COUNCIL OF THE GREAT LAKES REGION

POLLUTION PROBE

GREAT LAKES PLASTIC CLEANUP

Year One Final Report

ABOUT

The **Great Lakes Plastic Cleanup** combines the piloting of innovative litter capture technologies to collect and remove plastic from the water and anti-litter educational campaigns to remind people of their connection to the environment and the importance of the 3Rs – Reduce, Reuse, Recycle. It also provides an important opportunity for local communities to be involved firsthand in cleaning up our important freshwater resources. It is the single-largest deployment of Seabin and LittaTrap technologies in the world.

Council of the Great Lakes Region is a binational nonprofit organization that is dedicated to deepening the United States-Canada relationship in the Great Lakes Region. Its focus is on creating a stronger and more dynamic culture of collaboration in harnessing the region's economic strengths and assets, improving the well-being and prosperity of the Region's citizens, and protecting the Great Lakes for future generations. It achieves this mandate by conducting evidenced based policy research, connecting diverse perspectives at events like the Great Lakes Economic Forum, and acting as a strong voice for the Region's varied economic, social and environmental interests.

Pollution Probe is a national, not-for-profit, charitable organization that exists to improve the health and well-being of Canadians by advancing policy that achieves positive, tangible environmental change. Pollution Probe has a proven track record of working in successful partnership with industry and government to develop practical solutions for shared environmental challenges.

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About this Report

Plastics are one of the most revolutionary innovations of the modern world. They play a critical role in shaping our economy and our daily lives. However, the way in which plastics are used, managed and disposed of, can pose significant challenges for the environment and for our health. Many plastics have the ability to be recovered, recycled or reconstituted but this value is lost when they are discarded or improperly disposed of. Each day, plastic debris and fibres make their way into rivers, streams and lakes, where they accumulate. An estimated 10 million kilograms of plastic including bottles, food packaging and microplastics flow into the Great Lakes each year and approximately 80% of all of the litter found during shoreline cleanups is plastic.

In 2020, the Council of the Great Lakes Region (CGLR), Pollution Probe and partners launched the Great Lakes Plastic Cleanup (GLPC) to contribute to the achievement of zero-waste priorities and the reduction of plastic pollution. Made possible in its first year with support from Environment and Climate Change Canada, the Ontario Ministry of the Environment, Conservation and Parks and lead corporate sponsor, NOVA Chemicals, the GLPC combines the piloting of innovative litter capture technologies to collect and remove plastic from the water and anti-litter educational campaigns to remind people of their connection to the environment and the importance of the 3Rs – Reduce, Reuse, Recycle. It also provides an important opportunity for local communities to be involved firsthand in cleaning up our important freshwater resources.

This report provides an overview of the significant efforts made by partners, collaborators and supporters to address plastic pollution in the Great Lakes over the first year of the GLPC. The report is organized into the following three sections:

- **Section One** provides an overview of the Great Lakes and the impact of plastic pollution. It introduces the GLPC, including its objectives, partners and collaborators, and the specific locations of participating marinas. It also discusses the technologies used to capture and clean up plastic litter along Ontario's Great Lakes shoreline and other major waterways.
- **Section Two** describes the process followed by marinas and GLPC waste characterization partners to collect and characterize debris found in litter capture technologies. It also outlines the amount and types of plastic litter collected through the initiative over the 2020 season.
- **Section Three** highlights communications, promotion and engagement efforts undertaken during the first year of the GLPC, including those related to events, media and educational materials.

The report also describes the impact of the COVID-19 pandemic on the first season of the GLPC, notes important lessons learned and points to **Next Steps** as the initiative builds out over an initial five-year period.

To learn more about the GLPC, please visit www.greatlakesplasticcleanup.org

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Sleeping Bear Dunes, Lake Michigan

SECTION ONE

Great Lakes Plastic Cleanup Overview

THE GREAT LAKES

Shared by Canada and the United States, including the provinces of Ontario and Québec, and eight states from New York to Minnesota, the Great Lakes and their connecting waters form the largest freshwater system in the world. Because of the wealth of resources and opportunities the lakes offer, the region around them has grown into one of the most economically powerful and culturally diverse in the world.

Home to 107 million people, the broader Great Lakes region serves as the economic engine of North America, supporting over 50 million jobs, or one-third of the combined Canadian and American workforce. Key sectors include manufacturing, food production, power generation, transportation, higher education and innovation, professional services and tourism.

The Great Lakes hold 21% of the world's, and 84% of North America's, surface freshwater and they support the region's economy and ongoing development in many ways. The lakes provide drinking water to residents, and their climate and geology help to sustain a rich array of habitats with over 3,500 plant and animal species, some of which are found nowhere else on Earth.

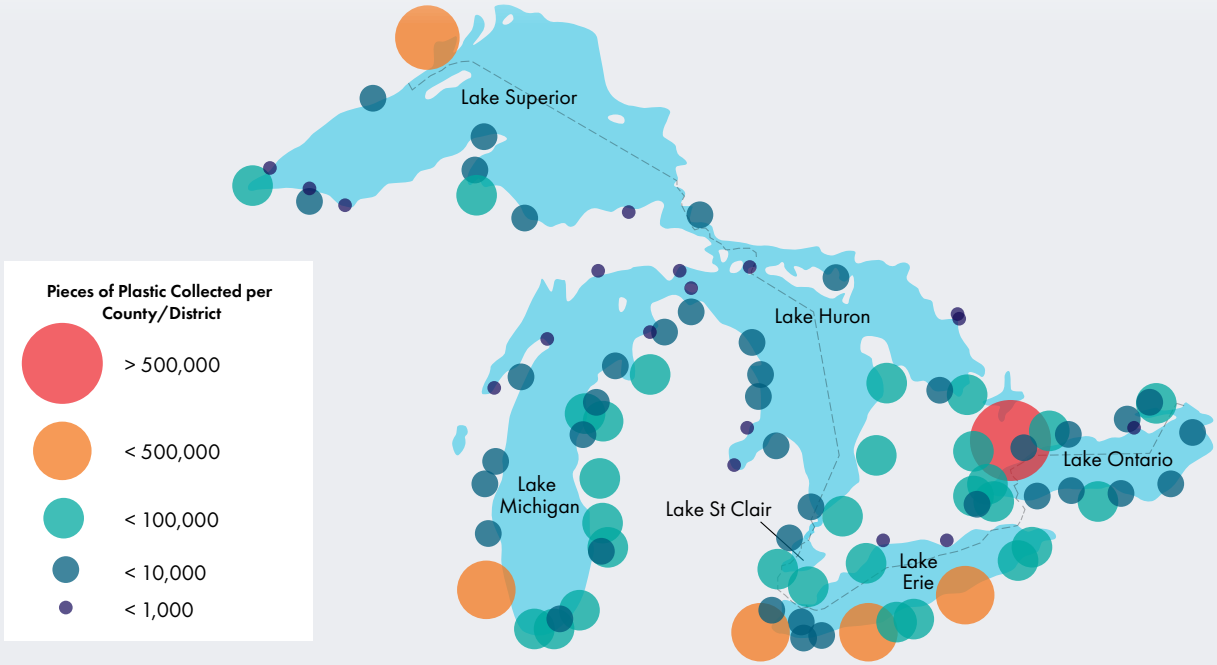
While many of the most visible environmental problems facing the Great Lakes have been addressed, industrialization and urban expansion have led to a number of new challenges, including those related to plastic pollution. Each day, plastic debris and fibres make their way into streams, rivers and lakes, where they remain or wash up onto shorelines.

UNDERSTANDING THE PLASTIC POLLUTION PROBLEM

Released in 2020, the National Oceanic and Atmospheric Administration's five-year Great Lakes Marine Debris Action Plan (GLMDAP) notes that while marine debris, including plastic pollution, is perhaps most commonly thought of as an oceanic problem, the Great Lakes region, with its complex system of habitats, wetlands, rivers and tributaries, is also significantly affected.

Each year, 80% of the Great Lakes region's waste ends up in landfill, including valuable plastic. This waste has the potential to find its way into the environment. Beach cleanups have found that 80% of the material washing up on the Great Lakes shoreline is plastic. Each year, community scientists collect one million pieces of plastic litter as part of the International Coastal Cleanup, which includes the Great Canadian Shoreline Cleanup. Figure 1 shows the distribution of the plastic picked up as part of these efforts between 2016 and 2018.

