. They can be encouraged to participate through well placed, easy to understand signage and club/marina posters and literature.



- 8) To use environmentally-safe products whenever and wherever possible
- 9) To operate my boat in a safe and considerate manner at all times, to operate the engines only when necessary, to avoid creating a wake when entering and leaving the dock, and to avoid causing a nuisance to all others using the marina's facilities.
- 10) To always show respect for the environment and for the fish, birds, and animals and all other creatures that share it with us.
- 11) To abide by all of the marina's Codes, including the Code of Conduct and Code of Practice for Noise.

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

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## APPENDIX F

### REFERENCES and RESOURCES

#### INTERNATIONAL WATER SKI FEDERATION

##### President

Mr Andres Botero  
 Medellin, Colombia  
 Office Phone: +57.426.045.26  
 Home phone: +57.431.312.22  
 Fax Number: +57.426.045.26  
 Email: [IWSF@epm.net.co](mailto:IWSF@epm.net.co)

##### Secretary General

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 Via Altopiano 55  
 40044 Pontecchio Marconi (BO), Italy  
 Office Phone: +39.051.615.295.6  
 Home phone: +39.051.845.285  
 Fax Number: +39.051.845.806  
 Email: [g.tognala.@bo.nettuno.it](mailto:g.tognala.@bo.nettuno.it)

#### IWSF Environment Subcommittee

| Chairperson:    | Region | Country       |
|-----------------|--------|---------------|
| Aubrey Sheena   | EAME   | Great Britain |
| <b>Members:</b> |        |               |
| Colin Ellison   | AA     | Australia     |
| Gillian Hill    | EAME   | Great Britain |

|               |       |                          |
|---------------|-------|--------------------------|
| Chris Howarth | AA    | China (Hong Kong)        |
| Leon Larsen   | PANAM | United States of America |
| Vern Oberg    | PANAM | Canada                   |

## **NATIONAL ORGANIZATIONS AND ASSOCIATIONS**

Every country and/or region has its own national and provincial/state organizations and associations that may be of interest. The following lists offer some of the possible titles to search for, keeping in mind that there may be variations in titles from country to country, and language to language.

Most of the listings can be located on the internet through a search by name and jurisdiction (i.e. 'Greenpeace and Germany' or 'American Water Ski Association'). Other sources are the library, your local phone book, and trade magazines or journals.

### **Water Ski and Boating**

National Water Ski Federation or Association  
 Water Skiing Associations  
 Marina Operators Association  
 Marine Manufacturers Association  
 Marine Industries Association/Federation  
 Marine Boatbuilders Association/Federation

### **Government**

Government Agency – Ministry of Natural Resources or Environment, Environmental Protection Agency, Department of Marine Management etc.  
 Conservation Authority

### **Environmental**

Greenpeace – by country  
 Conservation Associations/Clubs -- Audobon Society, Sierra Club

### **Other**

Cottagers Association  
 National Standards Institute / Association

### **Educational Institutions**

University – Departments of: Aquatic Sciences, Biology, Environmental Sciences, Ecology, Resource Management, Mechanical Engineering etc.  
 Library – local and university

## **ENVIRONMENTAL MANAGEMENT SYSTEMS (EMS)**

For consultants and general information on EMS search the internet under key words such as:

ISO and 14000

EMS Consultants

EMS and Marina

International Standards Organization Homepage -- <http://www.ndt.net>

ISO 14000 series on EMS

Both the Canadian Standards Association and the British Standards Institution have produced extensive materials on EMS. These can be obtained by contacting either organization on the internet or directly

Canadian Standards Association

<http://rts.ceogroup.com/csa/pg1.htm>

CSA

178 Rexdale Boulevard

Etobicoke, ON

M9W 1R3

Other Locations – CSA Edmonton, CSA Montreal, CSA Vancouver, CSA Hong Kong, CSA Japan, CSA California

British Standards Institution – [www.bsi-global.com](http://www.bsi-global.com)

British Standards House

389 Chiswick High Road

London, United Kingdom

W4 4AL

Tel: +44 (0) 208 996 9000

Fax: +44 (0) 208 996 7400

Customer Services:

Tel: +44 (0) 208 996 9001

Fax: +44 (0) 208 996 7001

## **INTERNET -- WEB SITES of INTEREST**

American Water Ski Association – [www.usawaterski.org](http://www.usawaterski.org)

British Columbia Marine Awareness Society – [wbs@pacificcoast.net](mailto:wbs@pacificcoast.net)

Center for Marine Conservation – <http://www.cmc-ocean.org>

Conservation and Land Management (Australia) – <http://www.wa.gov.au/>

Department of Transport Marine Section (Australia) (Rob Kay) – [rkay@dot.wa.gov.au](mailto:rkay@dot.wa.gov.au)

Environment Canada

Marine Environmental Data Service  
Leif Stephanson, Transportation Systems Branch – [leifstephanson@ec.gc.ca](mailto:leifstephanson@ec.gc.ca)

The Canadian Pollution Prevention Information Clearinghouse:

<http://www.ec.gc.ca/water/index.htm>

International Council of Marine Industry Associations (ICOMIA) – <http://www.marinedata.com/>

International Water Ski Federation – <http://www.iwsf.com>

Mining Company – <http://powerboat.miningco.com>

National Boat Network – <http://www.boatnetwork.com>

Boating Industry International Online: <http://www.boatbiz.com/>

North American Lake Management Society – <http://www.nalms.org>  
Canadian Office – [Canada@nalms.org](mailto:Canada@nalms.org)

Ontario Environmental Network – [oen@web.apc.org](mailto:oen@web.apc.org)

Recreational Boat Building Industry – <http://www.rbbi.com>

Swan River Trust (Perth, Australia) – [www.whitepages.com.au](http://www.whitepages.com.au)

United States Environmental Protection Agency – Office of Mobile Sources:  
[www.epa.gov/OMS](http://www.epa.gov/OMS)

USEPA – Boat Operation Management Measure:

USEPA -- Final rule on emission regulations:

USEPA – Management Measures for Marinas and Recreational Boating:

USEPA – Petroleum Control Management Measure:

Waterski News Online – <http://www.mooseweb.com/>

Water Ski Canada – <http://www.waterski.ca>

Worldwatch Institute – <http://www.worldwatch.org/>

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