Figure 1: Plastic picked up as part of the International Coastal Cleanup for years 2016 – 2018



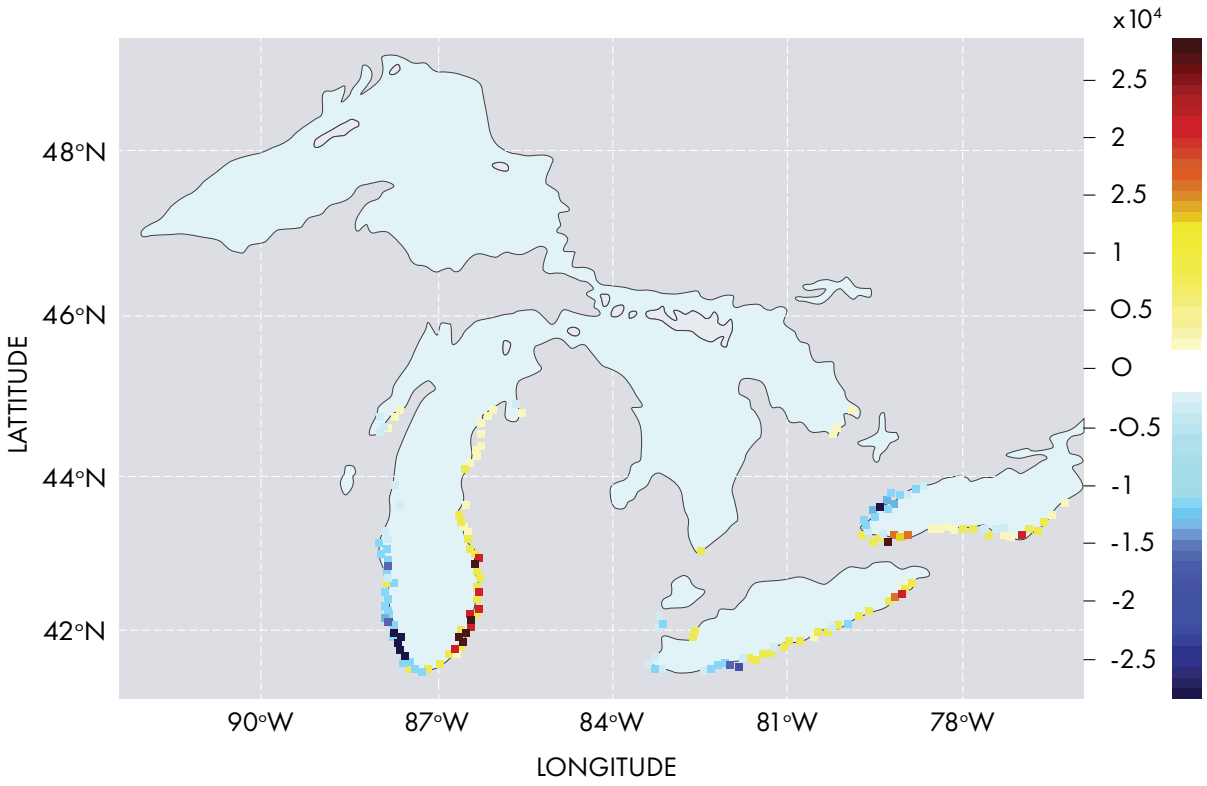
Source: Arielle Earn, U of T Trash Team

Studies concerning the prevalence, transport and fate of plastics in the environment have increased over the past decade thanks to computer modelling, beach cleanups and in-situ sampling. However, studies specific to the Great Lakes are still limited and there is a need for more data to better understand the amount and types of plastic debris found.

Models from the Rochester Institute of Technology (RIT) estimate that approximately 22 million pounds (10 million kilograms) of plastic could be entering the Great Lakes every year, with microplastics reaching levels as high as 1.25 million particles/km^2 – concentrations on par with those found in the ocean's garbage patches. Field studies have found microplastics present in Great Lakes surface water, sediment and on beaches, as well as in wastewater treatment plant (WWTP) effluent.[1]

A model developed by researchers at RIT to estimate the total plastic input for the Great Lakes and to show its transport over a six-year period from 2009 to 2014, found that plastic particles travel throughout and between the lakes.[2] Figure 2 shows that major population centres are primary sources for plastic particles entering the lakes (e.g., Chicago, Toronto, Cleveland, Detroit, etc.), releasing thousands more particles than are accumulated on their shores. The highest plastic particle densities were found in locations neighbouring large population centres with high releases. For example, particles released from Toronto stayed in the western basin of Lake Ontario before traveling around the southern part of the lake and accumulating in places like Rochester.[3]

Figure 2: Particles released between 2009 and 2014 from shore locations and those locations at the end of the simulation



*Blue areas are those where more plastic particles were released into the system than accumulated. Red areas are those where more plastic accumulated than was released.

Source: *Inventory and transport of plastic debris in the Laurentian Great Lakes,* M.J. Hoffman & E. Hittinger

1 Eriksen, M., Mason, S., Wilson, S., Box, C., Zellers, A., Edwards, W., et al. (2013). Microplastic pollution in the surface waters of the Laurentian Great Lakes. *Marine Pollution Bulletin, 77,* 177–182.

Corcoran, P. L., Norris, T., Ceccanese, T., Walzak, M. J., Helm, P. A., & Marvin, C. H. (2015). Hidden plastics of Lake Ontario, Canada and their potential preservation in the sediment record. *Environmental Pollution,* 204, 17–25.

Driedger, A. G., Dürr, H. H., Mitchell, K., and Van Cappellen, P. (2015). Plastic debris in the Laurentian Great Lakes: a review. *Journal of Great Lakes Research,* 41, 9–19.

2 Hoffman, M.J. & Hittinger, E. (2017). Inventory and transport of plastic debris in the Laurentian Great Lakes. *Marine Pollution Bulletin,* 115, 273-281.

3 Ibid.

Recent studies indicate that plastic debris may become entangled or ingested by fish and wildlife, where resulting impacts can range from damage to liver tissue, altered metabolism and changes to locomotive activity.[4] Plastic can also degrade in the environment, releasing harmful pollutants and contributing to further contamination that can impact drinking water near population centres.

While the full economic and environmental impact of plastic pollution in the Great Lakes remains unknown, estimates used by the United States Environmental Protection Agency in similar assessments on the West Coast indicate that it could cost $400 million annually to to curtail through clean up, public anti-littering campaigns, stormwater capture devices and advanced recycling infrastructure.

A number of regional plans and international commitments support the protection of the Great Lakes, including where plastic pollution is concerned. These include the Boundary Waters Treaty of 1909, the Great Lakes Water Quality Agreement and the recently signed Canada-United States-Mexico Agreement, which contains a new chapter on the environment and explicitly notes prioritizing the prevention and reduction of marine litter, including plastic and microplastics. The new draft *Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health* also includes a commitment to reduce plastic pollution in the Great Lakes Basin. However, addressing the enormity of the problem will require collaboration across a range of stakeholders and levels of government, together with local communities.

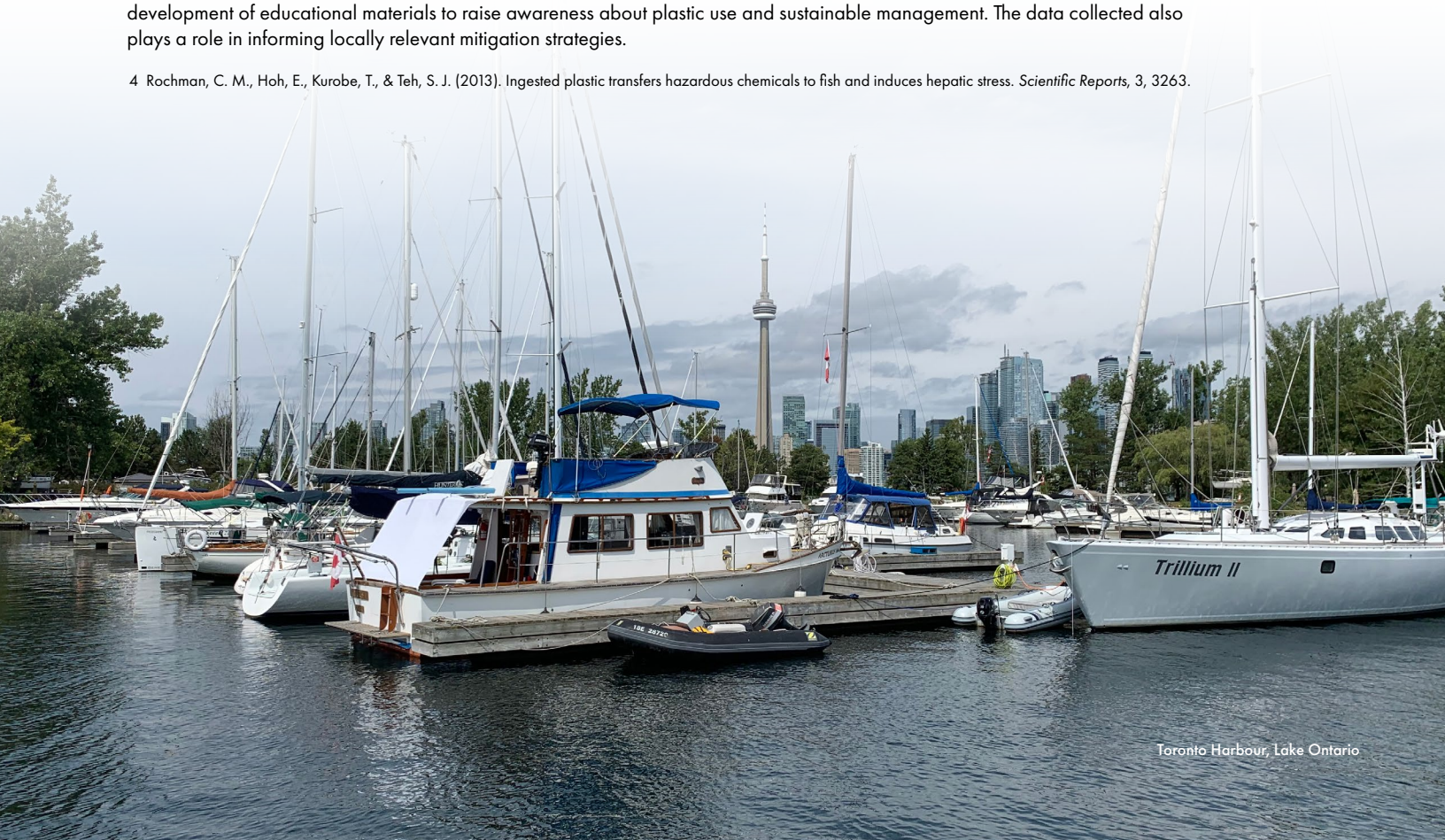
THE GREAT LAKES PLASTIC CLEANUP

With support from the Government of Canada, the Province of Ontario and lead corporate sponsor, NOVA Chemicals, the CGLR and Pollution Probe launched the GLPC in August 2020. A first-of-its-kind in North America, the GLPC is the single-largest deployment of innovative litter capture technologies in the world, which are described in more detail later in the report on page 6. Working with public and private marinas along Ontario's Great Lakes shoreline and other major waterways, the overall objectives of the initiative are three-fold:

1. Capture and remove plastic litter from the environment
2. Study the types and quantity of materials removed at each marina location in order to deepen our understanding of plastic pollution in the Great Lakes
3. Educate boaters and outdoor enthusiasts in local communities about the role they can play in preventing and reducing plastic litter

Litter capture technologies are piloted at participating marinas each year throughout summer and early fall. Debris collected during this timeframe is characterized in collaboration with academic institutions and local community groups to identify waste types, amounts and potential sources. Deploying the technologies and evaluating what is captured provides the basis for the development of educational materials to raise awareness about plastic use and sustainable management. The data collected also plays a role in informing locally relevant mitigation strategies.

4 Rochman, C. M., Hoh, E., Kurobe, T., & Teh, S. J. (2013). Ingested plastic transfers hazardous chemicals to fish and induces hepatic stress. *Scientific Reports*, 3, 3263.



Toronto Harbour, Lake Ontario

PARTNERS & COLLABORATORS

A range of partners and collaborators contributed to the success of the GLPC in its first year by providing their knowledge and extensive expertise related to keeping waterbodies clean and navigable and/or specifically addressing plastic pollution.

Table 1: Great Lakes Plastic Cleanup partners and collaborators

PARTNER ROLE	PARTNERS & COLLABORATORS	DESCRIPTION
Technology	• Poralu Marine • Water Products & Solutions • Enviropod	Seabins were procured from Poralu Marine and Water Products & Solutions. LittaTraps were procured from Enviropod.
	• Minotaur	Minotaur installed technologies at each marina.
	• PortsToronto	PortsToronto provided insights from experience with their own Seabin Program at the Outer Harbour Marina.
Marina Engagement	• Boating Ontario	Boating Ontario played a critical role in facilitating marina outreach and engagement based on their well-established relationships across the province.
	• Georgian Bay Forever	Georgian Bay Forever acted as a liaison for marinas in the Georgian Bay area, collected debris from Seabins, helped with troubleshooting and participated in marina training sessions.
Waste Characterization	• U of T Trash Team	The U of T Trash Team acted as lead waste characterization partner, supporting efforts to ensure that capture technologies were monitored and that the waste collected was effectively quantified and characterized. They also developed training resources, completed a number of waste characterizations, and compiled and analyzed the data from participating GLPC marinas.
	• Georgian Bay Forever	Georgian Bay Forever conducted several waste characterizations for marinas in the Georgian Bay region.
	• Western • Lambton College	Western University and Lambton College took the lead on characterizing the debris collected by capture and cleanup devices at several participating marinas.

Toronto Zoo LittaTrap

Toronto Harbour Seabin installation

Litter collecting in Seabin. Photo courtesy of Georgian Bay Forever

The COVID-19 pandemic had a significant impact on the opening and operation of marinas in Ontario in 2020, as well as the capacity of marina staff, researchers and community volunteers to support the initiative. Despite these challenges, 21 marinas from Lake Ontario to Lake Superior committed to join and participate in the GLPC over its initial five years. Another five marinas with Seabin technology already installed also joined the effort in its first year.

Marina participation reinforces the value of the GLPC's mission and the importance of working together to end plastic pollution. It is also a clear demonstration of the high level of environmental protection marinas are striving for in the province of Ontario, including through Boating Ontario's Clean Marine Eco-Rating Program. This voluntary program leads to an eco-rating (Gold, Diamond, and Platinum) based on efforts to reduce and prevent water, air and land pollution associated with recreational boating activities.

Table 2 shows the GLPC marina sites supported this season by funding from Environment and Climate Change Canada and Table 3 notes those supported by the Ontario Ministry of the Environment, Conservation and Parks. Table 4 outlines marinas that joined the initiative with their own Seabins. In addition, one Seabin and three LittaTraps were installed at the Toronto Zoo, which is visited by more than 1.2 million people each year, in an effort to increase public engagement about the GLPC and addressing plastic pollution. Additional marina locations are being considered as the GLPC looks to expand over the coming season.

Table 2: Marina locations funded by Environment and Climate Change Canada

MARINA	LOCATION	WATER BODY	TECHNOLOGY	
			Seabin	LittaTrap
Huck's Marine Resort	Rockport	Lake Ontario/St. Lawrence River	1	
Port of Whitby Marina	Whitby	Lake Ontario	1	1
Toronto Island Marina	Toronto	Lake Ontario	1	
Bay Port Yachting Centre	Midland	Lake Huron/Georgian Bay	1	2
Spanish Municipal Marina	Spanish	Lake Huron	1	
Prince Arthur's Landing	Thunder Bay	Lake Superior	1	1
Trent Port Marina	Trenton	Lake Ontario	1	2
Kon Tiki Marine	Lefroy	Lake Simcoe	1	
Queen's Cove Marina	Victoria Harbour	Lake Huron/Georgian Bay	1	
Thornbury Harbour	Thornbury	Lake Huron/Georgian Bay	1	
Wye Heritage Marina	Midland	Lake Huron/Georgian Bay	1	
Total			**11**	**6**

Table 3: Marina locations funded by the Ontario Ministry of the Environment, Conservation and Parks

MARINA	LOCATION	WATER BODY	TECHNOLOGY	
			Seabin	LittaTrap
Harbour West Marina	Hamilton	Lake Ontario	1	
Erieau Marina	Erieau	Lake Erie	1	
Cobourg Marina	Cobourg	Lake Ontario	1	3
Hindson Marina	Penetanguishene	Lake Huron/ Georgian Bay	1	
Mitchell's Bay Marine Park	Mitchell's Bay	Lake St. Clair	1	
Point Pleasant	Parry Sound	Lake Huron/ Georgian Bay	1	
Bridgeview Marina	Sarnia	Lake Huron	1	
Sarnia Bay Marina	Sarnia	Lake Huron	1	
South Bay Cove	Port Severn	Lake Huron/ Georgian Bay	1	
Township of Georgian Bay	Port Severn	Lake Huron/ Georgian Bay	1	2
Total			**10**	**5**

Table 4: Marina locations with devices already purchased and installed

MARINA	LOCATION	WATER BODY	SEABINS
Desmasdon's Boat Works	Pointe au Baril	Lake Huron/ Georgian Bay	1
Beacon Marine	Pointe au Baril	Lake Huron/ Georgian Bay	1
Town of Collingwood	Collingwood	Lake Huron/ Georgian Bay	1
Lefroy Harbour Resort	Lefroy	Lake Huron/ Georgian Bay	1
Outer Harbour Marina	Toronto	Lake Ontario	1
Total			**5**

ABOUT THE TECHNOLOGY

By enabling the deployment and piloting of innovative capture and cleanup technologies, beginning with Seabins and LittaTraps, the GLPC is creating a network of devices that will help collect more data and deepen our knowledge of the plastic pollution problem, both locally and across the Great Lakes region.

The Seabin is a "trash skimmer" designed to be installed in the water at marinas, yacht clubs and ports. In fact, the technology is suitable for any water body with a calm surface environment and appropriate services available for maintenance. The unit acts as a floating garbage bin, skimming the surface by pumping water into the device. The Seabin can intercept floating debris, macro and microplastics and even microfibres, with an additional filter. It is also able to extract contaminated organic material (leaves, seaweed, etc.). It is easily equipped with pads that absorb petroleum-based surface oils and detergents like those predominant in most marinas around the world.

Developed by Enviropod, the LittaTrap™ is a patented catch basin basket that sits inside the stormwater drain and prevents litter and other debris from entering the storm drain system. The trap's 5mm mesh basket is designed to capture and retain 100% of plastic and other debris over 5mm. The basket has high hydraulic conductivity – allowing water to pass through it easily – and is both lightweight and structurally robust, designed with engineered inert plastic for a 25-year lifespan.

In the future, the GLPC, working with the makers and distributors of other promising removal technologies, will look to leverage its network of partners and sites throughout the Great Lakes Basin to test and/or deploy additional litter capture devices, such as fishing line recycle bins, stormwater filtration devices, or other coastal waste collection solutions.

> *"With Seabins and LittaTraps, the GLPC is creating a network of devices that will help collect more data and deepen our knowledge of the plastic pollution problem, both locally and across the Great Lakes region."*

Seabin information video available on GLPC website

LittaTrap information video available on GLPC website

For more information on the capture technologies used by the GLPC, please visit www.greatlakesplasticcleanup.org/cleanup-technology

SECTION TWO

Waste Characterization

Waste characterization — the sorting and analysis of the debris found at participating marinas — is a critical component of the GLPC. The data collected will play an important role in ensuring that decision-makers have the evidence needed to make informed and effective decisions on addressing plastic pollution. The waste characterization for this season focused primarily on gaining a better understanding of the amount and the types of debris collected by the litter capture devices (i.e., Seabins & LittaTraps).

The COVID-19 pandemic had a significant impact on the ability of many marinas to collect data from their capture devices this year, and in a number of cases, installation occurred relatively late in the season. Despite these unanticipated challenges, participating marinas and partners worked together in an effort to successfully collect and analyze data from multiple sites. This process included the following activities:

- Provision of the materials and supplies necessary to support marinas in the collection of debris (i.e., a "waste characterization kit" and instructions).
- Use of a set of waste characterization protocols developed by the U of T Trash Team for daily data collection and for a more in-depth investigation of the materials found in both Seabins and LittaTraps.
- Use of the Data Trapper app developed by the U of T Trash Team that allows marinas to enter daily information about debris captured by their Seabin.
- Convening of training webinars that were recorded and shared with marinas.
- Shipment or pickup of debris from marinas and delivery to the appropriate waste characterization partner.
- Compiling, consolidation and analysis of data and the sharing of results from waste characterizations.

This season has contributed to a number of lessons learned about the waste characterization process and preliminary findings related to the amount of debris and types of materials captured. While the limited amount of data collected during the pandemic is not sufficient to point to definitive or long-term trends, these findings will serve as the foundation for further exploration moving forward.

This section outlines the waste characterization process and activities completed in Year One, while highlighting some of the preliminary findings.

Collection of debris at Point Pleasant Marina.
Photo courtesy of Jess Fargher and MPP Norm Miller

WASTE CHARACTERIZATION PARTNERS

The initiative's waste characterization network is comprised of some of Canada's leading plastics experts, including Dr. Chelsea Rochman and the U of T Trash Team, a founding partner. Dr. Patricia Corcoran and her team at Western's Faculty of Science are conducting vital research into the pathways of plastic pollution into the Great Lakes. The Research & Innovation department of Lambton College works with a range of organizations, focusing on the innovative use of technology to bring about meaningful economic, social and environmental outcomes. Georgian Bay Forever is a leading voice for the protection of bay.

To ensure sufficient waste characterization capacity across the GLPC network, participating marinas were paired with partners based on proximity. The following summarizes the activities undertaken by various waste characterization partners for the 2020 season:

U of T Trash Team: The U of T Trash Team acted as lead waste characterization partner, supporting efforts to ensure that capture technologies were monitored and that the waste collected was effectively quantified and characterized. The U of T Trash Team developed a set of standard protocols that were followed, and a simple mobile application that made collecting the daily data at each marina more intuitive. The app also helped to improve the consistency of record keeping, reducing the level of effort required to generate meaningful, in-situ data. The U of T Trash Team also played a key role in developing training resources including the creation of a video and helping walk marinas through the process for collecting debris during webinars convened by the GLPC. Finally, the team completed a number of waste characterizations, and compiled and analyzed the data from all participating marinas on behalf of the GLPC.

Georgian Bay Forever: The GLPC officially welcomed Georgian Bay Forever to the initiative in October 2020. Georgian Bay Forever acted as a liaison for marinas in the area, collected debris from their Seabins, helped with troubleshooting, participated in training sessions and meetings, and conducted several waste characterizations. Their involvement helped to deepen the focus and impact of the GLPC in the important Georgian Bay watershed.

Western and Lambton College: Western University and Lambton College officially joined the GLPC in November 2020 as research partners, taking the lead on characterizing the debris collected by capture and cleanup devices at several participating marinas. Both academic institutions are recognized leaders in environmental research and innovation, particularly on plastics and issues affecting Canada's freshwater ecosystems. With Western and Lambton College joining, the initiative was able to build out its research network and increase learning about the types of debris found in the Great Lakes region.

> *"This will be the largest initiative of its kind in the world to tackle plastic pollution in lakes and waterways. Removing plastic from the Great Lakes and educating the public about the proper disposal of plastic waste will help ensure impacts on wildlife are reduced, biodiversity is protected, and water resources and ecosystems are safeguarded for future generations. Engaging recreational water users and local communities in solutions to plastic pollution is critical."*
>
> David Piccini, MPP
> Northumberland-Peterborough South

U of T Trash Team sorting and characterizing Seabin debris. Photo courtesy of the U of T Trash Team

PROCESS & PROTOCOLS

As previously noted, two separate protocols were developed by the U of T Trash Team for the quantification of debris collected by the Seabins and/or LittaTraps. These protocols focused on the following approaches:

1. Simple waste characterization protocol which entails daily quantification of debris.
2. Detailed waste characterization protocol which quantifies and characterizes the debris collected over a 24-hour period.

Together, these approaches allow for an understanding of how much is diverted, along with the specific types of materials captured at each location. While the protocols were initially created for use with Seabins, they were also applied to the debris collected from the LittaTraps this season.

Marinas were provided with a number of resources to support their efforts to collect debris from their capture technologies, including the protocols, instructions and a step-by-step video created by the U of T Trash Team. The GLPC team also convened online training sessions so that participating marinas had the opportunity to ask questions directly of the U of T Trash Team.

The following section provides a brief overview the two protocols used. For more detail, please visit www.greatlakesplasticcleanup.org/resources.

Emptying the Seabin at Harbour West Marina, Hamilton. Photo courtesy of HOPA Ports

Waste characterization kits

1. Simple Waste Characterization Protocol

The purpose of the simple waste characterization is to collect the minimum amount of data necessary to estimate the amount of anthropogenic debris that is being diverted from the Great Lakes. Because the LittaTraps do not need to be emptied as often, the daily quantification only applied to the Seabins.

PROCESS
Marinas were asked to empty the Seabin at each location every 24 hours, or when it was full, and to provide information about when the bins were deployed, when they were removed from the water and whether the debris collection occurred during a "wet event" (> 10 mm of rain over a 24-hour period). The weight of the catch bag was submitted, along with a picture.

Marinas were provided with a number of recommendations related to safety and the operation of the Seabin when collected debris, including:

- Ensure the power is off and no longer pumping water when collecting debris. There is the potential for water and debris to continue to enter the Seabin when the mesh bag is removed, creating potential issues or damaging the pump.
- Wear a life jacket and use an extension or pike pole to make it easier to retrieve the bin.
- Wear gloves to protect from any potential sharp or dangerous materials that have been captured.

Two options were provided for recording the daily data: use of a paper datasheet or the Data Trapper app developed by the U of T Trash Team. The app is free to download and compatible with both Android and Apple devices. Several marinas noted that the use of the app made the process of submitting the data faster and less onerous.

2. Detailed Waste Characterization Protocol for Debris Collected Over a 24-Hour Period

The purpose of the detailed waste characterization of debris collected over a 24-hour period is to quantify and characterize what is found in the Seabins and LittaTraps. Data is synthesized and aggregated in an effort to understand the total impact across sites. In acknowledgement of the significant challenges faced by marinas due to the COVID-19 pandemic, debris was collected for a single deep dive this season, with the intent of increasing this number in future years.

PROCESS
Each marina was provided with a "waste characterization kit", comprised of the materials that they would need for the purpose of collecting, weighing and shipping the debris from their Seabins and LittaTraps.

Contents of the kit included:

- Sample bags for the debris
- Handheld scale to weigh the debris
- Labels for the samples
- Sample info sheets for inputting data
- Ice packs to keep debris cool and reduce the smell during transport
- Instruction sheets

Materials were shipped in a cooler so that it could be used to transport the wet and heavy debris removed from the Seabins and LittaTraps to waste characterization partners without fear of leakage.

A number of activities are required to prepare for the collection of debris from the capture devices. This includes pre-weighing and labelling bags or containers, recording the time and date when devices were last emptied and noting when they were removed from the lake. As with the daily data collection, weather and wind conditions are recorded when emptying the contents of the Seabin or LittaTrap and placing them into the sample bag.

Separating the debris. Photo courtesy of the U of T Trash Team

TRANSPORT OF DEBRIS

The following two approaches were used for the transport of debris removed from the capture technologies to waste characterization partners for the detailed data collection this season:

1. Academic institutions: Pollution Probe and CGLR arranged to ship debris directly to the corresponding academic partner by courier.
2. Local community organization: The Georgian Bay Forever team arranged to pick up samples directly from marinas and transport them to a central location where they undertook the waste characterization.

Waste characterization partners followed the same protocol to quantify and characterize each marina's sample, ensuring consistency across sites. Debris was separated by size, with smaller pieces removed from any plant material that also collected in the catch bag. While large debris could be sorted easily by hand, the process for small debris (i.e., smaller than a toonie and > than 2mm), required additional equipment including sieves of various sizes.

Once all debris was cleaned and separated, it was counted and tallied according to various categories (e.g., hard fragments, pellets, film, etc.). In cases where there were many pieces of small debris, they were subsampled by creating four equal piles and choosing one to count.

The data collected by various waste characterization partners was uploaded and shared with the U of T Trash Team for analysis.

Cleaned and separated debris. Photo courtesy of the U of T Trash Team

DATA ANALYSIS

Despite the significant impacts of the COVID-19 pandemic, several marinas contributed daily data to the GLPC over the past season. A number of deep dive waste characterizations were also successfully completed. Preliminary findings from these waste characterizations include a connection between the amount of vegetation collected by the Seabin and the number of small plastic debris. It also laid the foundation for future learnings around the types of plastic typically found in the Great Lakes.

This section summarizes findings from the data compiled and analyzed by the U of T Trash Team from this season based on contributions from marinas daily, and from the deep dive waste characterizations. It is important to note that the findings outlined in this report represent a brief period of time and a small number of capture technologies. While more data is necessary, the analysis introduced potential trends that will be explored and built upon in subsequent seasons and with further waste characterizations.

Contents of Seabin from Trent Port Marina, Trenton. Photo courtesy of the U of T Trash Team

DEBRIS DIVERTED BY SEABINS OVER A 24-HOUR PERIOD

Seabins and LittaTraps capture different amounts of debris each day, depending on a wide range of factors, including the location of the marina, where the technologies are installed on-site and weather conditions. The longer the devices stay in the water, the more debris they are able to trap and remove. Findings from this year pointed to a large proportion of the non-organic, anthropogenic material captured being various types of small plastic pieces. For this reason, the overall weight of the debris is relatively small.

Marinas reported Seabins typically being a quarter full when removed after a 24-hour period and many of the daily data submissions noted vegetation, seaweed or leaves present in the catch bag. Less than a quarter of the data entries occurred following a wet event with no significant difference in the average extrapolated weight of the small and large debris from dry conditions.

GLPC Seabins collected a total 96.64 kg of debris (i.e., vegetation and anthropogenic material) on the days that marinas submitted data on the weight of the contents of the catch bag. Reported weights ranged from 0.03 kg to 6.53 kg with an average for a typical day being 0.83 kg. Sites with the highest total weight of debris for a single day included:

- Harbour West (6.53 kg)
- Cobourg (6.20 kg)
- Prince Arthur's Landing (3.88 kg)
- Trent Port (2.34 kg)

As previously noted, many of the anthropogenic materials collected by the Seabins were small plastic pieces and when separated from the organic vegetation, the weight of the debris was much lower.

Contents from Seabin at Harbour West Marina, Hamilton. Photo courtesy of HOPA Ports

Table 5 outlines the total weight of anthropogenic debris diverted at each marina for the data entries submitted, as well as the average weight diverted over a typical 24-hour period. The numbers in the table were determined based on a model developed by the U of T Trash Team capable of predicting the weight and average weight of anthropogenic debris based on the total weight of materials found in the catch bag.

The findings indicate that on average, each Seabin diverted approximately 0.013 kg (13 g) of anthropogenic debris per day and in total, there was a reported 0.83 kg (830 g) captured. It is important to note that the true amount diverted by GLPC Seabins would have been much greater based on the fact that data was not provided by every marina this season and those that did submit data, may not have for every day that the Seabin was operational and capturing debris.

Table 5: Extrapolated total weight and average weight of anthropogenic debris over a 24-hour period

MARINA	WATER BODY	Extrapolated total weight of debris diverted (kg) this season	Extrapolated average weight diverted in a 24-hour period (kg)
Bay Port Yachting Centre (n= 1)	Lake Huron/Georgian Bay	0.0087480	0.0087480
Beacon Marine (n = 23)	Lake Huron/Georgian Bay	0.0979440	0.0046640
Cobourg Marina (n = 4) *	Lake Ontario	0.0911600	0.0227900
Harbour West Marina (n = 1) *	Lake Ontario	0.0399680	0.0399680
Outer Harbour Marina (n = 1)	Lake Ontario	0.0162240	0.0162240
Point Pleasant Marina (n = 14)	Lake Huron/Georgian Bay	0.0997360	0.0071240
Prince Arthur's Landing (n = 11) *	Lake Superior	0.009473455	0.1042080
Queen's Cove Marina (n = 1)	Lake Huron/Georgian Bay	0.0096608	0.0096608
Trent Port Marina (n = 29)	Lake Ontario	0.3577840	0.0127780
Wye Heritage Marina (n = 1)	Lake Huron/Georgian Bay	0.0055000	0.0055000

*Note: Asterisk denotes sites with highest extrapolated total and average weight diverted
*n = number of daily samples included in the calculation (from daily data)

SMALL DEBRIS COUNT

Given that much of the anthropogenic debris captured this season were various types of small plastic pieces, weight alone does not paint a clear picture of the extent to which plastic is found in the Great Lakes. Table 6 outlines the total and average count of small plastic pieces diverted in a 24-hour period by GLPC Seabins. As with weight, counts are based on a model developed by the U of T Trash Team capable of predicting the total and average number of small anthropogenic debris based on the total weight of materials found in the catch bag.

This season, a typical Seabin diverted an average of 103 pieces of small anthropogenic debris a day, and in total there were 6577 pieces captured. However, the true number of pieces diverted is expected to be much greater given that data was not submitted for every participating Seabin or for every day in which technologies were operational and capturing debris.

Table 6: Average and total count of debris diverted in a 24-hour period

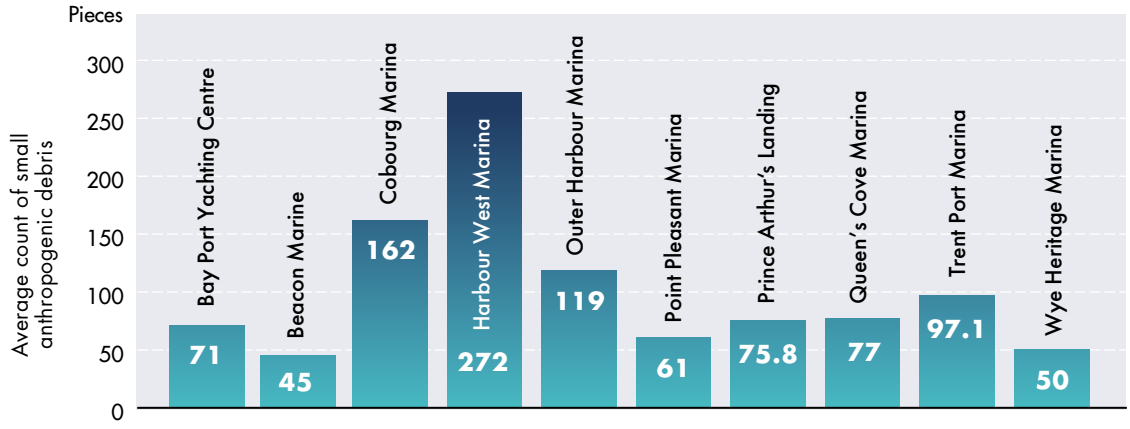
SITE	WATER BODY	Extrapolated total count of small anthropogenic debris diverted this season	Extrapolated average count of small anthropogenic debris diverted in a 24-hour period
Bay Port Yachting Centre (n= 1)	Lake Huron/Georgian Bay	71	71
Beacon Marine (n = 23)	Lake Huron/Georgian Bay	940	45
Cobourg Marina (n = 4) *	Lake Ontario	647	162
Harbour West Marina (n = 1) *	Lake Ontario	272	272
Outer Harbour Marina (n = 1) *	Lake Ontario	119	119
Point Pleasant Marina (n = 14)	Lake Huron/Georgian Bay	849	61
Prince Arthur's Landing (n = 11)	Lake Superior	833	75.8
Queen's Cove Marina (n = 1)	Lake Huron/Georgian Bay	77	77
Trent Port Marina (n = 29)	Lake Ontario	2718	97.1
Wye Heritage Marina (n = 1)	Lake Huron/Georgian Bay	50	50

*Note: Asterisk denotes sites with highest extrapolated total and average count of small anthropogenic debris diverted
*n = number of daily samples included in the calculation (from daily data)

Those marinas that reported the most debris captured by weight also had the greatest number of small pieces of debris. The three sites with the highest extrapolated average count are as follows:

1. Harbour West Marina (272, n=1)
2. Cobourg Marina (162, n=4)
3. Outer Harbour Marina (119, n=1)

Figure 3: Average extrapolated count of small anthropogenic debris diverted by marina over 24-hours

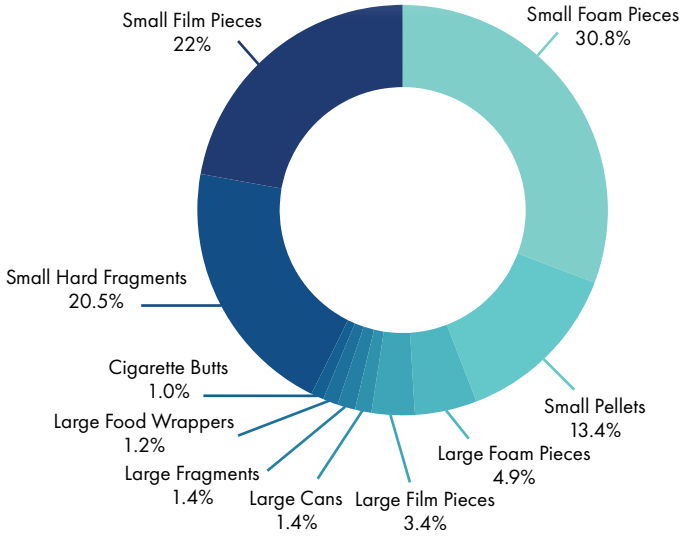


Source: U of T Trash Team

ITEMS COLLECTED

A range of different materials were collected by Seabins at participating GLPC marinas this season. Large items included bottles, cups, wrappers, cans, food containers, cigarette butts, personal protective equipment (PPE) and packaging. Small items included dock foam, pre-production plastic pellets, film and other fragments. Figure 4 shows the top ten items found during the deep dive waste characterizations using the detailed data protocol.

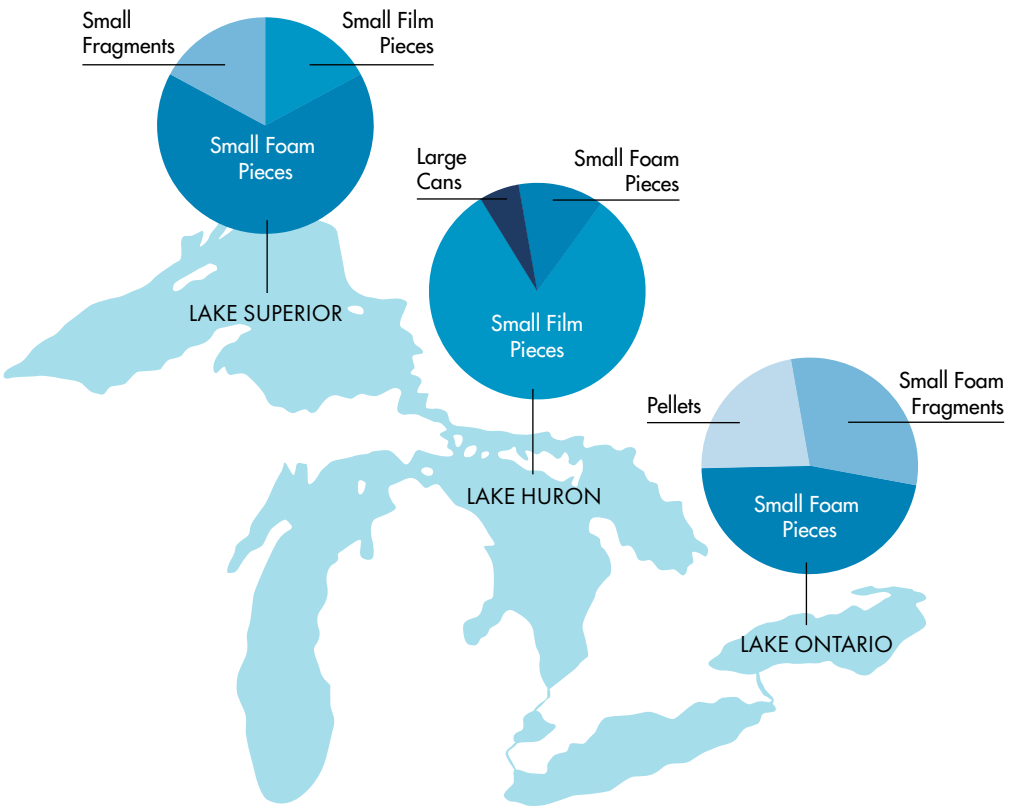
Figure 4: Top ten items collected by Great Lakes Plastic Cleanup Seabins



1. Small Foam Pieces
2. Small Film Pieces
3. Small Hard Fragments
4. Small Pellets
5. Large Foam Pieces
6. Large Film Pieces
7. Large Cans
8. Large Fragments
9. Large Food Wrappers
10. Cigarette Butts

Preliminary data from the deep dive waste characterizations also points to the prevalence of different types of anthropogenic debris varying by lake. However, while the ranking of top items may differ, many of the types of small anthropogenic debris were found across the lakes (e.g., small fragments, foam and film).

Figure 5: The top three plastic items collected from Seabins in Lake Superior, Lake Huron and Lake Ontario



The top three plastic items collected from Seabins in Lake Superior, Lake Ontario and Lake Erie were as follows:

LAKE SUPERIOR
1. Small fragment (23)
2. Small film (6)
3. Small foam (6)

LAKE HURON
1. Small film (203)
2. Small foam (32)
3. Large cans (15)

LAKE ONTARIO
1. Small foam (317)
2. Small fragment (208)
3. Pellets (153)

LITTATRAP WASTE CHARACTERIZATION

Fewer marinas had LittaTraps installed than Seabins and because they do not need to be emptied as often, debris did not collect as quickly and marina staff were required to visit them less frequently. However, this season provided an important opportunity to determine whether the protocol developed by the U of T Trash Team for Seabins could also be applied to LittaTraps.

Table 7 shows an example of the types of large debris found in a LittaTrap located in Cobourg where the catch bag weighed 1.86 kg and was reported to be ¼ full. It shows that the majority of debris collected by the LittaTrap was cigarette butts.

Table 7: Large debris retrieved from LittaTrap in Cobourg

DEBRIS TYPE	NUMBER OF ITEMS	PERCENTAGE OF TOTAL LARGE DEBRIS
Cigarette Butt	15	65%
Food Wrapper	3	13%
Film	2	9%
Lint	2	9%
Fragment	1	4%
TOTAL	23	100%

SECTION THREE

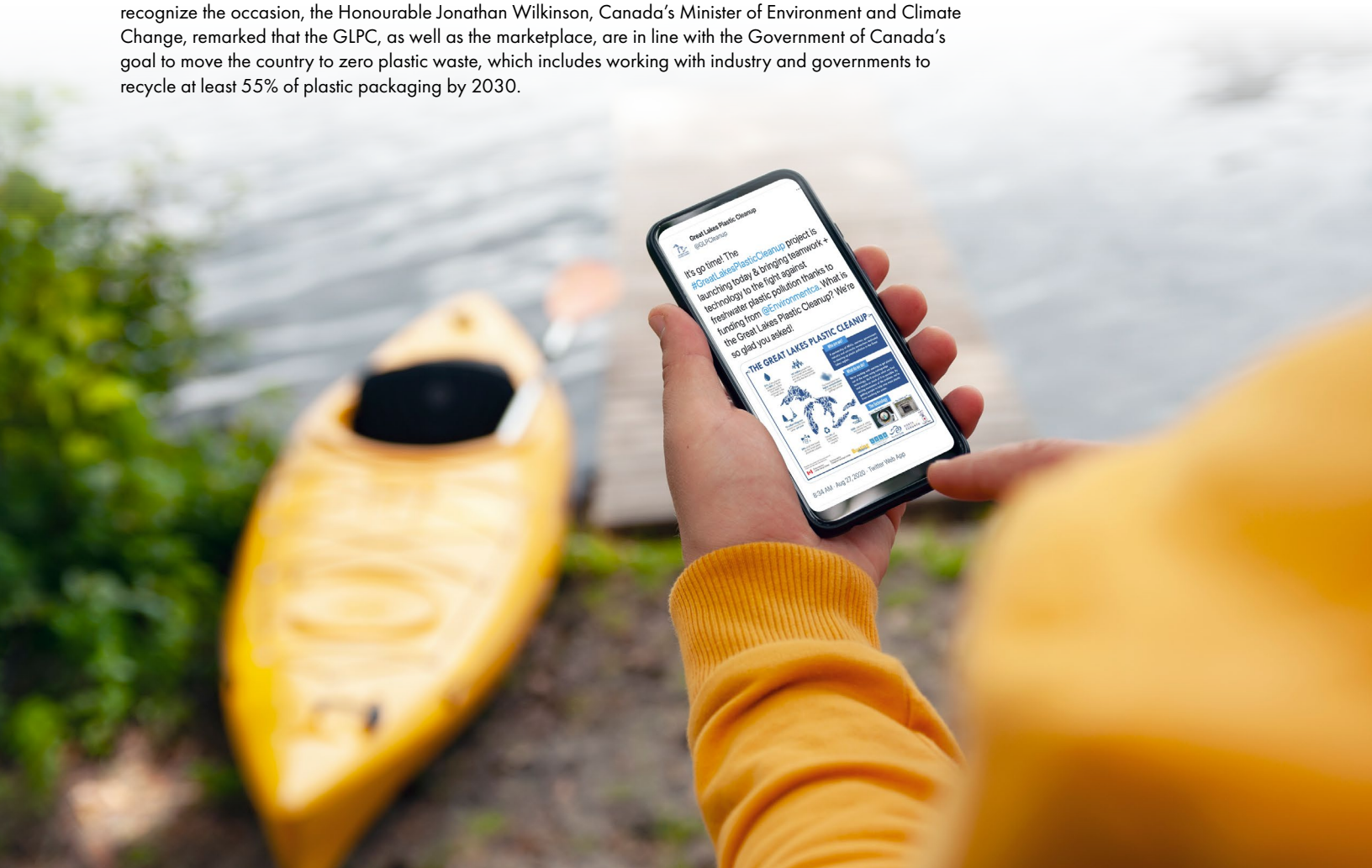
Communications, Promotion and Engagement

Since its launch in August 2020, the GLPC has gained increasing visibility throughout the binational Great Lakes region. During the pandemic and first season of the initiative, the focus was primarily on deploying the capture technologies, collecting preliminary data, and marketing and promotion. As previously noted, the challenges associated with the COVID-19 pandemic meant that awareness-building activities requiring direct, in-person engagement were not possible due to restrictions and safety concerns. As a result, information sharing occurred primarily via social media, direct engagement with marinas, boaters and the broader community, and through the GLPC website. The following section summarizes marketing and promotion efforts, communications and (socially distanced) events that took place this season.

ANNOUNCEMENTS & EVENTS

SUPPORT FROM THE GOVERNMENT OF CANADA

On May 12, 2020, CGLR announced financial support from Environment and Climate Change Canada to spearhead two innovative projects targeting plastic litter in the Great Lakes and the loss of valuable materials to landfills in Ontario — the Great Lakes Plastic Cleanup and the Ontario Materials Marketplace Pilot. To recognize the occasion, the Honourable Jonathan Wilkinson, Canada's Minister of Environment and Climate Change, remarked that the GLPC, as well as the marketplace, are in line with the Government of Canada's goal to move the country to zero plastic waste, which includes working with industry and governments to recycle at least 55% of plastic packaging by 2030.



LEAD CORPORATE SPONSOR NOVA CHEMICALS

On September 16, 2020, the GLPC officially welcomed NOVA Chemicals Corporation as its lead corporate sponsor for an initial five-year timeframe. As one of the largest Canadian petrochemical companies, NOVA Chemicals seeks to be a catalyst for change to address the challenge of plastic waste in the environment and waterways at home and around the world. The GLPC benefits enormously from the support of a company demonstrating leadership and with strong ties to Great Lakes communities, including in the Sarnia-Lambton region where they operate.

To mark the occasion, Mark Fisher, President and CEO of CGLR, Christopher Hilkene, CEO of Pollution Probe, and Rick Layzell, CEO of Boating Ontario, joined Rob Thompson, NOVA Chemicals Vice President of Manufacturing, Ontario Operations at the Andrew S. Brandt Marina at Sarnia Bay. Thompson announced support for the initiative and spoke of his experience as a recreational boater and area resident seeing litter and plastic on the shoreline. He noted that as the largest producer of polyethylene plastic in Canada, it is important for NOVA to be a catalyst for change.

Rick Layzell, Christopher Hilkene, Rob Thompson and Mark Fisher for official welcome to corporate sponsor Nova Chemicals, Andrew S. Brandt Marina, Sarnia. Photo courtesy of NOVA Chemicals

Mark Fisher, President and CEO of CGLR, Andrew S. Brandt Marina, Sarnia. Photo courtesy of NOVA Chemicals

> *"It takes all of us to shape a world that is better tomorrow than it is today. We are excited to join the Great Lakes Plastic Cleanup to ensure the long-term environmental health of this public waterway."*
>
> Luis Sierra, CEO, NOVA Chemicals

SUPPORT FROM THE GOVERNMENT OF ONTARIO

In support of Waste Reduction Week 2020, the Honourable Jeff Yurek, Minister of the Environment, Conservation and Parks, announced funding from the Government of Ontario to Pollution Probe to bring an additional 10 marinas into the GLPC. A media event took place at the Waterside Theatre at the Toronto Zoo on October 22nd, 2020. Due to guidelines related to COVID-19, a minimal number of guests attended the outdoor event in-person however, a live stream of the announcement was also made available. Christopher Hilkene, CEO of Pollution Probe, Rick Layzell, CEO of Boating Ontario and Dolf DeJong, CEO of the Toronto Zoo also shared remarks. The province's support allowed the GLPC to grow to the largest initiative of its kind in the world to tackle plastic pollution in our waters.

The Honourable Jeff Yurek, Minister of the Environment, Conservation and Parks, announced funding from the Government of Ontario to Pollution Probe, Toronto Zoo

LittaTrap display, Toronto Zoo

STRENGTHENING LOCAL CONNECTIONS IN THE TOWN OF COBOURG

On October 30th, 2020, David Piccini, Member of Provincial Parliament for Northumberland-Peterborough South, joined Mayor John Henderson from the Town of Cobourg, to celebrate the Government of Ontario's investment in innovative litter capture technologies at the Cobourg Marina on Lake Ontario.

Mark Fisher, President and CEO of CGLR, and Christopher Hilkene, CEO of Pollution Probe both have strong local ties to the community and were on hand to give remarks and welcome Cobourg Marina to the initiative. They also provided local media with a demonstration of how the Seabin works to collect floating debris from the lake.

Seabin demonstration, Cobourg Marina. Photo courtesy of Cobourg Marina

John Henderson and David Piccini. Photo courtesy of Cobourg Marina

Celebrating the Government of Ontario's investment in innovative litter capture technologies at the Cobourg Marina on Lake Ontario. Photo courtesy of Cobourg Marina

> *I am so pleased to be working collaboratively with both the Great Lakes Plastic Cleanup project, Pollution Probe and it's many project partners. Keeping our waterways clean has always been a priority for the town of Cobourg, and we are proud to support an initiative that will not only help protect but improve water quality for all."*
>
> John Henderson, Mayor of Cobourg

KEEPING POLYSTYRENE OUT OF ONTARIO'S LAKES & RIVERS

On November 5th, 2020, MPP for Parry Sound – Muskoka, Norm Miller, introduced a Private Member's initiative, Bill 228 *Keeping Polystyrene out of Ontario's Lakes and Rivers Act*. The legislation aims to help limit microplastic pollution by requiring that all new dock floats and buoys made from polystyrene are fully encapsulated to prevent the foam from breaking down and entering aquatic ecosystems.

The legislation was debated in the Legislature on February 23rd, 2021 and the efforts of the GLPC in researching the breadth of the issue through the use of litter capture technologies were singled out.

In support of MPP Miller's efforts, he visited participating GLPC marina, Point Pleasant, to see its new Seabin in operation and to speak with owner and operator, Drew Lichtenheldt. The two discussed the issue of dock foam at the marina and the importance of initiatives like the GLPC in addressing the issue.

MPP Norm Miller and Drew Lichtenheldt at Point Pleasant Marina, Parry Sound. Photo courtesy of Jess Fargher and MPP Norm Miller

> *Technologies like the Seabins are an important tool in monitoring and keeping the waters and shorelines clean, but it is much more effective to stop this pollution before it enters ecosystems."*
>
> Norm Miller, MPP,
> Parry Sound – Muskoka

Dock Foam in Seabin Catch Bag at Point Pleasant Marina, Parry Sound. Photo courtesy of Point Pleasant Marina

MPP Norm Miller. Photo courtesy of Jess Fargher and MPP Norm Miller

GREAT LAKES PLASTIC CLEANUP WEBSITE

The GLPC officially launched its website (www.greatlakesplasticcleanup.org) to coincide with the announcement of funding support from Environment and Climate Change Canada through CGLR for an initial 11 marinas. The website provides an introduction to the litter capture technologies, highlights the important work undertaken by partner organizations and sponsors, outlines the protocols used for waste characterization and encourages individuals and communities to learn how they can become a part of the effort.

The site also includes a dedicated webpage for each participating marina that highlights their sustainability efforts, along with results from the waste characterization for their Seabin or LittaTrap. Perhaps most importantly, the website houses educational material associated with plastic pollution, including an introduction to different types of plastic, an overview of sources and potential pathways for those found in freshwater systems and aggregated data from all of the participating marina sites. Infographics, video content and a pop-quiz provide those visiting the site with more opportunities to engage with the online content.

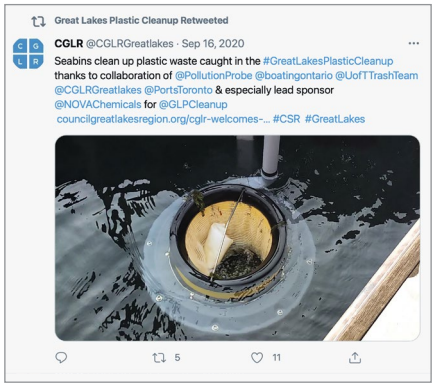
Taken together, this information contributes to a more informed understanding of the plastic found in the Great Lakes and what can be done to address the issue moving forward, including through this initiative.

MEDIA

The GLPC's social media accounts have been an important platform for providing updates on the initiative and for sharing information about plastic pollution. In addition, partner networks and social media channels (e.g., LinkedIn, Facebook, Twitter, Instagram) have contributed to amplifying messaging and increasing the reach of the initiative. In addition, an advertorial for the GLPC ran in the July/August issue of *Water Canada Magazine*.

Water Canada Magazine Advertorial

Pollution Probe and CGLR worked with Bubblegum Canada to create educational and promotional materials to assist marinas and local community organizations with promotion and engagement, including the tools necessary to ensure consistency and to maximize visibility across all regions in a user-friendly format. Materials include educational resources related to the plastic problem, background templates on how the program works, quantitative information, myths, facts and challenges, as well as the local, national and global impact of the GLPC, program FAQs, and infographics. A social media toolkit and event templates including news release, media advisory and pitch templates were also produced for use by marinas and partners. Video content was developed for the purpose of embedding on the GLPC website and for use on social media.

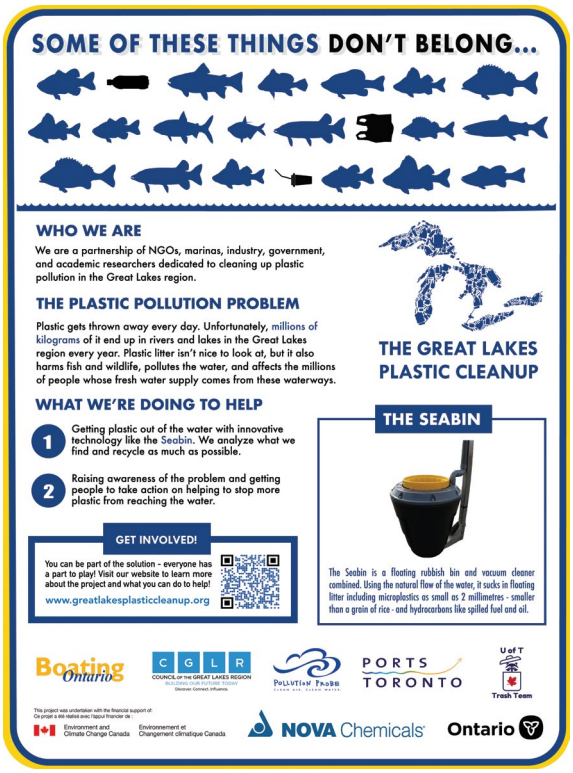


Social Media

SIGNAGE & EDUCATIONAL DISPLAYS

Educational signage was developed to help draw attention to the initiative and the litter capture technologies at each marina and at the Toronto Zoo. Two separate designs for Seabins and LittaTraps introduce the GLPC, outline the collaborative effort, highlight the plastic pollution problem, note what the initiative is doing to address the issue and encourage the public to get involved.

A range of other plastic displays and signage were created to help marinas provide information about the initiative to marina users and local communities. Examples include posters, stickers, retractable banners and acrylic cases to display examples of the debris collected through the initiative (e.g., large pieces like bottles or coffee cups, foam & cigarette butts, pre-production pellets and fragments, and wrappers).



Marina Signage

Poster

Next Steps

The GLPC officially launched at the height of the global COVID-19 pandemic. Despite a number of related challenges, the significant efforts of its partner organizations and participating marinas contributed to the successful launch and implementation of the single-largest deployment of Seabins and LittaTraps in the world. A total of 26 marinas joined the initiative this past season, in an effort to address plastic pollution by capturing debris found in the lakes, contributing to the collection of data and analysis by the GLPC network and engaging local businesses and communities to keep plastic out of our environment and waterways. Outcomes from the 2020 season point to the effectiveness of the initiative's unique combination of technology, collaboration, data collection and education as an important means of finding meaningful solutions to a critical environmental issue facing our Great Lakes.

The first year of the GLPC focused heavily on laying the groundwork necessary to continue to successfully grow and expand the initiative over an initial five-year period. The valuable insights gained through this process will inform the future of the GLPC and improve efforts to capture plastics in our Great Lakes, including through the collection and characterization of data, building awareness and supporting behavioural change through public engagement.

Key findings emerging from this season include those related to the maintenance and operation of the technologies, collection of debris for characterization, preliminary data, and community engagement. Examples include:

- Seabins require ongoing maintenance and must be emptied regularly to avoid mechanical issues
- The weave of the mesh Seabin catch bag should be chosen based on the type of vegetation that is prominent in the region
- Every site is unique and the installation location for Seabins and LittaTraps should be carefully considered to ensure effective capture of debris
- The waste characterization pointed to a connection between the amount of vegetation collected by the Seabins and the number of small plastic pieces
- Dedicated, local volunteers are crucial for the daily monitoring, as well as the waste characterization occurring through the year
- Marinas require support, such as signage and social media, to help engage their local community and tell the story of plastics in the Great Lakes

Scarborough Bluffs, Lake Ontario

Over the coming year, the GLPC will focus on further mobilizing and translating knowledge gained through the initiative, while continuing to thoughtfully grow and expand across the Great Lakes. To support this focus, the following three interrelated strategies will be pursued:

- **Continued collaboration and support for participating marinas and communities:** Outcomes and lessons learned from the 2020 season will play a key role in informing continued collaboration with participating marinas moving forward. Amplifying engagement and awareness has been identified as an important focus for the coming season, including through the use of knowledge mobilization to ensure a focus beyond the simple provision of educational resources and content, to supporting community engagement and stewardship.

- **Expanding to new marinas across the Great Lakes:** There has been considerable interest over the 2020 season from new marinas looking to join the GLPC and to help address plastic pollution. In addition to strengthening collaboration and support with current marinas, the initiative will look to build out by expanding to a strategic number of new marinas across the Great Lakes, including in those areas not yet represented. This may include additional locations in Ontario and expansion into the United States.

- **Exploring new opportunities and collaborative partnerships:** The GLPC benefits from collaboration across a multi-sectoral, multi-stakeholder project team, each of which contributes a wealth of knowledge and extensive expertise. Strategic partnerships will further strengthen the findings and outcomes of the GLPC and with this in mind, opportunities will be explored to partner with new sponsors, local community groups, and other organizations committed to addressing plastic pollution.

Taken together, these strategies will help to build the GLPC in a way that is sustainable and in line with its vision to end plastic pollution in the Great Lakes.

Visit www.greatlakesplasticcleanup.org for more information about the GLPC and how you can get involved.

> *Our government is committed to protecting our water resources and Great Lakes, and that includes tackling the millions of pounds of plastic pollution that enter our province's waterways each year. That is why I am proud to support this important initiative with Pollution Probe, which will help safeguard our precious water resources and the ecosystems that depend on them, for future generations."*
>
> The Honourable Jeff Yurek, Minister of the Environment, Conservation and Parks

Thirty Thousand Islands, Georgian Bay

Contact us for more information or to get involved

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